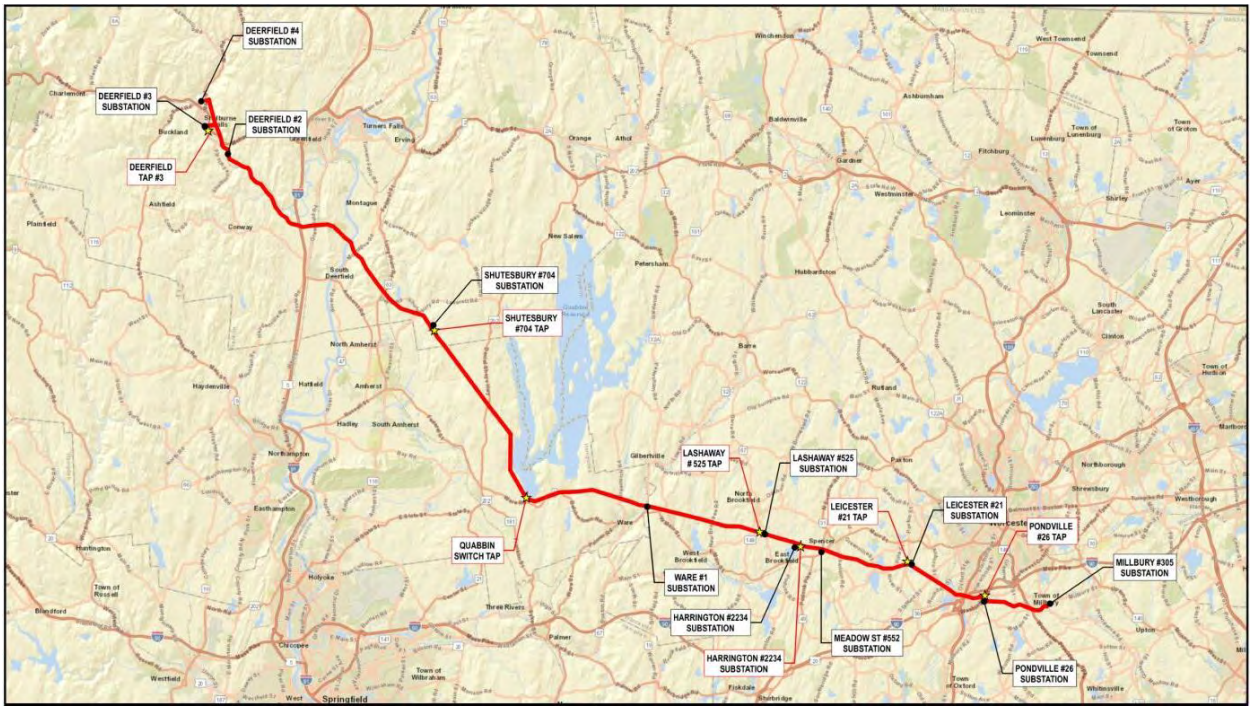
March 2025

New England Power Company d/b/a National Grid Central to Western Massachusetts Energy Improvement Project

Application to Support the Petition before the Energy Facilities Siting Board

EFSB 25-01



Millbury, Auburn, Leicester, Spencer, East Brookfield, North Brookfield, West Brookfield, Ware, Belchertown, Pelham, Shutesbury, Leverett, Sunderland, Deerfield, Conway, and Shelburne

This document has been reviewed for Critical Energy Infrastructure Information (CEII)

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Glossary	
ACEC	Areas of Critical Environmental Concern
ACSR	Aluminum Conductor, Steel Reinforced
ACSS	Aluminum-Conductor Steel-Supported Conductor
APE	Area of Potential Effects
APR	Agricultural Preservation Restriction
AR	Agriculture Restriction
BLSF	Bordering Land Subject to Flooding
BMPs	Best Management Practices
BVW	Bordering Vegetated Wetland
CGP	Construction General Permit
CMP	Conservation and Management Permit
CMR	Code of Massachusetts Regulations
Company	New England Power Company
CR	Conservation Restriction
CVP	Certified Vernal Pool
dB(A)	A-weighted Decibel
dB(C)	C-weighted Decibel
DCR	Department of Conservation and Recreation
DER	Distributed Energy Resources
DGA	Designated Geographic Area
DPU	Massachusetts Department of Public Utilities
EEA	Executive Office of Energy and Environmental Affairs
EENF	Expanded Environmental Notification Form
EF	Electric Field
EFI	Environmental Field Issue
EFSB	Energy Facility Siting Board
EIR	Environmental Impact Report
EJ	Environmental Justice

EMF	Electric and Magnetic Fields
ENF	Environmental Notification Form
EPA	U.S. Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
ft	Feet/Foot
GHG	Greenhouse Gas
gpm	gallons per minute
GWSA	Global Warming Solutions Act
Hz	Hertz
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IPaC	Information for Planning and Consultation
ISO-NE	Independent System Operator-New England
kcmil	Thousand Circular Mils
kV	Kilovolts
LiDAR	Light Detection and Ranging
MBTA	Massachusetts Bay Transportation Authority
MassDEP	Massachusetts Department of Environmental Protection
MassDOT	Massachusetts Department of Transportation
MassGIS	Massachusetts Geographic Information System
MECo	Massachusetts Electric Company
MEPA	Massachusetts Environmental Policy Act
MESA	Massachusetts Endangered Species Act
MF	Magnetic Fields
mG	Milligauss
MHC	Massachusetts Historical Commission
MUTCD	Uniform Traffic Control Devices
MVA	Mega Volt-Amp
MW	Megawatts
MWPA	Massachusetts Wetlands Protection Act

NEP	New England Power Company
NERC	American Electric Reliability Corporation
NESC	National Electrical Safety Code
NHD	National Hydrography Data
NHESP	Natural Heritage and Endangered Species Program
NHPA	National Historic Preservation Act
NOI	Notice of Intent
NPCC	Northeast Power Coordinating Council, Inc.
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NWA	Non-Wires Alternative
OPGW	Optical Primary Ground Wires
ORW	Outstanding Resource Waters
OSHA	Occupational Safety and Health Administration
PAL	Public Archaeology Laboratory, Inc.
PCN	Pre-Construction Notification
PH	Priority Habitat
ROW	Right-of-Way
SHPO	State Historic Preservation Officer
SJC	Supreme Judicial Court
SIS	System Impact Studies
SWPPP	Stormwater Pollution Prevention Plan
TGP	Tennessee Gas Pipeline
TMPs	Traffic Management Plans
ULSD	Ultra-Low-Sulfur Diesel
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WCE	Walter Cowls Jones Working Forest Wildlife Conservation Easement

WQC	Water Quality Certification

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1 PROJECT OVERVIEW

1.1 Introduction

New England Power Company d/b/a National Grid ("NEP" or the "Company") submits this Application to Support the Petition before the Energy Facilities Siting Board ("Siting Board" or "EFSB") ("Application") pursuant to G.L. c. 164, § 69J ("Section 69J Petition") seeking approval to remove the existing 69 kilovolt ("kV") E5/F6 lines (the "Existing Lines") and to rebuild them (the "Rebuilt Lines") to a 115 kV design within the existing electric transmission line right-of-way ("ROW") between NEP's Millbury #305 Substation in Millbury, Massachusetts ("Millbury Substation") and the Deerfield #4 Substation in Shelburne, Massachusetts ("Deerfield #4 Substation") (the "Central to Western Massachusetts Energy Improvement Project" or the "Project"). The Project also includes the reconstruction of three of the tap lines associated with the Existing Lines on the same ROWs as the Existing Taps: (1) the Quabbin Switch Tap Line, (2) the Shutesbury Tap Line and, (3) the Deerfield #3 Tap Line[1] (referred to as the "Existing Taps" and the "Rebuilt Taps") and the construction, reestablishment and improvement of access roads. Contemporaneous with the filing of the Section 69J Petition, NEP has filed a petition with the Massachusetts Department of Public Utilities ("DPU") requesting a determination that the Project is necessary and will serve the public convenience and be consistent with the public interest in accordance with G.L. c. 164, § 72 ("Section 72 Petition").

The Existing Lines connect Millbury Substation and Deerfield #4 Substation and supply power to NEP's Pondville, Leicester, Harrington, Lashaway, Belchertown, and Shutesbury Substations. Today, the Existing Lines and Taps provide electricity to 26 cities and towns in Massachusetts Electric Company's ("MECo") service territory and transmit power from the Deerfield #2, #3, and #4 generating stations to the New England region. The E5 Line and F6 Line are each approximately 67 miles in length. The lines pass through the towns of Millbury, Auburn, Leicester, Spencer, East Brookfield, North Brookfield, West Brookfield, Ware, Belchertown, Pelham, Shutesbury, Leverett, Sunderland, Deerfield, Conway, and Shelburne.

The Tap Lines each consist of two parallel single circuit lines. The Quabbin Switch Tap Lines are each approximately 0.1 miles long and connect the Existing Lines to the Quabbin Switch. The Quabbin Switch Tap Lines and Quabbin Switch are located in Belchertown. The Shutesbury Tap Lines are each approximately 0.02 miles long and connect the Existing Lines to Shutesbury Substation. The Shutesbury Tap Lines and Shutesbury Substation are located in Shutesbury. The Deerfield #3 Tap Lines are each approximately 0.5 miles long, pass through Shelburne, and connect the Existing Lines with Deerfield #3 generating station in Buckland.

The Existing Lines must be rebuilt because inherent design characteristics as well as physical deterioration have resulted in poor reliability. They are supported primarily on approximately 711 structures that date back to early 1900s when the lines were first energized and are currently supported on a combination of wood (98), lattice tower (538) and steel pole (75) structures. In addition, increased fiber optic capability is needed to both protect the lines from lightning and

[1] Conductors from the E5/F6 Lines to the following other tap lines will be replaced, but no structures will be rebuilt as part of the Project: Lashaway, Leicester, Harrington, Deerfield #2, and Pondville.

improve telecommunications. Lastly, the Existing Lines lack sufficient capacity to interconnect renewables and other green technology to the electric grid. As with the Existing Lines, the Existing Taps have a poor operating history and have insufficient capacity to interconnect renewables to the electric grid. The Existing Taps are currently supported on 34 wood and steel structures.

New structures on the Rebuilt Lines will be steel pole double circuit structures with an average height of 85 feet. In most locations, the Rebuilt Lines will be constructed slightly offset, by approximately five feet, from the centerline in the ROW. The Company will replace the existing copper conductors and Aluminum Conductor, Steel Reinforced ("ACSR") with Aluminum-Conductor, Steel Supported Conductor ("ACSS") and the existing shield wire will be replaced with two Optic Ground Wires ("OPGW"), which will increase the reliability and capacity of the Existing Lines and improve communication between stations. The Project also will replace all structures along the Tap Line ROWs. The Rebuilt Taps will also be 795 ACSS with two OPGW and will operate at 69 kV but will be designed to support future operation at 115 kV.

The Company proposes to construct the Rebuilt Lines using its 115 kV design standards even though there are currently no immediate reliability needs that would necessitate the operation of the Rebuilt Lines at 115 kV within the 10-year planning horizon. Even when operating at 69 kV, the Rebuilt Lines will provide increased capacity due to the proposed use of ACSS conductor. Notably, the Rebuilt Lines will support future operation at 115 kV, which will provide flexibility in meeting future transmission system needs as the implementation of electrification and climate change initiatives in the Commonwealth increase across the state.

As discussed further in *Section 4*, the Company proposes construction of the Rebuilt Lines and Taps along the route of, and in the same ROWs as, the Existing Lines and Taps because this route is superior to any other potential route given the need to provide continued transmission service to the switching and substations between Millbury Substation and the Deerfield Substation. Constructing the Project along other routes would result in increased costs, schedule delays, and new and/or increased impacts to human and natural environments. Figure 1-1 is a United States Geological Survey ("USGS") quadrangle base map showing the location of the Existing Lines and Taps.

DEERFIELD #4 SUBSTATION
DEERFIELD #3 SUBSTATION
DEERFIELD #2 SUBSTATION
DEERFIELD TAP #3
SHUTESBURY #704 SUBSTATION
SHUTESBURY #704 TAP
QUABBIN SWITCH TAP
LASHAWAY # 525 TAP
LASHAWAY #525 SUBSTATION
LEICESTER #21 TAP
LEICESTER #21 SUBSTATION
PONDVILLE #26 TAP
MILLBURY #305 SUBSTATION
WARE #1 SUBSTATION
HARRINGTON #2234 SUBSTATION
HARRINGTON #2234 TAP
MEADOW ST #552 SUBSTATION
PONDVILLE #26 SUBSTATION

Legend

- Study Area

Project Components

- Existing E5/F6 Transmission Line
- Existing E5/F6 Taps

System Components

- Substation
- Existing Transmission Lines

1 inch = 5 miles (0, 2.5, 5 Miles)

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Figure 1-1
United States Geological Survey (USGS) Locus Map

As set forth in detail below, and consistent with the requirements of G.L. c. 164, §§ 69H, 69J and 72, the Project will provide a reliable energy supply for the Commonwealth of Massachusetts with a minimum impact on the environment at the lowest possible cost. The Project will serve the public interest by: (1) improving the reliability of the electric system while minimizing environmental impacts and costs; and (2) increasing the thermal capacity and voltage capability of the Rebuilt Lines to meet existing and projected load requirements, including the connection of more renewable energy resources to the transmission system. For these reasons, NEP requests the Siting Board's approval of the Project.

1.2 Overview of Application

The balance of *Section 1* presents an overview of the Project. The remaining sections of this Application provide detailed information and analysis to support the Project, specifically the need for the Rebuilt Lines (*Section 2*), a comparison of Project alternatives (*Section 3*), a description of the route evaluation process that was used to ensure that the existing E5/F6 ROW is the optimal route for the Rebuilt Lines (*Section 4*), a detailed analysis of the Project's impacts on the natural and social environment, including mitigation of those impacts (*Section 5*), and an analysis of the Project's consistency with the health, environmental protection, resource use, and development policies of the Commonwealth of Massachusetts (*Section 6*).

1.3 Project Need

The key driver for the Project is the long-standing history of poor performance on the E5/F6 Lines. A review of the recent operating history, design, and physical condition of the Existing Lines demonstrates that they should be rebuilt to ensure reliable service. As discussed in *Section 2*, the Existing Lines, which were originally constructed in the early 1900s, reconductored in 2001, and reinsulated in 2020, are among the oldest transmission lines in New England and are supported by the original lattice structures. They are among NEP's worst performing transmission lines, due in large part to the original structure design, which makes them particularly susceptible to lightning and avian interaction.

The Existing Lines are the sole transmission source for approximately 24,000 customers in twelve Massachusetts municipalities and must be replaced as they are approaching the end of their asset life and have intrinsic flaws in their structural configuration, which has resulted in poor reliability. For example, close, tall trees adjacent to the ROW, as well as poor shielding angles and insulation levels when compared to present-day industry standard, have contributed to their poor performance. In addition, the Existing Lines and Taps do not have sufficient thermal capacity to support the connection of proposed and future distributed energy resources ("DER") to the electric grid. Even without proposed DER, equipment at multiple substations served by the Existing Lines would be subject to low voltage conditions under certain contingencies. The Rebuilt Lines will also provide increased fiber optic capability, which will both protect the lines from lightning and improve telecommunications. Accordingly, the Existing Lines and Taps must be replaced in the near term to allow NEP to continue to meet regional demands for a reliable supply of electricity.

1.4 Project Alternatives

In accordance with Siting Board precedent, NEP evaluated a series of Project alternatives for the potential to meet the identified need and to determine the approach that best balances reliability,

cost, and environmental impact. *Section 3* summarizes the analyses used to identify and evaluate alternative means of meeting the identified need. These include: (1) a No-Build Alternative; (2) Non-Wires Alternatives ("NWAs"); (3) two Partial Rebuild Alternatives; and (4) a Complete Line Rebuild Alternative (the Project). As shown in *Section 3*, the Project is the only alternative that meets all identified needs and achieves the appropriate balance between need, minimization of environmental impacts and cost.

After determining that completely rebuilding the Existing Lines was the only alternative that could meet all the identified needs, the Company assessed two transmission structure designs for the Rebuilt Lines – rebuilding the Existing Lines for operation at 69 kV or rebuilding the Existing Line to support present day operation at 69 kV and future operation at 115 kV. The Company determined that the Project as proposed – rebuilding the Existing Line to support future operation at 115 kV – will most effectively provide a reliable energy supply with the least impact on the environment at the lowest reasonable cost, as well as support long-term electric load growth.

1.5 The Project Route

NEP proposes replacing the Existing Lines with Rebuilt Lines within the existing ROW. *Section 4* of this Application describes the process by which NEP evaluated potential route alternatives to ensure no clearly superior route was overlooked. Route selection was heavily guided by the need to connect the two termini of the Existing Lines and Taps, as well as the ten substations between them. As an initial matter, the Company identified a geographic study area (the "Study Area") that encompassed possible route options for the Rebuilt Lines and Taps. The Study Area and the routing opportunities and constraints within it are described in *Section 4*. The Company also established criteria to identify, screen, and evaluate potential overhead routes. NEP assessed potential routes with a focus on maximizing the use of existing linear corridors, limiting construction constraints, and minimizing the potential for natural and social environmental impacts. After evaluating a wide array of potential route corridors and options, NEP determined that all potential alternative routes for both the E5/F6 Lines and Taps, as compared to the route along the Existing Lines and Taps ROWs (the "Project Route"), were clearly inferior in that they would be longer, have greater environmental impacts and more significant constructability issues and, therefore, would be more costly.

1.6 Summary of Project Schedule and Cost

Assuming receipt of all necessary permits and approvals, construction of the Project is expected to commence in April 2029; the Rebuilt Lines and Taps are expected to be energized as installed; and all Project-related activities, including removal of the Existing Lines and Taps, are expected to conclude in April 2035.

1.6.1 Project Schedule

A summary of the major Project elements and their corresponding target milestone dates are provided in Table 1-1, below.

Table 1-1: Anticipated Project Schedule

Project Component	Estimated Start Date	Estimated End Date
Access Route Construction, Reestablishment, and Improvements	April 2029	April 2033
Rebuild Existing Lines and Taps	September 2029	November 2034
Remove Existing Lines and Taps	January 2030	April 2035
Restore ROW (where required)	April 2029	April 2035

1.6.2 Project Cost

NEP estimates that the total cost of rebuilding the Existing Lines and Taps is approximately $896.9 million. This estimate is provided with an assumed accuracy level of –25%/+50%.

1.7 Construction Overview and Impact Minimization

Section 5 describes the methodology by which the Project will be constructed, assesses the potential for environmental impacts, and describes mitigation measures that will be implemented by the Company to minimize impacts of construction on the surrounding community.

Generally, there are eight phases of construction for an overhead transmission line project: (1) removal of vegetation and ROW mowing in advance of construction; (2) installation of soil erosion and sediment controls; (3) construction and improvements to access; (4) structure work pads and construction staging areas; (5) installation of foundations and transmission structures; (6) installation of overhead conductor and OPGW; (7) removal and disposal of existing transmission line components; and (8) restoration and stabilization of the ROW. Several phases of construction may be ongoing simultaneously in different sections of the route. The various construction activities occur as a progression of work activities along the ROW and each transmission structure location will be visited intermittently to complete each phase of construction.

Potential impacts from Project construction will include temporary traffic congestion, construction noise, and sediment generation. As discussed in *Section 5*, the Company has thoroughly assessed the potential for impacts to the environment and surrounding community as a result of the Project, and has avoided, minimized, or mitigated those impacts. The Project is simultaneously undergoing review pursuant to the Massachusetts Environmental Policy Act ("MEPA"), GL c. 30, §§ 61 through 62L. NEP submitted an Environmental Notification Form ("ENF") on January 15, 2025, provided as Appendix 6-1. the Company will provide the Secretary of Executive Office of Energy and Environmental Affairs ("EEA") Certificate on the ENF when it is available.

1.8 Agency and Community Outreach

NEP is committed to working with municipal officials, local businesses, residents, communities along the Project Route, and any interested stakeholders to provide proactive and transparent communication throughout the life of the Project. NEP's initial outreach efforts have been aimed at providing notification to abutting landowners of activities within the ROW and briefing local officials and other stakeholders on the need for the Project, providing details regarding the Project Route and Project schedule; and detailing the permitting and siting processes, including opportunities for public input. The Company will continue these efforts throughout the licensing and permitting process and will maintain a focused communications program during and after construction. This outreach program is designed to educate and engage the Project communities,

foster public participation, and solicit feedback from stakeholders. Key elements of NEP's outreach program for the Project are described below.

Open House: NEP held five in-person Project Open Houses to introduce the Project to the public on June 5, 2024, June 11, 2024, June 26, 2024, July 17, 2024, and September 17, 2024. NEP mailed invitations to landowners along the Project Route and to municipal officials (Table 1-3). The Open Houses provided the public an opportunity to speak with subject matter experts, ask questions, and share concerns about the Project. During the Open Houses, NEP provided a Project overview with a focus on the need, benefits, permitting process, location, design, schedule, and anticipated construction activities, as well as a summary of participation opportunities for all interested persons.

Environmental Justice Community Meeting: NEP hosted a virtual meeting pursuant to MEPA guidelines on December 19, 2024. Per 301 Code of Massachusetts Regulations ("CMR") 11.05(4)(b), on November 26, 2024, the Company sent advanced notification of the meeting in the form of a completed "Environmental Justice Screening Form" via electronic mail to all contacts on the Environmental Justice ("EJ") Reference List provided by the MEPA Office on September 3, 2024. EJ community members on the provided EJ Reference List, in addition to the municipality administrators and abutters within EJ communities, were invited to attend to learn more about the Project and its anticipated impacts on EJ community areas as identified by MEPA. Recipients of the invitation were encouraged to share the invitation on organization and municipal websites, forums, message boards, and social media channels. Invitation to the virtual meeting were published in English in three publications that spanned the sixteen municipalities along the Project Route. The three newspapers, the *Worcester Telegram & Gazette*, the *Greenfield Recorder*, and *The Republican*, have the highest circulation for each of their respective counties.

Door-to-Door: The Company has reached out in-person to landowners upon request and/or as needed to discuss ongoing field activities and future use of abutter properties, i.e., access and tree trimming. Targeted door-to-door outreach is planned pre-construction.

Website: NEP hosts a Project website, **https://www.cmatowmaenergy.com/.** The website provides basic Project information, maps, regular updates, meeting invitations, a construction process animation video, links to public filings, request for translation of Project materials, and contact information. The website can be viewed in English; however, content can be translated to other languages by submitting a request through a form on the website. The website will be maintained and updated for the duration of the Project.

Project Hotline: NEP has a dedicated toll-free Project hotline number (888-431-3536). The Project hotline number is provided at all community events and is included in all Project outreach materials, including mailings, email correspondence, and the Project website. NEP commits to responding promptly to all inquiries received via the Project hotline. Inquiries received through the hotline are typically answered within three business days (excluding weekends and Company recognized holidays).

Project Email: NEP has designated info@CMAtoWMAenergy.com as its Project email address. The email address is included in all Project outreach materials, including fact sheets, mailings, the website, and is provided at all community events. As with the Project hotline, NEP commits to responding promptly to all inquiries received via the Project email.

Multilingual Materials: All printed Project community outreach materials are available in English and can be translated as needed. Community outreach materials, such as the Project factsheet and Project Open House invitations include a QR code directing recipients to the Project website homepage. The Contact Us section includes a translation request form.

Municipal and Stakeholder Briefings: NEP has met with municipal officials and other stakeholders in Shelburne, Leverett, Sunderland, Conway, Pelham, Shutesbury, Spencer, Belchertown, West Brookfield, Ware, Auburn, Millbury, Leicester. A list of outreach meetings with the municipalities, regulatory agencies, and other officials is provided in Table 1-2 and Table 1-3.

Table 1-2: Select Board Outreach and Consultations

Date(s)	Activities and Milestones	Interaction Type / Description
12/04/2023	Shelburne	Select Board Presentation
12/05/2023	Leverett	Select Board Presentation
12/11/2023	Sunderland	Select Board Presentation
12/18/2023	Conway, Pelham	Select Board Presentation
02/13/2024	Shutesbury	Select Board Presentation
02/26/2024	Spencer	Select Board Presentation
03/03/2024	Belchertown	Select Board Presentation
03/04/2024	West Brookfield	Select Board Presentation
03/19/2024	Ware	Select Board Presentation
03/25/2024	Auburn	Select Board Presentation
03/26/2024	Millbury	Select Board Presentation
04/01/2024	Leicester	Select Board Presentation
1/18 and 02/05/2024	Deerfield - No Response/presentation; presentation shared via email	Select Board Presentation
2/5 and 2/14/2024	North Brookfield – No Response/presentation; presentation shared via email	Select Board Presentation
2/5 and 2/14/2024	East Brookfield – No Response/presentation; presentation shared via email	Select Board Presentation

Table 1-3: Community Outreach and Consultations

Date	Activities and Milestones	Interaction Type / Description
06/10/2022	Field activity/survey notification	Postcards
08/25/2023	Factsheet	Mailer
09/17/2023	Targeted Soil boring notification	Letter
11/2023	Targeted Forestry notification	Letter
06/26/2023	Targeted Cultural resource notification	Letter
05/31/2024	Notice of Project Open House in Sunderland	Mailer
06/05/2024	Notice of Project Open House in Belchertown	Mailer
06/05/2024	Notice of Project Open House in Shelburne	Mailer
07/10/2024	Notice of Project Open House in West Brookfield	Mailer
09/09/2024	Notice of Project Open House in Millbury	Mailer
06/05/2024	Sunderland	Project Open House
06/11/2024	Shelburne	Project Open House
06/26/2024	Belchertown	Project Open House
07/17/2024	West Brookfield	Project Open House
09/17/2024	Millbury	Project Open House

Construction Community Outreach Plan: NEP will execute a comprehensive construction community outreach plan to keep landowners, businesses, and municipal officials, including fire, police, and emergency personnel, updated on planned construction activities. NEP will notify abutting landowners and municipal officials of its planned construction start date and work schedule prior to commencing construction and will work closely with both groups to limit construction impacts. In addition to the Project website and hotline, this outreach plan will include:

- Targeted door-to-door outreach throughout construction to notify landowners of upcoming activities and to address any questions or concerns they may have. Translation services will be made available as requested.
- In-person pre-construction briefings with municipalities and other stakeholder groups.
- Regular email updates to municipal officials and any other stakeholders requesting this form of communication.
- Periodic communications with abutters and other stakeholders providing advance notice of scheduled construction activities. Written communications will be provided in English and translated as needed/requested.
- Meetings, emails, and phone calls with concerned landowners will be held on a case-by-case basis.
- Upon request, meetings with affected landowners prior to each major stage of construction.

1.9 Conclusion

NEP proposes to rebuild its E5/F6 Lines and the Quabbin, Shutesbury and, Deerfield #3 Tap Lines with steel pole structures, conductor, and OPGW designed to operate at 115 kV. The Rebuilt Lines and Taps will address underlying issues associated with the Existing Lines and Taps and will enhance reliability, increase resilience, and allow for easier future maintenance. In addition, the upgraded infrastructure will enable the Company to connect proposed renewable energy projects to the electric grid. The Company seeks authority to construct the Project to fulfill its obligations to ensure the safe and reliable transmission of power to its customers with a minimum impact on the environment at the lowest possible cost.

As described above and as demonstrated throughout this Application, the Project also will "serve the public convenience and is consistent with the public interest," consistent with the requirements of Section 72. Given the operational history of the Existing Lines and Taps, the Project is needed to address system reliability requirements. Further, NEP extensively considered potential alternatives to, and the environmental impacts of, the Project and has avoided and minimized environmental impacts and proposed appropriate mitigation for those impacts. As such, the Project meets the standards applicable under Section 72 for authorization to construct and operate its transmission facilities.

For the reasons described in greater detail in this Application, NEP has demonstrated that the Project is consistent with Siting Board and DPU standards and precedent on need, alternatives, routing, and minimization of environmental impacts under G.L. c. 164, § 69J, and therefore should be approved.

2 PROJECT NEED

2.1 Introduction

The NEP transmission system is an integral part of the regional power system, transmitting electricity to support regional electricity markets and delivering electricity to customers throughout New England. The need for the Project stems from NEP's fundamental obligation as an electric company to provide safe and reliable transmission service to residential, commercial, and industrial customers throughout its service territory. In addition, maintaining system reliability is critical to support recent local, state and federal climate change and electrification policies that are aimed at addressing the adverse effects of climate change and eliminating reliance on fossil fuels by increasing the use of electric vehicles and electric heating applications.

To maintain the integrity of this system, NEP must ensure that adequate and reliable transmission capacity is available to meet existing and projected load requirements and that a secure and reliable telecommunications network is in place to strengthen the security and resilience of critical infrastructure. The grid is designed to meet reliability standards and criteria developed by the North American Electric Reliability Corporation ("NERC"), which sets the minimum standards for electric power transmission for all North America, the Northeast Power Coordinating Council, Inc. ("NPCC") and the Independent System Operator-New England ("ISO-NE").

Accordingly, to ensure that its transmission assets are and will remain in condition to meet these objectives, the Company evaluates the reliability and condition of its assets to determine whether they should be replaced before their performance negatively impacts the provision of safe and reliable service. The need for the Project is consistent with the Company's proactive approach to ensuring the continued reliability of its transmission system.

A review of the recent operating history, design, and physical condition of the Existing Lines and Taps demonstrates that they should be rebuilt to ensure reliable service. As discussed below, the Existing Lines and Taps have inherent design characteristics that compromise the Company's ability to provide reliable service. Those characteristics, as well as physical deterioration on many of the century-old structures, have resulted in poor reliability performance. In addition, the Project is needed to provide increased fiber optic capability to both protect the lines from lightning and improve telecommunications.

To address these concerns, NEP proposes to replace the Existing Lines and Taps within their existing ROWs. Replacing these degraded assets will increase the reliability of the transmission system. The Project also includes installation of two new OPGWs, one for each line, which will better protect the wires from fault-causing lightning strikes and provide an upgraded communications path that will allow for fault detection and high-speed communication between the remote ends of the Rebuilt Lines. The Rebuilt Lines and Taps will be designed with additional capacity to meet known and anticipated future requirements, including the interconnection of new DER, and increasing transfers of power over time to support electrification within the Commonwealth. As further discussed in *Section 3*, the Rebuilt Lines and Taps will initially be operated at 69 kV but will be designed to allow for future operation at 115 kV as it becomes necessary in the future.

Section 2.2 describes the Existing Lines and Taps and their role in the regional transmission system. *Section 2.3* discusses the operating history and current condition of the Existing Lines and Taps. *Section 2.4* describes the need for increased fiber optic capability and *Sections 2.5* and *2.6* discuss the potential for additional capacity and voltage support as well as long-term needs for additional transmission capacity across New England to support state climate and renewable energy policies. Finally, *Section 2.7* summarizes the need for the proposed Project.

2.2 Description of the Existing Transmission System

2.2.1 Existing Lines, Tap Lines and Substations

NEP owns and operates the Existing Lines, which are part of the interconnected New England transmission system carrying network power flows and supplying distribution load-serving substations in western and central Massachusetts. The lines also connect DER resources in central and western Massachusetts and hydrogeneration facilities on the Deerfield River to the transmission system. The Existing Lines were constructed and put into service in the early 1900s. They are approximately 67 miles in length and operate at 69 kV.

The Existing Lines connect NEP's Millbury Substation in Millbury and Deerfield #4 Substation in Shelburne and also supply power to NEP's Pondville, Leicester, Meadow Street, Lashaway, Ware, Belchertown, and Shutesbury Substations. Today, the Existing Lines and Taps provide electricity to 26 cities and towns in MECo's service territory and transmit power from the Harrington, Deerfield #2, Deerfield #3, and Deerfield #4 generating stations to the New England region.

The Existing Lines and Taps are supported by approximately 711 structures centered within the existing ROWs. The existing structures consist of 538 double-circuit steel lattice towers, 75 steel monopole structures, and 98 wood pole structures, about 45 to 80 feet above ground. The existing transmission conductor is primarily ACSR[2]. Representative cross-sections of the Existing Lines and Taps are provided in Appendix 5-3.

From east to west, the substations and taps along the route of the Existing Lines are as follows:

- **Millbury #305 Substation**: NEP's Millbury Substation #305 in Millbury is a transmission and distribution switching station. The E5/F6 Lines extend approximately 4.2 miles along the ROW from Millbury Substation to the Pondville #26 Substation Tap.
- **Pondville #26 Tap and Substation**: The Pondville Substation Taps extend from the E5/F6 ROW approximately 0.01 miles to NEP's Pondville Substation #26 in Auburn, which serves MECo customers in Auburn, Bolton, Leicester, Millbury, Oxford, and Worcester. The E5/F6 Lines continue from the Pondville Tap approximately 5 miles along the ROW to the Leicester #21 Substation Tap.
- **Leicester #21 Tap and Substation**: The Leicester Substation Taps extend from the E5/F6 ROW approximately 0.01 miles to NEP's Leicester #21 Substation in Leicester, which

[2] The Deerfield #3 taps are copper conductor.

serves MECo customers in Leicester, Charlton, and Spencer. The E5/F6 Lines continue approximately 5.6 miles along the ROW from the tap to Meadow Street #552 Substation.

- **Meadow Street #552 Substation:** NEP's Meadow Street #552 Substation serves MECo customers in Spencer, Brookfield, Charlton, East Brookfield, Leicester, North Brookfield, Paxton, and Sturbridge. The E5/F6 Lines continue approximately 1.4 miles along the ROW from Meadow Street #552 Substation to Harrington #2234 Substation.
- **Harrington #2234 Tap and Generating Station:** NEP's Harrington #2234 Station in East Brookfield receives power from the Vuelta solar facility. The E5/F6 Lines extend approximately 2.1 miles along the ROW from the tap to the Lashaway #525 Substation Tap.
- **Lashaway #525 Tap and Substation:** The Lashaway Substation Taps extend from the E5/F6 ROW approximately 0.01 miles to NEP's Lashaway #525 Substation in North Brookfield, which serves MECo customers in Brookfield, East Brookfield, New Braintree, North Brookfield, Warren, and West Brookfield. The E5/F6 Lines continue approximately 7.3 miles along the ROW from the tap to Ware #1 Substation.
- **Ware #1 Substation**: NEP's Ware #1 Substation serves MECo customers in Ware, Barre, East Brookfield, Hardwick, New Braintree, Warren, and West Brookfield. The E5/F6 Lines continue approximately 7.5 miles along the ROW from Ware #1 Substation to the Quabbin Switching Tap.
- **Quabbin Switching Tap and Tower:** The Quabbin Switching Tap extends from the E5/F6 ROW approximately 0.1 miles to NEP's Quabbin Switching Tower in Belchertown, where the E5/F6 Lines connect to NEP's 69 kV B69 line[3]. The E5/F6 Line continues approximately 11.8 miles along the ROW from the Quabbin Tap to Shutesbury #704 Substation.
- **Shutesbury #704 Tap and Substation**: The Shutesbury Taps extend from the E5/F6 ROW approximately 0.02 miles to NEP's Shutesbury #704 Substation in Shutesbury, which serves MECo customers in Shutesbury, Leverett, New Salem, and Pelham. The E5/F6 Line extends approximately 17.2 miles along the ROW from Shutesbury Substation to Deerfield #2 Substation.
- **Deerfield #2 Generating Station:** The E5/F6 Lines extend approximately 2.2 miles along the ROW from Deerfield #2 to the Deerfield #3 Taps.
- **Deerfield #3 Taps and Generating Station:** The Deerfield #3 Taps extend from the E5/F6 ROW in Shelburne approximately 0.5 miles to the Deerfield #3 Generating Station in Buckland. The E5/F6 Lines extend approximately 1.8 miles along the ROW to their termination at Deerfield #4.

[3] The B69 Line, which is about two miles long and feeds Belchertown #509 Substation, is not a part of the Project

- **Deerfield #4 Substation and Generating Station:** Deerfield #4 interconnects several transmission lines, serves Western Massachusetts Electric Company customers and connects the Deerfield #4 generating station to NEP's electric transmission system.

The Existing Lines are the only transmission supplies to the Pondville, Leicester, Meadow Street, Lashaway, Belchertown, and Shutesbury Substations. In addition, the E5/F6 Lines are the only lines transmitting power from the Deerfield #2, #3 generating stations, as well as the Vuelta solar facility, which is connected to the Harrington Switching Station.

- All substations are directly adjacent to the E5/F6 Lines, except Deerfield #3 and Belchertown #509. The Deerfield #3 Taps, which are between Deerfield #2 and Deerfield #4 Substation, are each about 0.5 miles long.

Figure 2-1 shows the location of the Existing Lines, substations and tap lines. A one-line diagram of the existing transmission system is provided as Figure 2-2.

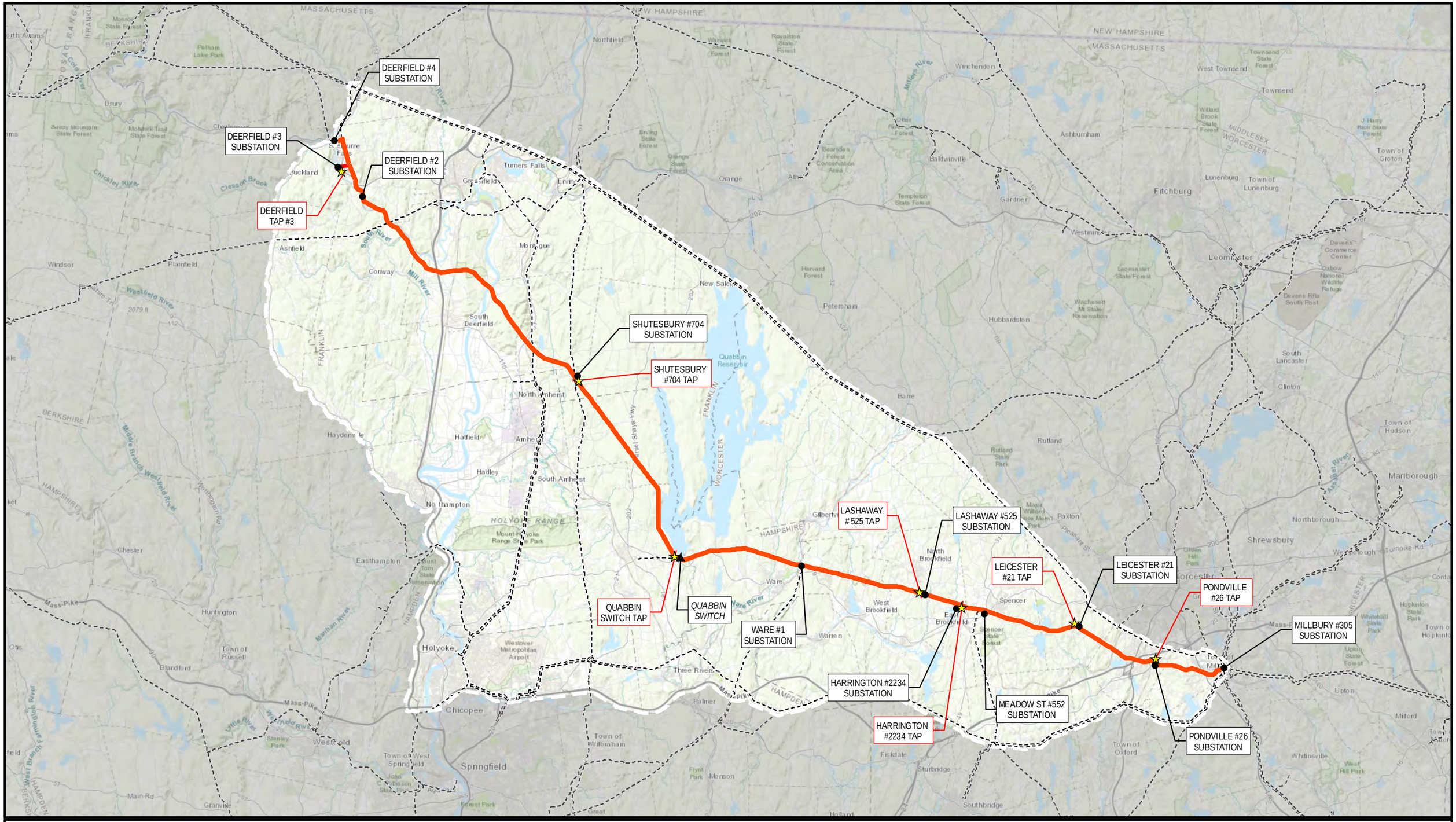

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Figure 2-1

Existing Lines and Interconnected Switchgear, Substations and Tap Lines

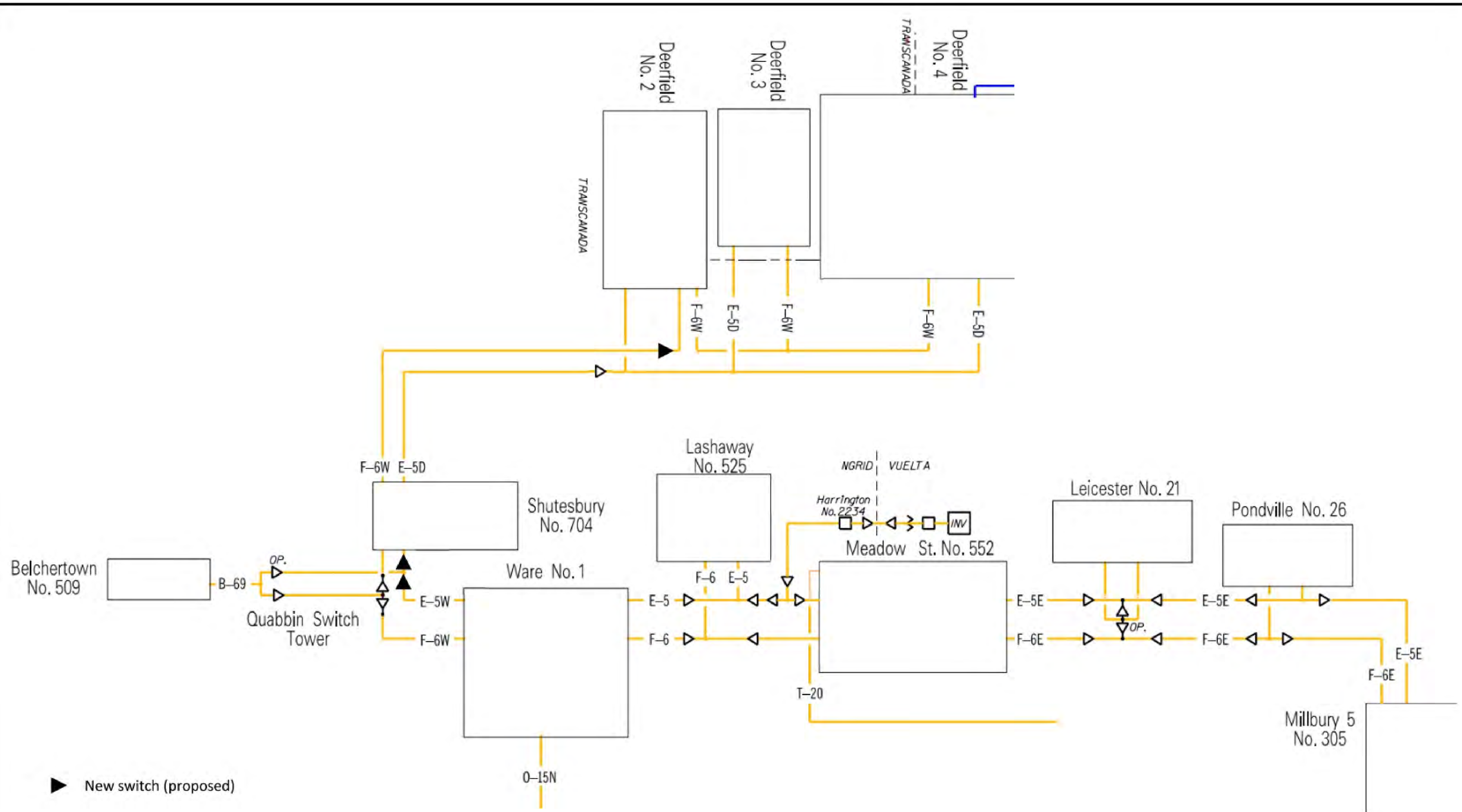

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Figure 2-2
One-line Diagram of the Existing Transmission System

2.2.2 Summer Peak Load

As shown in Table 2-1, approximately 33,000 electric customer accounts in 26 Massachusetts cities and towns are served from substations connected to the Existing Lines. The 2023 summer peak load for the substations served from the Existing Lines is approximately 126.17 megawatts ("MW").

Table 2-1: 2023 Summer Peak Load served by NEP from Existing E5/F6 Lines

Substation	Customers	Load (MW)	Towns Served
Pondville	5,366	8.58	Auburn, Bolton, Leicester, Millbury, Oxford, Worcester
Leicester	4,227	7.53	Leicester, Charlton, Spencer
Meadow Street	6,726	10.17	Spencer, Brookfield, Charlton, East Brookfield, Leicester, North Brookfield, Paxton, Sturbridge
Lashaway	5,038	9.99	Brookfield, East Brookfield, New Braintree, North Brookfield, Warren, West Brookfield
Ware	5,563	10.98	Ware, Barre, Hardwick, New Braintree, North Brookfield, Warren, West Brookfield
Belchertown	5,457	8.71	Belchertown, Amherst, Granby, Ware
Shutesbury	698	4.56	Shutesbury, Leverett, New Salem, Pelham

2.3 Operating History, Design Issues and Condition of Existing Lines

Recent analyses and studies demonstrate that the Existing Lines must be rebuilt to provide better shielding to reduce lightning and weather caused outages and to ensure the safe, efficient and reliable operation of the electric network. Specifically:

- The Existing Lines have a history of poor performance related to the age, condition and design of its structures. In the past six years, the Exiting Lines have experienced 70 outages.
- Poor shielding angles when compared to industry standards and close, tall trees along the ROW likely contribute to the poor performance of the Existing Lines.
- The structures on the Existing Lines have widespread damage, which poses a threat to the reliability of the transmission system.

2.3.1 Operating History

The Existing Lines have been among the least reliable lines on the NEP transmission system, consistently experiencing an unusually high rate of outages. Table 2-2 summarizes the outage history for the E5 Line for the last six years, 2019-2024. Table 2-3 provides the same information for the F6 Line. These issues persist today.

Table 2-2: E5 Line Outage History, 2019-2024

Circuit	Outage Date	Outage Duration (minutes)	Cause	Weather
E5D	2/25/2019	2683	Broken Tree Limb	Fair/Severe wind
E5E	6/30/2019	1	Lightning	Thunderstorms
E5E	7/6/2019	<1	Lightning	Thunderstorms
E5W	7/17/2019	<1	Lightning	Thunderstorms
E5E	7/31/2019	<1	Lightning	Thunderstorms
E5E	8/12/2019	<1	Unknown	Fair/Calm to light wind
E5E	8/18/2019	661	Broken Insulator	Fair/Mild wind
E5W	8/19/2019	<1	Lightning	Thunderstorms
E5D	10/31/2019	<1	Broken Tree Limb	Light rain/Strong wind
E5D	2/13/2020	560	Tree Fell	Freezing rain/Light wind
E5	6/29/2020	<1	Lightning	Thunderstorms
E5W	7/22/2020	<1	Lightning	Thunderstorms
E5D	7/28/2020	<1	Lightning	Thunderstorms
E5E	8/23/2020	<1	Lightning	Thunderstorms
E5	8/23/2020	<1	Lightning	Thunderstorms
E5	8/23/2020	<1	Lightning	Thunderstorms
E5E	10/7/2020	<1	Tree Fell	Light rain/Severe wind
E5D	3/1/2021	<1	Weather, Wind	Fair/Strong wind
E5E	3/1/2021	<1	Tree Fell	Fair/Strong wind
E5E	3/1/2021	<1	Tree Fell	Fair/Strong wind
E5D	3/12/2022	<1	Insulator Failure	Freezing Rain or Sleet
E5D	3/12/2022	1187	Insulator Failure	Freezing Rain or Sleet
E5	4/24/2022	<1	Unknown	Fair
E5W	8/5/2022	<1	Lightning	Thunderstorms
E5W	8/26/2022	<1	Unknown	Thunderstorms
E5E	11/19/2022	<1	Unknown	Fair
E5	3/14/2023	<1	Unknown	Snow
E5D	3/14/2023	<1	Unknown	Snow
E5D	3/14/2023	2129	Tree Fell	Snow
E5W	3/14/2023	<1	Unknown	Rain/Mild Wind
E5W	3/14/2023	1085	Unknown	Rain/Mild Wind
E5D	7/21/2023	<1	Unknown	Thunderstorms
E5D	9/8/2023	<1	Lightning	Thunderstorms
E5D	9/8/2023	<1	Lightning	Thunderstorms
E5E	1/7/2024	<1	Unknown	Snow
E5E	1/7/2024	<1	Unknown	Snow
E5E	1/7/2024	<1	Unknown	Snow
E5W	4/4/2024	<1	Unknown	Snow
E5E	6/26/2024	1	Unknown	Rain/Mild Wind
E53	7/4/2024	2	Unknown	Fair

Table 2-3: F6 Line Outage History, 2019-2024

Circuit	Outage Date	Outage Duration (Minutes)	Cause	Weather
F6W	2/25/2019	1567	Tree Fell	Fair/Severe wind
F6W	3/31/2019	< 1	Tree Fell	Fair/Calm to light wind
F6E	7/6/2019	< 1	Lightning	Thunderstorms
F6W	7/17/2019	< 1	Lightning	Thunderstorms
F6E	8/18/2019	< 1	Insulator Failure	Fair/Mild wind
F6W	8/19/2019	< 1	Lightning	Thunderstorms
F6	9/5/2019	< 1	Unknown	Fair/Calm to light wind
F6W	10/31/2019	878	Broken Tree Limb	Light rain/Strong wind
F6	3/30/2020	< 1	Device Failure	Fair/Calm to light wind
F6W	4/13/2020	< 1	Weather, Wind	Heavy rain/Mild wind
F6	6/29/2020	< 1	Lightning	Thunderstorms
F6W	7/22/2020	2	Lightning	Thunderstorms
F6E	8/4/2020	1017	Device Failure	Heavy rain/Major Storm
F6E	8/23/2020	< 1	Lightning	Thunderstorms
F6	8/23/2020	< 1	Lightning	Thunderstorms
F6W	10/27/2020	2	Unknown	Fair/Calm to light wind
F6W	3/1/2021	8	Weather, Wind	Fair/Strong wind
F6	5/31/2022	< 1	Lightning	Thunderstorms
F6W	8/26/2022	< 1	Unknown	Thunderstorms
F6E	12/30/2022	905	Unknown	Fair
F6W	2/24/2023	< 1	Unknown	Fair
F6W	3/4/2023	< 1	Unknown	Snow/Mild wind
F6W	3/14/2023	2392	Tree Fell	Snow/Mild wind
F6	6/15/2023	< 1	Device Failure	Fair
F6W	7/21/2023	< 1	Unknown	Thunderstorms
F6W	9/8/2023	< 1	Lightning	Thunderstorms
F6W	9/8/2023	< 1	Lightning	Thunderstorms
F6E	1/7/2024	<1	Unknown	Snow
F6W	4/4/2024	1	Unknown	Snow
F6E	7/4/2024	2	Unknown	Fair

As shown in Tables 2-2 and 2-3, the E5 Line experienced 40 momentary or sustained outage events in the most recent six-year period, while the F6 Line experienced 30 such events during that time period[4]. In comparison, 85% of NEP's transmission lines experienced five or fewer events during this period, and only 5% experienced ten or more events. The E5/F6 Lines are on the list of the top 10 Worst Performing NEP Circuits every year[5].

The above tables also show that 11 transmission line outages resulted in extended customer outages. In 2023, two outages on the E5 Line were approximately 18 and 35 hours long and one outage on the F6 Line was approximately 40 hours long. Note that even momentary outages may

[4] A momentary outage is an automatic outage with a duration of less than one minute that the transmission system can return to service without further intervention. A sustained outage is an outage with a duration greater than a minute that typically requires corrective action along a circuit prior to re-energization.

[5] NEP annually ranks the performance of its transmission lines based on their importance to the transmission system and the frequency of incidents over a rolling five-year period. This ranking is used to identify transmission lines in urgent need of improvement to maintain customer reliability.

have significant impacts on customers with sensitive equipment that must be taken offline or could be damaged by momentary voltage fluctuations.

Table 2-4 summarizes the causes of the outages on the Existing Lines during the 2019-2024 period.

Table 2-4: Line Outage Counts by Cause, 2019-2024

Line	Cause						
	Lightning	Weather/Wind	Vegetation/ Tree	Insulator Failure	Unknown	Device Failure	Total
E5	14	1	7	3	15	0	40
F6	10	2	4	1	10	3	30
Total	24	3	11	4	25	3	70

As shown in Table 2-4, lightning strikes accounted for 24 events, while 11 were attributed to interference with vegetation or trees. Three outages occurred during storms but could not be tied definitively to either lightning strikes or vegetative interference. In 25 cases, no cause could be definitively identified; however, at least some of these may be associated with either lightning strikes or vegetative interference. Given that most outages on the Existing Lines are associated with consequences from storm conditions, these outages are likely to continue – perhaps exacerbated by an increase in storm frequency and intensity due to climate change unless the Existing Lines are rebuilt with new, more resilient structures. The outages not the result of weather-related conditions demonstrate the general deterioration of the Existing Lines.

2.3.2 Design Issues Impacting Reliability

The design of a transmission line is of paramount importance because it affects its ability to provide reliable service under current and future transmission line load requirements. Most of the structures on the Existing Lines are the original construction, installed when the E5/F6 Lines were first energized in the early 1900s. However, best practices and standards for designing, constructing and operating transmission lines have evolved over time.

While the Existing Lines were first energized over a hundred years ago, portions of the E5/F6 Lines were refurbished in 2001. The refurbishment project consisted of replacing conductors and insulators from Millbury to Ware Substations and adding extensions to all lattice towers to enable the shield wire to be replaced with OPGW. In addition, as part of the refurbishment project, approximately 10% of the lattice towers were replaced with steel poles.

Finally, in 2019, the manufacturer of the insulators recommended that they be replaced because of manufacturing defects that cause premature deterioration, which could lead to safety and reliability issues. In 2019 and 2020, the Company replaced all the insulators with manufacturing defects and some of the remaining insulators on the E5/F6 Lines, totaling approximately 50% of the Existing Lines.

As discussed below, notwithstanding the refurbishment project, some inherent design features of these older lines can only be remedied by replacing the lines.

2.3.2.1 Need for Improved Resiliency from Lightning

Transmission lines require protection against direct lightning strikes to the electrical conductors that can cause severe damage. Accordingly, transmission lines must be designed with ground or

shield wires of adequate mechanical strength, which are appropriately located on the structure to properly shield the conductors.

The shield wire functions to intercept direct strikes to the conductors within a protective area beneath it. The area of greatest protection is measured by the shielding angle – i.e., the angle between a vertical line drawn through the shield wire at the attachment point on the structure and a line between the shield wire and the outermost conductor that is to be protected. Figure 2-3 below illustrates the concept of shielding (protecting) angle.

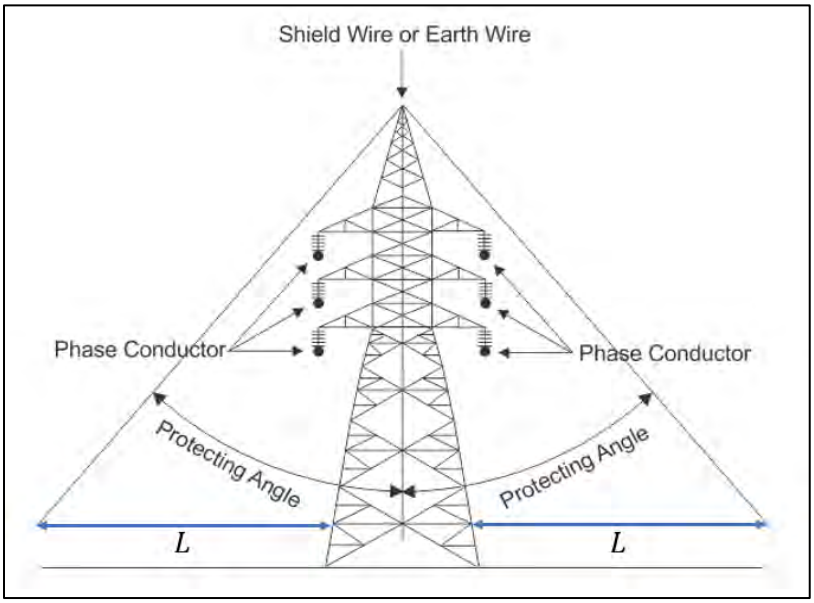

Figure 2-3: Diagram of the Shielding (Protecting) Angle

The smaller the shielding angle, the more directly under the shielding wire the conductors are, and the greater the protection of the conductors from lightning strikes. Lines with a greater shielding angle are more likely to have the conductors struck by lightning causing a flashover[6]. Extensions were installed on the existing structures when they were refurbished in 2001; however, even with the line extensions, the height of the structures still does not provide a sufficient shielding angle to adequately protect the E5/F6 Lines. The steel lattice towers on the Existing Lines have an approximately 40-degree shielding angle and the steel pole structures on the Existing Lines have an approximately 46-degree shielding angle.

National Grid policy and industry practice is to restrict shielding angle to 30 degrees or less, which allows the shield wire to intercept lightning strikes prior to the lightning hitting an energized conductor and, thus, significantly reduces the potential for a flashover creating an outage. Per Section 16.3 of National Grid Standard GL.06.01.121 Transmission Line Design Guide:

> For new construction at all transmission voltages, overhead groundwire(s) shall be utilized to protect the circuit from lightning strikes. The shielding angle shall

[6] A flashover is an unintended high voltage electric discharge over or around an insulator or sparking between two or more adjacent conductors. A flashover can cause damage to the line and nearby equipment, as well as interrupt service

> be no larger than 30°. For spans subjected to increased lightning activity, e.g., exceptionally long spans and river crossings, a smaller shielding angle should be considered. Deviations from the above may be appropriate in certain locations, such as in the vicinity of airports or where the circuit is naturally shielded by trees or other transmission lines but shall be made only with the approval of Transmission Line Engineering.

The use of a maximum 30-degree shielding angle is considered good utility practice and is recommended by the Rural Utility Service in Chapter 8 of Bulletin 1724E-200, which is broadly used by a number of utilities as a guideline for their standards.

Thus, the shielding angles on the Existing Lines is much greater than the current 30-degree standard for shield wire angles and provides insufficient shielding from lightning, which is consistent with, and predictive of, the types of outage events experienced on the Existing Lines. As shown in Table 2-4, lightning strikes account for one third of total line outages in the 2019-2024 period – and perhaps more, since some the outages attributed to "weather" and "unknown" may well be unidentified lightning strikes.

The only way to decrease the shield angle from the existing 40- or 46-degree angles is to increase the distance on each structure between the shield wire and the conductors. Adding extensions to the Existing Lines is not a feasible solution because pole extensions would add increased weight and introduce structural deficiencies. The only practical way to remedy this inherent structural design issue is to replace the existing structures with taller structures that will provide a shielding angle of less than 30 degrees. In addition, the Existing Lines are constructed with only one shield wire. The Project will include two OPGWs, one for each circuit, which will shield both lines from lightning strikes.

Another design feature of the Rebuilt Lines is that they will have more insulation and, therefore, will provide greater protection against lightning strikes. The Company is proposing construction of the Rebuilt Lines to a 115 kV design, which increases the length of the insulators in a conductor assembly as compared to the 69 kV design. While this requires a slightly higher structure, the additional insulation provides greater protection against a back-flashover across the insulation should a structure or shield wire be hit by lightning. When lightning contacts a shield wire, a traveling current wave is created, which in turn induces a traveling voltage wave. This traveling voltage wave typically increases in magnitude as it travels down the wire until it reaches a grounded element (transmission structure). The grounded transmission structure creates a reflection of the traveling voltage wave, which serves to cancel it out and prevents the traveling voltage wave from increasing. If the traveling voltage wave is of sufficient magnitude, the air gap between the energized conductors and grounded structure arm can be breached, creating a back-flashover of the insulators resulting in an outage. The greater the insulation, the lower the probability of occurrence of this event.

Lastly, the increase in spacing between conductor phases on the Rebuilt Line will reduce the potential for voltage induced by a lightning strike that travels to a single conductor from flashing over to an adjacent conductor. The vertical configuration of conductors on the Existing Lines has each arm that supports a conductor being the same length. The spacing between two adjacent phases of each circuit, as well as the space between one phase and the structure arm supporting the phase below, do not meet current applicable safety codes, including the National Electrical Safety Code ("NESC") and 220 CMR 125. The reduced vertical space between the two adjacent phases

of the conductor reduces the amount of insulation that can be placed between the conductors and the structure, which increases the line's susceptibility to lightning- and tree-caused outages. The current practice is to stagger the arm lengths of a delta configuration so that the conductors are not in a straight vertical line, which increases the space between the conductor phases. Staggering the arm lengths reduces the likelihood of conductor contact or flashover due to galloping (large amplitude conductor motion caused by snow or ice on the line and a steady wind) or ice shedding (sudden vertical conductor motion caused by ice falling off the lines).

In summary, the Project will replace the existing structures with taller structures with staggered arms, which will provide additional space to separate the shield wire/OPGW from the conductors and, therefore, decrease the shielding angle. In turn, the reduced shield angle will provide greater protection from lightning strikes to the conductors. The increased height of the structures on the Rebuilt Line will also allow longer suspension insulator strings to be installed, and greater spacing between conductor phases, each of which contributes to increased resilience to lightning events.

2.3.2.2 Interference from Vegetation

The height of structures, together with the location of structures on a ROW, contributes to a transmission line's reliability. If the structures are lower than adjacent off-ROW vegetation (i.e., trees not within the Company's control to manage), the line will be susceptible to interference from vegetation. When these trees fall or drop limbs during periods of high winds, they contact the existing conductors and cause either momentary or sustained outages.

These conditions exist on the Existing Line. The close proximity of tall trees along, but outside, the ROW contributes to the high frequency of tree-related outages on the Existing Lines. The configuration of the Existing Lines is generally vertical. Additionally, the elevation of the lowest existing conductor above grade is typically the minimum necessary to conform with the governing code. In many areas, the abutting land just beyond the ROW is densely vegetated with tall-growing species that exceed the height of the existing structures. As a result, when a tall-growing tree located outside the bounds of the ROW falls or drops limbs across the width of the ROW, there is a high probability that the vegetation will contact at least one phase and potentially both circuits supported by the existing structures, causing outages. As shown in Table 2-2 above, one of the longest outages of the last six years occurred on March 14, 2023, which lasted for approximately 36 hours and was caused by tree damage that took down both the E5 and F6 Lines. Replacing the existing structures with taller structures will decrease the likelihood of fallen vegetation causing outages.

While the Company performs frequent vegetation maintenance along the E5/F6 ROW (in addition to the regular five-year cycle for tree trimming and hazard tree removal), the dense off-ROW vegetation and the poor access road condition make these efforts insufficient. Rebuilding the line on taller and narrower structures, will reduce the likelihood of trees falling on the line.

2.3.3 Asset Condition

In addition to the inherent design issues discussed above, the deteriorating physical condition of the Existing Line structures also supports the need for the Project. Every five years, the Company conducts a ground level inspection of its transmission line assets to assess their condition and determine maintenance or refurbishment needs.

In 2019, NEP conducted a review of the physical condition of the Existing Lines and Tap structures to identify any issues that might negatively affect the service reliability of the lines. Approximately 34% of the structures on the Existing Lines and Taps were visually inspected at strategic locations. This was supplemented by an aerial inspection of all structures along the full length of the E5/F6 Lines and Taps. The inspections identified that the main issues on the lattice towers involve foundation damage, corrosion, bent/bowed components of the towers, and paint degradation. Steel poles issues include foundation damage and the proximity of dense vegetation. Wood poles show signs of deterioration due to pole top rot, and significant woodpecker activity was present at nearly every wood structure examined. Overall, the inspections indicate that woodpecker activity and other damage compromise the integrity of many structures on the Existing Lines. The deteriorated condition of these more than century-old structures supports their replacement.

The most recent cyclical inspection done in April 2022 supports these findings. Bent cross members and deteriorating foundations were observed on the lattice towers and continuing pole rot and woodpecker damage were observed on the wood structures. The inspection also identified broken insulators, missing ground wire and loose bolts on hardware.

2.4 Need For Enhanced Fiber Optic Capability

OPGW is a dual functioning cable that both acts as shield wire and contains optical fibers that are used for telecommunications purposes. Only a portion of the Existing Lines has OPGW, between the Deerfield #4 Substation and Structure #322 at the southern tip of the Quabbin Reservoir. The substations along the remaining portions of the Existing Lines are presently communicating through microwaves. The single existing OPGW is insufficient to provide adequate shielding and does not provide adequate telecommunications capabilities. Rebuilding the Existing Lines will enable the Company to install two OPGWs on the Rebuilt Lines and Taps in place of traditional shield wire, one for each of the circuits. The OPGWs will be placed in the topmost position of the transmission structure where they will shield the conductors from lightning while providing a telecommunications path to connect the substations along the transmission corridor.

In the OPGW cable, the optical fibers are surrounded by layers of steel and aluminum wire. The OPGW fibers are more reliable and secure than the microwave connections currently used for communication purposes on most of the Existing Lines because they are less affected by environmental factors, such as weather, noise or other obstacles. Moreover, OPGW fibers are harder to tap or hack because they do not radiate signals outside the cable. Microwave connections, on the other hand, are more vulnerable to interference and can be easily intercepted or disrupted.

Improving fiber optic coverage in the central Massachusetts area will allow NEP to phase out microwave and leased communication services between several substations in the area, improving communications and fault protection reliability. Fiber optic communication is used by NEP in the daily operation of the transmission system elsewhere on its system and it is becoming critically more important to manage the transmission system as automation and system condition monitoring equipment become more prevalent and involved in the management of transmission system operations.

By enabling direct high-speed communication between relays at each substation, OPGW can be used to monitor substations and remotely operate transmission system components (switches, breakers, etc.). It is also used to remotely access digital fault recorders and relay information without physically visiting a substation, which enables the Company to more quickly diagnose,

locate, and repair faults more quickly and cost-effectively. In addition, transmitting data between and among substations and control centers via OPGW is more secure and can be less costly than using public communications network services. Lastly, OPGW provides a communication path for substation security monitoring (cameras, access control, gunshot detection systems, etc.).

Adding OPGW to the existing structures is not feasible because the structures would not be able to support the weight of the additional OPGW. During the 2001 refurbishment project, increased loads associated with the larger conductor size utilized nearly all the available structural capacity of the existing towers. Hypothetically, it may be possible to modify the existing structures that are not already in deteriorating condition, to increase their structural capacity to support OPGW; however, these modifications would be extensive and labor-intensive, negating any savings compared to replacement of the structures with new structures designed to support two OPGWs.

2.5 Long Term Benefits

The proposed Project, with the ability to operate at 115 kV in the future should circumstances warrant, would provide the additional transmission capacity and voltage support needed along the E5/F6 corridor[7] to provide for increased electricity usage and the interconnection of future DER. With power delivery expectations on the power system increasing, and with high volumes of new devices and energy sources connecting to the system, NEP must ensure that the condition of the infrastructure does not become an obstacle to achieving its own, as well as state and regional, climate change goals. There will likely be a future need for additional transmission resources along the E5/F6 corridor to facilitate anticipated interconnection of solar photovoltaic and battery energy storage solution projects as well as increased load.

Over the next several decades, renewable resources like wind and solar photovoltaic generation are expected to substantially displace natural gas-fired generation as the region's primary resource, while at the same time, increased electrification is expected to significantly increase overall consumer demand for electricity and drive changes in usage patterns, including seasonal and daily shifts in peak demand. One of ISO-NE's responsibilities is ensuring the regional power system continues to operate reliably as system conditions change. Transmission planning helps to maintain system reliability and enhance the region's ability to support a robust, competitive wholesale power market by moving power from various internal and external sources to the region's load centers.

To facilitate a smooth, reliable clean energy transition, ISO-NE, in coordination with the New England States Committee on Energy, undertook a study of the ways in which the transmission system in New England may be affected by changes to the power grid. On February 12, 2024, ISO-NE issued the results in a document entitled "2050 Transmission Study" (provided as Appendix 2-1"), a comprehensive long-term regional transmission study undertaken to help inform stakeholders of the amount and type of transmission infrastructure necessary to provide reliable, cost-effective energy to the region throughout the transition to clean energy. The 2050 Transmission Study points to a long-term need for additional capacity across the New England transmission system to support long-term electric load growth driven by these regional

[7] "ROW" and "corridor" are both used to identify land currently owned/operated and managed by NEP and other utilities for transmission and sub-transmission assets. These terms will be used interchangeably throughout this section.

commitments. The 2050 Transmission Study concluded that assuming increased buildouts of renewable energy resources continue, and electrification of heating and transportation proceeds as expected, the region's aging transmission system has the potential to become a significant bottleneck to progress if it does not keep pace with changes to other elements of the power system. Thus, based on expectations from the 2050 Transmission Study, it is likely that the Existing Lines would become overloaded if not rebuilt. In addition, in recent years, developers have proposed over 550 MW of DER projects that would interconnect at more than 35 National Grid substations in central and western Massachusetts, including seven substations along the E5/F6 transmission corridor. NEP conducted a series of system impact studies ("SIS") to determine whether the interconnection of these projects would result in a significant adverse impact on the reliability, stability and operating characteristics of the New England bulk power transmission system and the National Grid transmission system. These SIS consisted of thermal, voltage, stability, and short-circuit analyses for three successive groups of proposed DER projects, known as Groups 1, 2 and 3. This series of studies is known collectively as the "Western Massachusetts Cluster Studies."

In June 2022, NEP issued its "Transmission System Impact Study Results for Group 3 of DER Additions in Western Massachusetts" ("Group 3 Cluster Study"), which is provided as Appendix 2-2. This study assessed the transmission system impact of interconnecting DER projects that were proposed since the Group 2 Cluster Study was issued, including a 40 MW solar project that would interconnect along the E5/F6 transmission corridor. The Group 3 Cluster Study found that interconnection of Group 3 DER projects along the E5/F6 Lines would result in violations of thermal reliability criteria for the Existing Lines, if the 40 MW solar facility in the ISO-NE Federal Energy Regulatory Commission ("FERC") generator interconnection queue were to be built. Although the proposed project has since withdrawn from the queue, it is likely that any future projects proposed along the E5/F6 transmission corridor would overload the Existing Lines. Consequently, this suggests a future need for additional transmission capacity along the E5/F6 corridor to support the interconnection of DER projects.

2.6 Conclusion

NEP is obligated to ensure the safe and reliable delivery of electricity to customers and the transmission of electricity to support regional electricity markets. Accordingly, the Company employs a forward-looking approach to asset management whereby it evaluates asset conditions to determine which assets should be replaced before their performance negatively impacts the provision of safe and reliable service.

The Existing Lines were built in the early 1900s to carry network power flows and supply distribution load-serving substations in western and central Massachusetts. Today, these more than century-old transmission lines continue to bring hydropower to Massachusetts and also serve as the sole transmission source for electric customers in 26 Massachusetts cities and towns. Despite their importance, the Existing Lines are among the least reliable lines on the NEP transmission system, consistently experiencing an unusually high rate of outages associated with lightning, vegetation contacts, and weather events.

This outage rate reflects both design issues inherent with the existing structures as well as the existence of tall, dense vegetation along many parts of the E5/F6 ROW that likely contributes to the frequency with which downed trees and dropped limbs interrupt power flow on the Existing Lines. The lightning masts and single shield wire on the Existing Lines are inadequate because the

shield angle does not meet current standards, and it is impossible to improve the shielding angle needed to properly protect the lines from lightning strikes while retaining the existing structures. In addition, many of the existing structures are in poor or deteriorating physical condition.

Repairing or replacing structures on a structure-by-structure basis would not allow the Company to address existing design issues and, therefore, would likely not significantly reduce outages. Completely rebuilding the Existing Lines with new, taller structures, with improved phase spacing, additional insulation and two OPGWs will reduce exposure to tree falls, dropped limbs, and provide greater resiliency from lightning and inclement weather impacts. Rebuilding the Existing Lines will not only improve reliability, but the new structures will have sufficient structural capacity to support OPGW that will provide an upgraded communications path between NEP's Millbury and Deerfield #4 Substations.

Further, with power delivery expectations on the power system increasing, and with high volumes of new devices and energy sources connecting the system, transmission infrastructure must not become an obstacle to achieving NEP's, state, and regional climate change goals. For all of the above reasons, the Project is needed to address the condition of the Existing Lines to improve their performance and ensure reliable service to the Company's electric customers.

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3 PROJECT ALTERNATIVES

3.1 Introduction

This section discusses the Project alternatives that NEP identified and evaluated for their potential to address the transmission resource needs identified in *Section 2*. Recent analyses and studies demonstrate that these century-old transmission lines are in poor condition and need to be rebuilt. Specifically:

- The Existing Lines have a history of poor performance related to their age and the original design of their structures.
- The most recent five-year inspection of the Existing Lines found physical issues on all of the structures examined, which pose a threat to the reliability of the transmission system.
- Inherent design issues contribute to the poor performance of the Existing Lines.
- Increased fiber optic capability is needed to serve fault protection and telecommunications needs.
- Reliable capacity will likely be needed on the E5/F6 Lines to support anticipated future loads.

The sections below describe the Project alternatives considered, including a No-Build Alternative (*Section 3.2*); Non-Wires Alternatives (*Section 3.3*); two Partial Rebuild Alternatives (*Section 3.4*); and a Complete Line Rebuild Alternative (*Section 3.5*). Of these, only the Complete Line Rebuild Alternative addresses the full range of needs identified in *Section 2*.

In addition, the Company considered two transmission structure designs for the Rebuilt Lines: one that complies with NEP's 115 kV design standards, and a second that complies with NEP's 69 kV design standards. *Section 3.7* compares these two structure designs with respect to transmission system reliability, environmental impacts, and project cost. This comparison also considers the ability of the two designs to support long-term electric load growth driven by regional commitments to address climate change through electrification and a deeper integration of renewable resources. These analyses demonstrate that the replacement of the Existing Lines with overhead lines built within the existing ROW to 115 kV specifications is the superior approach in terms of its ability to meet the identified need at the lowest reasonable cost, with the fewest environmental impacts, and with a high degree of reliability.

3.2 No-Build Alternative

Under the No-Build Alternative, the Existing Lines would remain in place and NEP would not execute a capital project to address performance issues and physical issues on the Existing Lines or the need for increased fiber optic capability. The Company would continue to address line components that are imminently about to fail on an ad hoc basis, as it does with all its transmission assets. Accordingly, the Company would repair or replace structures on an as-needed basis to address deterioration.

This approach is inferior to the Project for several reasons. As discussed in *Section 2*, the Existing Lines are experiencing poor performance, are in deteriorating condition, have inherent design

issues and will have insufficient capacity to meet anticipated future needs. While repairing and replacing structures on an as-needed basis would address physical issues on individual structures, it would not address the inherent design issues that affect the entire line. Replacing individual structures in a piecemeal fashion would not allow for all structures to be taller to improve the insulation level and shielding angle; therefore, a piecemeal approach to replacing the structures would not reduce the potential for outages due to lightning strikes. Further, because OPGW cannot be added to the Existing Lines, the No-Build Alternative would not provide fiber optic capability that would improve communication between substations. In short, the Existing Lines should be rebuilt to improve their performance and reliability. Because the No-Build Alternative would not meet the identified need, it was eliminated from further consideration.

3.3 Non-Wire Alternatives

NWAs use some combination of energy efficiency and demand response programs, distributed generation, and energy storage facilities as alternative means of deferring or addressing the underlying need for a transmission or distribution project. NWAs generally are appropriate when the underlying need for a project is driven by increasing load levels, so that the load reductions provided by the NWAs allow an increasing number of electric customers to be served with the existing transmission and distribution infrastructure.

While the Project will provide additional reliability and capacity, the underlying Project need is driven by the deteriorating condition and design of the Existing Lines, which are among the least reliable on NEP's transmission system, as well as the need for increased fiber optic capability. The implementation of an NWA would not address the inherent structure constraints that predispose the Existing Lines to outages from lightning strikes, or the proximity of tall, dense vegetation outside of the Company's control that exposes the lines to tree falls and dropped limbs, nor would it enable the Company to enhance its protection and telecommunication abilities. For these reasons, NWAs would not meet the identified resource needs and the Company eliminated them from further consideration.

3.4 Partial Rebuild Alternatives

The Company considered two Partial Rebuild Alternatives, one with minimal work and one with more extensive work. The Partial Rebuild Alternatives are targeted structure repair programs that would address the most pressing concerns regarding the deteriorating structures. Under the minimal work alternative, the Company would repair twenty lattice towers with deflecting or damaged components and replace one lattice tower that is leaning. The Company also would update grounding on five lattice towers and complete routine structure maintenance on lattice towers and routine foundation maintenance on both the lattice towers and steel pole structures. Under a more extensive Partial Rebuild Alternative, the Company would also replace ten wood pole structures with steel structures.

Under either Partial Rebuild Alternative, the existing structures, conductor and shield wire would remain in place. ROW and access improvements would be needed but would be limited to what is required to complete the structure repair work. Actions to address most of the needs identified in *Section 2* would be deferred until a later date.

Targeted repair programs like the Partial Rebuild Alternatives can be low-cost, low-impact strategies for extending the life of transmission lines if the primary issue is a limited number of damaged structures. However, this approach is not appropriate for the Existing Lines because it would leave all, or the majority of existing structures in place and, therefore, would not address the underlying reliability issues associated with the inherent design issues (i.e., poor shielding angle and inadequate conductor spacing).

Given that the original structures would mostly be retained rather than replaced, the Partial Rebuild Alternatives would not reduce the incidence of line outages associated with lightning strikes, downed trees, thunderstorms, and avian interference. Even under the more extensive Partial Rebuild Alternative, reliability improvements would be limited because these individual replacement structures would need to be physically consistent with the existing towers, which would remain unimproved. In addition, because OPGW would not be installed on each line, the Existing Lines would not be adequately protected from lighting strikes and the added benefit of high-speed communications between substations would not be realized. Lastly, these alternatives would not provide the additional capacity to meet future energy needs. At best, the Partial Rebuild Alternatives would extend the life of individual structures without providing improved reliability, better communications capability or increased capacity.

Because these alternatives do not address the key structure design issues associated with the poor reliability of the Existing Lines nor meet the other identified needs, they were dismissed from further consideration.

3.5 Complete Line Rebuild Alternative (Project)

The Project consists of rebuilding the Existing Lines and Taps within existing ROWs, completely replacing the existing structures, conductor, and shield wire. All steel pole suspension structures will have either direct-buried foundations or micropile foundations and all dead end or angle structures will be supported by drilled shaft foundations. Key components of this alternative include:

- Installing new, davit arm, steel monopole structures, on the Existing Lines and Taps and thereafter removing the existing the 538 lattice towers, 75 steel pole structures, and 98 wood poles,
- Removing the existing conductor and OPGW on both the Existing Lines and Taps and replacing with larger aluminum conductor,
- Installing two new OPGWs, one on the E5 Line and one on the F6 Line, and
- Performing vegetation management, upgrading existing access, and creating new access as required to construct and maintain the Rebuilt Lines.

Rebuilding the Existing Lines will address all the needs identified in *Section 2*. Replacing the existing structures with taller structures will correct the poor shielding angle and avoid many of the outages caused by lightning. In addition, the new, taller monopole structures will reduce opportunities for trees striking the line and for bird nesting. Taken together, these design changes will significantly reduce the frequency of outages on the Existing Lines and increase their reliability. In addition, access improvements will improve NEP's ability to quickly repair damage to the lines when an outage does occur. Lastly, replacing the existing conductors with 795 thousand

circular mils ("kcmil") ACSS conductor will increase normal thermal capacity by 172% compared to the Existing Lines will provide additional thermal capacity needed both to interconnect future DER, such as photovoltaic projects and battery energy storage systems, and to support projected electric load growth without the need for additional line upgrades in the foreseeable future. Replacing the single existing shield wire with two OPGW (one for each circuit) allows for increased fault protection and high-speed communication between substations along the Rebuilt Lines.

The Complete Line Rebuild Alternative is the only alternative that will improve performance of the Existing Lines and Taps by addressing all of the issues and provide the additional thermal capacity required to support future load growth. Accordingly, NEP selected it and dismissed other alternatives from further consideration.

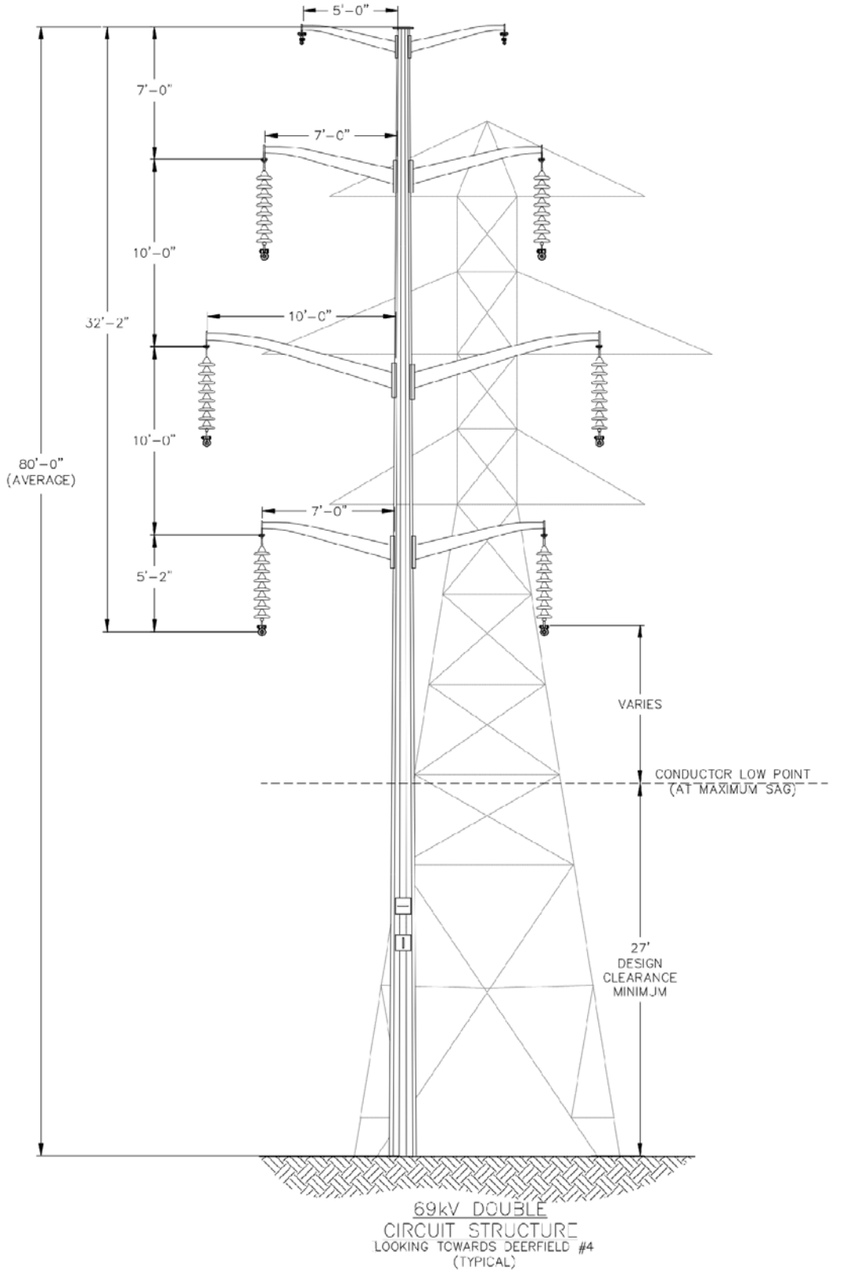
3.6 Design Alternatives

Having determined that a complete replacement of the Existing Lines and Taps is necessary, NEP then evaluated whether a 69 kV structure design or a 115 kV structure design would best meet the identified need while minimizing cost and environmental impacts and providing for the long-term reliability of the electric transmission system. The Company considered two transmission structure design alternatives: one that complies with NEP's 115 kV design standards ("115 kV Design"), and a second that complies with NEP's 69 kV design standards ("69 kV Design").

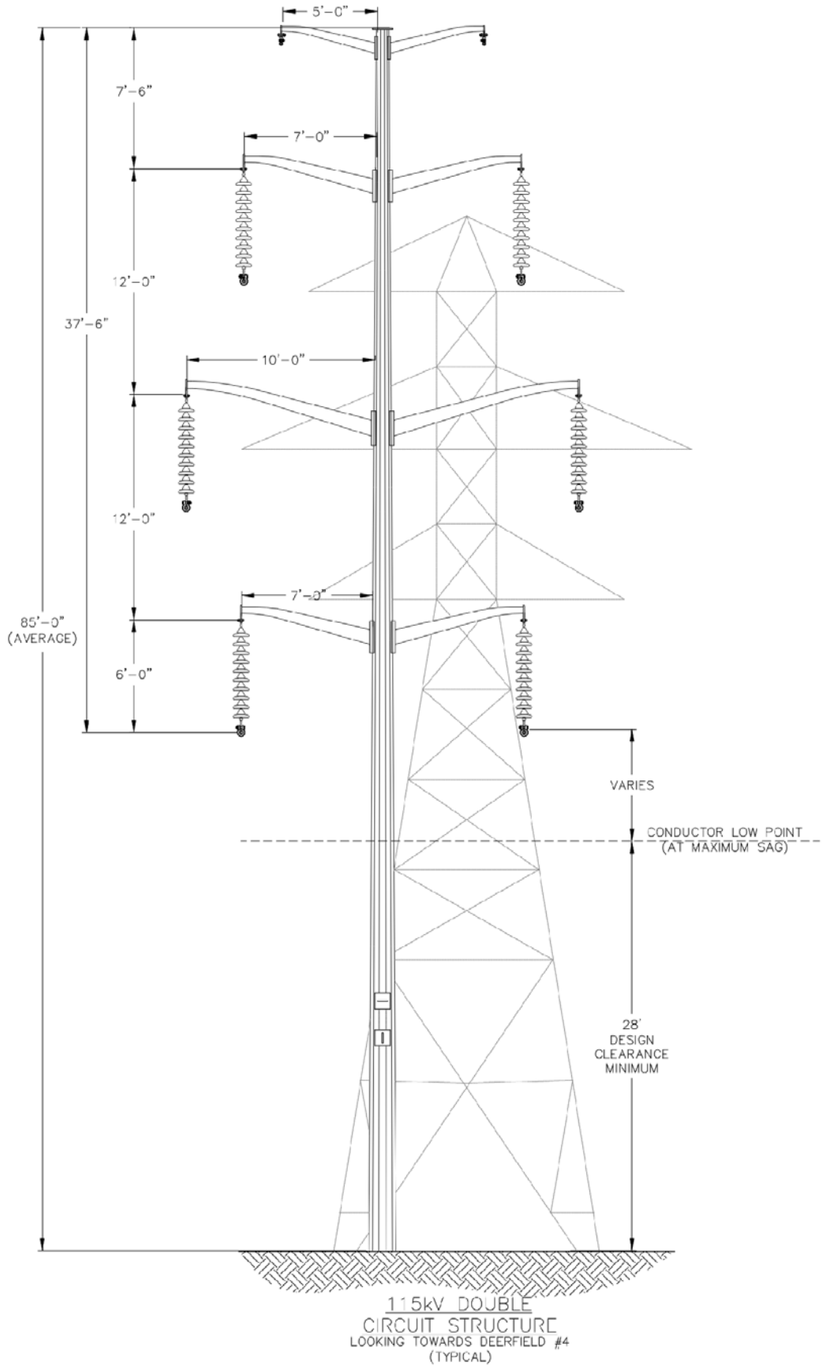
3.6.1 69 kV and 115 kV Designs

The Company has established design criteria for its transmission lines to assure acceptable reliability of its bulk transmission system facilities. These criteria apply to conductors, structures, and equipment and establish insulation levels and required clearances for various voltage transmission lines. For this Project, the Company evaluated the 69 kV and the 115 kV Design options.

Both structure designs would support the new conductors and would be contained within NEP's existing E5/F6 ROW. In addition, both designs elevate the new conductors above the existing locations. However, the 115 kV Design provides additional insulation and, more importantly, the ability to operate at a higher voltage in the future if conditions warrant. Figure 3-1 depicts typical 69 kV and 115 kV structure designs for the Project. The 69 kV and 115 kV Designs both use double circuit, vertically configured, davit arm, steel monopole structures with 795 kcmil ACSS "Drake" conductor installed on new lines and all taps. However, as seen in Figure 3-1, each insulator string on the 69 kV structure would carry seven insulators, while the 115 kV insulators strings would carry ten insulators. The additional spacing required to accommodate the longer insulator strings and larger required phase-to-phase and phase-to-ground clearance results in an approximately five to ten-foot increase in structure height for the 115 kV Design.



69kV DOUBLE
CIRCUIT STRUCTURE
LOOKING TOWARDS DEERFIELD #4
(TYPICAL)



115kV DOUBLE
CIRCUIT STRUCTURE
LOOKING TOWARDS DEERFIELD #4
(TYPICAL)

Central to Western Massachusetts Energy Improvement Project

nationalgrid
BSC GROUP

Figure 3-1

Typical 69kV and 115kV Structure Design

As discussed below, the Company evaluated reliability, environmental and cost considerations of constructing the Rebuilt Lines and Taps to 115 kV Design standards. The Company notes that the Existing Lines and Taps operate at 69 kV. There are no immediate reliability needs that would now necessitate the operation of the Rebuilt Lines and Taps at 115 kV within the 10-year planning horizon. If future planning studies find that increased DER penetration and/or increased load growth require the operation of the lines at 115 kV, NEP will advance any remaining upgrades required for such operation. As noted above, use of 795 kcmil ACSS conductor with either the 69 kV or 115 kV Design option will increase thermal capacity of the Rebuilt Line by up to 172% compared to the Existing Line.

3.6.2 Reliability Comparison

The 69 kV and 115 kV Designs both address the design issues associated with the poor performance record of the Existing Lines. In particular, the replacement structures under either design would have an approximately 15 degree shielding angle, consistent with the current industry practice of limiting the shielding angle to 30 degrees or less. Similarly, the higher elevation of the conductors on the Rebuilt Lines will reduce the probability of faults resulting from off-ROW vegetation striking the energized lines. In addition, the change in structure type from lattice towers to monopole structures will reduce the potential for avian-related outages. Birds are prone to use horizontal members on the existing lattice towers to construct nests, which results in greater opportunity for avian interaction to create momentary outages on the circuits. Overall, either design will result in significant improvements in line performance.

Notably, however, construction of the Rebuilt Lines and Taps to the 115 kV Design standard, even if operated at 69 kV, will provide both near-term and longer-term transmission system reliability benefits that the 69 kV Design would not.

In the short term, some physical differences between the 69 kV and 115 kV Designs will result in reliability benefits from operating the 115 kV Design at 69 kV namely, the length of the insulator string, phase spacing at the top of each monopole structure, and the distance in clearance to ground and nearby objects. The additional insulation and increased spacing between the conductor phases for the 115 kV Design would provide increased resilience to lightning and tree-related events. The increase in structure height, while limited, will provide additional vertical clearance that may further reduce the probability of off-ROW vegetation striking the energized conductor. In addition, the lowest conductor, which is the most likely to be struck by vegetation, will be elevated higher with the 115 kV Design, thus improving reliability for the 115 kV Design option.

In the longer term, future operation of the Rebuilt Lines and Taps at 115 kV will increase the thermal capacity of the Rebuilt Line by 66%, which will support future load growth and enable the future interconnection of DER. Table 3-1 shows the higher thermal ratings that can be achieved by operating the proposed 795 ACSS conductor at 115 kV rather than at 69 kV.

Table 3-1: Thermal Ratings of Proposed 795 kcmil ACSS Conductor at 69 kV and 115 kV

Overhead Line Conductor	Thermal Ratings when Operated at 69 kV	Thermal Ratings when Operated at 115 kV
795 kcmil ACSS DRAKE (Proposed)	220/220 Mega Volt-Amp ("MVA") (Summer Normal/Long Term Emergency)	366/366 MVA (Summer Normal/Long Term Emergency)
477 kcmil ACSR HAWK (Existing)	98/98 MVA (Summer Normal/Long Term Emergency)	--
336.4 kcmil ACSR LINNET	81/100 MVA (Summer Normal/Long Term Emergency)	--

Additionally, 115 kV lines characteristically have lower impedance than 69 kV lines on a per Mega Volt-Amp ("MVA") basis – that is, there is less reactance along the line and, therefore, less reactive power is required to maintain voltage. In practice, this helps avoid the need for additional transmission switching stations, capacitor banks, reactors, or dynamic voltage control devices to support new load.

Finally, future operation of the lines at 115 kV would facilitate interconnection with nearby transmission facilities and networks that currently operate at 115 kV. For example, Deerfield #4 Substation is also connected to the S197 115 kV transmission lines, and Millbury #5. is connected to several 115 kV tie lines to Millbury #2 Substation. Future operation of the lines at 115 kV would increase the thermal capacity by 66% as compared to 69 kV operation.

3.6.3 Environmental Comparison

Section 5 provides a detailed analysis of the environmental impacts of the Project using the 115 kV Design, which includes temporary and permanent impacts to wetlands and water resources, impacts associated with vegetation management and removal, access improvements, visual impacts associated with the proposed increase in structure heights, construction noise and traffic impacts. *Section 5* also summarizes the measures that NEP has taken during Project design and engineering to reduce and mitigate these impacts.

NEP anticipates that use of the 69 kV Design would not significantly reduce any of these impacts compared to the 115 kV Design. The same construction techniques would be used and, as a result, construction-related impacts, including vegetative clearing, access improvements, wetlands and water resource impacts, and construction noise and traffic, would be similar or identical. Although there would be an approximately five to ten-foot difference in structure height, visual impacts from the new structures will be minimal in either case. Magnetic fields at any given load level would marginally increase for the same reason.

Finally, the use of the 115 kV Design for the Project obviates the possible need to construct a new 115 kV line when reliability needs call for additional capacity. Using the 69 kV Design for the Rebuilt Line now would require the future construction of a new line using the 115 kV Design, including replacement of all structures because the structures would not have the appropriate phase-to-phase separation to allow for insulation or operation at 115 kV. This would require a re-mobilization and significant redundant construction efforts, which would place a repeat burden on the abutters along this ROW, as well as create an approximate doubling of environmental impacts.

On balance, NEP considers the 115 kV Design to be preferable to the 69 kV Design from the perspective of environmental impacts.

3.6.4 Cost Comparison

At the time the 115 kV Design was selected as the preferred alternative, the estimated cost of the Project, using the 115 kV Design, is approximately $896.9 million, while the estimated cost for the Project using the 69 kV Design is approximately $875.0 million. Most of the cost difference is associated with increased materials costs for the 115 kV Design.

The cost difference would amount to approximately $21.9 million, or less than 2% of the estimated cost of the Project. If the Existing Lines are built using the 69 kV Design, should the need arise to operate the lines at 115 kV in the future, not only would the full material, labor, and equipment costs associated with the structure replacements be incurred again, but the costs associated with engineering, permitting and construction would be incurred as well. Specifically, construction matting in sensitive areas, as well as associated mitigation costs, would be required where permanent access is not being constructed. These costs would far exceed the small percentage increase in cost at the time the Existing Lines are replaced. In addition, if the Company fails to take advantage of the opportunity to rebuild to 115 kV standards now and a second project is required later, it will not only be more costly, but likely result in wasted costs because the Rebuilt Lines will have to be removed well before their useful life has expired.

By constructing the lines to the Company's 115 kV Design standard now, no physical upgrades to the Rebuilt Lines would be required for future operation at 115 kV. The cost of moving from 69 kV to 115 kV operation would be limited to planning costs and crew time to implement the voltage switch. Note, however, that future operation of the Rebuilt Lines at 115 kV would require some substation upgrades. The Company anticipates that these station upgrade projects would be undertaken when needed in the future to address reliability or asset condition issues and would be independent of the selected design voltage for this Project.

3.6.5 Summary of 69 kV and 115 kV Designs

The Company proposes to construct the Rebuilt Lines with the 115 kV Design because the conductor phase spacing and increased insulation provide significant reliability benefits even when operated at 69 kV. Moreover, building to the 115 kV Design now provides the ability to operate the line at 115 kV in the future without constructing a new line when such need arises. If the Company fails to take advantage of the opportunity to rebuild the new line to 115 kV Design standards now, when the additional capacity of a 115 kV line is needed in the future, the Company would need to either replace the Rebuilt Lines with a new 115 kV line, or construct a second transmission line in the same area, both of which would result in a duplication of costs and impacts. As discussed above, the environmental impacts of the Project would be similar regardless of the structure design. The incremental cost of the 115 kV Design is low relative to the overall cost of the Project and ensures the ability to maximize the utilization of the line by enabling future operation at 115 kV without undertaking another new construction project.

NEP believes that constructing the Rebuilt Line to 115 kV Design is a prudent decision, particularly in light of the findings of ISO-NE's 2050 Transmission Study, which highlights the need for additional transmission capacity across New England to accommodate the electrification of heating and transportation systems and the large-scale integration of on-shore and off-shore

wind, solar, and storage resources. It is also consistent with the FERC's recent findings that underscore the need for transmission planning and grid enhancement to take advantage of "right-sizing" opportunities to cost effectively and efficiently add to the long-term reliability of transmission service. See generally, "Building for the Future Through Electric Regional Transmission Planning and Cost Allocation," 187 FERC ¶ 61,068 (2024). "Right-sizing" promotes efficiency by providing cost savings for customers and reducing construction impacts to both abutters and the community as would otherwise be experienced by a second cycle of construction to add needed equipment in the future.

The 115 kV Design provides reliability benefits and gives NEP the flexibility to operate the Rebuilt Line at 115 kV in the future without a costly upgrade project if needed to support large-scale electrification and interconnection of renewable energy sources. For these reasons, NEP selected the 115 kV Design for the Rebuilt Line.

3.7 Conclusion

As described in *Sections 3.2* through *3.6*, above, the Company initially considered various alternatives to meet the identified resource need. The No-Build, Non-Wires and two Partial Rebuild Alternatives were rejected because they would neither address the asset condition and design issues of the Existing Line, nor enable the Company to add OPGW.

NEP therefore determined that the needs identified in *Section 2* could only be met by replacing both the existing structures and conductor, as well as by adding OPGW to the entirety of the Existing Lines and Taps. In *Section 3.7*, NEP compared the cost, environmental impact, and reliability benefits associated with the use of a 69 kV structure design and a 115 kV structure design and concluded that the additional capacity and flexibility provided by the 115 kV Design outweighed the minor additional costs. Consequently, NEP concluded that the replacement of the Existing Lines in the existing ROW, using the 115 kV Design, would best address the identified needs at a low cost while minimizing environmental impact.

4 ROUTE SELECTION PROCESS

As discussed in previous sections, NEP proposes to replace the Existing Lines and Taps with Rebuilt Lines and Taps within their existing ROWs in Massachusetts. The Rebuilt Lines will address asset-condition and reliability concerns and allow for operation at 115 kV, should this become necessary to address future system requirements.

Consistent with the Siting Board's standards and the requirements of G.L.c.164, § 69J, this section describes the process by which NEP evaluated potential route alternatives[8] to ensure no clearly superior route was overlooked. NEP's review of potential route alternatives was informed by the need to maintain reliable service to electric customers in 26 Massachusetts cities and towns both during and after construction. As discussed in *Sections 2* and *3*, these towns are dependent on the E5/F6 Lines for electric service. Thus, any feasible alternative route must continue to serve the existing substations along the E5/F6 corridor.

Due to these constraints, routes with significant geographic diversity would not meet the Project need. In addition, the routing evaluation was informed by the common-sense premise that rebuilding a transmission line within its existing ROW generally will be more efficient, more cost-effective, and less disruptive than relocating it to a new ROW. Furthermore, even if an alternative route was selected, the existing E5/F6 Line infrastructure would still need to be deconstructed and salvaged for safety reasons, which would generate environmental impacts from access and work pad construction comparable to the anticipated impacts from the proposed rebuilding of the line. However, NEP did evaluate potential route alternatives to ensure the Project best balanced considerations of reliability, and minimization of environmental impacts and costs. When compared to other potential routing opportunities, the Existing Lines and Taps[9] ROWs offered clear advantages and, as such, is presented as the single route option for the Project ("Project Route").

4.1 Overview of Route Selection Methodology

The objective of NEP's routing evaluation was to identify technically feasible route alternatives that would maintain system function, minimize impacts to the natural and social environments, and minimize construction and operation costs.

The route evaluation began with NEP defining a study area centered on the existing E5/F6 ROW and developing a general set of route evaluation criteria. NEP then identified a wide variety of potential overhead routes using the most recent available mapping, databases, and aerial photography, focusing on identifying existing linear corridors located within or adjacent to the E5/F6 transmission corridor. These potential route options included existing electric transmission, railroad, natural gas pipeline, and highway and roadway corridors.

NEP then screened these linear corridors against the route selection criteria (described below in *Section 4.3*) to assess whether any would be a potentially superior route to the existing E5/F6

[8] "Alternatives" include full route alternatives and partial route variations, which may only be applicable to specific segments of the E5/F6 and Tap Line corridors.

[9] For the purposes of this section, references to the E5/F6 corridor or ROW includes the Taps.

ROW. Routes were initially screened out if they were clearly inferior to the Project Route because they could not maintain system function and operability. Following the initial screening, NEP continued to focus on maximizing the use of existing linear corridors while minimizing construction constraints, costs, and environmental impacts. As a result of this iterative process, NEP determined that no candidate routes were equal or superior to the Project Route, which maintains the E5/F6 Lines and Taps in their existing ROWs. As such, NEP is not proposing to construct the Project on any route other than along the existing E5/F6 corridor.

4.2 Definition of Study Area

NEP began the route evaluation by establishing a study area surrounding NEP's existing E5/F6 ROW between the Millbury #305 Substation and the Deerfield #4 Substation (the "Study Area"). To ensure that the full range of options was considered, and that a clearly superior route alternative was not overlooked, NEP broadly defined the Study Area to include land within the following boundaries as shown in Figure 4-1, below:

- NEP's A127 and B128 transmission ROWs (to the north of the existing E5/F6 ROW)
- NEP's V174 line, NSTAR Electric Company dba Eversource Energy's ("Eversource") 301 Line, Interstate Highway 90 ("I-90"), Interstate Highway 91 ("I-91"), State Route 9, and State Route 112 (to the south of the existing E5/F6 ROW).

Expanding outward from the E5/F6 ROW, the 1,047-square-mile Study Area is bounded by the first overhead transmission corridors that do not present reasonable options to supply power to the existing substations served by the E5/F6 Lines and Taps: (1) Millbury #305 Substation in Millbury, (2) Pondville #26 Tap and Substation in Auburn, (3) Leicester #21 Tap and Substation in Leicester, (4) Meadow Street #552 Substation in Spencer, (5) Harrington #2234 Tap and Substation in East Brookfield, (6) Lashaway #525 Tap and Substation in North Brookfield, (7) Ware #1 Substation in Ware, (8) Quabbin Switching Tap and Tower in Belchertown, (9) Shutesbury #704 Tap and Substation in Shutesbury, (10) Deerfield #2 Substation in Shelburne, (11) Deerfield #3 Tap and Substation in Shelburne, and (12) Deerfield #4 Substation in Shelburne.

In general, the Study Area contains municipalities in Worcester, Hampden, Hampshire, and Franklin Counties, of which Hampshire and Worcester Counties contain the most densely developed population areas, including Belchertown and Auburn. The majority of the Study Area consists of exempt properties[10], residential areas, and open lands interspersed with pockets of forest, mixed use, commercial, industrial, transportation corridors, and agricultural lands. Additionally, within the Study Area, a few municipalities own, maintain, and operate municipal light plants that provide electric services to their customers, including Leverett Municipal Light Plant.

[10] Exempt properties are properties that qualify from exemption from taxation under various provisions of the law and include public land and facilities, hospitals, schools, churches, and cultural institutions, G.L. c. 59 §5.

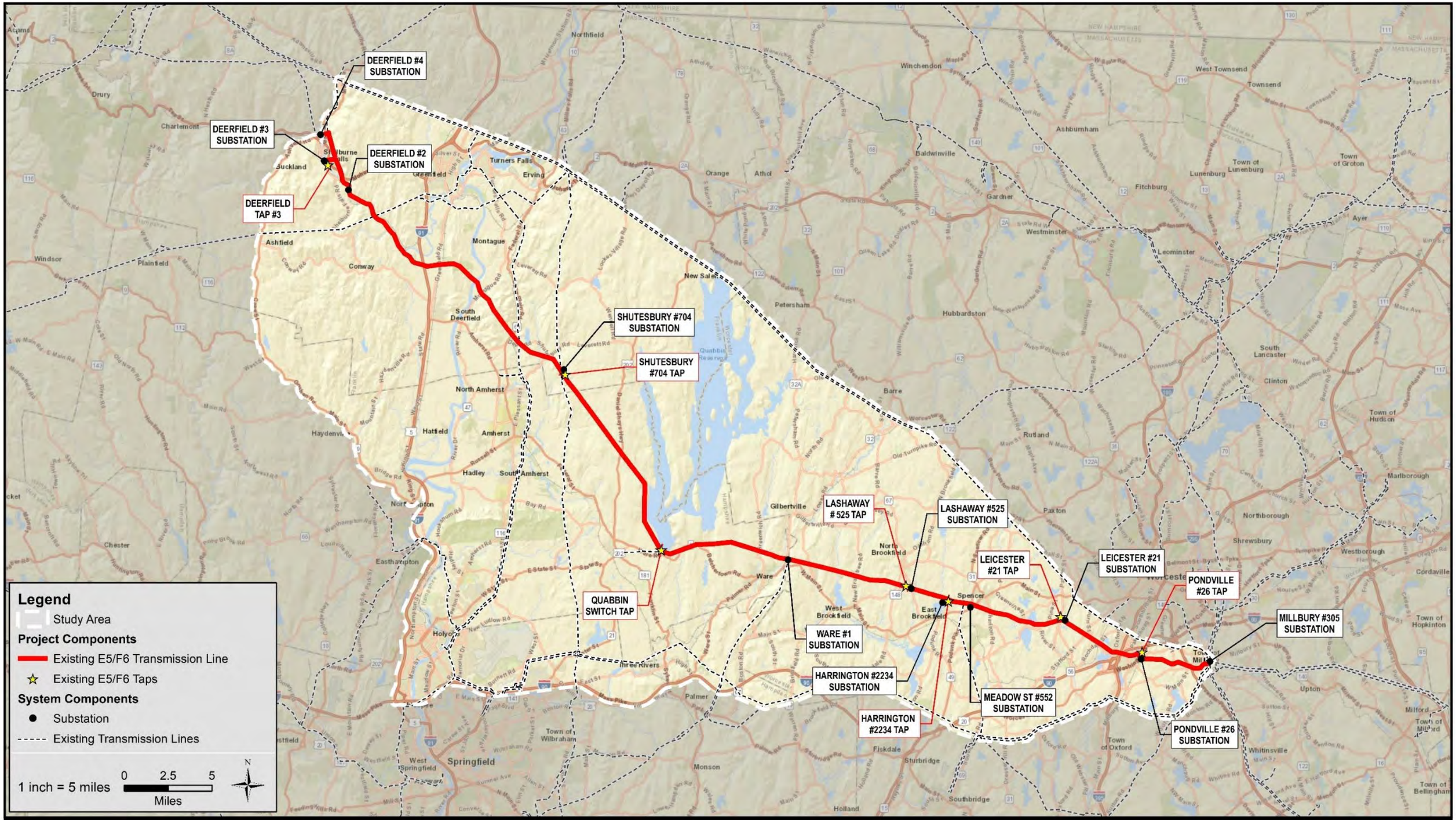


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Figure 4-1
Routing Study Area

4.3 Establishment of Route Evaluation Criteria

An initial step in NEP's analysis was to establish general criteria to identify potential overhead and underground routes. Important operational considerations in constructing the overhead line include compliance with vertical and horizontal clearance codes, maintenance of depths and setbacks from other active utilities, the need to continue service to intermediate substations along the ROW, and final connections to substations. Based on these operational considerations and additional construction and environmental considerations, NEP established the following general criteria:

1. **Maintain system function, operability, and reliability.** Because the Project is proposed to address existing asset-condition concerns and future system requirements, NEP's primary routing consideration was the need to maintain reliable delivery of electricity to customers in 26 Massachusetts cities and towns and the ability to connect the substations serviced by the E5/F6 Lines and Taps. The Existing Lines are the sole transmission supply to the majority of the substations listed in *Section 4.2*. In addition, comparable or superior routes must allow general accessibility[11] to the Rebuilt Lines for future maintenance or repair. Access to all locations along an overhead route is typically not required; however, all structure locations must be reachable from some appropriate access point. NEP accordingly sought routes that would minimize access restrictions.
2. **Maximize the use of existing linear corridors.** Where sufficient space is available, collocation along existing linear corridors already encumbered by infrastructure minimizes conflicts with federal, state, and local land use plans and policies; minimizes the need to acquire land or land rights; and decreases environmental impacts significantly as compared to the establishment of a new corridor. In particular, utilizing existing transmission line ROWs, offers the benefit of an established network of access routes and lands already encumbered with utility easements without the need to expand or create a new ROW. These attributes of existing linear corridors also have a positive impact on project cost and schedule. Accordingly, and because the Project can be accommodated within existing ROWs, established linear corridors (e.g., transmission line, highway, railroad, and pipeline corridors) were prioritized in the route evaluation.
3. **Minimize impacts to environmental resources.** NEP sought to identify route alternatives that would minimize impacts to environmental resources such as land use, wetlands and wildlife, rare species habitats, historical/archaeological resources, and other designated resources.
4. **Minimize cost.** NEP sought to identify route alternatives that would avoid costly remediation or construction requirements or, alternatively, would provide some opportunity for securing cost reductions when compared to utilizing the existing corridor.
5. **Limit construction constraints.** In evaluating potential route options within the Study Area, NEP gave preference to route alternatives that would minimize constructability constraints and limitations. For example, road/highway crossings or working within other utility corridors (e.g., railroad corridors) can result in access restrictions, workspace

[11] Accessibility includes access and work envelopes required to construct, operate, and maintain the Rebuilt Lines and Taps.

constraints, safety concerns, traffic disruptions, and restrictive work hours, all of which impact Project cost and schedule.

6. **Minimize impacts to densely developed areas.** The placement of transmission facilities in densely developed areas typically creates additional complexity both during initial construction and when maintenance or replacement is required. The potential for construction and maintenance work-hour restrictions, limited access availability, and the need for additional ROW and/or temporary workspace are more prevalent in densely populated areas. Therefore, NEP sought to identify route alternatives that would, to the extent practicable, minimize impacts to densely developed areas and the social environment.

4.4 Potential Route Options

Using the route evaluation criteria, NEP mapped existing linear corridors within the Study Area that could be used to develop routes that would maintain system function and operation without the need to create a new ROW. NEP focused on the use of existing utility and transportation corridors in proximity to the E5/F6 corridor. Numerous linear corridors were identified through a macro-review of USGS topographic maps, Massachusetts Geographic Information System ("MassGIS") data, and aerial imagery within the Study Area. These corridors were utilized to develop potential routes, including those associated with electric transmission lines, natural gas pipelines, railroads, highways and major roadways. The existing corridors identified in the Study Area are summarized below and depicted in Figure 4-2.

4.4.1 Electric Transmission Line Corridors

Fourteen existing overhead electric transmission line corridors were identified in the Study Area as shown in Figure 4-3. In addition to the E5/F6 ROW, NEP owns and operates the majority of ROWs 1, 2, 3, 4, 5, 6, 7, 11, and 14 and Eversource owns and operates the majority of ROWs 3, 8, 9, 10, 12, and 13.

The existing transmission line corridors identified in the Study Area are described below and shown on Figure 4-3. A detailed overview of existing transmission ROWs within the Study Area is provided in Table A, of the "Routing Selection Process – Supporting Information" in Appendix 4-1.

- **ROW 1**: This is an estimated 125-to-250-foot-wide transmission ROW that runs approximately 61.2 miles NW/SE through the northern corner of the Study Area.
- **ROW 2**: This is an estimated 200-to-250-foot-wide transmission ROW that runs approximately 15.6 miles E/W through the eastern corner of the Study Area.
- **ROW 3:** This is an estimated 200-foot-wide transmission ROW that runs approximately 25.8 miles E/W through the south-eastern corner of the Study Area.
- **ROW 4:** This is an estimated 80-to-130-foot-wide transmission ROW that runs approximately 8.9 miles N/S through the southern corner of the Study Area.
- **ROW 5:** This is an estimated 70-to-100-foot-wide transmission ROW that runs approximately 8.4 miles N/S through the south-eastern corner of the Study Area.

- **ROW 6:** This is an estimated 100-foot-wide transmission ROW that runs approximately 3.7 miles N/S through the western corner of the Study Area.
- **ROW 7:** This is an estimated 200-foot-wide transmission ROW that runs approximately 2.7 miles N/S through the north-western corner of the Study Area.
- **ROW 8:** This is an estimated 140-to-200-foot-wide transmission ROW that runs approximately 30.3 miles N/S through the center of the Study Area.
- **ROW 9:** This is an estimated 130-to-200-foot-wide transmission ROW that runs approximately 20 miles E/W through the western corner of the Study Area.
- **ROW 10:** This is an estimated 100-to-140-foot-wide transmission ROW that runs approximately 3.6 miles NE/SW through the western corner of the Study Area.
- **ROW 11:** This is an estimated 130-to-200-foot-wide transmission ROW that runs approximately 31.1 miles N/S through the central-west corner of the Study Area.
- **ROW 12**: This is an estimated 150-to-250-foot-wide transmission ROW that runs approximately 12 miles N/S through the south-western corner of the Study Area.
- **ROW 13:** This is an estimated 150-to-200-foot-wide transmission ROW that runs approximately 9.6 miles E/W through the south-western corner of the Study Area.
- **ROW 14:** This is an estimated 100-foot-wide transmission ROW that runs approximately two miles NW/SE through the center of the Study Area.

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DEERFIELD #4 SUBSTATION
DEERFIELD #3 SUBSTATION
DEERFIELD #2 SUBSTATION
DEERFIELD TAP #3
SHUTESBURY #704 SUBSTATION
SHUTESBURY #704 TAP
LASHAWAY # 525 TAP
LASHAWAY #525 SUBSTATION
LEICESTER #21 TAP
LEICESTER #21 SUBSTATION
PONDVILLE #26 TAP
PONDVILLE #26 SUBSTATION
MILLBURY #305 SUBSTATION
MEADOW ST #552 SUBSTATION
HARRINGTON #2234 SUBSTATION
HARRINGTON #2234 TAP
WARE #1 SUBSTATION
QUABBIN SWITCH TAP

Legend

- Study Area

Project Components

- Existing E5/F6 Transmission Line
- Existing E5/F6 Taps

System Components

- Substation
- Existing Transmission Lines
- Existing Railroads
- Natural Gas Pipeline
- Interstates
- Highways
- Major Roads

1 inch = 5 miles

0 2.5 5 Miles

N

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Figure 4-2
Potential Route Options within the Study Area

DEERFIELD #4 SUBSTATION
DEERFIELD #3 SUBSTATION
DEERFIELD #2 SUBSTATION
DEERFIELD TAP #3
ROW 6
ROW 7
ROW 10
ROW 9
SHUTESBURY #704 SUBSTATION
SHUTESBURY #704 TAP
ROW 1
ROW 11
ROW 8
ROW 14
LASHAWAY # 525 TAP
LASHAWAY #525 SUBSTATION
LEICESTER #21 TAP
LEICESTER #21 SUBSTATION
PONDVILLE #26 TAP
MILLBURY #305 SUBSTATION
QUABBIN SWITCH TAP
ROW 4
WARE #1 SUBSTATION
ROW 13
ROW 12
ROW 3
HARRINGTON #2234 SUBSTATION
ROW 5
ROW 2
MEADOW ST #552 SUBSTATION
HARRINGTON #2234 TAP
PONDVILLE #26 SUBSTATION

Legend

- Study Area
- **Project Components**
  - Existing E5/F6 Transmission Line
  - Existing E5/F6 Taps
- **System Components**
  - Substation
  - Existing Transmission Lines
  - Existing Railroads
  - Interstates
  - Highways
  - Major Roads
  - ROW 1
  - ROW 2
  - ROW 3
  - ROW 4
  - ROW 5
  - ROW 6
  - ROW 7
  - ROW 8
  - ROW 9
  - ROW 10
  - ROW 11
  - ROW 12
  - ROW 13
  - ROW 14

1 inch = 5 miles

0 2.5 5

Miles

N

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Figure 4-3

Electric Transmission Line Corridors

4.4.2 Municipal Utility Corridors

No viable municipal utility corridors were identified within the Study Area.

4.4.3 Railroad Corridors

Several railroad corridors run north-south and east-west through the Study Area as shown in Figure 4-4. All railroad corridors identified within the Study Area have been described in Table B in Appendix 4-1. Of the railroad corridors identified, eight run east-west in proximity to the E5/F6 corridor as described below:

- The CSX Boston Subdivision Railroad runs approximately 53 miles east-west through the eastern corner of the Study Area. Portions of the railroad corridor are located within the Leicester #21 Substation and the Pondville #26 Tap and Substation.
- The Patriot Corridor Railroad runs approximately 49 miles east-west through the western corner of the Study Area. Portions of the corridor are located in the vicinity of Deerfield #3 Tap and Substation.
- Several smaller sections of railroad corridors traverse the Study Area in east-west direction, including the following:
- The East Brookfield & Spencer Railroad runs approximately two miles east-west through the eastern portion of the Study Area.
- The Williamsburg Branch Railroad runs approximately seven miles east-west through the western portion of the Study Area.
- The East Deerfield Loop Railroad runs approximately one mile east-west through the north-central corner of the Study Area.
- The North Brookfield Railroad (Local) – North Brookfield Railroad runs approximately five miles east-west through the eastern portion of the Study Area.
- The Palmer Industrial Park Railroad runs approximately one mile east-west through the southern portion of the Study Area.
- The Greenfield Running Railroad runs approximately four miles east-west through the north-western corner of the Study Area.

A detailed overview of the rail corridors within the Study Area is provided in Table B in Appendix 4-1.

4.4.4 Highway and Major Roadway Corridors

Several major highways and roadway corridors run north-south and east-west through the Study Area as shown in Figure 4-5. Of the existing roadway and highway corridors identified, the following run proximate to the E5/F6 corridor in an east-west direction:

- US State Highway 20 - US State Highway 20 generally runs east-west through the Study Area, but well to the south of the Millbury #305 Substation.

- State Route 2/2A – State Route 2/2A generally runs east-west through the Study Area, but well to the north of the Deerfield #4 Substation.
- State Route 9 - State Route 9 generally runs east-west through the Study Area, but well to the south of the Quabbin Switch Tap and Meadow Street #552 Substation.
- State Route 116 - State Route 116 generally runs proximate to Shutesbury #704 Tap and Substation in a east-west direction through the towns of Holyoke, South Amherst, Amherst, North Amherst, South Deerfield, Conway, and Ashfield.

A detailed overview of the highway and roadway corridors within the Study Area is provided in Table C in Appendix 4-1.

4.4.5 Local Roadway Network

There are numerous local roadway networks throughout the municipalities located within the Study Area. Some roadway networks are concentrated in urban areas such as Auburn and Millbury, while a majority are more rural, including those crossing through the towns of Pelham and Leverett. The local roadway networks across the Study Area are typically paved, but also consist of gravel and dirt roadways.

4.4.6 Natural Gas Pipeline Corridors

One natural gas pipeline, the Tennessee Gas Pipeline ("TGP"), was identified within the eastern corner of the Study Area, as shown in Figure 4-6. The TGP corridor runs through the towns of Charlton, Millbury, and Spencer, along with a small portion in Auburn within the Study Area.

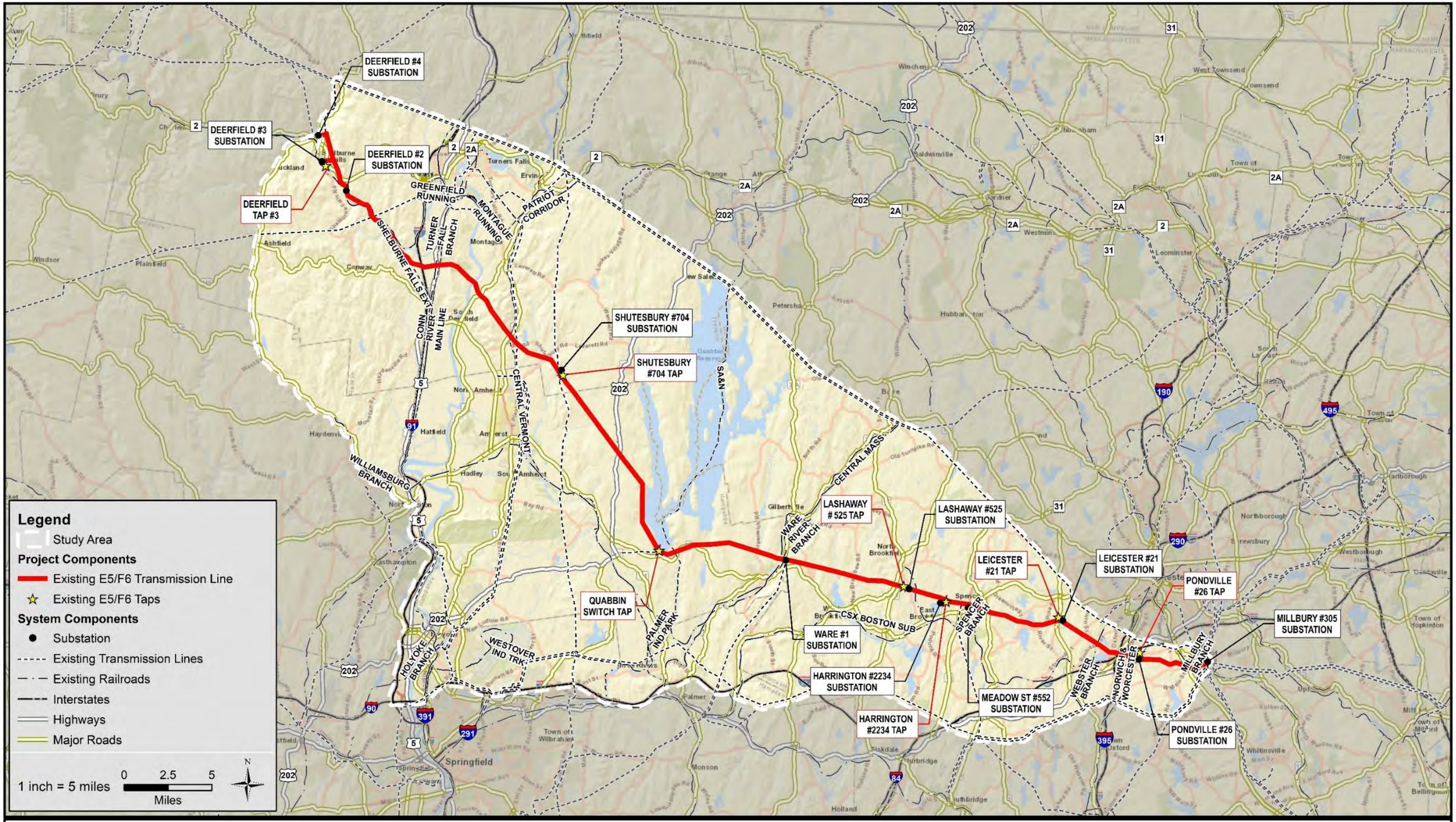

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Figure 4-4
Railroad Corridors

DEERFIELD #4 SUBSTATION
DEERFIELD #3 SUBSTATION
DEERFIELD #2 SUBSTATION
DEERFIELD TAP #3
SHUTESBURY #704 SUBSTATION
SHUTESBURY #704 TAP
QUABBIN SWITCH TAP
LASHAWAY # 525 TAP
LASHAWAY #525 SUBSTATION
WARE #1 SUBSTATION
HARRINGTON #2234 SUBSTATION
HARRINGTON #2234 TAP
LEICESTER #21 TAP
LEICESTER #21 SUBSTATION
MEADOW ST #552 SUBSTATION
PONDVILLE #26 TAP
PONDVILLE #26 SUBSTATION
MILLBURY #305 SUBSTATION

Legend
- Study Area

Project Components
- Existing E5/F6 Transmission Line
- Existing E5/F6 Taps

System Components
- Substation
- Existing Transmission Lines
- Interstates
- Highways
- Major Roads

1 inch = 5 miles
0 2.5 5
Miles
N

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Figure 4-5
Highway and Major Roadway Corridors

DEERFIELD #4 SUBSTATION
DEERFIELD #3 SUBSTATION
DEERFIELD #2 SUBSTATION
DEERFIELD TAP #3
SHUTESBURY #704 SUBSTATION
SHUTESBURY #704 TAP
QUABBIN SWITCH TAP
LASHAWAY # 525 TAP
LASHAWAY #525 SUBSTATION
LEICESTER #21 TAP
LEICESTER #21 SUBSTATION
PONDVILLE #26 TAP
MILLBURY #305 SUBSTATION
WARE #1 SUBSTATION
HARRINGTON #2234 SUBSTATION
HARRINGTON #2234 TAP
MEADOW ST #552 SUBSTATION
PONDVILLE #26 SUBSTATION

Legend

- Study Area

Project Components

- Existing E5/F6 Transmission Line
- Existing E5/F6 Taps

System Components

- Substation
- Existing Transmission Lines
- Natural Gas Pipeline
- Interstates
- Highways
- Major Roads

1 inch = 5 miles

0 2.5 5
Miles

N

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Figure 4-6
Natural Gas Pipeline Corridors

4.5 Identification and Screening of Potential Route Options

NEP applied the route evaluation criteria to identify and evaluate existing linear corridors that could serve as a potentially superior route alternative for some or all of the Project. All corridors evaluated in the initial screening process are shown in Figure 4-2.

4.5.1 Initial Screening: Maintaining System Function, Operability, and Reliability

NEP's initial screening of existing linear corridors focused on identifying corridors that could provide system function and service to the 26 communities served by the Existing Lines, as well as allow for general accessibility for future maintenance or repair. Corridors that did not share the generally southeast-to-northwest orientation of the Existing Lines or provide access to each of the intermediate substations, were eliminated during this screening. Figure 4-7 highlights the linear corridors that provide no practical connection to the substations currently served by the Existing Lines and have therefore been eliminated. Please refer to Tables D, E, F, and G in Appendix 4-1 for a detailed summary of the corridors eliminated from further consideration.

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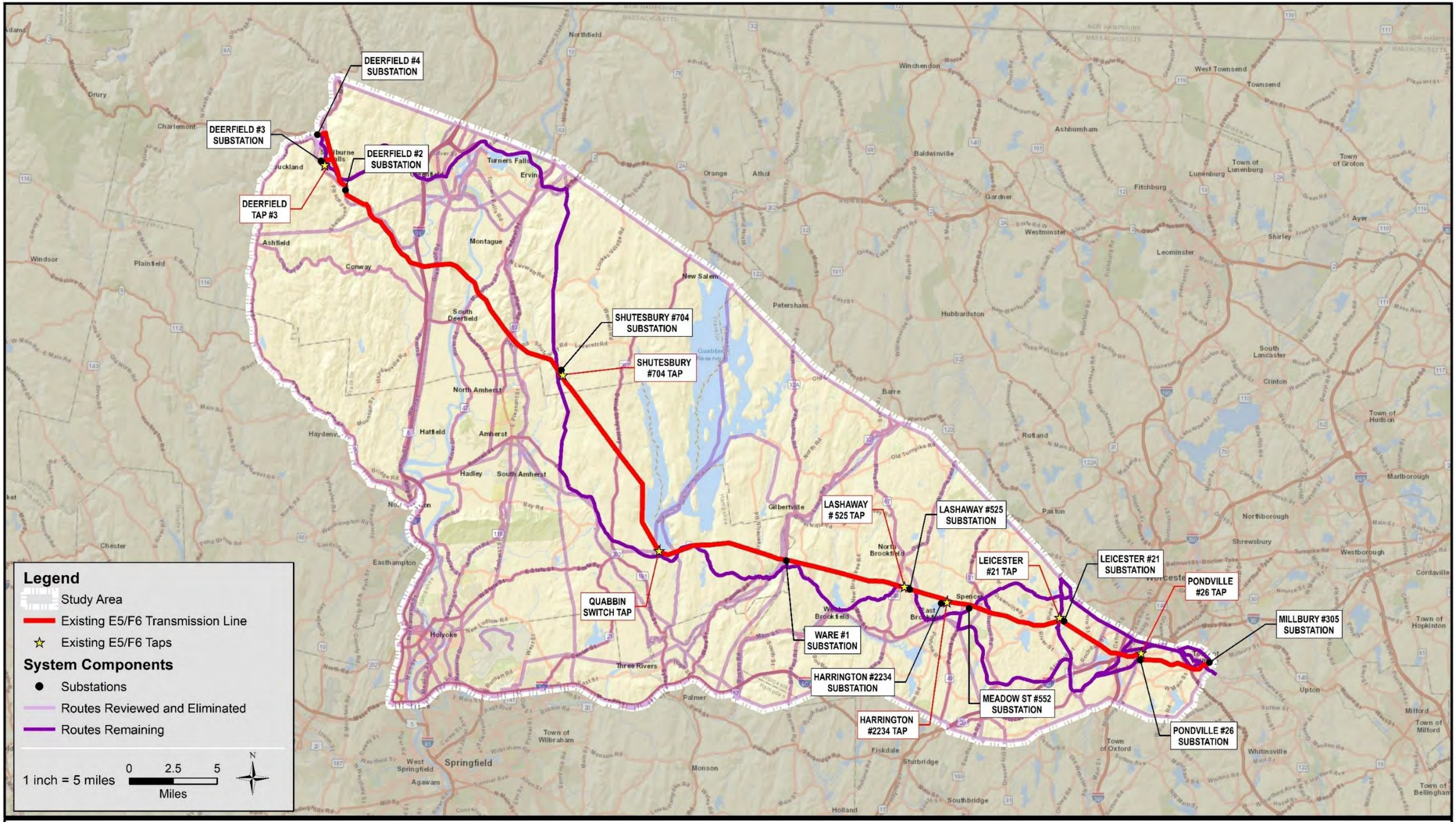

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Figure 4-7
Routes Eliminated from Further Consideration

4.5.2 Secondary Screening

Following the initial route screening, NEP reviewed the remaining linear corridors (depicted in Figure 4-8 and determined that no feasible route alternatives were available for the entirety of the E5/F6 transmission corridor.

However, as part of the secondary screening, NEP further evaluated these linear corridors for their ability to serve as potential alternate routes for the existing EF/F6 corridor, with a focus on minimizing engineering, construction, and future operating constraints, as well as potential natural and social/developed environmental constraints. Of the linear corridors remaining for consideration, potential route segment variations consisted of electric transmission line, railroad, highway, major roadways, and the local roadway network.

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DEERFIELD #4 SUBSTATION
DEERFIELD #3 SUBSTATION
DEERFIELD #2 SUBSTATION
DEERFIELD TAP #3
ROW 8
SHUTESBURY #704 SUBSTATION
SHUTESBURY #704 TAP
ROW 4
QUABBIN SWITCH TAP
LASHAWAY # 525 TAP
LASHAWAY #525 SUBSTATION
WARE #1 SUBSTATION
HARRINGTON #2234 SUBSTATION
HARRINGTON #2234 TAP
LEICESTER #21 TAP
LEICESTER #21 SUBSTATION
PONDVILLE #26 TAP
ROW 1
MILLBURY #305 SUBSTATION
CSX BOSTON SUB
MEADOW ST #552 SUBSTATION
PONDVILLE #26 SUBSTATION
PROVIDENCE & WORCESTER

Legend

- Study Area

Project Components

- Existing E5/F6 Transmission Line
- Existing E5/F6 Taps

System Components

- Substation
- Existing Transmission Lines
- Existing Railroads
- Interstates
- Highways
- Major Roads

Remaining Routes

- Transmission Line
- Highways and Major Roads
- Railroad

1 inch = 5 miles

0 2.5 5

Miles

N

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Figure 4-8

Linear Corridors Remaining after Initial Screening

The majority of the potential route segment variations identified presented alternatives to the portion of the E5/F6 corridor located between Lashaway #525 Substation and Millbury #305 Substation, with more limited options available for the northern portion of the route. These potential route segment variations for the E5/F6 corridors are summarized in Table 4-1.

Table 4-1: Potential Route Variations Reviewed During Secondary Screening

Corridor Type	Potential Route Segment Variation	Location
Transmission Line and Roadway Combination	ROW 8 (Eversource 354) and State Route 2/2A	Between Deerfield #3 Substation in Shelburne and Shutesbury Substation in Shutesbury
Transmission Line and Roadway Combination	Combination of State Route 32, portion of ROW 4 (National Grid O15N Line), State Route 9, State Route 67, State Route 148, and Project Route (National Grid E5/F6 Line)	Between Ware #1 Substation in Ware and Lashaway Substation in North Brookfield
Railroad and Roadways Combination	Portion of North Brookfield and State Route 9	Between Lashaway #525 Substation in North Brookfield and Meadow Street #552 Substation in Spencer
Roadways only	State Route 56 and State Route 9	Between Meadow Street #552 Substation in Spencer and Leicester #21 Substation in Leicester
Transmission Line and Roadway Combination	Combination of State Route 9, State Route 31, and Project Route (National Grid E5/F6 Line)	
Railroad and Roadways Combination	Combination of State Route 9, State Route 49, portion of CSX Boston Sub, and State Route 56	
Transmission Line and Roadway Combination	Combination of State Route 56, portion of ROW 1 (National Grid A127 and B128 Line) and U.S. Highway 20	Between Leicester #21 Substation in Leicester and Pondville #26 Substation in Auburn
Major Highways and Roadways Combination	Combination of U.S. Highway 20 and State Route 56	
Major Highways and Roadways Combination	Combination of U.S. Highway 20, State Route 146, Interstate 290 (I-290), State Route 12, State Route 9, and State Route 56	
Transmission Line and Roadway Combination	Combination of U.S. Highway 20, and portion of ROW 1 (National Grid A127 and B128 Line)	Between Pondville #26 Substation in Auburn and Millbury #305 Substation in Millbury
Major Highways and Roadways Combination	Combination of State Route 122A and U.S. Highway 20	
Railroad and Roadways Combination	Combination of a portion of Providence and Worcester and U.S. Highway 20	
Railroad and Roadways Combination	Combination of U.S. Highway 20 and Interstate 90 (I-90), State Route 122/122A and/or Providence and Worcester (“P&W”)	

These potential segment variations were compared to the EF/F6 corridor using the route evaluation criteria to ensure no superior route alternatives were overlooked. While all potential route segment variations would involve utilizing existing linear corridors to the maximum extent feasible, installation of a new overhead line along other electric transmission lines, railroads, highways, and major roadways would require obtaining new property rights, and encroaching upon open space and residential properties in some locations.

In addition, all potential route variations, including other electric transmission lines, would require the use of railroad, highway, and/or major roadway corridors in order to provide an alternative that would maintain system function. The installation of a new overhead line along railroad, highways, and major roadways would result in a longer and less direct route compared to the Project Route (E5/F6 Line), resulting in a significant construction and maintenance constraints, and associated cost. Collocating a transmission line along a railroad corridor or highway corridor may be possible; however, a project proponent must demonstrate to the applicable transportation agency that there is no feasible alternative to collocating these facilities, which is not the case here. In addition, working within other utility corridors (e.g., railroad corridors) and road/highway crossings would result in access restrictions, workspace constraints, safety concerns, traffic disruptions, and restrictive work hours during both initial construction and long-term maintenance and operations activities. Finally, locating new overhead transmission lines along major highways, roadways, and railroads would result in new visual, traffic, and environmental impacts to communities and natural systems.

For the reasons summarized above, given the availability of the existing E5/F corridor, the remaining electric transmission line, railroad, highway, and major roadway corridors were eliminated from further consideration. A detailed overview of the explanation of elimination of potential route variation is provided in Table H in Appendix 4-1.

While local roadways may provide route options that present reasonable connections to the substations served by the Existing Lines and Taps, these corridors were dismissed from further consideration because the installation of new overhead lines would require obtaining new property rights, grants of location, encroach on open space and residential properties, and potentially require the release of conservation lands via the Article 97 land disposition process through the Legislature of the Commonwealth. Since the Project presents an option that would maintain the Rebuilt Lines within existing and established ROWs, the local roadway network does not offer superior route alternatives and has been removed from further consideration.

4.5.3 Summary and Proposed Project Route

NEP evaluated existing linear corridors within an extensive Study Area centered on the existing E5/F6 ROW to ensure that no clearly superior route alternatives to the Existing Lines were overlooked. Using the route evaluation criteria, NEP screened potential linear corridors and eliminated local roadway networks, highways, railroads, and other overhead transmission line corridors because the existing E5/F6 corridor is clearly superior and best balance considerations of reliability and minimization of environmental impacts and cost. Therefore, the existing E5/F6 corridor is proposed as the Project Route (Figure 4-9). Specifically, the Project Route provides the following benefits:

- The Project Route provides a direct route between the Deerfield #4 Substation and Millbury #305 Substation and rebuilding the Existing Lines within their existing ROWs will maintain system function and service to the 26 communities they currently serve. Although several route options could be delineated using existing linear corridors within the Study Area, none would be shorter, less costly, or have less overall impact to the human and natural environments, while still maintaining the existing function of the transmission lines.

- The Existing Lines have been situated along the proposed Project Route since the early 1900's, and the Tap Lines are also well established and maintained NEP assets. As such, the existing E5/F6 ROW has been historically accessed and maintained for the purpose of NEP's operations. Maintaining system operability and reliability has included vegetation maintenance, placing temporary construction mat crossings within existing wetland systems crossing the ROW, and accessing and performing repairs where assets are located within EJ communities. While access route improvements will be necessary as part of the Project, utilizing the existing E5/F6 ROW offers the benefit of an established network of access routes and lands already encumbered for this use.
- While the Project Route will require expansion of existing transmission line ROW to accommodate specific new pole and wire locations on up to 15 properties, as well as additional rights for four access easements for Project construction, the need to acquire land or land rights is minimal compared to potential route options evaluated.

4.6 Conclusion

NEP's process for selecting the Project Route for the proposed Rebuilt Lines and Tap Lines addresses the Siting Board's standards applicable to jurisdictional energy facilities in an objective and comprehensive fashion. NEP approached the process by identifying existing linear corridors within a broad routing Study Area to fulfill a review of potential route alternatives. Providing significant consideration to the unique scope of the Project and the significant length, cost, and reliability concerns, the route evaluation satisfied NEP's responsibility to ensure that no clearly superior route was overlooked. As a result of the in-depth screening process, no candidate routes were found to meet the route evaluation criteria and/or provide benefits comparable to rebuilding the Existing Lines and Taps within their existing ROWs, the Project Route.

While it is feasible to construct the Project using alternative routes consisting of existing linear corridors, this would result in increased costs, schedule delays, and new and/or increased impacts to human and natural environments. Developing and proposing an alternative route over 69 miles for which public notice would be given ("Noticed Alternative Route") would require a significant expenditure of funds and would unnecessarily raise concerns among a new set of abutters along an inferior route where NEP has no intention of constructing the Project. Thus, NEP determined that designating a Noticed Alternative Route was not warranted under these circumstances.

A more detailed examination of the Project Route is presented in *Section 5* of this Application.

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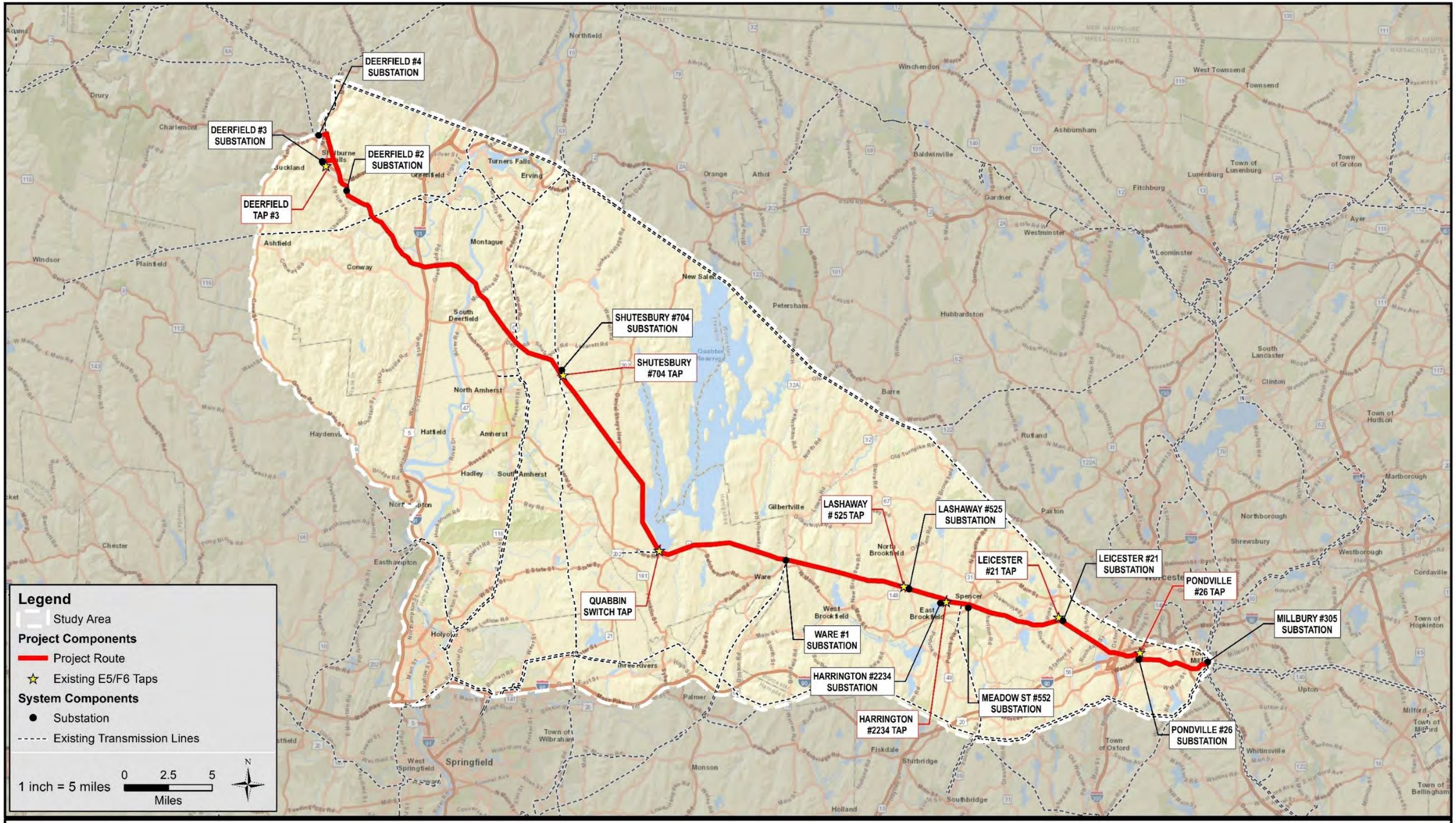

Central to Western Massachusetts Energy Improvement Project

nationalgrid
BSC GROUP

Figure 4-9
Project Route

5 PROJECT IMPACT ANALYSIS

5.1 Introduction

This section provides a detailed analysis of the Project's impacts on the natural and social environment. To assess these potential environmental impacts and mitigation, NEP evaluated a series of natural and social environmental criteria including land use, protected land and open space, historical/archaeological sites, tree removal, wetlands and water crossings, rare species habitat, public water supplies, visual, noise, traffic, and electric and magnetic fields ("EMF").

The potential impacts of the Project are both construction-related (temporary) impacts and siting and operation-related (permanent) impacts. Examples of potential temporary construction-related impacts include the temporary placement of construction matting in wetlands for access and the establishment of work areas in wetlands, ground disturbance associated with structure installation and removal, traffic impacts at roadway crossings, and short-term construction noise associated with the operation of heavy equipment. Examples of permanent impacts include gravel fill material used to establish work areas, tree removal, and potential visual impacts.

A description of the Project Route is provided in *Section 5.2*. Related maps and figures are found in Appendices 5-1 and 5-3 of this Application. *Section 5.3* provides an overview of NEP's construction methodology and impact avoidance and minimization measures.

Project impacts to the natural and social environment, as well as proposed mitigation measures, are discussed in *Section 5.4*. In *Section 5.5*, an estimate for the total cost of rebuilding the Existing Lines and Taps is provided. Finally, a summary of the analysis and conclusion are provided in *Section 5.6*.

5.2 Description of the Project Route

5.2.1 Project Route

NEP proposes to replace the Existing Lines and Taps with Rebuilt Lines and Taps within existing ROWs in Massachusetts. The Project Route is illustrated in the Map Book in Appendix 5-1, typical ROW cross-sections are included in Appendix 5-3 and typical structure details are shown in Figure 3-1. The Existing Lines and Taps will be replaced in Millbury, Auburn, Leicester, Spencer, East Brookfield, North Brookfield, West Brookfield, Ware, Belchertown, Pelham, Shutesbury, Leverett, Sunderland, Deerfield, Conway, and Shelburne, Massachusetts.

The Existing Lines and Taps are situated entirely within existing ROWs comprised of NEP easements or land owned in fee. The existing E5/F6 ROW encompasses approximately 67 miles of the Project Route and is, on average, 80 feet to 125 feet wide, with some areas up to 200 feet in easement width. A list of all the Existing Taps with their respective lengths is provided in *Section 2.2.1.* Of those Existing Taps, the Project entails reconstruction of the Quabbin Switch Tap Lines, the Shutesbury Tap Lines and the Deerfield #3 Tap Lines. The construction, re-establishment, and improvement of access will also be required as described in *Section 1*, above and in *Section 5.3.1*,

below. Table 5-1 provides a breakdown of each of the Project Route components[12]. and their respective ROW configuration.

Table 5-1: Project Route Components – Approximate ROW Configuration

Project Route Component	Existing ROW Width	Average Maintained ROW Width	Approximate Mileage (rounded to tenth)
Existing E5/F6 Line ROW	Varied width: 80 to 200 feet (ft.) Average Width: 125 ft.	Maintained width: 80-170 ft. Average Existing Maintained Width: 100 ft. Proposed Maintained Width:125 ft.	67
Existing Quabbin Switch Tap Lines ROW	80 to 190 ft *	Average Existing Maintained Width: 80 ft. Proposed Maintained Width:80 ft on ROW and 100 ft. on fee-owned property	0.1
Existing Deerfield Tap Lines	125 ft.	Maintained width: 80-125 ft. Average Existing Maintained Width: 100 ft. Proposed Maintained Width: 125 ft.	0.5
Total			**67.6 miles**

** The Quabbin Switch Tap Lines ROW corridor contains the Quabbin Switch Tap Lines and the B69 Lines. Where they are collocated on ROW, the width is approximately 80 feet. However, the Quabbin Switch Tap Lines are also located on a fee-owned parcel with a width of approximately 190 feet.*

The Rebuilt Lines and Taps will generally be constructed on davit arm monopole weathering steel structures ranging in height from approximately 75 feet to 145 feet above ground (i.e., average 85 feet above ground). The E5/F6 structures will be double circuited, while the Tap structures will be single circuited.

With the exception of the Deerfield #3 and Quabbin Switch Tap Line, the majority of the proposed suspension structures will be direct embedded. Dead-end structures along the Rebuilt Lines will be supported by concrete caisson foundations. The proposed caisson foundations are larger than the existing footprint of the concrete footing supporting the lattice towers, as well as the footprint of existing wood pole structures. Alternative foundation types such as helical piles and micropile foundations may be utilized if warranted by site conditions or other factors.

5.2.1.1 Route Maps

Project Route maps supporting the evaluation of Project impacts are provided in 11-inch by 17-inch format in Appendix 5-1.

5.2.1.2 Land Use Maps

The Land Use Maps, also provided in Appendix 5-1, illustrate land uses within the Project ROWs and an area of 300 feet measured from the edges of the Project Route. Land uses include, exempt

[12] The Shutesbury Tap Lines are not included in the table because they are approximately 130 ft. (0.02 miles) in length and located entirely within NEP fee-owned property.

property,[13] vacant land,[14] industrial, residential, forested and more as described in *Section 5.4.1*. The land use information was obtained from the MassGIS website. Land use mapping from MassGIS is based on 2022 aerial photography, and illustrates existing physical conditions identified by aerial photographs rather than zoning districts. A discussion of applicable zoning information and districts as they pertain to land use is provided for the Project Route in the sections below.

5.2.1.3 Environmental Resources Maps

The Environmental Resources Maps provided in Appendix 5-1 illustrate the natural and social environmental resources within the Project Route. Environmental resources include open space/recreational land, historic/archaeological sites, wetlands and water crossings, vernal pools (certified and potential), rare species habitat, and Outstanding Resource Waters ("ORW"). A detailed description of the environmental resources is presented in *Section 5.4*.

5.2.1.4 Environmental Justice Maps

The EJ Maps provided in Appendix 5-1 illustrate the 2020 EJ block groups, based upon demographic socioeconomic indicators developed by the Massachusetts Office of Energy and EEA within the 1-mile and 5-mile buffer to the ROW. The EJ Maps include demographic data for the residents of each United States Census block group within the 1-mile and 5-mile radius of the Project Route including Minority, Income, and Minority and Income. A summary of the EJ populations in the vicinity of the Project Route is provided in *Section 5.4.13*.

5.3 Construction Methods and Procedures

NEP has long established policies and procedures for minimizing construction related disturbances throughout all phases of construction. NEP and its contractors will follow these procedures for construction of the Project. These policies and procedures include National Grid's ROW Access, Maintenance and Construction Best Management Practices ("BMPs") EG-303NE ("National Grid's BMPs"), provided as Appendix 5-2.

This section describes the general construction methods and procedures anticipated for the Project.

5.3.1 Overhead Transmission Line Construction Sequence

Conventional overhead electric transmission line construction techniques will be used to construct the Rebuilt Lines and Taps. The work will be completed in a progression of activities that will generally proceed as follows:

1. Environmental compliance documentation and training.
2. Removal of vegetation and ROW mowing in advance of construction.

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[13] Exempt Property are properties that qualify from exemption from taxation under various provisions of the law and include public land and facilities, hospitals, schools, churches, and cultural institutions, G.L. c. 59 §5.

[14] According to G.L. c. 59 §2A, vacant land includes developable land, potentially developable land, undeveloped land, and agricultural/horticultural land not included in Chapter 61A. Source - Bureau of Local Assessment. (2019, April). Property Type Classification Codes - Massachusetts. PROPERTY TYPE CLASSIFICATION CODES. Retrieved April 4, 2023, from https://www.mass.gov/doc/property-type-classification-codes-non-arms-length-codes-and-sales-report-spreadsheet/download

3. Installation of soil erosion and sediment controls.
4. Construction of access routes and access route improvements.
5. Construction of work pads and staging areas.
6. Installation of foundations and structures.
7. Installation of conductor, OPGW, and shield wire.
8. Removal and disposal of existing transmission line components.
9. Restoration and stabilization of the ROW.

The following subsections describe the sequence of construction activities that will be used for the installation of the Rebuilt Lines and Taps. In general, Project activities will be sequenced to reduce impacts to the natural and human environment. Project work will be completed in a progression of activities such that construction will not occur along the entire Project ROW all at one time. The Project activities will be conducted in segments along the Line, which reduces the duration of activities within a given segment to less than the overall duration of construction. No long-term impacts on soil, vegetation, surface water, groundwater, wetland resources or air quality will occur.

In addition to construction activities, this section also addresses construction-related issues such as traffic, work hours, equipment, environmental compliance and monitoring, safety and public health considerations, and vegetation maintenance.

Environmental Compliance Documentation and Training

Prior to construction start, NEP and its consultants will develop an Environmental Field Issue guidance document ("EFI") that serves as a resource and field reference for field construction personnel and environmental monitors. It will provide a summary of Project permits and approvals secured to facilitate completion of the Project, as well as a summary of conditions that must be met to ensure compliance for the duration of the Project. In addition, a copy of the Final Decision issued by the Siting Board, and copies of all other permits and approvals, will be provided as attachments for reference and review. The EFIs will be provided to and reviewed by NEP project managers and construction supervisors in advance of construction. These documents will also be provided to the contractor's project manager and construction supervisor prior to construction. Contractors will be required, through their contracts with NEP, to understand and comply with Siting Board conditions or requirements and any other applicable Project permits and approvals. NEP also will require contractors to keep EFIs on site and available to all personnel during construction and throughout restoration.

EFIs, including permit conditions, National Grid's Environmental Guidance and Procedure documents, and Project specific highlights will be reviewed during a construction kick-off meeting and EFI trainings with NEP representatives and contractor personnel. While extensive training will be held for all team members prior to the start of construction, all new/additional contractor personnel supporting the lifecycle of the Project will receive EFI training before commencing work. EFI training typically includes:

- A field orientation/review,
- A description of the natural resources within the Project area,
- A review of the work sequence and work methods (in relation to minimizing impacts to natural resources),

- A review of the Project plans,
- A review of the Project permits and conditions,
- An explanation of National Grid's Environmental Guidance and Procedure documents, which address BMPs, including erosion and sediment control measures that will be employed to minimize or eliminate impacts to sensitive areas, and management of hazardous materials and waste in accordance with 310 CMR 30.000 and 310 CMR 40.1070 (2),
- A review of cultural resources concerns and an explanation of expected procedures and contact information if contractors encounter an unanticipated cultural resource, including stop work authority,
- A review of access routes that will be used to access work areas,
- Safety considerations, and
- Any other information that should be conveyed to ensure compliant completion of the Project.

Tree Removal, ROW Mowing and Removal of Vegetation in Advance of Construction

Within the Project ROWs, mowing or other vegetation management will be required prior to the start of construction to provide access to structure locations, to facilitate safe vehicular and equipment passage, and to provide safe work sites for personnel. Mowing will be completed by mechanical means. Small trees and shrubs will be mowed as necessary with the intent of preserving root systems to the extent practical. Where the Project Route crosses streams and brooks, any necessary vegetation mowing along the stream bank will be minimized to the extent practicable to reduce disturbance of soils and the potential for construction-related erosion.

Tree removal and trimming will also be necessary to maintain required clearances between vegetation and the transmission line structures and conductors for reliable operation of the transmission facilities. The wood from trees removed within the ROWs will be offered to individual landowners, donated to a community wood bank, chipped, and removed from the site or applied to upland areas. In certain environmentally sensitive areas, such as wetland resource areas and buffer zones, it may be necessary and desirable to leave felled trees and/or snags to decompose in place.

Installation of Sediment and Erosion Controls

Following vegetation removal activities, erosion, and sediment control devices such as straw bales, straw wattles, siltation fencing, compost socks, and/or chip bales will be installed in accordance with National Grid's BMPs and approved plans and permit requirements. Installation of erosion and sediment controls may occur concurrently with installation of work pads, pulling pads, and/or access route construction. The installation of these erosion and sediment control devices will be supervised by NEP contractors and reviewed by NEP construction supervisors and/or designated environmental monitors. Erosion and sediment controls will be installed between the work site and environmentally sensitive areas such as wetlands, streams, drainage courses, roads, and adjacent properties when work activities would disturb soil and result in the potential for soil erosion and sedimentation. Erosion and sediment control devices will function to mitigate construction-related

soil erosion and sedimentation and will also serve as a physical boundary to delineate resource areas and to contain construction activities within approved areas. NEP contractors, supervisors, and environmental monitors will regularly monitor installed controls.

In addition to those locations described above, erosion and sediment control devices will be installed along the perimeter of identified wetland resource areas prior to the onset of soil disturbance activities to ensure that stockpiles and other disturbed soil areas are confined and do not result in downslope sedimentation of wetland resources. Where structures requiring concrete foundations are located near wetlands, sedimentation controls will be installed to prevent transport of materials to these downgradient resource areas.

Construction and Improvement of Access

In preparation for construction, NEP will establish the physical access required to construct, inspect, and maintain the Rebuilt Lines and Taps through improvement of existing or historic accessways, temporary placement of construction mats, and construction of new access where necessary. Existing and proposed access routes are shown on the Environmental Resources Maps in Appendix 5-1.

Where upland access is not available, access across wetlands and streams will be accomplished by the temporary placement of construction mats. The use of construction mats allows for heavy equipment access within wetland areas, minimizes the need to remove vegetation beneath the access way, and helps to reduce the degree of soil disturbance, soil compaction, and rutting in soft wetland soils. Construction mats most often used by NEP are wooden timbers, typically bolted together into 4-foot by 16-foot sections. Typically, construction mats are installed on top of the existing vegetation; however, in some instances cutting or mowing woody vegetation may be required.

With respect to necessary stream crossings, construction matting provides a stable crossing while protecting the integrity of the stream bed and banks, thus minimizing impact. Specifically, stream crossings will be bridged using construction mats or other temporary minimally intrusive measures. Where the width of the stream allows, construction mats will be installed to span the entire watercourse without placing stringers in the water. Footers may be placed across the top of the stringers to distribute the weight of the construction equipment and further protect the stream banks. At stream crossings that cannot be spanned by a single section of construction matting, and where permits allow, stringers will be placed atop the stream bed parallel to the flow of water to support the construction mats. In addition, during both installation and removal of the construction mat span/bridge, care will be taken to ensure that the stream bed and banks are not damaged and that the stream flow is not unduly restricted. Depending on the location and sensitivity of the stream/wetland system, installation and removal of stream spans are often conducted under the supervision and direction of a wetland scientist. In addition, sediment controls are implemented to contain any materials used in the mat to access road transitions, if mats are installed in a wetland area.

Access construction and improvements will be carried out in compliance with the conditions and approvals of the appropriate federal, state, and local regulatory agencies. Dust suppression measures, such as the use of water trucks to spray access surfaces, will be implemented as required to minimize fugitive dust from construction vehicle travel along the ROW. Crushed stone aprons/tracking pads will be used at all access entrances to public roadways as needed to minimize

the migration of soils off-site from construction equipment. Additionally, stormwater BMPs will be installed as necessary as part of the access construction and improvement phase of the Project. These BMPs will reduce adverse impacts from stormwater flows, maintain the longevity of the access routes, and reduce overall maintenance needs.

Construction of Work Pads, Pulling Pads, and Staging/Laydown Areas

Work pads will be constructed to provide a safe and level work area for construction equipment to undertake foundation work and structure assembly, and to provide adequate space for the live line construction associated with the Project. Mowing of low growing woody vegetation and brush, and grading, may be necessary to create a work pad of approximately 145 feet by 80 to 125 feet at each proposed structure location. The work pads may be slightly smaller or larger depending on terrain, equipment, and overall site conditions at each structure location. Upland work pads will be constructed by grading and/or adding gravel or crushed stone to provide a stabilized work surface. Within agricultural areas and wetlands, work pads will consist of temporary construction matting placed on top of existing vegetation. Once construction is complete, some work pad locations (e.g., those located in environmentally sensitive areas, such as Riverfront Area, floodplain, and potentially rare species habitat) will be stabilized with topsoil and seeded to allow vegetation to reestablish. In some cases, per agency review, stone and gravel will also be removed.

Construction of wire stringing and pulling sites will be required at some angle points and dead-end structures on the Rebuilt Lines to provide a level workspace for equipment and personnel. Upland stringing and pulling sites may require mowing and grading to create a level work surface. Sites in agricultural and sensitive resource areas, such as wetlands and certain areas within the rare species habitat, will consist of construction matting placed on top of vegetation, where feasible. All temporary wire stringing and pulling sites will be restored, stabilized, and allowed to revegetate.

Temporary storage areas, staging areas, and laydown areas will also be needed to support construction. NEP and/or their designated contractor(s) will be responsible for selecting these areas and making arrangements with property owners for use of the land during construction. Selected staging areas and contractor laydown areas will typically be previously developed properties, where environmental resources can be avoided.

Installation of Foundations and Structures

Rebuilding the Existing Lines and Taps requires replacing both steel and wood structures with engineered weathering steel monopole structures to support the Rebuilt Lines and Taps. Monopole structures will be directly embedded into the ground or set upon reinforced concrete caisson foundations. Alternative foundation types such as helical piles and micropile foundations may be utilized if warranted by site conditions or other factors.

Structures supported by concrete caisson foundations will result in approximately 79 square feet of fill (approximately 8 feet in diameter). It is anticipated that there might be some outliers for areas with heavy structural loading, river crossings, etc. Structures installed through direct embedment will result in approximately 50 square feet of fill (approximately 72 inches in diameter). Excavation will be performed using augers or rock drills and depending on field conditions, backhoes and excavators.

For direct embedment structures, a corrugated metal pipe will be placed vertically into the excavated hole and backfilled. The annular space between the pole and the steel casing will then be backfilled with crushed stone. Caissons will be constructed by drilling a vertical shaft, installing casing, installing a steel reinforcing bar cage, placing anchor bolt clusters, pouring concrete, and backfilling as needed. The poles will be field assembled and lifted by cranes, then placed onto either the anchor bolts or into the embedded corrugated metal pipe, for each respective foundation type.

Alternatively, should micropile foundations be installed, a small-diameter non-displacement grouted pile would be utilized. A hole would be drilled into the soil, casing is installed in the hole to the determined cased depth, and the remaining required micropile depth would be drilled into the desired competent layer. Steel reinforcement would be placed into the hole and the drilled hole would be filled with grout using a plastic tremie attached to the steel reinforcement. Grout would be either placed by gravity or pressure grouting. A steel pile cap then would be fastened to the installed piles, and the poles would be lifted by cranes and bolted onto the steel pile cap.

Excavated material will be temporarily stockpiled next to the excavation; however, this material will not be placed directly into wetland resource areas. If a stockpile is in close proximity to wetlands, the excavated material will be enclosed by staked straw bales or other sediment controls. Additional controls, such as watertight spin-off boxes or geotextile filter fabric, may be used for saturated stockpile management in work areas in wetlands (e.g., construction mat platforms) where sediment-laden runoff would pose an issue for the surrounding wetland. Excess excavated soil will be spread over upland areas outside of any applicable wetland buffer zones or other wetland resource areas or removed from the site in accordance with NEP's policies and procedures.

Dewatering may be required during the foundation installation. Groundwater pumped from an excavation would be discharged to an upland area if there is adequate vegetation to function as a filter medium. Where conditions are not adequate for infiltration, water would be pumped into a sediment filter bag within a straw bale/silt fence corral (basin) located within an upland area. The basin and all accumulated sediment would be removed following dewatering operations, and the area would be restored, as needed.

Rock that is encountered during foundation excavation will generally be removed by means of drilling with rock coring augers rather than a standard soil auger. This method allows the same drill rig to be used and maintains a constant diameter hole. However, in some cases, rock hammering and excavation may be used to break up the rock. No blasting is currently anticipated for the Project.

Installation of Conductor and OPGW

Following the construction of transmission line structures, insulators will be installed on the structures. The insulators will isolate the energized power conductors from the structure. OPGW and power conductors will then be installed using stringing blocks and wire stringing equipment. The wire stringing equipment is used to pull the conductors from a wire reel on the ground through stringing blocks attached to the structures to achieve the desired sag and tension condition. During the stringing operation, temporary guard structures or boom trucks will be placed at road and highway crossings, railroad crossings, and at crossings of existing utility lines. These guard structures, and similar practices, are used to ensure public safety and uninterrupted operation of other utilities by keeping the wire away from other utility wires and clear of the traveled way.

Helicopter work is not anticipated at this time but may be considered depending on the work methods proposed by the construction vendors. NEP would notify municipal officials, fire, and police departments, and affected landowners, particularly those with livestock, in advance of any helicopter work.

Removal and Disposal of Existing Transmission Line Components

After the Rebuilt Lines and Taps have been placed into service, the existing structures will be removed. The majority of the existing structures are comprised of steel lattice towers. To facilitate their removal, a hydraulic shear will be used to cut and remove the steel lattice towers supporting the Existing Lines, and the steel will be salvaged. Conductors and insulators will also be salvaged and any equipment and debris that cannot be recycled will be transported to an appropriate off-site disposal facility. Handling of such materials will be performed in compliance with applicable laws and regulations and in accordance with NEP policy.

Wood pole structures will be removed in their entirety unless the complete removal of the pole would create an adverse impact to environmentally sensitive areas. The resulting hole will be backfilled and thoroughly tamped to minimize settling, then capped with native topsoil and allowed to revegetate. NEP will transport used wood poles to the nearest ROW street crossing that is accessible by truck for subsequent pick up. Treated wood poles will be transported for disposal at a licensed landfill or incinerator. All cross-arms, braces, and other hardware will be removed from the site and disposed of properly.

Restoration and Stabilization of the ROW

Typical restoration efforts, including removal of construction debris, final grading, and stabilization of disturbed soil, will be completed following construction. Existing stone walls and fences will be restored in accordance with property owner agreements and applicable local ordinances. Where authorized by property owners, permanent gates and access roadblocks will be installed at key locations to restrict access onto the ROW by unauthorized persons or vehicles.

Regulated environmental resource areas temporarily or permanently disturbed by construction will be restored or replicated in accordance with applicable permit conditions. The Company will work with each community's Conservation Commission or authorized representative (i.e., Agent), as well as Massachusetts Department of Environmental Protection ("MassDEP") and United States Army Corps of Engineers ("USACE") to ensure restoration complies with all performance standards in applicable wetlands regulations and permits, as well as each municipal Order of Conditions. All disturbed areas around structure work pads and other graded locations will either be stabilized with a gravel surface or vegetated. Erosion control blankets, or similar, may be used to stabilize the soil in accordance with applicable regulations. Temporary sediment control devices will be removed following the stabilization of disturbed areas.

Construction mats will be removed following completion of construction, and areas will be restored to reestablish pre-existing topography and hydrology, as necessary.

NEP's environmental monitor(s) will inspect restored areas in accordance with *Section 5.3.2*.

5.3.2 Environmental Compliance and Monitoring

NEP will retain the services of environmental compliance monitors to observe civil construction activities, including the installation and maintenance of soil erosion and sediment control BMPs, on a routine basis to ensure compliance with all federal, state, and local permit commitments. NEP's Environmental Monitor(s) will have the necessary expertise in wetlands protection. In addition, per the requirements outlined in the U.S. Environmental Protection Agency's ("EPA") Construction General Permit ("CGP"), Environmental Monitors will also be "qualified persons" who have, at a minimum, either completed the EPA construction inspection course and have passed the exam; or hold a current valid construction inspection certification or license from a program that covers principles and practices of erosion and sediment control and pollution prevention practices at construction sites, proper installation and maintenance of erosion and sediment controls and pollution prevention practices used at construction sites; and performance of inspections, including the completion of required reports and documentation, consistent with the CGP.

In addition, NEP will require that its construction contractors designate a construction supervisor or equivalent to be responsible for coordinating with the environmental monitor and for regular inspections and compliance with permit requirements. This person, or the team involved, will be responsible for ensuring EFI training and any other appropriate training has been provided, and members of the construction crew receive direction regarding work methods as they relate to permit compliance and construction mitigation commitments. Daily tailboard meetings will occur including a review of the day's environmental requirements and considerations. Regular construction progress meetings will be held to reinforce contractor awareness of these mitigation measures.

In addition, and as part of the EFI mentioned in *Section 5.3.1* above, NEP will develop and maintain a Stormwater Pollution Prevention Plan ("SWPPP") and Soil Erosion and Sediment Control Plan for the Project. The SWPPP will identify controls to be implemented to avoid and minimize the potential for erosion and sedimentation from soil disturbance during construction. The SWPPP will include a construction personnel contact list, a description of the proposed work, stormwater controls and spill prevention measures, and inspection practices to be implemented for the management of construction-related stormwater discharges from the Project. The SWPPP will be adhered to by the contractors during all phases of Project construction in accordance with the general conditions prescribed in the Project's EPA Stormwater CGP. As necessary, deficiencies of erosion and sediment control measures and other permit compliance matters will be immediately brought to the attention of the contractor's construction supervisor for implementation of corrective measures.

Post construction, NEP will monitor mitigation associated with impacted environmental resources in accordance with the federal, state, and local permitting conditions specified for the Project. At a minimum, NEP's standard is to monitor the restoration of impacted wetlands and waterways and mitigation areas annually during the growing season following construction to ensure wetland areas are stable and support 75% vegetative cover. NEP's environmental monitor(s) will inspect restored areas to ensure there are no noticeable adverse effects to the plant community, soil characteristics, and micro-topography. Should the environmental monitor observe adverse effects, or if the restoration timelines are not in compliance with permit conditions, the Company will perform additional corrective actions, such as hand grading, seeding, or mulching. After all work

has been satisfactorily completed and vegetation has been reestablished to a minimum of 75% cover, all non-biodegradable materials (e.g., siltation fencing, straw bale strings, stakes, straw wattle mesh casing, etc.) shall be disposed of properly off-site. NEP will work with each community's representative (i.e., Agent) as well as MassDEP, Natural Heritage and Endangered Species Program ("NHESP"), and USACE to ensure observed restoration complies with all performance standards in applicable wetland regulations and permits.

5.3.3 Construction Traffic

Intermittent construction-related traffic will occur over the entire construction period. Construction equipment will typically gain access to the Project Route from public roadways crossing the ROW in various locations. Because each of the construction tasks will occur at different times and locations over the course of construction, traffic will be intermittent at these entry roadways. Traffic will consist of vehicle types ranging from pick-up trucks to heavy construction equipment.

NEP's contractors will coordinate closely with state transportation authorities to develop acceptable Traffic Management Plans ("TMPs") for work within state highway layouts. NEP will coordinate with local authorities for work on local streets and roads. At locations where construction equipment must be staged in a public way, the contractors will follow a pre-approved work zone traffic control plan. Further traffic information is provided in *Section 5.4.10*. As necessary, NEP will notify affected landowners in advance of any use of off-ROW access and will work on a case-by-case basis with any abutting landowners that express concern.

5.3.4 Construction Work Hours

Construction activities and related deliveries will be limited to 7:00 a.m. to 7:00 p.m. on weekdays and 8:00 a.m. to 5:00 p.m. on Saturdays, with no construction on Sundays or state/federal holidays. Some work tasks such as concrete pours and transmission line stringing, once started, must be continued through to completion, and may go beyond normal work hours. Wire stringing across highways or railroads may also be required to occur outside normal work hours. Construction hours will be developed in consultation with the relevant municipalities, the Massachusetts Department of Transportation ("MassDOT"), and the Massachusetts Bay Transportation Authority ("MBTA").

Some municipalities have specific limits on construction work hours (for instance, Sunderland and Conway), but the majority determine work hours on a case-by-case basis. NEP will work closely with each of the municipalities to negotiate mutually agreeable work hours. In addition, during construction, NEP will assign a community outreach representative to keep abutting property owners and municipal officials informed about the Project as it progresses along the ROW through each community.

5.3.5 Safety and Public Health Considerations

NEP will construct and maintain the proposed Project so that the health and safety of the public is protected. This will be accomplished through adherence to all federal, state, and local regulations, and industry standards and guidelines established for protection of the public. Practices that will be used during construction will include, but not be limited to, establishing traffic control plans for construction traffic on busy streets to maintain safe driving conditions, restricting public access

to potentially hazardous work areas, and using temporary guard structures at road and electric line crossings to prevent accidental contact with the conductor during installation.

In addition, NEP implements safety measures based upon site-specific conditions associated with each individual work area and proposed work activity, including potential temporary barricades in high human use areas such as residential, industrial, and commercial areas. In agricultural areas, NEP will coordinate with underlying landowners to ensure that animals typically pastured within a work site are either relocated to a temporary pasture, timing of the work is sequenced to fall when a particular pasture is not in use, and/or temporary gates and fences are installed to keep livestock out of work areas. In areas adjacent to public ways, the Company will utilize TMPs that include signage, flaggers, and other traffic controls as necessary to support the safe execution of the relevant scope of work in addition to temporary guard structures and other such protective measures (as required by permit conditions) during wire pulling activities.

Prior to construction, NEP will ensure all contractors are familiar with and understand NEP's detailed public safety measures. All safety measures will conform to NEP's Safety Procedures and Work Area Protection Manual. Site-specific measures in this document include traffic control, excavation protection, exclusionary fencing, warning signs/devices, safety and orientation training for all crew members, and general housekeeping. Additionally, contractors are required to complete Occupational Safety and Health Administration ("OSHA") training that specifies the requirements for adequate sanitation and the proper disposal of unsanitary waste on the construction site.

Following construction, all transmission structures will be clearly marked with warning signs to alert the public to potential hazards if climbed or entered. Throughout the Project design and implementation sequence, NEP will evaluate locations that may require the installation of signs, and/or other types of barriers (e.g., large stones) at access points from public roads.

5.4 Environmental Impact Analysis

This section describes the existing conditions along the Project Route, presents an analysis of potential impacts to specific resources as a result of Project construction, and describes the measures NEP proposes to undertake to avoid, minimize, and mitigate such impacts.

Categories of potential impacts considered include land use, protected lands and open space, historic and archaeological resources, tree removal, wetlands and water resources, rare species habitat, noise, visual, traffic and transportation, EMFs, climate change, and EJ considerations. Data on natural and social environmental resources were compiled for the Project Route using field collected data and most recently available MassGIS data and mapping.

5.4.1 Land Use and Sensitive Receptors

The Project Route is predominantly located within existing ROW corridors held in fee or easement by NEP[15]. Project construction will be generally contained within existing NEP ROWs and along h

[15] The vast majority of NEP's ROW corridors are held through easements, with only a small percentage of properties along a ROW held in fee. Land held in fee, also known as fee simple, is the ownership of land and, in most cases, the buildings and structures located thereon. An easement is a nonpossessory, irrevocable legal interest in another party's land for a specific purpose. In NEP's case, as an easement holder, NEP typically has a right to access the landowner's property and to construct, operate and maintain a transmission line along a ROW corridor.

istorically utilized access routes. However, additional property rights are needed for access and ROW design, including select new pole and wire locations. For the remainder of the Project Route, there are no anticipated permanent changes to abutting land uses associated with construction of the Project.

NEP has evaluated land uses within the Project ROWs, as well as adjacent lands within 300 feet, to identify potential impacts to abutting stakeholders during construction. To identify land uses along the route, MassGIS land use data layers were overlaid onto aerial photographs, field investigations were completed to confirm existing conditions, and Project-specific land use categories and maps were created by combining MassGIS data with information collected in the field. As listed in Table 5-2, land uses along the Project ROW are predominantly exempt properties, and vacant land, interspersed with residential areas, and industrial uses. Within 300 feet of the Project ROW, land uses are predominantly exempt properties and residential areas, interspersed with mixed use and vacant land. Land use types along the Project Route are also shown in the Map Book in Appendix 5-1.

Table 5-2: Land Uses Within the Project ROWs and 300-foot Buffer to ROW

Project Route		
Land Use Type	**Within Existing ROWs (Acres)**	**300-foot Buffer to Existing ROWs (Acres)**
Agricultural/Horticultural	41	185
Commercial	12	67
Exempt Property	264	1,328
Forest Land	86	391
Industrial	167	367
Mixed Use	138	708
Recreation	17	73
Residential	167	1,032
Transportation	2	147
Unknown*	2	4
Vacant	221	645
Water	7	86
Total	**1,125**	**5,033**

** Based on guidelines developed by the Department of Revenue, each Board of Assessors determines the proper classification of property according to its use. "Unknown" Land Use has not yet been classified by the applicable municipality and/or passed the MassGIS Quality Assurance procedures required for publishing.*

As shown in Table 5-2, the primary land use on the Project ROWs and within 300 feet consists of approximately 1,592 acres combined of exempt property. Exempt property associated with the Project includes land owned primarily by municipalities, local town governments, state agencies, religious organizations, conservation groups, and the Department of Conservation and Recreation ("DCR"). Municipal lands include the Walter Cowls Jones Working Forest Wildlife Conservation Easement ("WCE") in Shutesbury, the High Ledges Wildlife Sanctuary in Shelburne, the Totman Farm Agricultural Preservation Restriction ("APR") in Conway, and the Bradwell Farms

Shelburne. DCR properties include the Connecticut River Greenway State Park, Daniel S. Horgan Memorial Skating Rink, Quabbin Reservoir Watershed, South River State Forest, Spencer State Forest, and West Brookfield State Forest.

Secondarily, approximately 221 acres on the Project ROW and 645 acres within 300 feet are classified as vacant land use. Vacant land includes developable land, potentially developable land, undeveloped land, and agricultural/horticultural land. Vacant land is predominantly located in Shelburne, Conway, Deerfield, Sunderland, Leverett, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn and Millbury.

Within 300 feet of the Project ROW, residential areas are the second most dominant land use. Of the total residential land uses within 300 feet, the majority are located in Spencer, Millbury, and Auburn. Within the Project ROW, residential land uses occur primarily at Nicole Drive, Woodland Street, and Elm Court in Millbury, and Leicester Street in Auburn. Per the current version of the MassGIS standardized assessors' parcel data set, there are 123 local roads/residential access routes and 55 private driveways that directly cross the ROW.

Industrial development accounts for approximately 167 acres on ROW and 367 acres within 300 feet. Industrial land use is predominantly found in the towns of Auburn, Conway, and Shelburne. These land uses include NEP's Millbury #1 Substation in Millbury, and solar fields in East Brookfield, Leicester and North Brookfield.

Sensitive receptor land uses are defined as public facilities including hospitals, elder care facilities and nursing homes, public and private schools, cemeteries, licensed daycares, district courts, police stations, fire stations, and places of worship. There are no sensitive receptors within the Study Area, however, Table 5-3 below provides the land use type within 300 feet of the Project ROW and number of receptors/units associated within each land use type. The receptor/unit counts relate to the number of land use dependent entities/properties within the buffer distances. Properties include any portion of a parcel classified as that land use type. Units include residential dwellings and commercial or industrial buildings/structures relevant to the land use type listed.

Table 5-3: Land Use Receptors and Units

Land Use Type	Number of Receptors		Sensitive Receptor Land Uses
	Properties	Units	
Agricultural/ Horticultural	18	0	0
Commercial	11	0	0
Exempt Property	70	3	0
Forest Property	30	0	0
Industrial	47	13	0
Mixed Use	54	1	0
Recreational Property	8	0	0
Residential	302	19	0
Vacant	109	4	0
Transportation	10	0	0
Unknown	2	3	0
Water	10	0	0
Total	671	43	0

5.4.1.1 Avoidance, Minimization, and Mitigation

There are no anticipated permanent changes to abutting land uses associated with construction of the Project along the Project Route. The Rebuilt Lines and Taps are replacing Existing Lines and Taps within the E5/F6 corridors held in fee or easement by NEP. This is consistent with the existing and surrounding utility infrastructure and current land uses. While Project construction may result in temporary impacts to abutting stakeholders, the Project infrastructure is not anticipated to interfere with any residential, business, or other public facilities.

A construction communication outreach plan will be developed for the Project that will provide outreach during construction and a consistent point of contact for the public. Recognizing the varying needs of its stakeholders, NEP is developing various communication methods to inform stakeholders of construction activities, including, as needed: work area signage; advance notification of scheduled construction; personal contact with residents, community groups, and businesses; and regular e-mail updates to residents (upon request) and local officials that will include information on upcoming construction activity. A public website (https://cmatowmaenergy.com) has been made available for this Project which provides details of the Project, an interactive map, and contact information.

As discussed in further detail in the Sections that follow, NEP will mitigate temporary impacts related to noise (*Section 5.4.9*) and traffic and transportation (*Section 5.4.10*). With the implementation of these measures, the anticipated impacts of the Project on adjacent land uses will be minimized.

5.4.2 Protected Lands, Open Space and Recreation

Within areas classified as protected lands or open space and recreation, Project construction is predominantly contained within existing NEP ROWs and along historically utilized access routes. As such, there are no anticipated permanent changes to open space and recreational land uses associated with construction of the Project along the Project Route. However, NEP has evaluated protected lands and properties used for open space and recreation within the Project ROWs, as well as adjacent lands within 300 feet, to identify potential impacts to abutting stakeholders during construction.

Protected open space and recreational land uses were identified using the MassGIS Protected and Recreational Open Space data layer[16] and are depicted in the Map Book in Appendix 5-1. Table 5-4 shows a summary of all Open Space and Recreation Resources identified for the Project. As part of this analysis, NEP also evaluated Areas of Critical Environmental Concern ("ACECs")[17]. No ACECs are located in the Project ROW or within 300 feet of the ROW.

[16] MassGIS (Bureau of Geographic Information); December 2021.

[17] ACECs are identified as environmentally significant places in Massachusetts that receive special recognition because of the quality, uniqueness, and significance of their natural and cultural resources.

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Table 5-4: Open Space and Recreation Resources[18]

Municipality	Site Name	Agency	Owner	Primary Purpose
Auburn	Auburn Recreation Complex	Local	Town of Auburn	R
	Daniel S. Horgan Memorial Skating Rink	State	DCR - Division of State Parks and Recreation	R
	Water Tank	Local	Town of Auburn	W
	Ball Field	Local	Millbury Auburn Realty Trust Cable Al	R
	Hillside Cemetery	Local	Town of Auburn	H
Belchertown	Quabbin Reservoir Watershed	State	DCR - Division of Water Supply Protection	W
Conway	Deerfield River (USGen New England) - Great River Hydro Conservation Restriction (“CR”)	Local	Great River Hydro	C
	South River State Forest	State	DCR - Division of State Parks and Recreation	B
	Shallcross Agriculture Restriction (“AR”)	Local	Shallcross, Bruce R and Alice L	A
	Totman Farm Agriculture Preservation Restriction (“APR”)	Local	Totman, Leland K and Betty A	A
Deerfield	Bar Way Farm Inc.	Local	Melnik	A
	Bridges DLT APR	Local	Bridges, Richard D	A
	New England Forestry Foundation - Tabak Forest CR	Local	New England Forestry Foundation	B
	New England Forestry Foundation - Pine Nook Forest CR	Local	New England Forestry Foundation	C
	Deerfield River (USGen New England) - Great River Hydro CR	Local	Great River Hydro	C
	Connecticut River Greenway State Park	State	DCR - Division of State Parks and Recreation	B
	Mill Village	Local	Mill Village Inc and Walter Melnik	A
	Localio CR	Local	Localio, Arthur and Ruth	C
Leicester	Hillcrest Country Club	Local	Town of Leicester	W
	Meadow Lake Park	Local	Meadow Lake Association	R
	Meadow Lake Beach	Local	Meadow Lake Association	R
	Memorial School	Local	Town of Leicester	R
Leverett	Teawaddle Hill Farm CR	Local	Teewaddle Trust	C
	East Leverett Meadow Conservation Area	Local	Rattlesnake Gutter Trust	C
	Kuzmeski CR	Local	Kuzmeski, Paul W	C
	Bates Sanctuary	Local	Rattlesnake Gutter Trust	C
	Walter Cowls Jones Working Forest WCE	Local	W. D. Cowls Inc.	C
	Williams Family Conservation Area	Local	Town of Leverett	C
	Adams Family Conservation Area	Local	Town of Leverett	C
	Heronemus Forest	Local	Kestrel Land Trust	C
	Schuyler CR	Local	Schuyler, Robert and Evelyn	C
Millbury	Elmwood Street & Shaw Schools Recreational Fields	Local	Town of Millbury	R
North Brookfield	Fullam Hill Road Conservation Area	State	Town of North Brookfield	C
	Edwards George L APR	Local	Edwards, George L and Hanna S	A
	North Brookfield Town Forest	Local	Town of North Brookfield	C
	Donovan Road Conservation Area	Local	Town of North Brookfield	C
Pelham	Amherst Water Supply Land	Local	Town of Amherst	W
	Cook-Johnson Cemetery	Local	Town of Amherst	H
	Robinson Road Conservation Area	Local	Town of Pelham	C
	Buffam Brook Community Forest	Local	Kestrel Land Trust	C
	Buffam Brook Road Conservation Area	Local	Town of Pelham	C
	Quabbin Reservoir Watershed	State	DCR - Division of Water Supply Protection	W
	Amherst Watershed	Local	Town of Amherst	W
	Cadwell Memorial Forest	State	Commonwealth of Massachusetts	C

[18] This list contains G.L. c. 59 §2A - Land which is not otherwise classified, and which is not taxable under the provisions of Chapter 61, 61A or 61B, or taxable under a permanent conservation restriction, and which land is not held for the production of income but is maintained in an open or natural condition and which contributes significantly to the benefit and enjoyment of the public. Chapter 61, 61A, 61B Property Being Classified as Open Space Source might overlap with Exempt Property above. Source - Bureau of Local Assessment. (2019, April). Property Type Classification Codes - Massachusetts. PROPERTY TYPE CLASSIFICATION CODES. Retrieved April 4, 2023, from https://www.mass.gov/doc/property-type-classification-codes-non-arms-length-codes-and-sales-report-spreadsheet/download

Municipality	Site Name	Agency	Owner	Primary Purpose
Shelburne	Deerfield River (USGen New England) - Great River Hydro CR	Local	Great River Hydro	C
	High Ledges Wildlife Sanctuary	Local	Massachusetts Audubon Society	C
	Bassett Road CR	Local	Ashenden Rebecca C and Marcy John	C
	Bradwell Farms CR	Local	Bradwell Farms	C
Shutesbury	Walter Cowls Jones Working Forest WCE	Local	W. D. Cowls Inc.	C
	Amherst Watershed	Local	Town of Amherst	W
	Conservation Area	Local	Town of Amherst	C
Spencer	Holy Rosary Cemetery	Local	Roman Catholic Bishop of Worcester	H
	O'Gara Park	Local	Town of Spencer	R
	Spencer Fish and Game Club	Local	Spencer Fish and Game Club	R
	Spencer State Forest	State	DCR - Division of State Parks and Recreation	B
	Bixby Road CR	Local	South Middlesex Non-Profit Housing Corporation	C
Sunderland	Mt. Toby Wildlife Management Area	State	Department of Fish and Game	C
	Shilling	Local	Shilling, Carolyn Whitmore	A
	Connecticut River Greenway State Park	State	DCR - Division of State Parks and Recreation	B
	Patterson Donald F Jr APR	Local	Patterson, Donald F Jr and Susan T	A
	Connecticut River Greenway State Park	State	DCR - Division of State Parks and Recreation	B
Ware	Ware Water Supply Land	Local	Town of Ware	W
	Quabbin Reservoir Watershed	State	DCR - Division of Water Supply Protection	W
	Frohloff Farm	Local	East Quabbin Land Trust	C
West Brookfield	Rock House Reservation	Local	The Trustees of Reservations	C
	Kibbe Corydon W APR	Local	Kibbe, Corydon W and Nancy N	A
	West Brookfield State Forest	State	DCR - Division of State Parks and Recreation	B
	Pynchons Grist Mill	Local	East Quabbin Land Trust	C
R: Recreation (activities are facility based) - W: Water Supply Protection - H: Historic / Cultural - C: Conservation (activities are non-facility based) – B: Recreation and Conservation - A: Agricultural				

NEP identified 50 federal, state, private, municipal, and non-profit owned open space lands located within or adjacent to the Project ROWs, consisting of a total of approximately 2,181 acres of open space. Of this, 377 acres are within the Project ROW, and 1,804 acres are within 300 feet of the Project ROW. The primary purposes of these protected lands include recreation, conservation, water supply protection, and cultural/historical. Many of these areas provide year-round recreational opportunities such as hiking and nature study, and seasonal activities such as fishing. The majority of the open space areas located adjacent to the Project ROWs provide scenic views and are often associated with rivers, reservoirs, wetlands, streams, rivers, and state forests.

DCR owns and manages reservoirs, conservation lands, and state forests within 300 feet of the Project ROW. These properties account for 167 acres of land within the Project ROWs, and approximately 802 acres of land within 300 feet. The largest state forest area is the South River State Forest in Conway. South River State Forest is a protected forest popular for hiking and outdoor pursuits. The Project ROW runs along the eastern boundary of the forest, and a number of trails either transect or start/end near the ROW. DCR trails vary in type from forest roads and trails with natural surfaces to processed gravel, varying in width and condition. The other state forests consist of the Spencer State Forest in Spencer, and West Brookfield State Forest in West Brookfield. These DCR properties offer opportunities for recreational activities to residents and visitors. Several multi-use trails intersect the existing ROWs. DCR trails vary in type from forest roads and trails with natural surfaces to processed gravel, varying in width and condition. Additionally, the Project ROW is adjacent to the Quabbin Reservoir Watershed in Belchertown. Quabbin Reservoir is one of the largest unfiltered waters supplied in the country. Similarly, the Project ROW also crosses through the Connecticut River Greenway State Park, which is a protected environment with public recreation features that consists of open spaces, scenic areas, archaeological and historical sites, as well as critical wildlife and plant habitats.

The majority of Project construction activities will take place within the existing ROWs to minimize impacts to adjacent open spaces. NEP's easements for the Existing Lines and Taps predate the establishment of DCR properties and state forests in these areas. NEP holds easements that grant rights for the construction and maintenance of towers, poles, wires, and other structures for the transmission of electric power in these locations. The Project has been designed to utilize existing access within NEP easements wherever feasible. However, temporary improvements to existing off-ROW access will be required within State Forest lands. Any off-ROW access improvements will be restored in coordination with DCR as part of the Construction & Access Permit process.

5.4.2.1 Avoidance, Minimization, and Mitigation

The Project Route is predominantly located within existing ROWs held in fee or easement by NEP. Rebuilding the Existing Lines and Taps along the Project Route is consistent with the existing use of these ROWs. Since the Project will continue to support utility infrastructure, it is not anticipated to interfere with any long-term existing or future land uses.

NEP will provide notification of the intended construction plan and schedule to any affected abutters so that the effect of any temporary disruptions may be minimized. To mitigate temporary construction-phase disturbances to public open spaces, specifically existing trail systems, NEP will coordinate with the affected stakeholders and will develop an outreach plan to include safety signage and temporary detours around active construction zones. Normal operation at all facilities will continue and existing land uses will be allowed to continue following construction.

Some wildlife habitat functions associated with forested areas will be permanently altered as a result of tree removal; however, they will be replaced with the increasingly scarce scrub/shrub habitat. Post-construction stabilization and restoration of the ROWs will also facilitate natural revegetation on the ROW and reestablish available wildlife habitats on the ROW.

With the implementation of these measures, the anticipated impacts of the Project on protected, open space, and recreational lands will be minimized.

5.4.3 Historic and Archaeological Resources

As part of the federal consultation process under Section 106 of the National Historic Preservation Act ("NHPA"), NEP's cultural resource consultant, The Public Archaeology Laboratory ("PAL"), initiated a cultural resource due diligence review for the Project in June 2022 to identify historic architectural properties, archeological sites, and other cultural resources within the Project's Area of Potential Effects ("APE"), and to make recommendations regarding consultation with the Massachusetts Historical Commission ("MHC"), office of the State Historic Preservation Officer ("SHPO"), and any appropriate additional cultural resource investigations. Additional field work to identify historic architectural properties was conducted in the fourth quarter of 2024 and work is ongoing. PAL also started an archaeological survey of the Project APE in October 2022 and work is on-going. PAL plans on submitting the archaeological and architectural reports to the MHC, and federally and state recognized Tribes in the second quarter of 2025.

To date, a total of 22 above-ground resources have been inventoried within or overlapping the Project ROW consisting of 19 districts and three individual resources. Of the 19 districts, four are listed on the National Register. None of the individual resources have been evaluated for National Register listing. Four post-contact archaeological sites and 12 pre-contact archaeological sites have been inventoried within or overlapping the Project ROW. None of the pre-contact sites within the Project ROW have been evaluated as to their National Register eligibility, except for one site in Deerfield that was determined ineligible for listing. NEP will continue to consult with the MHC, USACE, Native American Indian Tribes, and other stakeholders to avoid, minimize, or mitigate any effects the Project may have on historic properties, including the development of any related archaeological site avoidance and protection plans and associated treatment measures, if needed.

5.4.3.1 Avoidance, Minimization, and Mitigation

The Project Route is located within established ROWs associated with the Existing Lines and Taps. For the majority of the Project Route, the Rebuilt Lines and Taps and associated tree removals are not expected to impact the existing viewshed from abutting above ground resources. Construction within the ROW has the potential to impact archaeological sites depending on the depth and extent of planned ground disturbance in relation to archaeological resources.

The Project is subject to review under Section 106 of the NHPA ("Section 106") and will require a permit from the USACE. The Project will also be subject to review by the MHC under G.L. c. 9, §§ 26–27C. NEP will coordinate with the USACE and MHC to incorporate avoidance and/or minimization measures as needed to avoid adverse effects to potential National Register of Historic Places ("NRHP") eligible or -listed cultural resources. As part of the USACE Section 404 permit review, and pursuant to Section 106, the USACE will also consult with federally recognized Native American Indian Tribes that express an interest in the cultural resources that may be affected by the Project.

NEP will continue to coordinate with PAL, in consultation with MHC and the USACE, to identify historic, archaeological, or cultural resources prior to construction and to avoid, minimize, or mitigate impacts to cultural and historic resources. Any protection or avoidance measures required to avoid or minimize impacts to significant resources will be outlined in an Avoidance and Protection Plan. While Project specific, Avoidance and Protection Plans typically include instructions to be incorporated into construction documents and delivered to construction personnel. No access to site areas is allowed and protective fencing is put in place with signage. No ground disturbance within site areas is permitted, including no vegetation removal, no parking of vehicles, no equipment storage, and no collection of artifacts. Site conditions are to be documented before and after the construction process.

Procedures to handle unanticipated discoveries during construction will be specified as part of a Post Review Discoveries Plan. In addition, in the event of an unanticipated cultural resource discovery, NEP EFI procedures (see *Section 5.3.1*) include stopping the work activity at the location of the potential discovery and notifying the Company's environmental lead, environmental monitor, and archaeological contractor and/or appropriate authorities. Avoidance measures will be put in place and documentation completed (if necessary). Authorities include the local medical examiner for potential human remains and the State Archaeologist or archaeological reviewer for potential historic finds.

5.4.4 Tree Removal

As described in *Section 5.4.1*, the Project ROWs primarily traverse forested, exempt properties. To provide a safe area for construction, future maintenance, and operation, and to ensure the reliability of the Rebuilt Lines and Taps, NEP will remove trees in select locations along the edges of the existing Project ROWs as follows:

- The E5/F6 ROW is currently maintained clear of tall woody vegetation to approximately 100 feet wide on average throughout the corridor. NEP is proposing to remove trees in select locations to maintain approximately 125 feet of its 80-to-200-foot-wide ROW.
- The Quabbin Switch Taps ROW is currently maintained clear of tall woody vegetation to approximately 80 feet wide on average throughout the corridor. NEP is proposing to remove trees in select locations to maintain the 80-foot width. Where the Quabbin Switch Tap is located on fee-owned property, approximately 100 feet of the 190-foot width will require select tree removal.
- The Deerfield Taps ROW is currently maintained clear of tall woody vegetation to approximately 100 feet wide on average throughout the corridor. NEP is proposing to remove trees in select locations to maintain the entire 125-foot-wide ROW.

The Rebuilt Lines and Taps will also need to continue to comply with clearance requirements set forth in the NERC document FAC-003-4 "Transmission Vegetation Management".

To determine the acreage of the proposed tree removals within the Project ROWs, NEP used Light Detection and Ranging ("LiDAR") data to measure, digitize, and assess vegetation heights and existing canopy along the Project Route to determine the risk of vegetation falls on the Rebuilt Lines and Taps. This analysis, coupled with field reviews, allowed NEP to determine where tree removal will be required to ensure conformance with the appropriate vegetation management

operating criteria within the ROWs, and where trimming, pruning, or other management techniques will be sufficient. Lower growing shrubs identified during this analysis will be allowed to remain in all areas not required for construction work pads and access ways.

For tree removal off-ROW, only trees required to safely accommodate passage of construction equipment and vehicles will be removed.

Table 5-5 provides the breakdown of anticipated tree removals both on and off-ROW. Refer to Environmental Resources Maps in Appendix 5-1.

Table 5-5: Proposed Tree Removal for the Project Route

Tree Removal Location	Project Route (on-ROW) (acreage)[19]	Access (off-ROW) (acreage)
Forested Uplands	161	58
Forested Wetlands [20]	20	1
Subtotal Tree Removal	181	59
Total Tree Removal	**240 Acres**	

Temporary impacts to wildlife are anticipated in association with tree removal along the forested edge of the Project Route, but they will be minimal. Forest edges already exist due to the presence of the existing ROW, and large blocks of intact woodland adjacent to the ROW will not be impacted and will remain for wildlife use. Mobile species such as large mammals white-tailed deer (*Odocoileus virginianus*) and birds are expected to temporarily relocate from construction areas but are unlikely to be permanently impacted by the displacement. Small mammals such as gray squirrels (*Sciurus carolinensis*), woodchucks (*Marmota monax*), and possibly furbearers (skunks and raccoons), as well as herpetofauna have smaller home ranges and are less mobile. Tree removal will cause changes to their local habitats, and they are unlikely to relocate. Some individuals may be directly impacted by tree removal activities and habitat alteration, but these species are abundant and population level impacts are unlikely. Additionally, the early-stage habitat maintained in the ROW is suitable or preferred for a wide range of species currently present, and the incremental increase in the size of the ROW will be beneficial to them.

5.4.4.1 Avoidance, Minimization, and Mitigation

Utilizing the existing ROWs associated with the Project Route greatly minimizes the need for new tree removal for the Project. Specifically, the majority of the Project Route consists of the existing E5/F6 ROW, which has been actively maintained for over a century. Therefore, the Project Route likely predated many of the adjacent land uses, and the vegetation maintenance cycle has regularly modified the landscape on- and off-ROW for decades. Similarly, the Tap Lines have been refurbished and subject to regular maintenance cycles.

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[19] Rounded to the nearest 100th. Acreage includes the approximate, existing canopy cover to be removed as a result of trees being removed from within the ROW.

[20] Wetlands include local, state, and federal freshwater wetlands as defined in the Federal Clean Water Act (33 U.S.C. §§ 1251 et seq., Section 404 and Section 401), Massachusetts Wetlands Protection Act ("MWPA") (G.L. c. 131 § 40) and Regulations (310 CMR 10.00), and local bylaws/ordinances for each municipality along the Project Route. These wetlands include all field delineated Bordering Vegetated Wetland ("BVW") within and adjacent to the Project ROW.

Due to the avoidance and mitigation measures summarized above, tree removal proposed in forested wetlands is minimal (2% of the overall wetland acreage). However, where necessary, felled trees and/or snags and slash piles may be left in place and may provide some wildlife habitat features. As feasible, trees may be topped to offer wildlife habitat benefits. Low scrub/shrub plant communities will be left intact with the exception of access routes where temporary construction matting is proposed. Areas permanently maintained as low-growing, herbaceous, or scrub/shrub communities will have appropriate conservation seed mixes applied to bare soil surfaces. This promotes biodiversity, provides pollinator habitats, and ecologically valuable community types.

Prior to tree removal, trimming, and mowing, the boundaries of wetlands will be clearly marked to prevent unauthorized vehicular encroachment into wetland areas. Appropriate forestry techniques will be implemented within wetlands to minimize ground disturbance. Other sensitive resources, such as cultural resource features and NHESP state-listed plant species, will be flagged and encompassed with protective fencing prior to removal of vegetation on the ROW. Temporary construction mats will be used to gain access to and across wetlands, to minimize wetland disturbance, and to provide stable platforms for safe equipment operation.

NEP anticipates the final mitigation package will be developed during the federal, state, and local permitting processes outlined in the next section, and that the package will fully address the required permit conditions and agency concerns. If required or otherwise determined to be necessary, a mitigation plan using native plant species may be implemented to supplement the reestablishment of vegetation.

5.4.5 Wetlands, Water Resources and Vernal Pools

The Project's wetland, watercourse, and vernal pool impacts have been minimized to the greatest extent practicable by utilizing ROWs associated with the Existing Lines and Taps and existing access ways where feasible. However, given the scale and landscape setting of the Project, certain wetland impacts cannot be avoided.

The assessment of wetlands and watercourses within the Project ROWs is based on field reviews and wetland delineations performed for the Project in Summer and Fall of 2022, and Winter of 2024. The vernal pool assessment and identification of wetlands, water crossings, and vernal pools located outside of the Project ROWs is based on field delineations and the following digital data layers:

- MassDEP Wetlands Data[21]
- USGS National Hydrography Data ("NHD")[22]
- MassGIS NHESP Certified Vernal Pool ("CVP") Maps[23]

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[21] MassGIS. 2017. MassGIS Data: MassDEP Wetlands. Retrieved October 26, 2022 from https://www.mass.gov/info-details/massgis-data-massdep-wetlands-2005#downloads-.

[22] United States Geological Survey. 2016. NHD Viewer. Retrieved May 26, 2021, from https://nhd.usgs.gov/NHD_High_Resolution.html.

[23] MassGIS. 2024. MassGIS Data: NHESP Certified Vernal Pools. Retrieved February 2, 2024 from https://www.mass.gov/info-details/massgis-data-nhesp-certified-vernal-pools.

Table 5-6 below summarizes the wetlands, watercourses, and vernal pools associated with the Project, which are also depicted in the Map Book in Appendix 5-1.

Table 5-6: Wetlands, Watercourses, and Vernal Pools Associated with the Project

Resources	Units	Existing Wetlands along Project Route		Potential Impacts (acreage)		
		ROW1	Off-ROW*	Temporary	Secondary	Permanent
Wetlands[24]	**Acreage**	**234**	**25.5****	**43.8**	**21.6**	**0*****
Streams (Perennial)	**Number**	**58**	**11**	**0.53**	**0.56**	**0**
Streams (Intermittent)	**Number**	**159**	**122**	**0.43**	**0.72**	**0**
Certified Vernal Pools	**Number**	**3**	**7**	**0**	**0******	**0**

** Based on field delineated data of NEP overhead transmission line ROW and digital data listed above.*
*** Calculated for within 30 feet of the access routes.*
**** Rounded to the nearest tenth. Equivalent to a total of 1,507 square feet.*
***** Rounded to the nearest tenth. Equivalent to a total of 261 square feet.*

In summary, a total of 259.5 acres of wetlands were identified along the Project Route. Approximately 234 acres of wetlands were identified within the Project ROWs, and 25.5 acres were delineated off-ROW adjacent to Project activities (e.g., access improvements). Wetlands are found sporadically throughout the entire Project Route. These wetlands typically consist of scrub/shrub, emergent marsh, or wet meadow communities. In accordance with the federal classification system found in Cowardian (1979),[25] Palustrine Forested Wetlands, Palustrine Emergent Wetlands, and Palustrine Scrub Shrub Wetlands, were identified on the existing ROWs.

Construction will result in temporary, secondary, and permanent impacts to wetland resources. Temporary impacts associated with the construction of the Project include placement of construction matting, secondary impacts include tree removal, and permanent impacts include fill associated with the installation of the structures. Based on preliminary design, construction of the Project will result in approximately 43.8 acres of temporary impacts, 21.6 acres of secondary impacts, and zero acres (or 1,507 square feet) of permanent impacts to wetlands.

5.4.5.1 Avoidance, Minimization, and Mitigation

To reduce the impacts associated with the construction and operation of the Project, NEP incorporated design measures to minimize permanent impacts and BMPs to minimize temporary alterations associated with construction. In addition to using existing ROWs, design measures include utilizing existing access routes and avoiding the placement and construction of structures

[24] Wetlands include local, state, and federal freshwater wetlands as defined in the Federal Clean Water Act (33 U.S.C. §§ 1251 et seq., Section 404 and Section 401), MWPA (G.L. c. 131 § 40) and Regulations (310 CMR 10.00), and local bylaws/ordinances for each municipality along the Project Route. These wetlands include all field delineated BVW within and adjacent to Project ROW.

[25] The Cowardin system is used by the USFWS for the National Wetlands Inventory. In this system, wetlands are classified by landscape position, vegetation cover and hydrologic regime. The Cowardin system includes five major wetland types: marine, tidal, lacustrine, palustrine, and riverine.

and access in wetlands and watercourses where possible. This has resulted in the avoidance and minimization of impacts to wetlands, watercourses, and vernal pools to the greatest extent practicable, resulting in only 1,507 square feet of permanent impact.

Additional impact minimization measures include utilizing temporary construction mats for wetland access and work pads instead of permanent fill (i.e., stone, or similar) and selective tree removal where feasible for off-ROW access. As described in *Section 5.3.1*, NEP will install and maintain erosion and sediment controls throughout construction, as well as other typical measures described in National Grid's BMPs. NEP is currently in the preliminary phases of discussions with the USACE, MassDEP, and NHESP, and will be consulting with all applicable Conservation Commissions, to develop an appropriate mitigation package so there is no net loss of wetland functions and values as a result of the Project. Examples of possible wetland mitigation strategies include wetland restoration, targeted property acquisition for land preservation, and participation in the USACE Massachusetts in-lieu fee program. Permit applications to be submitted to state and federal regulatory agencies will provide the specific mitigation information required for the Project. At the local level, NEP will work with local Conservation Commissions to discuss impacts and proposed mitigation as part of the Notice of Intent process. In addition, post construction, NEP will prepare applications for Certificates of Compliance from each of the Conservation Commissions. These Certificates ensure that wetland resources have been restored, and losses have been mitigated, as applicable.

NEP is committed to developing a mitigation package that will address impacts of the Project. It is anticipated that mitigation will result in no net loss of existing wetland functions values and statutory interests within the watershed. While Project information presented herein is thorough with regard to impacts, and proposed mitigation measures are identified and described, NEP is still evaluating specific details related to wetland mitigation.

5.4.6 Rare Species Habitat

Impacts to rare species have been minimized to the greatest extent practicable by utilizing existing, managed ROWs and existing access routes where feasible. The vegetation maintenance cycle and ROW maintenance and improvements have modified the landscape on and off the ROW for decades. However, improvements to access and construction of new access and work pads will temporarily and permanently alter habitats within the ROWs.

To assess the potential for plant and/or animal species listed as state or federally endangered, threatened, and/or special concern to be present along the Project Route, NEP reviewed MassGIS 2021 Priority and Estimated Habitat data layers, solicited database information from the NHESP, and reviewed the Project Route for federal species using the United States Fish and Wildlife Service ("USFWS") Information for Planning and Consultation ("IPaC") tool, which is available on their website.

The USFWS IPaC review determined that four federally listed species may be present within the Project area, consisting of a threatened mammal, a candidate insect, an endangered plant, and a threatened plant. Additionally, based on NHESP data layers and information, the Project Route contains habitat for 26 state-listed species (four bird, three reptile, five invertebrates, one fish, and13 plant species), along portions of the Project Route in the towns of Spencer, East Brookfield, North Brookfield, West Brookfield, Ware, Belchertown, Shutesbury, Leverett, Sunderland,

Deerfield, Conway, and Shelburne. Specific species are not identified herein at the NHESP's request.

The Priority Habitat ("PH") data layer available from MassGIS depicts approximately 222 acres, or 19.3% of the ROW, within rare species habitat. Based on the preliminary Project design, approximately 48 acres (44.1 acres upland, 3.8 acres wetland) of tree removal, and approximately 28.5 acres of temporary matting (17 acres upland, 11.3 acres wetland) is proposed in PH. Additionally, approximately 40 acres (all upland) of permanent impacts associated with access and work pad improvements is proposed. The permanent impacts to PH will occur within the towns of East Brookfield, Spencer, Ware, Belchertown, West Brookfield, North Brookfield, Shelburne, Sunderland, Shutesbury, Deerfield, Conway, and Leverett. Consultation is ongoing with NHESP to determine if any of these impacts will constitute a "take" of state-listed species.

During the regulatory review process, NHESP staff will review activities proposed within rare species habitat to determine whether the Project will impact state-listed species and their habitats. If it is determined that a proposed action will result in a "take" and cannot be revised to avoid a "take," then NEP will file for the issuance of a Conservation and Management Permit ("CMP") and take action to meet the performance standards for the CMP.

5.4.6.1 Avoidance, Minimization, and Mitigation

In addition to using existing, managed ROWs and access to the maximum extent practicable, habitat information obtained through desktop assessments and field surveys was used to design the Project to avoid and minimize impacts to rare species habitat where feasible. Wherever possible, permanent impacts to PH will be minimized by limiting the extent of access and work pads to the minimum safe size required for conducting utility line maintenance work. Tree removals will follow guidelines from NHESP.

In addition to avoiding and minimizing species and habitat impacts to the maximum extent feasible, NEP is working closely with NHESP to develop mitigation measures for each species associated with the Project Route. At this time, proposed mitigation includes, but is not limited to, the following:

- Habitat restoration;
- Species-specific protection plans;
- Protective enclosures and fencing;
- Extensive "sweeps" and monitoring during construction; and
- Training for construction personnel.

Consultation with NHESP is ongoing and NEP will implement the necessary actions to avoid, minimize, and mitigate Project-related impacts to comply with the Massachusetts Endangered Species Act ("MESA") permit issued for the Project. If, after consultation with NHESP, it is determined that a "take" will occur, a CMP will be prepared to comply with MESA. Mitigation options under a CMP may include, but are not limited to, funding of programs that directly benefit the affected species, on-site and/or off-site habitat protection and/or creation. Off-site habitat protection typically requires the acquisition of land, under fee ownership or Conservation Restriction ("CR"), for permanent habitat conservation. Other mitigation options include financial contribution toward land acquisition, conservation research funding, habitat management, or other

programs that directly benefit the affected species. With the implementation of these measures, impacts on rare species and their habitats as a result of the Project will be minimized.

5.4.7 Public Water Supplies

The existing Project ROWs traverse various public water supply resources as summarized in Table 5-7. However, potential impacts are anticipated to be negligible and associated with construction only.

Public water supplies can be sourced from either groundwater aquifers or surface waters. To identify public water supply areas within the Project ROWs, the following resources were used:

- MassGIS ORW Datalayer (2010)[26]
- MassGIS Aquifers (2007)[27]
- MassGIS Approved Wellhead Protection Areas (Zone II, Zone I, IWPA) Datalayer (2022)[28]
- USGS NHD Waterbody (2022)[29]
- MassGIS Major Watershed (2000)[30]

As stated in 310 CMR 22.02, a Zone II Wellhead Protection Area is defined as: "that area of an aquifer which contributes water to a well under the most severe pumping and recharge conditions that can be realistically anticipated (180 days of pumping at safe yield, with no recharge from precipitation). It is bounded by the groundwater divides which result from pumping the well and by the contact of the aquifer with less permeable materials such as till or bedrock."

MassGIS Aquifer Dataset maps show high, medium, and low yield aquifers. The definition of high and medium yield varies between panels, as it does on the source manuscripts. Medium yield aquifers for most basins are between 100 and 300 gallons per minute ("gpm"); however, this range may vary greatly from basin to basin. High and low yield definitions vary from basin to basin as well.

MassDEP has established a category of waterbodies known as ORWs, which are designated in the Massachusetts Surface Water Quality Standards Regulations (314 CMR 4.00) and include high quality waters with socioeconomic, recreational, ecological and/or aesthetic values. Class A Public Water Supplies, their tributaries and NHESP CVPs are classified as ORWs. Other waters can be

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[26] MassGIS. 2010. MassGIS Data: Outstanding Resource Waters. Retrieved March 18, 2024 from https://www.mass.gov/info-details/massgis-data-outstanding-resource-waters#downloads.

[27] MassGIS. 2007. MassGIS Data: Aquifers. Retrieved March 18, 2024 from https://www.mass.gov/info-details/massgis-data-aquifers#downloads.

[28] MassGIS. 2024.MassDEP Wellhead Protection Areas (Zone II, Zone I, IWPA). Retrieved July 29, 2024 from https://www.mass.gov/info-details/massgis-data-massdep-wellhead-protection-areas-zone-ii-zone-i-iwpa#downloads.

[29] USGS. 2022. NHD Waterbody. Retrieved March 18, 2024 from https://www.usgs.gov/national-hydrography/access-national-hydrography-products.

[30] MassGIS. 2000. MassGIS Data: Major Watersheds. Retrieved March 18, 2024 from https://www.mass.gov/info-details/massgis-data-major-watersheds#downloads.

specifically designated by the MassDEP as ORWs. Replacement structures, temporary construction mat access, pull pads, and work envelopes are proposed within wetlands mapped as ORWs associated with Atkins Reservoir, Ludlow Reservoir and Quabbin Reservoir. Public water supply information and aquifer locations for the Project Route are provided in the Map Book in Appendix 5-1.

Table 5-7: Public Water Supplies Traversed by the Project

Resource Areas	Name	Project Route (acres)
Zone II	Deerfield Fire District, Cherry Valley/Rochdale Water District, Auburn Water District, Spencer Water Department, Sunderland Water District. Ware Water Department	70
Aquifers	Deerfield River Basin, Connecticut River Basin, Chicopee River Basin, and Blackstone River Basin	132
ORWs	Amethyst Brook, Ludlow Reservoir, Atkins Reservoir, and Quabbin Reservoir.	159
Water Supply Watersheds	Deerfield, Connecticut, Chicopee, and Blackstone	155
Reservoirs	Atkins Reservoir, Ludlow Reservoir, and Quabbin Reservoir.	137

5.4.7.1 Avoidance, Minimization, and Mitigation

Potential impacts to surface water supplies could occur only as a result of unanticipated failure of sedimentation and erosion controls during construction. Therefore, impacts to public water supply sources are not anticipated. However, if an impact were to occur as a result of construction activity, it would be negligible. Potential impacts to groundwater supplies could occur from spills of fuel or hydraulic oil related to the construction equipment. Equipment used for the construction of the Rebuilt Lines and Taps will be properly maintained and operated to reduce the chances of spill occurrences of petroleum products. Refueling equipment will be required to carry spill containment and prevention devices (i.e., drip pans, absorbent pads, etc.) and fueling of equipment will only occur in upland areas, unless equipment cannot be moved. No blasting will occur within Zone II Wellhead Protection Areas along the Project Route.

Proposed structures and work areas for the Project have been sited to avoid permanent impacts to ORWs to the extent practicable. In locations where ORWs cannot be avoided, sediment and erosion controls will be implemented to minimize sediment migration outside of the limits of disturbance. Any temporary construction matting will be removed immediately after the construction activities are complete. Any required restoration or stabilization, after the mat removal, will be completed as the equipment and vehicles de-mobilize from the ROW. Additionally, NEP will work closely with DCR for work within the Quabbin Reservoir.

It is anticipated that most tree and vegetation removal will be done mechanically. The Project will comply with the National Pollutant Discharge Elimination System ("NPDES") CGP and SWPPP requirements, requirements of the Section 401 Water Quality Certification, Massachusetts Wetlands Protection Act ("MWPA") and implementing regulations, and other restrictions as may be applied by the local Conservation Commissions in accordance with the MWPA.

Appropriate sediment and erosion control, spill prevention, and response measures will be implemented, and these controls will be closely monitored and managed. NEP will require its contractors to adhere to BMPs regarding the storage and handling of oil and potentially hazardous

materials during the Project. Equipment used for the construction of the Rebuilt Lines and Taps will be properly maintained and operated to reduce the chances of spill occurrences of petroleum products. Refueling equipment will be required to carry spill containment and prevention devices (e.g., drip pans, absorbent pads).

Following construction, the normal operation and maintenance of the transmission line facilities will have no impact on public water supply resources. Vegetation management within sensitive areas, including public water supply areas, will follow the same procedures as are currently used on the ROW.

5.4.8 Visual Impact Assessment

This section describes the potential visual impacts of the Project from properties and public ROWs located adjacent to or within close proximity to the Project.

Most of the Project Route traverses exempt properties that are predominantly densely forested areas where structures are only seen from road crossings, open water, open fields, and occasional commercial or residential uses directly adjacent to the ROW as shown in Land Use Maps in Appendix 5-1. Since the Rebuilt Lines and Taps will be located predominantly within the existing ROWs, tree removal will be minimized and limited to discrete areas where the ROWs have not been fully maintained and where additional tree removal is required to achieve compliance with vegetation management standards. Therefore, existing vegetation will provide some screening.

For this Project, 21 key viewpoints were identified where there is a potential for greater visibility and/or sensitivity to views of new structures. Each location/viewpoint is accessible to the public via highways, roads, sidewalks, and publicly owned land. In Table 5-8, entitled Viewpoints to the Project ROW, each location is identified by a View number, street name, and municipality.

Table 5-8: Viewpoints to the Project ROW

Viewpoints from Public Streets		
Location	**Viewpoint**	**Description**
Providence St, Millbury	View 2	Represents view of the rebuilt structure from the street adjacent to residential property along Providence Street.
S Main and Rice Rd, Millbury	View 4	Represents view of the rebuilt structure from the street adjacent to residential property along S Main and Rice Road.
Woodland St, Millbury	View 6	Represents view of the rebuilt structure from the street adjacent to residential property along Woodland Street.
Woodland St, Millbury, MA	View 7	Represents view of the rebuilt structure from the street adjacent to residential property along Woodland Street.
Nicole Dr, Millbury	View 18	Represents view of the rebuilt structure from the street adjacent to residential property along Nicole Dr.
Greenwood St, Millbury	View 20	Represents view of the rebuilt structure from the street adjacent to residential property along Greenwood Street.
Ridgewood Dr, Auburn	View 51	Represents view of the rebuilt structure from the street adjacent to residential property along Ridgewood Dr.
Leicester St, Auburn	View 68	Represents view of the rebuilt structure from the street adjacent to residential property along Leicester Street.
Bunker Hill Rd, Leicester	View 86	Represents view of the rebuilt structure from the street adjacent to residential property along Bunker Hill Road.
Douglas Dr, Leicester	View 109	Represents view of the rebuilt structure from the street adjacent to residential property along Douglas Dr.
Ferncroft Rd, Leicester	View 110	Represents view of the rebuilt structure from the street adjacent to residential property along Ferncroft Road.
Greenville St, Spencer	View 112	Represents view of the rebuilt structure from the street adjacent to residential property along Greenville Street.
Ash St, Spencer	View 127	Represents view of the rebuilt structure from the street adjacent to residential property along Ash Street.
Smith and Hanson Rd, West Brookfield	View 198	Represents view of the rebuilt structure from the street adjacent to residential property along Smith and Hanson Road.
Shea Rd, West Brookfield	View 217	Represents view of the rebuilt structure from the street adjacent to residential property along Shea Road.
Madden Rd, West Brookfield	View 218	Represents view of the rebuilt structure from the street adjacent to residential property along Madden Road.
Old Gilbertville Rd, Ware	View 256	Represents view of the rebuilt structure from the street adjacent to residential property along Old Gilbertville.
Old Gilbertville Rd, Ware	View 256	Represents view of the rebuilt structure from the street adjacent to residential property along Old Gilbertville.
Old Gilbertville Rd, Ware	View 257	Represents view of the rebuilt structure from the street adjacent to residential property along Old Gilbertville.
Cushman Rd, Leverett	View 455	Represents view of the rebuilt structure from the street adjacent to residential property along Stillwater Road.
Stillwater Rd, Deerfield	View 558	Represents view of the rebuilt structure from the street adjacent to residential property along Stillwater Road.

Visual renderings were prepared from these observation points. Appendix 5-4 depicts existing and simulated future conditions at these representative locations along the Project Route.

The Existing Lines and Taps are presently visible to varying degrees from all 21 viewpoints listed in Table 5-8. The Existing Lines generally include the following structures:

- Grey steel lattice structures ranging from 40 to 80 feet high on the E5/F6 Lines.
- Grey steel monopole structures ranging from 60 to 95 feet high on the E5/F6 Lines.
- Various wood multi-pole structures ranging from 50 to 90 feet high on the E5/F6 Lines.
- Wooden monopole structures at 40 to 50 feet high on the Deerfield Tap Lines.
- Wooden monopole structures at 35 to 40 feet high on the Quabbin Tap Lines.

The existing monopoles are more visually solid than lattice structures.

The proposed replacement structures will be taller than the existing structures. Proposed structures range from 70 to 145 feet high (averaging 85 feet in height, above ground), an increase in average height of approximately 10 feet on the E5/F6 Lines. The visual contrast between existing views is most distinct where the height of the new structures extends above adjacent vegetation and can be discerned more clearly and/or from a greater distance. In many instances new structures on the horizon will be more visible than the existing structures.

In cases where brown weathering steel monopoles are visible against the sky, they may represent a greater contrast than grey or galvanized structures. However, when viewed against the tree line by a person standing at close proximity to the poles, the weathering steel structures are less discernable against dark backgrounds (e.g., vegetation) as compared to galvanized poles from the same perspective. Only limited vegetation removal will be required in the Project ROW to accommodate the installation of the monopole structures. Therefore, the color of the structures will have little impact on change in visibility.

The majority of locations where structures are visible are where they cross public roads. For some residents, such as the view to Structure 20, the primary view change is within or behind the property. To better understand how this change presents at landscape scale refer to Appendix 5-4.

Overall, the potential for visual impact along the Project Route has been minimized through use of existing ROWs associated with the Existing Lines and Taps. These ROWs are located primarily in undeveloped and forested areas with relatively few residential or commercial abutters.

5.4.8.1 Avoidance, Minimization, and Mitigation

Impacts from the Project will be minimized due to the limited need for tree removal in locations near sensitive viewers and the location of the Project within managed ROWs. NEP will work with abutting landowners who experience a material change in view as a result of construction to determine reasonable and practical screening that could be provided on their properties.

During the Project's restoration phase, representatives from the Company and a landscaper to be retained by the Company will meet with those individual landowners whose views have materially changed as a result of construction of the Project and who have expressed the desire for visual mitigation, to discuss what reasonable and feasible screening can be provided. Screening options may be in "soft" form (e.g., vegetation) or "hard" form (e.g., fencing), or a combination of the two. The type of visual screening will be determined through a collaborative conversation between the landowner, the landscaper and the Company. Ultimately, the type of screening that is chosen will be based on feasibility and cost.

With the implementation of these measures, the visual impact of the Project will be minimized.

5.4.9 Noise

This section evaluates the potential for noise impacts from construction of the Project. The Project is not anticipated to generate noise during operation; consequently, noise impacts associated with the Rebuilt Lines and Taps will be limited to the construction period, which currently is anticipated to extend from April 2029 to November 2034, following the transmission line construction sequence described in *Section 5.3.1.* Construction is expected to occur during typical work hours, though in specific instances, at some locations, or at the request of a municipality or state agency, NEP may seek municipal approval to work at night. The noise ordinances applicable to the municipalities that the planned construction will affect are shown in Table 5-9.

Table 5-9: Municipal Noise Ordinance and Bylaw Summary[31]

Municipality Code	Allowed Construction Hours		Exceptions/Decibel Limits
	Weekday	Weekend	
Town of Shelburne Zoning Bylaw 21.12.6 (c) and (d)3	7:00 a.m. - 7:00 p.m.	Not Permitted	The noise generated during construction or operation will adhere to the Massachusetts Department of Environmental Protection's Division of Air Quality Noise Regulations (310 CMR 7.10), as amended, and will not exceed the average ambient noise level by more than 5 A-weighted decibel ("dB(A)"). Additionally, sound levels will remain below 40 dB(A) during the day and 30 dB(A) at night to align with typical rural or quiet residential area standards. NEP will work with the town to ensure compliance with applicable bylaws, as required.
Town of Conway Zoning Bylaw 12.12 (i) (ii) a., b., c., and d.	7:00 p.m. and 7:00 a.m.	Not Permitted	The noise generated during construction shall comply with the provisions of the Massachusetts Department of Environmental Protection's Division of Air Quality Noise Regulations (310 CMR 7.10), as amended, or the provisions of this Bylaw, whichever is more restrictive. A sound source will be in violation of this Bylaw if it: Increases the broadband sound level by more than 5 dB(A) above pre-construction ambient levels during construction and operation, or increases broadband sound by more than 5 C-weighted decibel ("dB(C)") above pre-construction levels; Produces a "pure tone" condition where an octave band center frequency sound pressure level exceeds the two adjacent center frequencies by three decibels or more; Results in noise levels exceeding 35 dB(A) during the day or 30 dB(A) at night,

[31] Noise ordinance and Bylaw information was not available for the towns of Shutesbury, West Brookfield, North Brookfield, East Brookfield, Spencer, and Leicester.

Municipality Code	Allowed Construction Hours		Exceptions/Decibel Limits
	Weekday	Weekend	
			consistent with rural or quiet residential standards; or For low-frequency sounds (octave center frequencies ≤125 Hertz (" Hz"), produces a maximum noise level outside the property boundary exceeding 40 dB(C). NEP will work with the town to ensure compliance with applicable bylaws, as required.
Town of Deerfield Article 7 (Zoning)	Not Specified	Not Specified	No person shall operate or permit the operation of any sound source that produces a sound level exceeding 80 dBA or 10 dBA above ambient levels, whichever is lower, as measured at the property boundary of the receiving land use. NEP will coordinate with the town to ensure compliance with applicable bylaws, as required.
Town of Sunderland Chapter 125, Zoning Bylaws Section 3(E)	Not Specified	Not Specified	No use shall be allowed if it will cause sound, noise, vibration, odor or flashing (except for warning devices, temporary construction or maintenance work, No use shall be permitted if it generates sound, noise, vibration, odor, or flashing (excluding warning devices, temporary construction or maintenance, parades, recreational, or agricultural activities) that is perceptible without instruments beyond 200 feet from the boundaries of the originating premises. For uses adjacent to or within sensitive areas, such as wilderness areas, wildlife preserves, historical site areas, etc., no use shall cause sound, noise, vibration, odor, or flashing perceptible without instruments beyond the originating premises.
Town of Leverett Code of the Town Chapter 127	10:00 p.m. -6:30 a.m.	10:00 p.m. - 6:30 a.m.	The bylaw does not prescribe specific decibel level limits. Additionally, the prohibitions outlined in the previous section do not apply to or restrict highway and utility maintenance or construction, including necessary excavation or repairs of bridges, streets, highways, or public utility installations conducted by or on behalf of the town, any public utility, or any agency of the Commonwealth of Massachusetts.
Town of Pelham Zoning Bylaw §125-21. B (2)	9:00 p.m. - 7:00 a.m.	9:00 p.m. - 7:00 a.m.	The bylaw does not prescribe specific decibel level limits. However, no person shall engage in or cause noisy construction activities on a site abutting a residential use between 9:00 p.m. and 7:00 a.m.

Municipality Code	Allowed Construction Hours		Exceptions/Decibel Limits
	Weekday	Weekend	
Town of Belchertown Chapter 145 Zoning 145-32. B (2)	10:00 p.m. and 7:00 a.m.	10:00 p.m. and 7:00 a.m.	The maximum permissible sound-pressure level of any continuous, regular, or frequent source of sound produced by any use or activity shall not exceed 70 dB(A) at the property line from 7:00 a.m. to 10:00 p.m. and 60 dB(A) from 10:00 p.m. to 7:00 a.m. NEP will work with the town to ensure compliance with applicable bylaws, as required.
Town of Ware	7:00 a.m. -9:00 p.m.	7:00 a.m. - 9:00 p.m.	The maximum permissible sound-pressure level from any continuous, regular, or frequent source of sound produced by any use or activity shall not exceed 70 dB(A) from 7:00 a.m. to 9:00 p.m. and 60 dB(A) from 9:00 p.m. to 7:00 a.m. NEP will work with the town to ensure compliance with applicable bylaws, as required.
Town of Auburn Zoning Bylaw 9.4.6.6	Not Specified	Not Specified	Noise beyond the property line shall not exceed the average level of street and traffic noise, and shall not be objectionable in terms of intermittence, beat frequency, or shrillness. NEP will work with the town to ensure compliance with applicable bylaws, as required.
Town of Millbury	Not Specified	Not Specified	No use shall cause sound, noise, vibration, odor, or flashing perceptible beyond 400 feet from the property boundaries, except in specific cases like warning devices or temporary work. The Building Inspector may require proof of compliance via engineering analysis or examples of similar facilities. A permit issued based on this evidence certifies the town's acceptance of the structure and equipment, but any future changes must also comply with the standards. NEP will work with the town to ensure compliance with applicable bylaws, as required.

Construction of the Rebuilt Lines and Taps will require the use of various types of equipment during the construction sequence. The duration of construction activities outlined in Table 5-9 will vary on a site-by-site basis depending on several factors such as the amount of vegetation removal and mowing to occur, nature of the terrain, the subsurface conditions associated with a particular foundation location, and the type of structure being installed.

Table 5-10 identifies the types of equipment to be used for each phase of construction and provides a range of typical sound levels from the equipment at a specific location and for the Project as a whole, as well as typical durations by activity. The typical sound levels are provided at a distance of 50 feet from the source and have also been extrapolated for noise levels at 100, 200, and 300 feet. The estimated noise levels range from 80 A-weighted decibel ("dBA") to 98 dBA at a distance of 50 feet from the construction activity.

Table 5-10: Typical Construction Sound Levels Along the Project Route

Description of Activity	Types of Equipment	Typical Sound Levels at 50 Feet (ft) (dBA)	Estimated Typical Sound Levels (dBA) at Various Distances from Noise Sources			Typical Durations (Approximate)
			100 ft	200 ft	300 ft	
Vegetation Removal and ROW Mowing	Grapple trucks Bulldozers Track-mounted mowers Motorized tree shears Log forwarders Chippers, Chain saws Box trailers	84 to 98	78 to 92	72 to 86	69 to 83	One day per 2000 ft of access and work area mowing One day per 1000 ft for vegetation removal
Erosion/Sediment Controls and Access Route Improvements and Maintenance	Dump trucks Bulldozers, Excavators, Backhoes Graders, Forwarders 10-wheel trucks with grapples, Cranes	80 to 93	74 to 87	68 to 81	65 to 78	One day per 500 linear ft for graded access and work areas One day per 300 linear ft for matted access and work areas
Installation of Foundations and Structures	Backhoes and Excavators Rock drills mounted on excavators Cluster drills with truck mounted compressors Concrete trucks Cranes Aerial lift equipment Tractor trailers	80 to 90	74 to 84	68 to 78	65 to 75	Two days per direct embed foundation, 5 days per concrete caisson foundation One day per suspension structure, two days per dead-end structure
Conductor and Shield Wire Installation	Puller-tensioners Conductor reel stands Cranes Bucket trucks Flatbed trucks	80 to 93	74 to 87	68 to 81	65 to 78	Five days per mile of conductor install/removal One day per mile of shield wire install/removal
Removal and Disposal of Existing Transmission Line Components	Cranes Flatbed trucks Pullers with take-up reel Excavators	80 to 90	74 to 84	68 to 78	65 to 75	One half day per tower
Restoration of the ROW	Bulldozers Excavators Tractor-mounted York rakes Straw blowers Hydro-seeders	80 to 90	74 to 84	68 to 78	65 to 75	One day per 1000 linear ft for graded access and work area One day per 500 linear ft of matted access and work area

As shown in Table 5-11, there are few residential areas that are within the ROW or touch the edge of the ROW. Residences within 50 feet, 100 feet, 200 feet and 300 feet of the Existing Lines and Taps may potentially be impacted by construction noise during one or more phases of construction. However, typical sound levels of construction noise experienced at any given residence will be temporary and intermittent.

Table 5-11: Residential Areas Within or Abutting the ROW

Project Component	Closest Residence (ft)	Residences within 50 ft of ROW	Residences between 50-100 ft of ROW	Residences between 100-200 ft of ROW	Residences between 200-300 ft of ROW	Total residences within 300 ft
E5/F6 ROW	25	133	102	194	198	627
Deerfield Sub Taps #3	442	0	0	0	0	0
Quabbin Switch Taps	Unknown	0	0	0	0	0

5.4.9.1 Avoidance, Minimization, and Mitigation

To the extent practicable, NEP will comply with the noise ordinances in the municipalities within which the Project is proposed. The Company will mail notifications to abutting residents in advance of scheduled work in their neighborhood, providing dates, times, and a description of the work. As part of this notification, NEP will flag anticipated activities that may be louder than typical construction. Updates will also be placed on the Project website. NEP will coordinate with abutters over the life of the Project to determine if there are any specific schedule constraints that can be introduced to address abutter concerns, such as not working on a specific weekend due to an event at an abutting residence.

On a limited basis, work occurring per scheduled outages and other work tasks, once started, may require continuous operation until completion outside of planned work hours (including Sundays and holidays). These tasks include concrete pours associated with concrete caisson foundations and wire stringing activities. The decibel levels are as outlined in Table 5-9 as it relates to "Installation of Foundations and Structures" (80 to 93 decibels) and "Conductor and Shield Wire Installation" (80 to 93 decibels). The duration of a concrete pour is typically scheduled to last a full ten-hour working day as concreting must be completed in a continuous, monolithic pour. The duration of wire stringing activities for any single wire varies depending upon the length of the wire pull. Wire stringing is typically planned at a rate of installing one wire (a single phase of conductor or a single shield wire) per day in any given wire pulling section. Wire stringing activities and the installation of concrete caissons will be necessary in residential areas. In these instances, NEP will seek advanced approval from the applicable municipality and provide notice to abutters.

Temporary noise impacts from construction equipment will be mitigated by maintaining equipment in good working condition and by the use of appropriate mufflers. Noise sources that may operate continually during the day, such as generators or air compressors, will be located away from populated areas to the extent possible. NEP and its contractors will also comply with state law (G.L. c. 90, § 161A) and MassDEP regulations (310 CMR 7.11(1)(b)), which limit vehicle idling to no more than five minutes, to the greatest extent feasible based upon the construction task, type of equipment/vehicle, and weather conditions. There are exceptions for

vehicles being serviced, vehicles making deliveries that need to keep their engines running, and vehicles that need to run their engines to operate accessories. Where construction takes place adjacent to residences, NEP will notify landowners in advance of construction and will provide a point of contact for Project related questions and concerns. With the implementation of these measures, noise impacts associated with the Project will be minimized.

Information specific to Project noise protocols, rules, and regulations are provided in bid documents, part of contract requirements, and discussed during pre-bid and pre-construction meetings. NEP holds weekly meetings during construction with the contractor responsible for the successful delivery of the Project. Overall progress and compliance with permit and contract requirements are discussed at each meeting. Additionally, the Company will employ construction field supervisors to oversee the construction of the Project in accordance with contract documents. The construction field supervisor will be on-site daily.

5.4.10 Air Quality

The Project will not have any permanent air quality impacts and will not generate any permanent air quality emissions. Limited and temporary air quality impacts are anticipated during the construction of the Project due to vehicle and equipment exhaust and dust creation. Table 5-10 lists typical equipment that may be used during construction.

5.4.10.1 Avoidance, Minimization, and Mitigation

Air quality impacts associated with the Project will be temporary in nature and confined to the amount of time necessary for construction. NEP will mitigate air quality impacts during the construction process by carefully coordinating construction phasing; implementing established policies and procedures for minimizing construction related impacts; and requiring its contractors to implement air quality and dust control measures on-site throughout the construction period in compliance with National Grid's BMPs guidance document.

Dust control measures such as water sprays during excavation, stockpiling, and loading of demolition and soil materials for removal, and site watering to mitigate wind erosion, will be implemented as required to minimize dust from construction activities and vehicle travel along the ROW. Additional measures, such as secure covering of piles of excavated materials, properly secured covers on truck cargos during materials transport, and minimization of the free drop height of excavated or aggregate material during earthwork operations will be implemented to reduce other sources of dust. Tire cleaning areas at construction vehicle entrances and exits and street sweeping of adjacent local roadways will address potential sediment accumulation.

Emissions from construction equipment and transport of construction materials will be minimized in accordance with Massachusetts' anti-idling law, G.L. c. 90, § 16A, c. 111, §§ 142A–142M, and 310 C.M.R. 7.11. NEP limits vehicle idling time to five minutes except when engine power is necessary for delivery of materials or to operate accessories to the vehicle, such as power lifts.

NEP requires contractors to use Ultra-Low-Sulfur Diesel in off-road diesel vehicles. NEP will also comply with MassDEP's Diesel Retrofit Program. The Program requires that all diesel-powered non-road construction equipment with 50 or more horsepower used for 30 or more days during Project construction will either be EPA Tier 4–compliant or will have EPA-verified (or equivalent) emission control devices installed. Such devices include oxidation catalysts or other comparable technologies.

With respect to enforcement of the idling restrictions, it is the responsibility of every person on a job site to be in full compliance with all safety and environmental rules and policies. Supervisors and foremen at job sites are responsible for enforcement of these rules on a continuous basis, and environmental inspections will be conducted on a weekly basis.

5.4.11 Traffic and Transportation

The Project will not have any permanent traffic impacts and post-construction traffic impacts will be limited to those associated with occasional ROW and transmission line maintenance activities. However, limited temporary construction-related impacts are anticipated for the Project. Potential traffic impacts were evaluated using the MassGIS Open Data Portal. Roadways are identified by four functional classification system categories developed by MassDOT as shown in Table 5-12.

Table 5-12: Roadways Crossed by the Project Route

Functional Classification System Category	Project Route
Local Street or Road (Class 0)	66
Interstate (Class 1)	3
Urban or Rural Principal Arterial (Class 2 & 3)	10
Urban Minor Arterial or Collector (Class 5 & 6)	37
Total	**116**

The annual average daily traffic of each roadway impacted by the Project has not been determined. Generally, the traffic volumes from highest to lowest along the four classification categories, as follows:

- Interstate (Class 1),
- Urban or Rural Principal Arterial (Class 2 & 3),
- Urban Minor Arterial or Collector (Class 5 & 6) and
- Local Street or Road (Class 0).

Traffic data is available along select roadways where MassDOT count stations are provided. Based on the data available for state-owned roadways impacted by the Project, traffic volumes along these roadways range from approximately 5,000 to 110,000 vehicles per day. Interstate 90 (Massachusetts Turnpike) is the highest-volume roadway impacted by the Project and falls under the highest volume classification.

Construction of the Project along the Project Route will not result in a significant increase in traffic or material impacts to existing traffic patterns. During construction, the main impacts will occur when stringing transmission conductors over road crossings and at ROW construction access locations. At the ROW access locations, construction equipment and personnel will enter and exit the ROW from public roads and temporarily increase traffic. Since the various construction tasks will occur at different times and locations, traffic at these entry roadways will be intermittent. Generally, the larger construction equipment will enter the ROW once while working in a specific area; however, multiple trips may be conducted when delivering materials such as construction matting, stone, or concrete. Smaller vehicles such as pick-up trucks carrying construction workers will access the ROW daily.

Additional impacts, including lane closures or temporary traffic stops, are anticipated when conductors and shield wire need to be strung over public roadways. At such times, boom trucks may be set up in travel lanes, shoulders, or medians to serve as support to the lines as they are attached to the permanent transmission line structures. In addition, construction equipment may be necessary to install temporary guard structures. Traffic will be stopped for a short period of time to allow a rope to be manually pulled across the roadway. The conductors will then be attached to this rope and pulled above the roadway onto the temporary guard structures; traffic typically will be able to flow while the conductors are attached to the structures. Line stringing will be required along the Project Route across 116 roadway crossings and two railroad crossings. Permits from MassDOT will be required for this work at state highway crossings.

The following MassDOT state highways listed in Table 5-13 will require lane closures or other restrictions, such as shoulder closures, to access utility structures throughout the various phases of construction and/or to string transmission conductors over road crossings:

Table 5-13: Towns and Access to Utility Structures

Town	Access
Shelburne	Main Street (Route 112)
	Mohawk Trail (Route 2)
Deerfield	Interstate 91
	Greenfield Road (Route 5, 10)
Leverett	Long Plain Road (Route 63
Pelham	Daniel Shay Highway (Route 202)
Ware	Belchertown Road (Route 9)
	Gilbertville Road (Route 32)
Spencer	West Main Street (Route 9)
Auburn	Interstate 290
	Southbridge Street (Route 12)
	Massachusetts Turnpike
	Washington Street (Route 20)
Millbury	Worcester-Providence Turnpike (Route 146)

The timeline for implementing the lane/shoulder restrictions will be determined based on the construction/outage schedule and through consultation with MassDOT.

Along local roadways, NEP will coordinate with the municipalities on requirements for work hours, signage, and police details.

Additionally, there are eight active railroad crossings within or adjacent to the ROW. NEP will coordinate with respective owners for permitting/permissions to work in these areas.

5.4.11.1 Avoidance, Minimization, and Mitigation

Traffic impacts associated with the Project will be temporary in nature and confined to the amount of time necessary for construction. NEP will carefully coordinate construction to minimize impacts to adjacent residences and businesses and others relying on neighboring transportation corridors.

Prior to beginning construction, NEP will work closely with the municipalities and MassDOT to develop construction TMPs, which include construction-phase traffic controls to minimize the impacts of construction on the traveling public. These plans are developed for each specific location based on guidelines specified by MassDOT and the Manual on Uniform Traffic Control

Devices ("MUTCD"). Components of these plans are reliant on road type, posted speed limit, geometry, daily volumes, and other variables pertaining to the existing conditions and type of proposed work. TMPs for state-owned and maintained highways are submitted to MassDOT as part of a State Highway Access Permit application. Once the TMPs are revised to MassDOT's satisfaction, State Highway Access Permit(s) will be issued allowing the work to be performed per their requirements. TMPs are a function of the MassDOT permitting process and the number of TMPs required for the Project depends on the number of locations where work is proposed in the ROW of a state-owned highway.

Two main types of TMPs are anticipated for this Project, including access plan setups for any delivery/removal of materials and/or personnel to the Project site and crossing set ups for wire pulls. Based on consultations with MassDOT to date, 15 access plans and 15 crossing plans, totaling 30 TMPs, are expected to be developed for this Project. General components of each TMP include:

- Reflective cones or drums to delineate shifts/closure in travel lanes/shoulders.
- Advanced warning signage posted in each travel direction to alert drivers of the upcoming work zone.
- Police officers and/or flaggers positioned as necessary to facilitate traffic flow.
- Portable changeable message signs posted prior to the work zone.
- Truck-mounted attenuators positioned in the travel lane/shoulder as required prior to the work zone.

Additional site-specific TMP components will be included as required. Together, these components minimize the impacts of construction on the traveling public by allowing traffic to flow safely and efficiently through the work zone.

Implementation of a well-designed TMP will reduce the potential for traffic disruptions and inconvenience to drivers. All TMP work must conform to the MUTCD and MassDOT standards. With the implementation of these measures, the temporary traffic disruptions anticipated from the Project will be minimized.

For municipality-owned roadways, NEP and its contractors will coordinate directly with the individual municipalities, often including government and public safety officials, to develop construction work zones, practices and procedures, which may be based on MassDOT and MUTCD design standards.

For the eight railroad crossings, NEP will consult with railroad owners/operators to establish agreed upon practices and procedures for undertaking stringing operations in each location. Requirements may include railroad-specific safety training, timing restrictions, guard structures, and utilizing flagmen and other trained personnel.

5.4.12 Electric and Magnetic Fields

NEP's consultant, Gradient, assessed EMF associated with the Existing and Rebuilt Lines and Taps along the Project Route at annual average and system peak loading conditions. Gradient conducted the EMF modeling at a height of one meter (3.28 feet) above the ground surface. EMF

modeling was performed for the existing overhead circuit configuration in the ROW cross sections (referred to in the report as "pre-Project" case) and for two post-Project cases:

1) For the overhead circuit configuration after the E5/F6 Lines have been replaced and current loadings representative of the in-service year operating at 69-kV ("69 kV post-Project case").
2) For a second post-Project case with current loadings for the E5/F6 Lines representative of the in-service year operating at 115-kV ("115 kV post-Project case").

Modeling was conducted for eight representative ROW cross sections. For all but two of the representative cross sections, there are no other circuits within the Project ROW. For representative cross section 1 (as shown in Table 5-14 below) that occurs for the ROW segment entering the Deerfield #4 Substation, the 69 kV D4 line is present in the ROW along with the E5/F6 Lines, and this line was included in the EMF modeling for this cross section to determine the cumulative EMF levels at the ROW edges. For representative cross section 5 that occurs for a ROW segment between the Harrington #2234 Substation and the Meadow Street #552 Substation, the 69 kV T20 line[32] is present in the ROW along with the E5/F6 Lines, and it was included in the EMF modeling for this cross section to determine the cumulative EMF levels at the ROW edges.

EMF modeling was conservatively conducted for the location of lowest conductor sag[33] for each cross section, and for both annual average and system peak load levels. Additional information about Gradient's modeling methods and results are provided in the EMF Modeling Analysis Report in Appendix 5-5. Gradient's results are summarized below.

5.4.12.1 Magnetic Fields

Table 5-14 summarizes magnetic field modeling results for annual average loading conditions.

[32] The T20 circuit is typically open and was thus assumed to carry no current for both the annual average and system peak loading cases included in this EMF modeling assessment. Although it is currently a 69 kV circuit, it was assumed to be energized at 115 kV per NEP's request.

[33] As provided by NEP, a minimum conductor height above ground of 19.4 feet was used for pre-Project modeling of all representative cross sections and a minimum conductor height above ground of 23 feet was used for post-Project modeling of all representative cross sections based on state code clearance requirements associated with 115 kV design. Modeling at the location of lowest conductor sag is conservative because this is the location with the least clearance between the lines and the ground surface and is thus representative of the highest EMF levels that will be found beneath the lines.

Table 5-14: Summary of Modeled Pre-Project and Post-Project Edge-of-ROW Magnetic Fields for the Representative ROW Cross Sections for Annual Average Loading Scenarios

Representative Cross Section	ROW Segment	Magnetic Field (MF)					
		Left Edge-of-ROW			Right Edge-of-ROW		
		Pre-Project	Post-Project (69 kV)	Post-Project (115 kV)	Pre-Project	Post-Project (69 kV)	Post-Project (115 kV)
Cross Section 1 (D-13148-NE sh. 1)	From Deerfield No. 4 Substation	1.1	2.1	2.5	2.9	3.2	4.5
Cross Section 2 (D-13148-NE sh. 2)	From Deerfield 4 to Deerfield 3 Tap	1.1	1.9	2.2	1.1	1.3	1.7
	From Deerfield 3 Tap to Deerfield 2	<1	1.6	2.0	1.7	1.8	2.0
	From Deerfield 2 to Shutesbury	1.3	2.2	2.4	1.3	1.5	1.8
	From Shutesbury to Quabbin Switch Tap	1.6	2.5	2.6	<1	1.1	1.6
	From Quabbin Switch Tap to Ware	<1	<1	1.2	2.2	2.3	2.3
	From Ware to Lashaway	<1	1.4	1.8	1.9	2.1	2.1
	From Lashaway to Harrington St	2.0	2.8	2.7	1.2	1.1	<1
	From Harrington St to Meadow St	1.8	2.6	2.5	1.0	<1	1.0
	From Meadow St to Leicester	<1	1.3	1.8	<1	1.0	1.4
	From Leicester to Pondville	<1	1.3	1.7	<1	1.0	1.4
	From Pondville to Millbury	<1	<1	1.0	<1	<1	1.0

Representative Cross Section	ROW Segment	Magnetic Field (MF)					
		Left Edge-of-ROW			Right Edge-of-ROW		
		Pre-Project	Post-Project (69 kV)	Post-Project (115 kV)	Pre-Project	Post-Project (69 kV)	Post-Project (115 kV)
Cross Section 3 (D-13148-NE sh. 3)	Deerfield 3 Tap	<1	0.9	0.5	<1	<1	<1
Cross Section 4 (D-13148-NE sh. 4)	Quabbin Switch Tap	1.6	4.1	2.4	1.2	3.4	2.0
Cross Section 5 (D-13148-NE sh. 5)	From Harrington St to Meadow St	1.9	2.8	2.7	<1	<1	<1
Cross Section 6 (D-13148-NE sh. 6)	From Deerfield 2 to Shutesbury	2.3	10.3	11.7	2.1	10.6	12.2
Cross Section 7 (D-13148-NE sh. 7)	From Deerfield 2 to Shutesbury	1.4	7.5	8.5	<1	6.4	7.3
Cross Section 8 (D-13148-NE sh. 8)	From Deerfield 2 to Shutesbury	4.0	8.2	9.1	1.3	1.2	1.5
	From Shutesbury to Quabbin Switch Tap	4.4	8.6	9.3	<1	<1	1.3

Note: kV = Kilovolt; mG = Milligauss; ROW = Right-of-Way; Sh. = Sheet.

As shown in Table 5-14, the Project will generally result in small increases to edge-of-ROW magnetic fields ("MF") levels as compared to the pre-Project case that are frequently less than 1 Milligauss ("mG") and that reach a maximum of 10.06 mG. A maximum edge-of-ROW MF level of 12.18 mG was observed for the right (northeast) ROW edge for representative cross section 6 for the post-Project modeling case assuming 115 kV operation of the E5/F6 Lines, and this MF level remains only about 0.6% of the International Commission on Non-Ionizing Radiation Protection ("ICNIRP") health-based guideline of 2,000 mG. Moreover, MF levels continue to drop off rapidly with increasing distance from the ROW edge, reaching a value of 3.26 mG 50 feet from the ROW edge.

Table 5-15 summarizes pre- and post-Project magnetic fields under the system peak loading scenario.

Table 5-15: Summary of Modeled Pre-Project and Post-Project Edge-of-ROW Magnetic Fields for the Representative ROW Cross Sections for System Peak Loading Scenarios

Representative Cross Section	ROW Segment	Magnetic Field (mG)					
		Left Edge-of-ROW			Right Edge-of-ROW		
		Pre-Project	Post-Project (69 kV)	Post-Project (115 kV)	Pre-Project	Post-Project (69 kV)	Post-Project (115 kV)
Cross Section 1 (D-13148-NE sh. 1)	From Deerfield No. 4 Substation	1.8	3.3	3.9	4.1	4.2	2.6
Cross Section 2 (D-13148-NE sh. 2)	From Deerfield 4 to Deerfield 3 Tap	1.8	3.0	3.5	1.5	1.8	2.5
	From Deerfield 3 Tap to Deerfield 2	1.2	2.3	3.1	2.6	2.9	3.2
	From Deerfield 2 to Shutesbury	2.2	3.6	3.9	2.0	2.3	2.8
	From Shutesbury to Quabbin Switch Tap	2.4	3.9	4.0	1.6	2.0	2.6
	From Quabbin Switch Tap to Ware	<1	1.1	2.0	3.5	3.7	3.6
	From Ware to Lashaway	1.2	2.1	2.7	2.2	2.4	2.7
	From Lashaway to Harrington St	2.6	3.8	3.7	1.4	1.2	1.3
	From Harrington St to Meadow St	1.2	2.2	2.7	2.2	2.9	3.0
	From Meadow St to Leicester	1.0	1.7	2.5	1.0	1.2	1.9
	From Leicester to Pondville	1.0	1.7	2.5	1.0	1.2	1.9
	From Pondville to Millbury	<1	<1	1.3	<1	0.6	1.5
Cross Section 3 (D-13148-NE sh. 3)	Deerfield 3 Tap	<1	1.8	1.1	<1	0.6	<1
Cross Section 4 (D-13148-NE sh. 4)	Quabbin Switch Tap	2.3	5.9	3.5	1.7	4.9	2.9
Cross Section 5 (D-13148-NE sh. 5)	From Harrington St to Meadow St	1.3	2.3	3.0	1.5	2.1	2.1
Cross Section 6 (D-13148-NE sh. 6)	From Deerfield 2 to Shutesbury	3.8	16.3	18.4	3.2	16.6	19.1
Cross Section 7 (D-13148-NE sh. 7)	From Deerfield 2 to Shutesbury	2.4	11.9	13.3	1.4	10.0	11.5
Cross Section 8 (D-13148-NE sh. 8)	From Deerfield 2 to Shutesbury	6.4	13.2	14.5	1.9	1.9	2.3
	From Shutesbury to Quabbin Switch Tap	6.8	13.5	14.6	1.6	1.6	2.1

Note: kV = Kilovolt; mG = Milligauss; ROW = Right-of-Way; Sh. = Sheet.

Slightly higher post-Project edge-of ROW MF increases were observed for system peak load levels due to the higher currents typical of this line loading scenario as compared to the modeling for annual average load levels, but edge-of-ROW increases remained small in magnitude and were frequently less than 1-2 mG and <1 mG for the left and right ROW edges, respectively. The highest post-Project edge-of-ROW MF level of 19.08 mG, which was observed for the right (northeast)

ROW edge for representative cross section 6 for the modeling case assuming 115 kV operation of the E5/F6 Lines, remained less than 1% of the ICNIRP health-based guideline of 2,000 mG.

In order to minimize magnetic fields associated with the Rebuilt Lines, NEP has selected conductor arrangements and phasing configurations that promote magnetic field cancellation. Exposure to magnetic fields is further mitigated by the Project's primarily rural setting and the very limited number of residential structures located within 50 feet of the Project ROWs (see Table 5-16).

Table 5-16: Residential Structures Located Within 50 feet of the Project ROW

Town	Line	Residences within 50ft
Auburn	E5/F6 Lines	28
Leicester	E5/F6 Lines	35
Leverett	E5/F6 Lines	1
Millbury	E5/F6 Lines	26
North Brookfield	E5/F6 Lines	3
Pelham	E5/F6 Lines	1
Shelburne	E5/F6 Lines	1
Spencer	E5/F6 Lines	17
Ware	E5/F6 Lines	14
West Brookfield	E5/F6 Lines	7
Total		**133**

In short, Gradient's modeling indicates that the Project will result in minor magnetic field increases along the E5/F6 ROW. The resulting post-Project magnetic field levels are unusually low for a transmission line ROW and are well below both the ICNIRP health-based guidelines of 2,000 mG for allowable public exposure to 60-Hertz ("Hz") MF. Finally, public exposure to magnetic fields is minimized by the generally rural location of the Project.

5.4.12.2 Electric Fields

Table 5-17 summarizes electric field modeling for both annual average and system peak loading scenarios. As shown in Table 5-17, pre-Project and post-Project modeled electric field ("EF") values at the ROW edges are well below the ICNIRP health-based guideline of 4.2 kilovolt per meter ("kV/m") for all modeled cases. Because EFs are not dependent on conductor loading (i.e., current), only negligible differences in EFs were obtained for annual average and system peak load levels for the post-Project 69 kV operation of the two circuits due to small differences in voltages of the E5 and F6 circuits that were provided by National Grid for the two-line loading scenarios. Because EFs are dependent on voltage, higher EFs were obtained for the post-Project 115 kV operation of the two circuits as compared to the post-Project 69 kV operation. For the 69 kV modeling cases, our modeling analysis indicates that the Project will frequently result in negligible changes to EFs at the ROW edges that are less than 0.02 kV/m, and a maximum edge-of-ROW increase of 0.50 kV/m. For the 115 kV modeling cases, there are some slightly larger changes in EFs at the ROW edges (ranging from -0.05 kV/m up to 0.86 kV/m), although edge-of-ROW EF levels remain low overall (all <0.9 kV/m).

Table 5-17: Summary of Modeled Pre-Project and Post-Project Edge-of-ROW Electric Field Values for the Representative ROW Cross Sections

Representative Cross Section	ROW Segment	Line Loading Scenario	Electric Field (kV/m)					
			Left Edge-of-ROW			Right Edge-of-ROW		
			Pre-Project	Post-Project (69-kV)	Post-Project (115-kV)	Pre-Project	Post-Project (69-kV)	Post-Project (115-kV)
Cross Section 1 (D-13148-NE sh. 1)	From Deerfield No. 4 Substation	Ann. Avg.	0.01	0.05	0.09	0.61	0.60	0.61
		Sys. Pk.	0.03	0.06	0.09	0.62	0.62	0.63
Cross Section 2 (D-13148-NE sh. 2)	From Deerfield 4 to Deerfield 3 Tap	Ann. Avg.	0.03	0.05	0.08	0.03	0.04	0.06
		Sys. Pk.	0.03	0.05	0.08	0.03	0.04	0.06
	From Deerfield 3 Tap to Deerfield 2	Ann. Avg.	0.03	0.05	0.08	0.03	0.04	0.06
		Sys. Pk.	0.03	0.05	0.08	0.03	0.04	0.06
	From Deerfield 2 to Shutesbury	Ann. Avg.	0.03	0.05	0.08	0.03	0.04	0.06
		Sys. Pk.	0.03	0.05	0.08	0.03	0.04	0.06
	From Shutesbury to Quabbin Switch Tap	Ann. Avg.	0.03	0.05	0.08	0.03	0.04	0.06
		Sys. Pk.	0.03	0.05	0.08	0.03	0.04	0.06
	From Quabbin Switch Tap to Ware	Ann. Avg.	0.03	0.04	0.07	0.02	0.03	0.06
		Sys. Pk.	0.03	0.04	0.07	0.02	0.03	0.06
	From Ware to Lashaway	Ann. Avg.	0.02	0.04	0.08	0.02	0.04	0.06
		Sys. Pk.	0.02	0.04	0.08	0.03	0.04	0.06
	From Lashaway to Harrington St	Ann. Avg.	0.04	0.05	0.08	0.04	0.05	0.07
		Sys. Pk.	0.03	0.05	0.08	0.04	0.04	0.07
	From Harrington St to Meadow St	Ann. Avg.	0.03	0.05	0.08	0.04	0.04	0.07
		Sys. Pk.	0.03	0.05	0.08	0.03	0.04	0.07
	From Meadow St to Leicester	Ann. Avg.	0.03	0.05	0.08	0.03	0.04	0.06
		Sys. Pk.	0.03	0.05	0.08	0.03	0.04	0.06
	From Leicester to Pondville	Ann. Avg.	0.03	0.05	0.08	0.03	0.04	0.06
		Sys. Pk.	0.03	0.05	0.08	0.03	0.04	0.06
	From Pondville to Millbury	Ann. Avg.	0.02	0.04	0.08	0.02	0.03	0.06
		Sys. Pk.	0.02	0.04	0.07	0.02	0.03	0.06
Cross Section 3 (D-13148-NE sh. 3)	Deerfield 3 Tap	Ann. Avg.	0.12	0.30	0.50	0.12	0.30	0.50
		Sys. Pk.	0.12	0.30	0.50	0.12	0.30	0.50
Cross Section 4 (D-13148-NE sh. 4)	Quabbin Switch Tap	Ann. Avg.	0.17	0.08	0.13	0.33	0.27	0.44
		Sys. Pk.	0.17	0.08	0.13	0.33	0.26	0.44
Cross Section 5 (D-13148-NE sh. 5)	From Harrington St to Meadow St	Ann. Avg.	0.03	0.07	0.09	0.39	0.39	0.39
		Sys. Pk.	0.01	0.06	0.09	0.39	0.39	0.39
Cross Section 6 (D-13148-NE sh. 6)	From Deerfield 2 to Shutesbury	Ann. Avg.	0.03	0.44	0.73	0.04	0.54	0.90
		Sys. Pk.	0.03	0.44	0.73	0.04	0.53	0.89
Cross Section 7 (D-13148-NE sh. 7)	From Deerfield 2 to Shutesbury	Ann. Avg.	0.03	0.30	0.50	0.02	0.30	0.50
		Sys. Pk.	0.03	0.29	0.49	0.02	0.30	0.49
Cross Section 8 (D-13148-NE sh. 8)	From Deerfield 2 to Shutesbury	Ann. Avg.	0.07	0.36	0.61	0.03	0.03	0.05
		Sys. Pk.	0.07	0.36	0.60	0.03	0.03	0.05
	From Shutesbury to Quabbin Switch Tap	Ann. Avg.	0.07	0.36	0.61	0.03	0.03	0.05
		Sys. Pk.	0.07	0.36	0.60	0.03	0.03	0.05

Notes: Ann. Avg. = Annual Average; kV = Kilovolt; kV/m = Kilovolts per Meter; ROW = Right-of-Way; Sh. = Sheet; Sys. Pk. = System Peak.

5.4.12.3 Substations

The EMF modeling results for the representative overhead transmission line cross sections are informative with respect to EMF levels in the vicinity of substations along the Project Route. This is because it is well-established that the transmission and distribution lines entering and leaving substations are generally a stronger source of EMFs outside the fence lines of substations than the electrical equipment within substations (IEEE, 2014).[34] For substation buswork and other electrical equipment (e.g., transformers, switchgear), conductors are typically arranged in very close proximity to each other, resulting in the rapid decay of EMF levels inside substation fence lines.

Based on the pre-Project and post-Project edge-of-ROW MF for the representative ROW cross sections for annual average load levels and for systemic peak load levels provided in Table 5-14 and 5-15 above (Table 1.1 and Table 1.2 in Appendix 5-5), Tables 5-18 and Table 5-19 below summarize the magnetic field modeling results representative of pre-Project and post-Project MF levels at the ROW edges in the vicinity of substations along the E5/F6 Lines for the annual average and system peak loading scenarios, respectively. In addition, based on the summary of modeled pre-Project and post-Project edge-of-ROW EF values for the representative ROW cross sections provided in Table 1.3 in Appendix 5-5, Tables 5-20 and Table 5-21 below summarize the EF modeling results representative of pre-Project and post-Project EF levels at the ROW edges in the vicinity of substations along the Project Route.

[34] Institute of Electrical and Electronics Engineers, Inc. (IEEE). 2014. "IEEE Guide for the Design, Construction, and Operation of Electric Power Substations for Community Acceptance and Environmental Compatibility." IEEE 1127 - 2013. 50p.

Table 5-18: Summary of Modeled Pre-Project and Post-Project Magnetic Fields Representative of ROW Edges in the Vicinity of Substations Along the Project Route: Annual Average Loading Scenario

Substation	Representative Cross Section	Magnetic Field (mG)					
		Left Edge-of-ROW			Right Edge-of-ROW		
		Pre-Project	Post-Project (69 kV)	Post-Project (115 kV)	Pre-Project	Post-Project (69 kV)	Post-Project (115 kV)
Millbury 305 Substation	Ahead Span: Cross Section 2 (D-13148-NE sh. 2)	0.55	0.70	0.98	0.59	0.57	1.01
Pondville Substation	Back Span: Cross Section 2 (D-13148-NE sh. 2)	0.55	0.70	0.98	0.59	0.57	1.01
	Ahead Span: Cross Section 2 (D-13148-NE sh. 2)	0.80	1.32	1.74	0.85	0.96	1.35
Leicester Substation	Back Span: Cross Section 2 (D-13148-NE sh. 2)	0.80	1.32	1.74	0.85	0.96	1.35
	Ahead Span: Cross Section 2 (D-13148-NE sh. 2)	0.81	1.33	1.75	0.86	0.97	1.36
Meadow Street Substation	Back Span: Cross Section 2 (D-13148-NE sh. 2)	0.81	1.33	1.75	0.86	0.97	1.36
	Ahead Span: Cross Section 5 (D-13148-NE sh. 5)	1.88	2.79	2.70	0.70	0.68	0.63
Harrington Switchyard Substation	Back Span: Cross Section 2 (D-13148-NE sh. 2)	1.76	2.61	2.52	0.97	0.93	0.97
	Ahead Span: Cross Section 2 (D-13148-NE sh. 2)	1.95	2.84	2.65	1.18	1.10	0.87
Lashaway Substation	Back Span: Cross Section 2 (D-13148-NE sh. 2)	1.95	2.84	2.65	1.18	1.10	0.87
	Ahead Span: Cross Section 2 (D-13148-NE sh. 2)	0.75	1.38	1.78	1.94	2.14	2.09
Ware Substation	Back Span: Cross Section 2 (D-13148-NE sh. 2)	0.75	1.38	1.78	1.94	2.14	2.09
	Ahead Span: Cross Section 2 (D-13148-NE sh. 2)	0.56	0.64	1.16	2.16	2.33	2.26
Quabbin Substation	For Tap: Cross Section 4 (D-13148-NE sh. 4)	1.56	4.08	2.43	1.20	3.37	2.01
Deerfield 3 Substation	For Tap: Cross Section 3 (D-13148-NE sh. 3)	0.34	0.87	0.52	0.10	0.29	0.17
Deerfield 4 Substation	For Tap: Cross Section 1 (D-13148-NE sh. 1)	1.07	2.11	2.53	2.86	3.15	4.53

Notes: kV = Kilovolt; mG = Milligauss; ROW = Right-of-Way; sh. = Sheet.

Table 5-19: Summary of Modeled Pre-Project and Post-Project Magnetic Fields Representative of ROW Edges in the Vicinity of Substations Along the Project Route: System Loading Scenario

Substation	Representative Cross Section	Magnetic Field (mG)					
		Left Edge-of-ROW			Right Edge-of-ROW		
		Pre-Project	Post-Project (69 kV)	Post-Project (115 kV)	Pre-Project	Post-Project (69 kV)	Post-Project (115 kV)
Millbury 305 Substation	Ahead Span: Cross Section 2 (D-13148-NE sh. 2)	0.69	0.88	1.34	0.57	0.61	1.45
Pondville Substation	Back Span: Cross Section 2 (D-13148-NE sh. 2)	0.69	0.88	1.34	0.57	0.61	1.45
	Ahead Span: Cross Section 2 (D-13148-NE sh. 2)	1.00	1.73	2.49	0.97	1.19	1.90
Leicester Substation	Back Span: Cross Section 2 (D-13148-NE sh. 2)	1.00	1.73	2.49	0.97	1.19	1.90
	Ahead Span: Cross Section 2 (D-13148-NE sh. 2)	1.00	1.74	2.50	0.98	1.20	1.91
Meadow Street Substation	Back Span: Cross Section 2 (D-13148-NE sh. 2)	1.00	1.74	2.50	0.98	1.20	1.91
	Ahead Span: Cross Section 5 (D-13148-NE sh. 5)	1.25	2.34	2.96	1.52	2.09	2.11
Harrington Switchyard Substation	Back Span: Cross Section 2 (D-13148-NE sh. 2)	1.15	2.15	2.73	2.21	2.88	2.95
	Ahead Span: Cross Section 2 (D-13148-NE sh. 2)	2.58	3.77	3.70	1.39	1.16	1.26
Lashaway Substation	Back Span: Cross Section 2 (D-13148-NE sh. 2)	2.58	3.77	3.70	1.39	1.16	1.26
	Ahead Span: Cross Section 2 (D-13148-NE sh. 2)	1.18	2.11	2.73	2.19	2.43	2.66
Ware Substation	Back Span: Cross Section 2 (D-13148-NE sh. 2)	1.18	2.11	2.73	2.19	2.43	2.66
	Ahead Span: Cross Section 2 (D-13148-NE sh. 2)	0.82	1.05	1.96	3.46	3.74	3.62
Quabbin Substation	For Tap: Cross Section 4 (D-13148-NE sh. 4)	2.25	5.89	3.52	1.73	4.87	2.91
Deerfield 3 Substation	For Tap: Cross Section 3 (D-13148-NE sh. 3)	0.67	1.75	1.05	0.20	0.58	0.35
Deerfield 4 Substation	For Tap: Cross Section 1 (D-13148-NE sh. 1)	1.75	3.26	3.90	4.14	4.23	2.59

Notes: kV = Kilovolt; mG = Milligauss; ROW = Right-of-Way; sh. = Sheet.

Table 5-20: Summary of Modeled Pre-Project and Post-Project Electric Fields Representative of ROW Edges in the Vicinity of Substations Along the Project Route: Annual Average Loading Scenario

Substation	Representative Cross Section	Electric Field (kV/m)					
		Left Edge-of-ROW			Right Edge-of-ROW		
		Pre-Project	Post-Project (69 kV)	Post-Project (115 kV)	Pre-Project	Post-Project (69 kV)	Post-Project (115 kV)
Millbury 305 Substation	Ahead Span: Cross Section 2 (D-13148-NE sh. 2)	0.02	0.04	0.08	0.02	0.03	0.06
Pondville Substation	Back Span: Cross Section 2 (D-13148-NE sh. 2)	0.02	0.04	0.08	0.02	0.03	0.06
	Ahead Span: Cross Section 2 (D-13148-NE sh. 2)	0.03	0.05	0.08	0.03	0.04	0.06
Leicester Substation	Back Span: Cross Section 2 (D-13148-NE sh. 2)	0.03	0.05	0.08	0.03	0.04	0.06
	Ahead Span: Cross Section 2 (D-13148-NE sh. 2)	0.03	0.05	0.08	0.03	0.04	0.06
Meadow Street Substation	Back Span: Cross Section 2 (D-13148-NE sh. 2)	0.03	0.05	0.08	0.03	0.04	0.06
	Ahead Span: Cross Section 5 (D-13148-NE sh. 5)	0.03	0.07	0.09	0.39	0.39	0.39
Harrington Switchyard Substation	Back Span: Cross Section 2 (D-13148-NE sh. 2)	0.03	0.05	0.08	0.04	0.04	0.07
	Ahead Span: Cross Section 2 (D-13148-NE sh. 2)	0.04	0.05	0.08	0.04	0.05	0.07
Lashaway Substation	Back Span: Cross Section 2 (D-13148-NE sh. 2)	0.04	0.05	0.08	0.04	0.05	0.07
	Ahead Span: Cross Section 2 (D-13148-NE sh. 2)	0.02	0.04	0.08	0.02	0.04	0.06
Ware Substation	Back Span: Cross Section 2 (D-13148-NE sh. 2)	0.02	0.04	0.08	0.02	0.04	0.06
	Ahead Span: Cross Section 2 (D-13148-NE sh. 2)	0.03	0.04	0.07	0.02	0.03	0.06
Quabbin Substation	For Tap: Cross Section 4 (D-13148-NE sh. 4)	0.17	0.08	0.13	0.33	0.27	0.44
Deerfield 3 Substation	For Tap: Cross Section 3 (D-13148-NE sh. 3)	0.12	0.30	0.50	0.12	0.30	0.50
Deerfield 4 Substation	For Tap: Cross Section 1 (D-13148-NE sh. 1)	0.01	0.05	0.09	0.61	0.60	0.61

Notes: kV = Kilovolt; kV/m = Kilovolts per Meter; ROW = Right-of-Way; sh. = Sheet.

Table 5-21: Summary of Modeled Pre-Project and Post-Project Electric Fields Representative of ROW Edges in the Vicinity of Substations Along the Project Route: System Peak Loading Scenario

Substation	Representative Cross Section	Electric Field (kV/m)					
		Left Edge-of-ROW			Right Edge-of-ROW		
		Pre-Project	Post-Project (69 kV)	Post-Project (115 kV)	Pre-Project	Post-Project (69 kV)	Post-Project (115 kV)
Millbury 305 Substation	Ahead Span: Cross Section 2 (D-13148-NE sh. 2)	0.02	0.04	0.07	0.02	0.03	0.06
Pondville Substation	Back Span: Cross Section 2 (D-13148-NE sh. 2)	0.02	0.04	0.07	0.02	0.03	0.06
	Ahead Span: Cross Section 2 (D-13148-NE sh. 2)	0.03	0.05	0.08	0.03	0.04	0.06
Leicester Substation	Back Span: Cross Section 2 (D-13148-NE sh. 2)	0.03	0.05	0.08	0.03	0.04	0.06
	Ahead Span: Cross Section 2 (D-13148-NE sh. 2)	0.03	0.05	0.08	0.03	0.04	0.06
Meadow Street Substation	Back Span: Cross Section 2 (D-13148-NE sh. 2)	0.03	0.05	0.08	0.03	0.04	0.06
	Ahead Span: Cross Section 5 (D-13148-NE sh. 5)	0.01	0.06	0.09	0.39	0.39	0.39
Harrington Switchyard Substation	Back Span: Cross Section 2 (D-13148-NE sh. 2)	0.03	0.05	0.08	0.03	0.04	0.07
	Ahead Span: Cross Section 2 (D-13148-NE sh. 2)	0.03	0.05	0.08	0.04	0.04	0.07
Lashaway Substation	Back Span: Cross Section 2 (D-13148-NE sh. 2)	0.03	0.05	0.08	0.04	0.04	0.07
	Ahead Span: Cross Section 2 (D-13148-NE sh. 2)	0.02	0.04	0.08	0.03	0.04	0.06
Ware Substation	Back Span: Cross Section 2 (D-13148-NE sh. 2)	0.02	0.04	0.08	0.03	0.04	0.06
	Ahead Span: Cross Section 2 (D-13148-NE sh. 2)	0.03	0.04	0.07	0.02	0.03	0.06
Quabbin Substation	For Tap: Cross Section 4 (D-13148-NE sh. 4)	0.17	0.08	0.13	0.33	0.26	0.44
Deerfield 3 Substation	For Tap: Cross Section 3 (D-13148-NE sh. 3)	0.12	0.30	0.50	0.12	0.30	0.50
Deerfield 4 Substation	For Tap: Cross Section 1 (D-13148-NE sh. 1)	0.03	0.06	0.09	0.62	0.62	0.63

Notes: kV = Kilovolt; kV/m = Kilovolts per Meter; ROW = Right-of-Way; sh. = Sheet.

5.4.12.4 Conclusion

Gradient's EMF modeling analysis demonstrated that all model-predicted, post-Project MF levels for the representative cross sections, including for both annual average and system peak load levels, are well below the ICNIRP health-based guideline for allowable public exposure to 60 Hz MF (2,000 mG; ICNIRP, 2010). Due in part to the higher post-Project load levels for both the E5 and F6 Lines, for the 115 kV operation case, the Project will generally result in small increases to edge-of-ROW MF levels for the representative cross sections (frequently less than 1 mG and less than 1-2 mG for annual average and system peak load levels, respectively). The EMF modeling analysis also showed that, for the representative cross sections, all model-predicted, post-Project

edge-of-ROW EF levels are well below the ICNIRP health-based guideline for allowable public exposure to 60-Hz EF (4.2 kV/m; ICNIRP, 2010). The modeling analysis indicates that the Project will result in only small changes to EFs at the ROW edges across the modeling results (i.e., all edge-of-ROW EF changes were less than 0.5 kV/m and less than 0.9 kV/m for the post- Project 69 kV and 115 kV operating cases, respectively). Modeled EMF levels are both far below relevant health-based standards.

5.4.13 Climate Change Considerations

This Project is part of NEP's efforts to ensure the long-term longevity and reliability of the region's electrical infrastructure in the face of growing demand for electricity and the changing climate. The Project will result in a more climate-ready and resilient transmission system that can withstand more extreme weather events; address existing system capacity shortages and increased demand; and support future interconnection of renewable energy projects.

The increased capacity of the Rebuilt Lines and Taps will support higher volumes of currently active and forecasted renewable energy resources in this region. This longer-term view aligns with the State Hazard Mitigation & Climate Adaptation Plan, which projects electricity consumption during summer may triple, as well as results of the ISO-NE 2050 Transmission Study, which point to a long-term need for additional capacity across the New England transmission system to support long term electric load growth driven by regional commitments for renewable and clean energy, greenhouse gas ("GHG") reduction, and net-zero carbon policies.

NEP consulted the Resilient MA Action Team Climate Resilience Design Standards Tool ("the Tool") for the Project. The Tool assigns climate risks based on three variables: sea level rise and storm surge, extreme precipitation including urban flooding and riverine flooding, and extreme heat. According to the preliminary analysis, the Project Route is at high risk from extreme/moderate precipitation and extreme heat. It is not exposed to sea level rise/storm surge. The Rebuilt Lines and Taps will be made more resilient through installation of concrete caisson foundations, steel structures, and state of the art conductors that respond well to corrosion and operate at higher maximum operating temperatures. Further, the Project's engineering design used structure loading criteria required by the NESC, 220 CMR 125, and National Grid Design Loads for Overhead Transmission Structures. The NESC load criteria require consideration of combined ice and wind district loading, extreme wind conditions, and extreme ice with concurrent wind conditions. Local compensatory flood storage will be provided in accordance with local and state regulations for any proposed fill in Bordering Land Subject to Flooding ("BLSF").

Together, the Rebuilt Lines and Taps contribute to regional climate resilience by providing capacity to meet the region's growing energy demand, reducing the frequency of outages, and incorporating provisions such as enhanced ROW access and modernized transmission line switches, which should reduce response times, shortening the duration of outages when they do occur.

5.4.14 Environmental Justice Considerations

This section reviews the Company's efforts to identify and engage with EJ populations within the Project's designated geographic area ("DGA"), along with the potential impacts to these EJ communities. The Project has a DGA of a one-mile radius of the Project Route. EJ communities within the one-mile radius of the Project are depicted in the Map Book under Environmental

Justice Maps in Appendix 5-1. NEP is developing and implementing this Project consistent with the Commonwealth's environmental and resource use laws and policies, including enhancing opportunities for public involvement. NEP aims to promote a robust transmission system and to properly plan for and address the Commonwealth's energy needs in an efficient and timely way. NEP has taken proactive steps to enhance community involvement and engagement during the planning of the Project.

As part of its stakeholder outreach plan, NEP has promoted and will continue to promote public involvement by the EJ populations located within one mile of the Project Route through the use and dissemination of Project fact sheets, website content, and meeting invitations. No populations within the DGA are classed as being linguistically isolated. Therefore, Project information is being provided in English, with an opportunity to request translations, as necessary. Based on review of the Massachusetts EJ Populations Mapping Tool, there are 19 EJ populations within one mile of the Project, distributed in 13 municipalities, as described in Table 5-22 (below). Of these populations, only four overlap or are within proximity of the ROWs (shaded in blue and bolded in the table below). Out of the 67 miles of Project ROW, only 4.6 miles ROW are within an EJ population. Table 5-22 lists the EJ populations in the vicinity of the Project Route.

Table 5-22: Environmental Justice Populations within One Mile of the Project Route[35]

Municipality	Block Group, Census Tract, County
Amherst	Block Group 1, Census Tract 8203, Hampshire County
Amherst	Block Group 1, Census Tract 8207, Hampshire County
Auburn	Block Group 3, Census Tract 7365, Worcester County
Buckland	Block Group 3, Census Tract 415.02, Franklin County
Charlemont	Block Group 4, Census Tract 401, Franklin County
Hardwick	Block Group 2, Census Tract 7231, Worcester County
Leicester	**Block Group 3, Census Tract 7352, Worcester County**
Millbury	**Block Group 2, Census Tract 7372, Worcester County**
Millbury	Block Group 1, Census Tract 7372, Worcester County
North Brookfield	Block Group 3, Census Tract 7251, Worcester County
Shelburne	**Block Group 4, Census Tract 415.02, Franklin County**
Spencer	Block Group 3, Census Tract 7262, Worcester County
Spencer	Block Group 4, Census Tract 7262, Worcester County
Sunderland	Block Group 2, Census Tract 408, Franklin County
Sunderland	Block Group 3, Census Tract 408, Franklin County
Sunderland	**Block Group 4, Census Tract 408, Franklin County**
Ware	Block Group 2, Census Tract 8201.02, Hampshire County
Ware	Block Group 3, Census Tract 8201.02, Hampshire County
West Brookfield	Block Group 3, Census Tract 7241, Worcester County

The Project is predominantly proposed within the existing ROW, thereby minimizing adverse environmental impacts. Due to the nature of the Project, outage constraints in the region, and NEP's efforts to reduce impacts to the natural and human environment, Project activities will be

[35] Table contains revised block groups since the filing of the EENF based on the updated Massachusetts 2020 Environmental Justice Population Interactive Map (Updated November 2022). https://mass-eoeea.maps.arcgis.com/apps/webappviewer/index.html?id=1d6f63e7762a48e5930de84ed4849212

sequenced. No long-term impacts to soil, bedrock, vegetation, surface water, groundwater, wetland resources, or air quality will occur. Construction-period activities, such as grading, road building, vehicle travel, and other earth-disturbing work may result in a temporary increase in airborne dust. Fugitive dust is generated during demolition, construction, and site preparation activities, such as the movement of vehicles, stockpiling of soil, and construction traffic, and placement of construction matting in the site. Impacts to air quality will be minimized by managing the control of dust movement with practices such as spreading wood mulch or straw and using water trucks to spray dried soil to keep it moist. The potential for dust generation is only anticipated during the construction period. Post construction, soil will be stabilized and re-vegetated.

NEP will be implementing measures to avoid, minimize, and mitigate potential environmental impacts throughout the entire Lines, including where it crosses through or is within one mile of mapped EJ populations. These include, but are not limited to, use of construction matting in wetlands to reduce soil disturbance and protect water quality, as well as implementation of the SWPPP to avoid impacts to receiving waters from sediment laden stormwater runoff or from spills or other inadvertent releases of fuels, oils, or other hazardous materials used in equipment or as incidental use during construction.

Because the nature and severity of Project impacts are minimal on all populations, including EJ populations, the Project will not materially exacerbate any existing unfair or inequitable environmental or public health burden impacting the EJ population. Overall, the Project will improve transmission system infrastructure and comply with comprehensive regional plans for maintaining electric transmission reliability in New England, for EJ and non-EJ populations alike.

The Company will continue outreach to EJ community members during the permitting and development phases of the Project to support participation by the EJ community.

5.4.15 Conclusion – Environmental Impacts

The preceding sections have reviewed the environmental and community impacts associated with the Project, including those related to land use, protected land and open space, historical/archeological sites, tree removal, wetlands and water crossings, rare species habitat, public water supplies, visual, noise, traffic, and EMF. In addition, these sections have addressed climate change considerations and the potential for impacts to EJ populations. Since the Project Route is aligned along the existing E5/F6 Line and Tap ROWs, which have been operated and maintained by NEP for decades, permanent impacts to abutters and communities have been minimized. Construction related impacts will be mitigated through use of BMPs, which will be designed and implemented in compliance with federal, state, and local rules and regulations.

5.5 Project Cost

INEP estimates that the total cost of rebuilding the Existing Lines and Taps is approximately $896.9 million. This estimate is provided with an assumed accuracy level of –25%/+50%.

5.6 Conclusion

The Project will provide a reliable and resilient energy supply for the Commonwealth with minimum impact on the environment at the lowest possible cost. Therefore, NEP concludes that, consistent with the Siting Board's statutory mandate, the construction of the Project along the

Project Route properly minimizes environmental impacts and achieves an appropriate balance among conflicting environmental concerns, as well as among environmental impacts, cost, and reliability.

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6 CONSISTENCY WITH THE CURRENT HEALTH, ENVIRONMENTAL PROTECTION, AND RESOURCE USE AND DEVELOPMENT POLICIES OF THE COMMONWEALTH

6.1 Introduction

Pursuant to G.L. c. 164, § 69J, the Siting Board shall approve a petition to construct a facility only if it determines that the plans for the applicant's new facilities are consistent with current health, environmental protection, and resource use and development policies of the Commonwealth. As discussed below and in more detail throughout this Application, the Project not only satisfies the requirements of this standard, but is also fully consistent with other important state energy laws and policies, such as the Electric Utility Restructuring Act of 1997 (the "Restructuring Act"), the Green Communities Act (c. 169 of the Acts of 2008), the Global Warming Solutions Act (c. 298 of the Acts of 2008) (the "GWSA"), the Energy Diversity Act (c. 188 of the Acts of 2016), the Clean Energy Act (c. 227 of the Acts of 2018), An Act Creating a Next Generation Roadmap for Massachusetts Climate Policy (c. 8 of the Acts of 2021) (the "Roadmap Act"), and An Act Driving Clean Energy and Offshore Wind (St. 2022, c. 179) (the "Drive Act"). See, e.g., Conservation Law Foundation v. Energy Facilities Siting Board, 494 Mass. 594 (2024); GreenRoots, Inc. v. Energy Facilities Siting Board, 490 Mass. 747 (2022); Town of Sudbury v. Energy Facilities Siting Board, 487 Mass. 737 (2021).

6.2 Health Policies

The Project will be consistent with applicable health policies of the Commonwealth. The Restructuring Act provides that "reliable electric service is of the utmost importance to the safety, health and welfare of the [C]ommonwealth's citizens and economy." See Restructuring Act § 1(h). The Legislature has expressly determined that an adequate and reliable supply of energy is critical to the state's citizens and economy and the Massachusetts Supreme Judicial Court (the "SJC") has affirmed these principles provided in the Restructuring Act, noting that "State law makes it clear that the residents of the Commonwealth simply cannot be exposed to foreseeable and avoidable power outages." Sudbury, 487 Mass. at 748. The Project will be fully consistent with this tenet of the Restructuring Act. As discussed herein, the Project will enhance and ensure the reliability of the Company's interconnected electric transmission and distribution system that is served by the Rebuilt Lines by replacing the existing transmission lines, which are subject to frequent outages, with new higher-capacity lines, thus ensuring the availability of sufficient and reliable electric service to the citizens and businesses of the Commonwealth and the region.

In addition, the Company will design, build, and maintain the Project so that the health and safety of the public are protected. Throughout the construction and operation of the Project, the Company will adhere to all applicable federal, state, and local regulations, and industry standards and guidelines established for protection of the public. As discussed in *Section 5,* all design, construction, and operational activities will comply with applicable governmental and industry standards, such as the Massachusetts Code for the Installation and Maintenance of Electric Transmission Lines (220 C.M.R. §§ 125.00 et seq.) and the NESC and OSHA regulations and will have no adverse health effects. The Project will be designed in accordance with sound engineering

practices using established design codes and guidelines published by, among others, the DPU, the Institute of Electrical and Electronic Engineers, the American Society of Civil Engineers, the American Concrete Institute, and the American National Standards Institute.

In sum, because the Project will be consistent with and promote the Commonwealth's energy policies as outlined in the Restructuring Act, and because reliable electric service is of "utmost importance to the safety, health and welfare of the [C]ommonwealth's citizens and economy," the Project will also be consistent with the Commonwealth's health policies.

6.3 Environmental Protection Policies

The Company will obtain all environmental approvals and permits required by federal, state, and local agencies and will construct and operate the Project in full compliance with applicable federal, state, and municipal statutes, regulations, and environmental policies. Thus, the Project will contribute to a reliable, low cost, diverse energy supply for the Commonwealth while avoiding, minimizing, and mitigating environmental impacts to the maximum extent practicable.

6.3.1 The Restructuring Act

The Restructuring Act requires that the Company demonstrate that the Project minimizes environmental impacts consistent with the minimization of costs associated with avoidance, minimization, and mitigation of the environmental impacts of the Project. Accordingly, an assessment of all impacts of a proposed project is necessary to determine whether an appropriate balance is achieved both among conflicting environmental concerns as well as among environmental impacts, cost, and reliability. A project that achieves the appropriate balance meets the requirement in G.L.c. 164, § 69J to minimize environmental impacts at the lowest possible cost.

To determine if a petitioner has achieved the proper balance among environmental impacts, cost and reliability, the Siting Board first determines if the petitioner has provided sufficient information regarding environmental impacts and potential mitigation measures. The Siting Board then determines whether environmental impacts are avoided, minimized, and mitigated to the maximum extent possible. Similarly, the Siting Board evaluates whether the petitioner has demonstrated that the project is needed and has provided sufficient cost information in order to determine if the appropriate balance among environmental impacts, cost, and reliability has been achieved.

Sections 3, 4, and *5* demonstrate that the Company compared a range of alternative projects and potential route options, and proposed specific plans to avoid, minimize and mitigate environmental impacts associated with the construction, operation, and maintenance of the Rebuilt Lines, consistent with cost minimization. As such, the Project is consistent with the environmental policies of the Commonwealth as set forth in the Restructuring Act.

6.3.2 State and Local Environmental Policies

The Company will obtain all environmental approvals and permits required by federal, state and local agencies and the Project will be constructed and operated to comply fully with all applicable federal, state and local regulations and environmental policies. Thus, the Project will contribute to a reliable, low cost, diverse energy supply for the Commonwealth with minimal environmental

impact. By meeting the requirements for acquiring each of the requisite federal, state and local permits, the Project will be consistent with applicable state and local environmental policies. Table 6-1 identifies the anticipated permits, reviews, and approvals required for the Project. By meeting the requirements for acquiring each of these federal, state, and local permits, the Project will comply with applicable state and local environmental policies.

Table 6-1: Required Federal, State and Local Permits

Agency	Permit	Status
FEDERAL		
USACE	Section 404 Pre-Construction Notification ("PCN") Permit and consultations under Section 106 of National Historic Preservation Act ("NHPA") and Section 7 of the Endangered Species Act	Targeted to be filed in October 2026
EPA	National Pollutant Discharge Elimination ("NPDES") System Construction General Permit ("CGP") Authorization, Clean Water Act, 33 U.S.C. §1251 et. seq.: General Permit for Stormwater Discharges and Construction Dewatering Activities/SWPPP	To be filed at least 14 days prior to the start of construction.
STATE		
DPU	G.L. c. 164, § 72, approval to construct and operate a transmission line ("Section 72 Petition")	NEP filed motions with the Siting Board and the Department requesting that the Section 72 Petition be referred to the Siting Board and consolidated for hearing with the Section 69J Petition.
Executive Office of Energy and Environmental Affairs ("EEA")	MEPA, 301 CMR 11.00	NEP filed the ENF on January 15th, 202536. Certificate on the ENF is anticipated to be issued on February 24th, 2025.
MassDEP	Section 401 of the Federal Clean Water Act (Water Quality Certificate); 314 CMR 9.00 Superseding Order of Condition 310 CMR 10.00 (Potential) Chapter 91 Waterways Notice of Minor Project Modification 310 CMR 9.00 (Potential)	Targeted to be filed in 2026.
MHC	Consultation under G.L. c. 9 in accordance with 950 CMR 70-71	Consultation with MHC is ongoing.
MassDOT	State Highway Access Permit (G.L. c.81 §21/G.L. c.85 § 2) Permits for crossing over state roads with utility lines.	In progress. Consultation with MassDOT is ongoing. Targeted to be filed in October 2026.
DCR	Construction Access Permit	In progress. Consultation with DCR is ongoing.

36 The ENF for the Project is provided as Appendix 6-1,

LOCAL		
Conservation Commissions in Auburn, Belchertown, Conway, Deerfield, East Brookfield, Leicester, Leverett, Millbury, North Brookfield, Pelham, Shelburne, Shutesbury, Spencer, Sunderland, Ware, and West Brookfield	Order of Conditions per the Massachusetts Wetland Protection Act ("MWPA")37 and local bylaws	Anticipated Summer/Fall 2026

6.3.3 The Green Communities Act

The Green Communities Act is a comprehensive, multi-faceted energy reform law that encourages energy and building efficiency, promotes renewable energy, creates green communities, implements elements of the Regional Greenhouse Gas Initiative (a program where Northeastern and Mid-Atlantic states cooperate to reduce GHG emissions) and provides market incentives and funding for various types of energy generation. The Green Communities Act (as amended and supplemented by St. 2012, c. 209, An Act Relative to Competitively Priced Electricity) has resulted in greater renewable supplies and substantial new conservation initiatives since enactment and continuing in future years.

The replacement of the Existing Line will strengthen and improve the reliability of the Company's transmission system. While the primary Project purpose is to meet that specific need, the more robust system will also enable the future integration of additional clean energy generated by renewables suppliers, expansion of electrification projects in the area, and will support increased usage of electric vehicles and the associated installation of electric charging stations, consistent with the Green Communities Act. The Project will meet the identified need in a reliable, cost-effective, and environmentally benign manner and therefore, is consistent with the Green Communities Act.

6.3.4 Global Warming Solutions Act and the Roadmap Act

The GWSA established aggressive GHG emissions reduction targets of 25 percent from 1990 levels by 2020 and 80 percent from 1990 levels by 2050. Pursuant to the GWSA, the Secretary of the EEA issued the Clean Energy and Climate Plan for 2020 in December 2010 and updated the plan in December 2015. Among other provisions, the GWSA requires administrative agencies such as the Siting Board to consider reasonably foreseeable climate change impacts (e.g., additional GHG emissions) and related effects (e.g., sea level rise) when considering and issuing permits. In April 2020, the Secretary of EEA established a 2050 statewide emissions limit of net zero GHG emissions (and in no event greater than 85% below 1990 levels). Further, in December 2020, the Secretary issued the Massachusetts 2050 Decarbonization Roadmap that calls for increased electrification (e.g., electric vehicles, electric home heating, new heat pump technologies), new local renewable resources (e.g., wind, solar and battery storage), and the delivery of power from remote clean energy resources, such as offshore wind.

[37] MWPA Orders of Conditions are local permits unless and until a superseding Order of Conditions is issued by MassDEP.

In 2021, the Roadmap Act codified commitment to net-zero emissions by 2050 and advances and extends the goals of the GWSA by establishing new interim goals for emissions reductions and authorizing a voluntary energy efficient building code for municipalities. The interim goals include: (1) by 2030, emissions must be 50% lower than they were in Massachusetts in 1990; and (2) by 2040, emissions must be 75% lower. The Roadmap Act also increases the required percentage of Massachusetts electricity that comes from renewable sources, requires an additional 2,400 MW of offshore wind, bringing the state's total renewable energy target to 5,600 MW, and improves access to solar power through a low-income services solar program trust.

Finally, the GWSA amended MEPA to require that agencies, departments, boards, commissions, and authorities, in considering and issuing permits, licenses, and other administrative approvals and decisions, consider reasonably foreseeable climate change impacts, including additional GHG emissions, and effects, such as predicted sea level rise. MEPA's GHG Emissions Policy and Protocol ("GHG Policy") requires that projects subject to MEPA quantify the project's GHG emissions and identify measures to avoid, minimize, or mitigate such emissions. The GHG Policy also requires proponents to quantify the impact of proposed mitigation in terms of emissions and energy savings.

GHG emissions from the Project will be below the applicable reporting threshold and, during the construction phase, short-term localized air quality effects will be minimal. On January 15, 2025, NEP submitted an Environmental Notification Form ("ENF") for the Project in accordance with MEPA. The certificate for the ENF is expected to be received by March 10th, 2025. The Company's adherence to the MEPA process demonstrates the Project's consistency with the requirements of the GWSA and the Roadmap Act.

NEP has taken steps to promote climate change adaptation and resiliency in the design of the Project and continues to consider climate change and long-term infrastructure resiliency as an important goal in its long-term infrastructure planning. The Project will result in a more climate-ready and resilient transmission system that can withstand more extreme weather events; address future increases in demand; and support future interconnections from renewable energy projects. In addition, the Project uses an existing ROW, thereby minimizing alteration of new land resources to construct the Project.

The system upgrades, as proposed, are intended to help ensure the long-term longevity and reliability of the region's electrical infrastructure in the face of growing demand and the changing climate. The Rebuilt Lines and the access route improvements will improve the resiliency of this energy infrastructure and provide high speed communications between substations, which will improve outage response times and help protect communities from outages during severe weather events.

The proposed Project has been designed to align with NEP's reliability goals and strategies by: (1) incorporating current design standards; (2) providing needed upgrades to existing electric transmission infrastructure; (3) providing the shortest project delivery time to meet the identified needs; (4) minimizing impacts to natural and social environments; and (5) providing a stronger electrical transmission system, vital to the public's safety, security, and economic prosperity.

The Project as designed will strengthen the regional transmission system and is consistent with both the Commonwealth's electric facility siting requirements and these future-state and local planning initiatives. Consequently, the Project is consistent with the GWSA and the Roadmap Act.

6.3.5 Energy Diversity and Clean Energy Acts

The Energy Diversity Act facilitates the procurement and integration of renewable energy generation resources, including new offshore wind energy generation, firm service hydroelectric generation, and a new class of renewable energy facilities that meet eligibility criteria. The Clean Energy Act amends the Energy Diversity Act to further encourage energy storage efforts and requires the Department of Energy Resources to investigate the potential for additional clean energy solicitations.

The Project will not only improve the reliability of the transmission system, but the Rebuilt Lines will also be able to accommodate future increased injections of renewable and other clean energy resources, such as new energy storage units, solar and wind. Accordingly, the Project is consistent with the Energy Diversity Act as amended by the Clean Energy Act.

6.3.6 Drive Act

The Drive Act includes several new climate change measures aimed at renewable energy and transportation sector GHG emissions and provides funding for offshore wind energy and electricity grid improvements and aims to bolster offshore wind industry by removing the price bidding cap. The law also increases offshore wind procurement to 5,600 MW and authorizes Massachusetts to join with other New England states when bidding for renewable energy projects, such as wind and solar. In addition, the Drive Act provides for the potential procurement of transmission infrastructure necessary to support the development of offshore wind generation for Massachusetts and the region. The Project is consistent with the Drive Act in that the Rebuilt Lines will be able to accommodate increased injections of renewable and other clean energy resources that may come online in the future.

6.4 Environmental Justice

The Roadmap Act includes several provisions that address the Commonwealth's EJ policies. See Conservation Law Foundation, 494 Mass. at 601; GreenRoots, Inc., 490 Mass. at 753. It requires the Secretary to direct EEA agencies, including the Siting Board, to consider EJ principles in making "any policy, determination or taking any other action related to a project review, or in undertaking any project pursuant to MEPA and related regulations that is likely to affect environmental justice populations." The Roadmap Act defines those EJ principles as including: (1) the meaningful involvement of all people with respect to the development, implementation and enforcement of environmental laws, regulations, and policies, including climate change policies; and (2) the equitable distribution of energy and environmental benefits and environmental burdens.

The Roadmap Act includes revisions to the MEPA review process and requires the Secretary to consider EJ principles during MEPA review to "reduce the potential for unfair or inequitable effects upon an environmental justice population." For projects subject to MEPA, the Roadmap Act requires an Environmental Impact Report ("EIR") for any project that is "likely to cause damage to the environment" and that is located within one mile of an EJ population (this distance is extended to five miles for a project that impacts air quality). The EIR must assess any existing unfair or inequitable environmental burden and related public health consequences impacting the EJ population from any prior or current operation or project that has damaged the environment. If such an assessment indicates an unfair or inequitable environmental burden or related health consequence, the EIR must also: (1) identify any environmental and public health impact from the

proposed project that would likely result in a disproportionate adverse effect on such population; and (2) potential impact or consequence from the proposed project that would increase or reduce the effects of climate change on the EJ population.

The Roadmap Act also requires the Secretary to provide opportunities for meaningful public involvement through the MEPA review process. Where an EJ population is present within the one-mile DGA (or five miles if the project impacts air quality), and lacks English language proficiency, the proponent is required to indicate on an ENF if the population is reasonably likely to be affected negatively by the project. In such cases, the Secretary must require additional measures to improve public participation by the EJ populations, including: (1) translating public notices, ENFs, EIRs, and other key documents related to the Secretary's review and decisions in languages spoken by a significant number of the affected EJ population; (2) providing interpretation services at public meetings where a significant portion of the affected EJ population lacks English language proficiency; (3) requiring public meetings be held in accessible locations that are near public transportation; (4) providing appropriate information about the project review procedure for a proposed project; and (5) establishing a local repository for project review documents. MEPA has promulgated updated regulations and issued protocol to implement the provisions of the Roadmap Act (MEPA Interim Protocol for Analysis of Project Impacts on Environmental Justice Populations and the MEPA Public Involvement Protocol for Environmental Justice Populations).

The Company has implemented all EJ requirements that are applicable to the Project. The Company has undertaken, and will continue to undertake, ongoing community outreach in EJ communities in or adjacent to the Project area to facilitate the meaningful opportunity to participate by all. There are 19 EJ block groups within one mile of the Project, distributed in 13 municipalities. Only four of these block groups overlap with or are adjacent to the ROWs. These populations meet the EJ criteria for minority, low-income, and minority and low-income: wherein at least 14% of households have a median household income 65% or less than the state median household income. The Company has taken measures to enhance public involvement by EJ populations and conducted a baseline assessment of any potential existing unfair or inequitable environmental burdens and related public health consequences impacting EJ populations. The Company facilitated meaningful participation of residents of the proximate EJ communities by encouraging participation in outreach activities and soliciting feedback from the neighborhoods the Project will traverse. As part of the stakeholder outreach plan, NEP has promoted and will continue to promote public involvement by the EJ populations located within one mile of the Project through the use and dissemination of Project fact sheets, website content, meeting invitations and translation services for future presentations if requested. All contacts on the EJ Reference List were provided Advanced Notification of the MEPA filling of the Project via the EJ Screening Form on November 26, 2024, which contained information on how to request a meeting or additional Project materials. The EJ Reference List and municipality administrators were also notified by email of a virtual community meeting held on December 19, 2024, and the community was notified via meeting advertisements in three newspapers: the *Worcester Telegram & Gazette*, the *Greenfield Recorder*, and *The Republican*. NEP presented the Project to the Town's Select Boards and hosted open houses for residents in the towns listed in Table 6-2 below. Three Towns did not respond to the offer of hosting select board meetings and were provided with a digital copy of the presentation instead. These towns included Deerfield, East Brookfield, and North Brookfield. Dates of these meetings are provided below in Table 6-2. Continued outreach to EJ communities will be consistent with the Roadmap Act and the rules and protocols promulgated thereunder.

Table 6-2: Select Board and Open House Meetings and Dates

Date	Municipality	Interaction Type
4-Dec-23	Shelburne	Selectboard Presentation
5-Dec-23	Leverett	Selectboard Presentation
11-Dec-23	Sunderland	Selectboard
18-Dec-23	Conway and Pelham	Select Board Presentation
13-Feb-24	Shutesbury	Select Board Presentation
26-Feb-24	Spencer	Board of Selectmen Presentation
3-Mar-24	Belchertown	Select Board Presentation
4-Mar-24	West Brookfield	Board of Selectmen Presentation
19-Mar-24	Ware	Selectboard Presentation
25-Mar-24	Auburn	Select Board Presentation
26-Mar-24	Millbury	Board of Selectmen Presentation
1-Apr-24	Leicester	Select Board Presentation
5-Jun-24	Sunderland, Leverett, and Deerfield	Open House
11-Jun-24	Shelburne and Conway	Open House
17-Jul-24	West Brookfield, East Brookfield, North Brookfield, and Spencer	Open House
26-Jun-24	Belchertown, Shutesbury, Pelham, and Ware	Open House
17-Sep-24	Millbury, Auburn, and Leicester	Open House

In addition to facilitating public involvement, NEP has designed the Project to minimize the Project's impacts to all populations, including EJ populations. The Project poses no inherent public safety or environmental risk to the communities along or adjacent to the Lines. All person, regardless of race or income, would experience these same impacts associated with the Project. The type of facilities proposed by the Company exist in virtually every community in the state, including within the Project area.

The Project is carefully designed to minimize impacts associated with wetlands, noise, traffic, air, EMFs, safety, hazardous waste, flooding, visual aesthetics, and other environmental considerations. The Project is proposed within the existing ROW, thereby minimizing adverse environmental impacts to both EJ and non-EJ populations. NEP will implement measures to avoid, minimize, and mitigate potential environmental impacts throughout the entire Project alignment, including where it crosses through or is within one mile of mapped EJ populations. Permanent impacts to abutters and communities have been minimized and construction related impacts will be mitigated through use of BMPs, which will be designed and implemented in compliance with federal, state, and local rules and regulations. For these reasons, none of the impacts of the Project will result in disproportionately high or adverse human health or environmental effects to either EJ or non-EJ populations in the area. Because the nature and severity of Project impacts are minimal on all populations, including EJ populations, the Project will not materially exacerbate any existing unfair or inequitable environmental or public health burden impacting the EJ population. Overall, the Project will improve transmission system infrastructure and comply with

comprehensive regional plans for maintaining electric transmission reliability in New England, for EJ and non-EJ populations alike.

Regarding the equitable distribution of energy and environmental benefits and environmental burdens, the energy and environmental benefits of the Project greatly outweigh the minimal impacts of the Project, even considering existing environmental burdens in the community. The Siting Board has previously stated that it views electric system reliability as an important energy benefit in its analysis of jurisdictional facilities. NSTAR Electric Company d/b/a Eversource Energy, Energy Facilities Siting Board ("EFSB") 22-01, at 160 (2022), affirmed Conservation Law Foundation, 494 Mass. at 602. To that end, the Project is needed to serve the electricity requirements of residents and businesses in the Project Area. Replacing the Existing Line, which is among the worst performing lines in the Company's system, with new, more resilient structures and conductors will improve the reliability of the electric system. In addition, the Project will allow for full participation in the electrification goals and the related objective of reducing emissions to offset the adverse effects of climate change, as set forth in the Commonwealth's 2050 Decarbonization objectives. Thus, from an energy resource perspective, the Project not only fully complies with the Roadmap Act and other statutory and regulatory policies, but it will contribute to advancing climate change and emission reduction initiatives and avoid a detrimental impact to the community and its residential and commercial inhabitants. A reliable electric supply is an essential need of society on which the health and welfare of citizens and the business interests of the Commonwealth are fundamentally dependent. See Town of Sudbury, 487 Mass. at 748 referencing St. 1997, c. 164, § (h) (Electric Utility Restructuring Act) ("reliable electric service is of utmost importance to the safety, health, and welfare of the commonwealth's citizens and economy"); St. 1997, c. 164, § 1 (a) ("electricity service is essential to the health and well-being of all residents of the commonwealth, to public safety, and to orderly and sustainable economic development"). The Project will ensure continued reliability of electric service in the Project area.

For all the foregoing reasons, the Project is consistent with the Commonwealth's EJ policies as codified in the Roadmap Act.

6.5 Resource Use and Development Policies

The Project, which will contribute to the long-term maintenance and reliability of the electric transmission system in the Project area and the region, will be constructed and operated in compliance with Massachusetts's policies regarding resource use and development. For example, in 2007, the EEA's Smart Growth/Smart Energy policy established the Commonwealth's Sustainable Development Principles, including: (1) supporting the revitalization of city centers and neighborhoods by promoting development that is compact, conserves land, protects historic resources and integrates uses; (2) encouraging remediation and reuse of existing sites, structures and infrastructure rather than new construction in undeveloped areas; and (3) protecting environmentally sensitive lands, natural resources, critical habitats, wetlands and water resources and cultural and historic landscapes. As described more fully in *Section 5*, the Project will support these principles because, among other reasons, the Rebuilt Lines will support the reliability of service to central Massachusetts, thereby supporting its revitalization and will not adversely affect environmentally sensitive lands because it will be predominantly located within previously disturbed parcels of land on an existing ROW.

Accordingly, the Project is in compliance with, and furthers, the Commonwealth's policies regarding resource use and development.

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Appendices

Application to Support the Petition before the Energy Facilities Siting Board

Central to Western Massachusetts Energy Improvement Project

Appendix 2-1: ISO-NE "2050 Transmission Study"

Appendix 2-2: NEP "Transmission System Impact Study Results for Group 3 of Distributed Energy Resources (DER) Additions in Western Massachusetts" ("Group 3 Cluster Study")

Appendix 2-1: ISO-NE “2050 Transmission Study”

2050 Transmission Study

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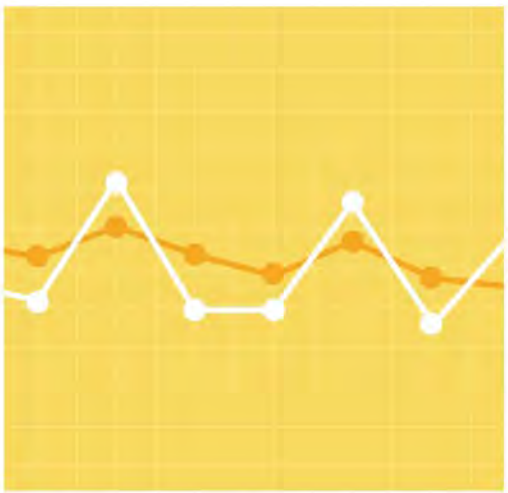
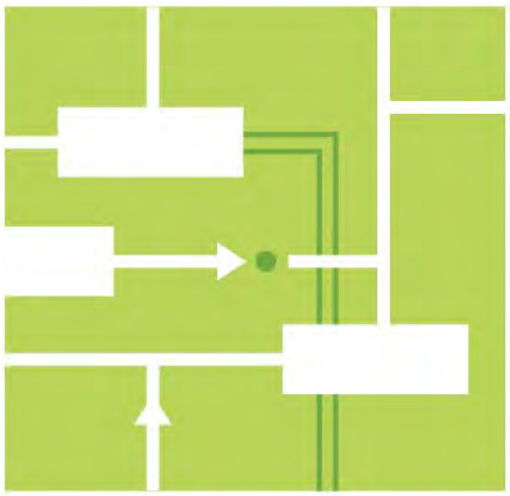
Transmission Planning

FEBRUARY 12, 2024

ISO-NE PUBLIC







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Section 1: Study Overview

The New England power system is in the midst of an unprecedented shift in the ways in which electricity is produced and consumed. Five of the six New England states have committed to reducing their carbon dioxide emissions by at least 80% by 2050, prompting ongoing changes in the grid's resource mix and the increased electrification of the heating and transportation sectors.[1] Driven largely by these statewide commitments, the grid continues its shift toward renewable resources like wind and solar photovoltaic (PV) generation. Over the next several decades, these renewable resources are expected to substantially displace natural gas-fired generation as the region's primary resource type. At the same time, increased electrification is expected to significantly increase overall consumer demand for electricity and drive changes in usage patterns that include seasonal and daily shifts in peak demand.

Among ISO New England's responsibilities as a Federal Energy Regulatory Commission (FERC)-authorized Regional Transmission Organization is ensuring the regional power system continues to operate reliably as system conditions change. Transmission planning helps to maintain system reliability and enhance the region's ability to support a robust, competitive wholesale power market by moving power from various internal and external sources to the region's load centers. This 2050 Transmission Study is a pioneering look at the ways in which the transmission system in New England may be affected by changes to the power grid, and includes roadmaps designed to assist stakeholders in their efforts to facilitate a smooth, reliable clean energy transition.

1.1 Study Background and Objectives

In October 2020, the New England States Committee on Electricity (NESCOE) released the New England States' Vision for a Clean, Affordable, and Reliable 21st Century Regional Electric Grid. This vision statement recommended that the ISO work with stakeholders to conduct a comprehensive long-term regional transmission study. This study, eventually titled the 2050 Transmission Study, would help inform stakeholders of the amount and type of transmission infrastructure necessary to provide reliable, cost-effective energy to the region throughout the clean energy transition.

> ***Who is NESCOE?*** *NESCOE is a not-for-profit entity that represents the collective perspective of the six New England Governors in regional electricity matters and advances the New England states' common interest in the provision of electricity to consumers at the lowest possible prices over the long-term, consistent with maintaining reliable service and environmental quality.*

In response to NESCOE's vision statement, the ISO revised Attachment K to the ISO New England Open Access Transmission Tariff to incorporate a new transmission planning process designed to look beyond the current 10-year planning horizon. The first phase of the effort established the rules that will allow New England states, through NESCOE, to request that the ISO perform longer-term scenario-based transmission planning studies, such as this one, on a routine basis. Changes to the ISO Tariff were approved by FERC in early 2022. The 2050 Transmission Study is the first example of its kind within New England.

[1] The six New England states are Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont. The five states with the emissions reduction goals described here are Connecticut, Maine, Massachusetts, Rhode Island, and Vermont.

The longer-term transmission study process is currently informational. The process does not include a formal mechanism for triggering the construction of a new transmission project. However, the ISO is currently discussing the second phase of the longer-term transmission study Tariff changes that will establish a process to enable the states, through NESCOE, to move policy-related transmission projects forward, with an associated cost allocation. This effort began at stakeholder meetings in October 2023, and will continue through early 2024.

1.1.1 Development of Study Objectives and Study-Specific Terms

In 2021, the ISO began coordination with NESCOE to develop objectives and assumptions for this study.

The 2050 Transmission Study has two main objectives:

- Determine the region's transmission needs in order to serve load while satisfying North American Electric Reliability Corporation (NERC), Northeast Power Coordinating Council (NPCC), and ISO reliability criteria.[2]
- Develop *roadmaps* for transmission upgrades designed to satisfy those needs while considering both the feasibility of construction and cost.

In this study, the term *roadmap* is intended as a high-level plan designed to show generally how transmission-related objectives can be accomplished. The roadmaps provided in this study are not intended as comprehensive or detailed plans for construction. They include:

- Conceptual projects specific to the input assumptions of the study.
- Concerns defined as *high-likelihood*; projects that address these concerns are considered useful to the region because they are less dependent on the specific locations of generation and supply to load.
- Lessons learned that can be applied to future long-term transmission studies.

1.1.2 Source of Study Inputs for the Future Scenarios Examined

The future scenarios envisioned by NESCOE included load forecasts and potential resource mixes for the years 2035, 2040, and 2050 that were based on the All Options Pathway in Massachusetts' Deep Decarbonization Roadmap report, published in December 2020. This Pathway was also used in the ISO's recent Future Grid Reliability Study Phase 1 (FGRS), referred to in FGRS as Scenario 3. This future scenario will be referred to in this report as the All Options Pathway.

The All Options Pathway provided two types of data input for the 2050 Transmission Study: 1) New England's expected hourly loads for all hours in a year for 2035, 2040, and 2050 and 2) renewable and conventional energy capacity for the same years. This data was combined with hourly wind and solar production data developed by an advisory firm, DNV, for various locations in New England to create year-round hourly profiles of renewable generation output.[3] Using this data, the ISO developed "snapshots" for the years studied, which combined load and resource profiles for contingency analysis. Contingencies are unexpected events that affect the flow of power on the transmission system, such as the loss of a transmission line, a transformer, or certain types of

[2] Load is defined as the demand for electricity measured in megawatts; electricity consumption; the amount of electric power delivered to any specified point on a system, accounting for the requirements of the customer's electrical equipment.

[3] For further details on the data set created by DNV, please see the "Variable Energy Resource (VER) Data" page on the ISO-NE website.

substation equipment. This contingency analysis was designed to test peak load boundary conditions, which represent the most extreme or severe cases of combined load and renewable resource output that could realistically be expected to occur. An example of a boundary condition would be a particularly cold winter peak hour, corresponding with high loads, in which weather conditions resulted in low renewable resource production. Essentially, boundary conditions in this study were designed to represent the realistic "worst case scenario" for future transmission planning needs related to serving peak loads.

It is important to note that all conceptual projects in this 2050 Transmission Study are formulated from one particular pathway among the eight mentioned in the MA Deep Decarbonization Roadmap. Changing inputs to the No Thermal Pathway, or the 100% Renewable Pathway, for example, would impact the conceptual projects list.[4] It is likely that the future power system will differ from the assumptions found in the All Options Pathway. As an example, the expected nameplate capacity of battery energy storage for 2030 has already exceeded the All Options Pathway's assumptions for 2035. As the system evolves, the quantity and location of generating resources and load will likely lead to differences between reality and this study's results. However, this study's key takeaways and high-likelihood concerns still represent crucial high-level directional results that can be used by stakeholders to plan for a smooth clean energy transition.

1.1.3 Summary of Input Assumptions for the Future Scenarios Examined

The first input taken from the All Options Pathway was the hourly load for each snapshot year, which was then recast from a 2012 weather year to a 2019 weather year.[5] The next inputs were the highest-load hours from the winter and summer periods. For winter periods, each state in New England was at or near its own peak load while New England as a whole was at its overall peak load, so a single snapshot in time captured worst-case or near-worst-case conditions in all six states. For summer periods, three varieties of peak loads were chosen in order to ensure the study captured the most severe conditions for each part of New England. The first was a summer daytime peak condition, intended to represent a period when total power consumption is highest. This condition is likely to be most pronounced in areas with little behind-the-meter solar penetration, such that solar power production cannot offset the hottest mid-day temperatures. The two remaining conditions used as summer period inputs were evening peak conditions, where the total load served by the transmission system (end-user load less any reductions for behind-the-meter solar) was greatest. During summer evenings, load decreases due to slightly lower consumption, but behind-the-meter solar production is low or zero. Hence, net load is greatest during this time. The All Options Pathway data showed that the three northern New England states (Maine, New Hampshire, and Vermont) tended not to peak at the same time as the region as a whole. To ensure that the worst-case conditions for the northern states were captured, a second summer evening peak snapshot was created, reflecting the hour in which load served from the transmission system was highest in the three northern states.

The resulting loads in each snapshot were significantly higher than any loads seen to-date in New England, and rose significantly from 2035 to 2040 and from 2040 to 2050. The highest load modeled was the 2050 winter evening peak snapshot, at approximately 57 gigawatts (GW). For

[4] The No Thermal Pathway assumed all thermal capacity retired by 2050; the 100% Renewable Pathway assumed no fossil fuels allowed, with zero-carbon combustion fuels allowed for electricity generation by thermal power plants.

[5] For further details on the reasons for this recasting and the process used, please see slide 11 of the following presentation: https://www.iso-ne.com/static-assets/documents/2021/04/a8_2021_economic_study_request_assumptions_part_1_rev2_clean.pdf

comparison, the highest load observed to date on the New England system was the 2006 summer peak of just over 28 GW, and the highest winter load observed to date was the January 2004 peak of just below 23 GW. The loads analyzed in each year studied are shown in Figure 1-1.

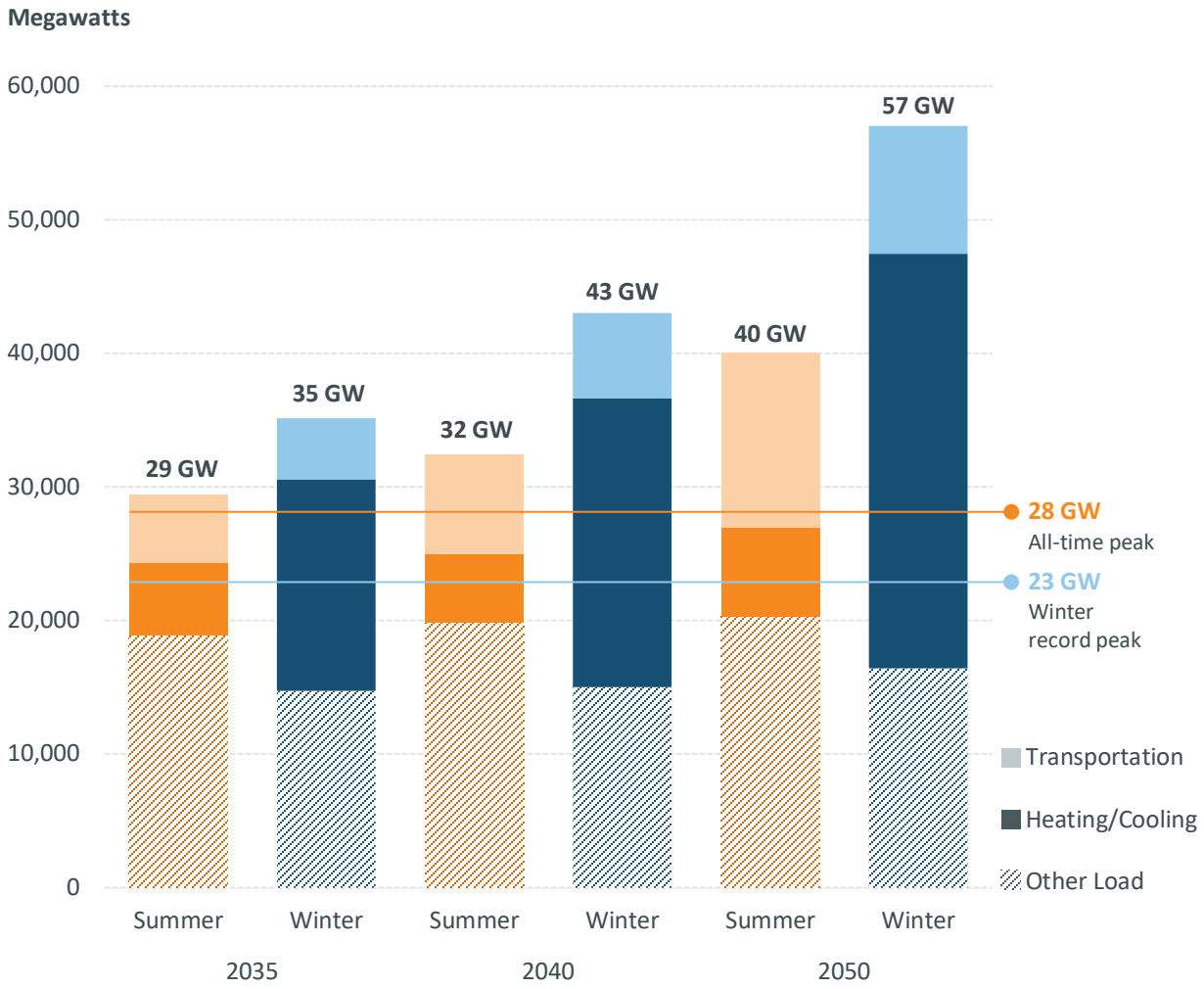

Figure 1-1: Load Levels Analyzed by Study Year

These loads were assumed to be served by a generation fleet that differs significantly from today's resource mix. All coal, oil, diesel, and municipal solid waste-fueled generation, as well as a portion of today's natural-gas-fueled generation, was assumed retired by 2035, the earliest year studied. The remainder of today's natural-gas-fueled generation, as well as biomass, nuclear, hydroelectric, and renewable generators, were assumed to remain operational through 2050. The retired generation, as well as the increases in load, were assumed to be offset by a significant increase in wind and solar generation, as well as battery energy storage and increased imports from neighboring power systems in New York and Québec. Much of this increased wind capacity is located offshore, either off the coast of southeastern Massachusetts and Rhode Island, or in the Gulf of Maine. Figure 1-2 shows the growth in renewable generation and energy storage assumed as inputs for this study.

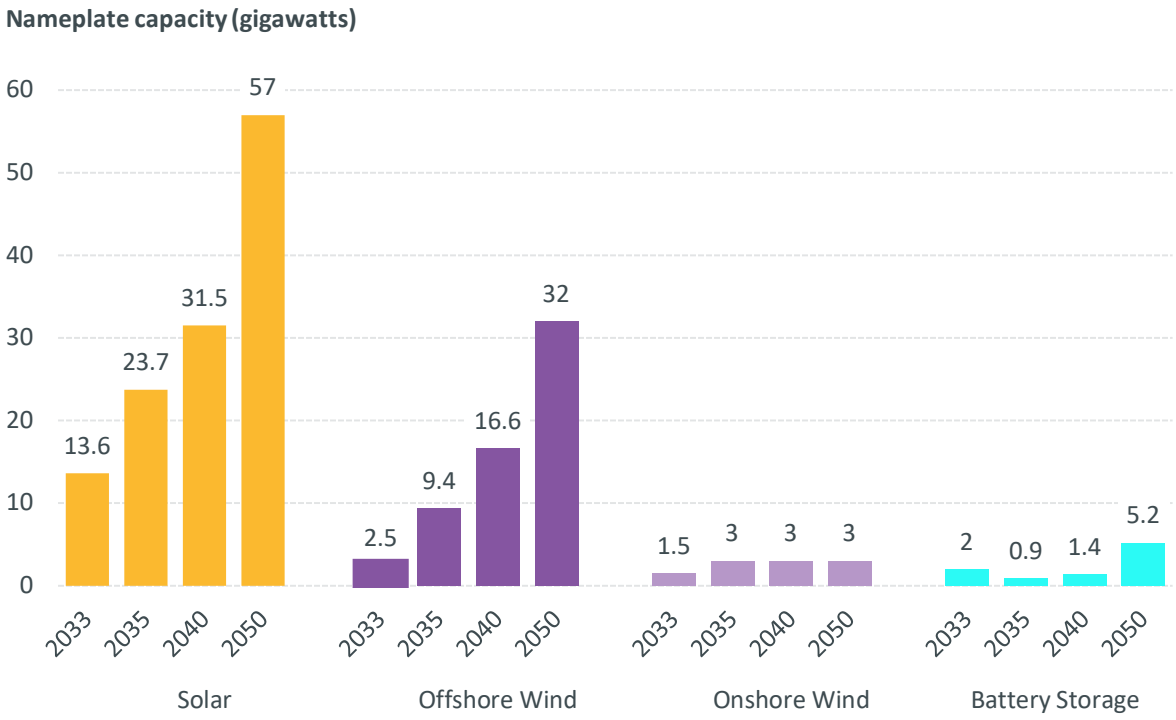

Figure 1-2: Renewable Generation and Energy Storage Input Assumptions

While the All Options Pathway specified a total amount of each generation type by state, transmission planning studies like the 2050 Transmission Study require location data on a more granular level. Exact generator location is needed to develop useful results. In this study, new offshore wind generation was initially assumed to interconnect at major 345 kilovolt (kV) substations near the coast of New England, in order to minimize the length of cables between the interconnection points and offshore wind locations. As the study progressed, some of these interconnection points were relocated in order to eliminate transmission system concerns to the extent possible without changing the total amount of generation in each state (see section 2.4 for further details on generator relocation decisions). Similarly, energy storage facilities were initially assumed to interconnect at major 345 kV stations, but were later relocated within the same state to reduce transmission concerns where possible. Many of these relocations were from 345 kV stations to 115 kV stations. Finally, solar generation was distributed evenly across each 115 kV substation in each state, with certain substations in densely populated areas excluded due to the lack of available land.

In addition to generation located within New England, the All Options Pathway assumed that New England would import power to serve some of its peak load needs from neighboring areas. The following inter-area imports were part of the All Options Pathway and were used in all snapshots examined in this study:

- 1,000 MW imported from New Brunswick over existing 345 kV AC ties.
- 1,850 MW imported from New York over the existing 345 kV, 230 kV, 115 kV, and 69 kV AC ties.

- 1,400 MW imported from Quebec over the existing Phase II HVDC tie (interconnected at Sandy Pond substation in Ayer, Massachusetts).
- 225 MW imported from Quebec over the existing Highgate HVDC back-to-back converter (interconnected in Highgate, Vermont).
- 1,200 MW imported from Quebec over the under-construction New England Clean Energy Connect HVDC tie (interconnecting at Larrabee Road substation in Lewiston, Maine).
- 1,000 MW imported from Quebec over a hypothetical new HVDC tie between Quebec and Vermont (assumed to interconnect at the Coolidge substation in Cavendish, Vermont).

1.1.4 Practical Considerations and Limitations

Three major practical considerations were applied to this study and are important to note when interpreting study results. First, analysis is restricted to thermal steady-state analysis, which identifies thermal overloads that could only be solved by major transmission additions or upgrades. Thermal overloads occur when transmission lines, transformers, or certain substation equipment carries more than its rated amount of current or power flow. This condition can lead to overheating, equipment disconnection, or, in some cases, permanent damage. Analysis of voltage, short circuit or transient stability performance was omitted, and will need to be explored in future studies. This simplification allowed the study team to quickly identify major transmission line and transformer additions, which are usually more expensive and harder to site than the substation upgrades typically required for voltage, short circuit, or transient stability needs.

Second, analysis in this study is limited to transmission needs and conceptual transmission projects. Significant upgrades to the distribution systems will be necessary to accommodate a 2050 peak load that will be roughly double what New England has historically experienced. This anticipated expansion of the distribution system or the sub-transmission infrastructure is beyond the scope of this study, and will likely add significant costs to the evolution of the power system. This consideration required a simplification by modeling all loads at substations operated at 69 kV and above rather than at the lower voltage substations at which they actually connect.

The third and final practical consideration involves resource adequacy. This study found that the resource quantities assumed by the All Options Pathway, when combined with the resource availability assumptions made by the ISO, were insufficient to meet the snapshot loads for the Summer Evening and Winter Evening Peaks of 2035, 2040 and 2050. The largest observed shortfall was roughly 12,000 MW in the 2050 57 GW Winter Peak snapshot. In order to conduct analysis of the transmission system during these snapshots and ensure the model could run, shortfall MWs were added as needed in order to meet load.[6] These shortfall MWs were added at offshore wind points of interconnection (POIs). Future work will be needed to determine more specifically how shortfalls will be resolved. For the purposes of this study, the added shortfall MWs can be thought of as more offshore wind (either higher output or higher installed capacity), battery storage that charges from excess wind during times of high production and discharges when wind production is lower, or additional imports from regions outside of New England through a hypothetical inter-area offshore grid.

[6] For further details, please see the November 2021 presentation on the 2050 Transmission Study scope of work.

1.2 Overview of the New England Transmission System

This section is designed as a primer for those unfamiliar with the New England transmission system. Those readers who are more familiar with transmission planning are invited to skip ahead to Section 2.

1.2.1 General Configuration of the New England Transmission System

ISO New England is responsible for the long-term planning of the networked portions of the high-voltage transmission system (known in New England as the Pool Transmission Facilities, or PTF), and this study was performed in support of this objective.[7] The role of the electric transmission system is to efficiently deliver electricity over long distances, from generation within New England or imports from adjacent areas, to connections to local distribution systems. The transmission system is a networked grid of high-voltage transmission lines and transformers, with electric power naturally distributing itself among many parallel paths according to the locations of supply (generation/imports), demand (load), and electrical characteristics of the high-voltage transmission lines and transformers. Substations, found at the intersection of transmission lines, handle switching, protection, and transformation from one voltage level to another. At many of these substations, transformers step power down from higher transmission voltages, typically 69 kV and above, to distribution voltages below 69 kV. Local transmission owners and distribution companies, rather than the ISO, are responsible for the planning of any radial portions of the transmission system (which have only a single connection to the rest of the transmission system), the transmission-distribution interface, and the distribution systems.

The future evolution of the power system toward renewable and variable or intermittent resources increases the importance of a robust transmission system. Many of the best locations for renewable resources like large-scale wind and solar farms are not near major load centers (i.e., the urban areas of New England) and the transmission system will be relied on to deliver the power from these renewable resources to electricity consumers. While distributed resources, such as rooftop solar, can be located in more populated areas, the transmission system still helps bring power into these areas during nighttime periods or other times when intermittent renewable resources' output is not sufficient to meet the local load. Transmission can also help to provide geographic diversity in renewable resources, smoothing out variations in wind and solar production in different parts of the power system. Finally, with the expected future increase in the electrification of the heating and transportation sectors, summer and winter peak loads are expected to increase dramatically. Additionally, New England's current summer peaking system is forecasted to become winter peaking by the mid 2030s. A robust transmission system will ensure that loads under these future conditions can be served reliably.

New England's power system provides electricity to diverse geographic areas, ranging from rural communities to densely populated cities. The majority of consumer demand, roughly 77%, is located in the southern states of Massachusetts, Connecticut, and Rhode Island.[8] Although the land area in the northern states is larger, the greater urban development in southern New England creates greater demand and corresponding transmission density. However, it is the larger areas of land in northern New England that offer greater potential for renewable power generation. Today,

[7] An exact definition of the New England PTF may be found in section II.49 of the ISO New England Open Access Transmission Tariff.

[8] The distribution of loads between the New England states can vary from month to month, day to day, and hour to hour. Values cited are seasonal approximations.

flows on the transmission system are primarily from west to east and from north to south. However, flows change throughout each day, and the predominant flows will change significantly by 2050 due to additional new renewable generation and significant load growth. Because the demands on the New England transmission system can vary widely, the system must at all times be able to reliably move power from various internal and external sources to the region's load centers under a wide-ranging set of conditions. Included in these conditions are contingencies. The exact lists of contingencies that must be analyzed are set by reliability standards created by the North American Electric Reliability Corporation (NERC), the Northeast Power Coordinating Council (NPCC), and the ISO. In accordance with these standards, the 2050 Transmission Study examines "N-0" conditions (all facilities in-service), "N-1" conditions (single contingency), and "N-1-1" conditions (two consecutive contingencies, with time for manual system readjustments between contingencies).

1.2.2 Geographic Location and Types of Transmission Lines in New England

The New England transmission system consists of mostly 115, 230, and 345 kilovolt (kV) transmission lines, which are generally longer and fewer in number in northern New England than in the southern states.[9] The region has 13 interconnections with neighboring power systems in the United States and eastern Canada. Nine interconnections are with New York (NYISO)—two 345 kV ties; one 230 kV tie; one 138 kV tie; three 115 kV ties; one 69 kV tie; and one 330-megawatt (MW), ±150 kV high-voltage direct-current (HVDC) tie, the Cross-Sound Cable interconnection. New England and the Maritimes (New Brunswick Power Corporation) are connected through two 345 kV alternating current (AC) ties.[10] New England also has two HVDC interconnections with Québec (Hydro-Québec, or HQ). One is a 120 kV AC interconnection with a 225 MW back-to-back converter station (Highgate in northern Vermont), which converts AC to direct current (DC) and then back to AC. The second is a ±450 kV HVDC line with terminal configurations allowing up to 2,000 MW to be delivered at Sandy Pond in Massachusetts (Phase II).

[9] Detailed maps and diagrams of the New England transmission system may be found on ISO-NE's website, at https://www.iso-ne.com/about/key-stats/maps-and-diagrams.

[10] One exception is that Aroostook County and part of Washington County in Maine receive electricity from New Brunswick, and are administered by the Northern Maine Independent System Administrator (NMISA) rather than ISO New England.

Section 2: Key Takeaways

The 2050 Transmission Study resulted in several high-level observations related to transmission-related challenges the future grid may face as a result of the clean energy transition. These key takeaways are detailed in the following subsections. They are:

1. Reducing peak load significantly reduces transmission cost.
2. Targeting and prioritizing high likelihood concerns is highly effective.
3. Incremental upgrades can be made as opportunities arise.
4. Generator locations matter.
5. Transformer capacity is crucial.

2.1 Reducing Peak Load Significantly Reduces Transmission Cost

Increases in load become significantly more expensive (with regard to transmission costs) as peak load levels increase. This is especially true at levels above ~51 GW of load.[11] Increases in load at peak load levels below 51 GW do increase costs (roughly $0.75 billion per GW of load added from 28 GW to 51 GW), but these increases are small when compared to the increase in costs above 51 GW of load (roughly $1.5 billion per GW of load added from 51 GW to 57 GW). Figure 2-1 shows the approximate cost required for transmission expansion to serve load reliably in each year studied.

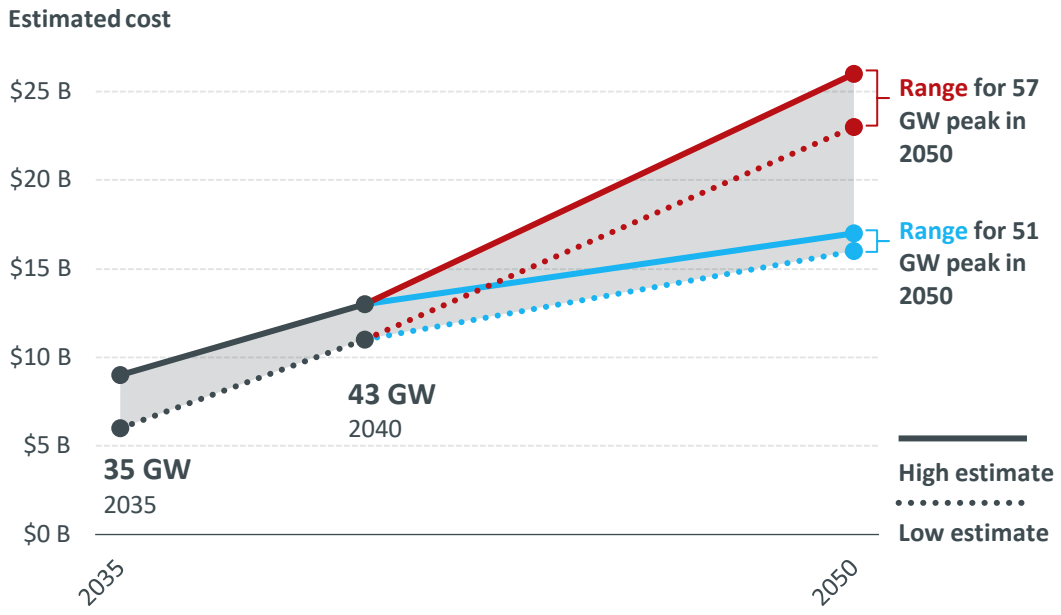

Figure 2-1: Costs by Year Studied

Limiting load growth to no more than a 51 GW peak load level could be achieved in several different ways. A 2050 New England grid with 100% heating and transportation electrification is expected to result in a ~57 GW peak load. However, a 51 GW peak could be achieved under a scenario in which

[11] This subsection concentrates on winter peak loads, which are the highest loads in the 2050 Transmission Study. These winter peak loads occur after sunset, so there is no difference between "gross load," or the actual amount of power consumed by end users before reductions due to rooftop solar, and "net load," or the load served by the transmission system after these reductions.

New England retains some stored fuels like natural gas, oil, propane, hydrogen, etc. for heating and transportation. Since loads above 51 GW would only occur during extremely cold winter days, peak load could be limited to 51 GW in a scenario in which the grid is 100% electrified for most of the year, with only the coldest days using some stored fuels for heating. If the full 6 GW of load reduction came out of heating, this could still represent approximately 80% heating electrification while still maintaining 100% transportation electrification.

Alternately, more aggressive demand response (when customers reduce their electrical consumption for compensation) and peak shaving programs (e.g., smart thermostats that reduce the set temperature during a winter peak time) that could shift load to times of lower demand may also help maintain a 51 GW peak load level, thereby reducing transmission costs. The extent of these forms of load reduction would need to be in addition to those already assumed by the "All Options" pathway, which considered that 50% of electric vehicle charging load, 15% of space heating/cooling load, and 25% of water heating load could be shifted. Work from other studies, however, including Economic Planning for the Clean Energy Transition (EPCET), have shown a potential overall energy deficit in the winter months whether these strategies are deployed or not. Since shifting MWs to other hours of the day would still lead to an overall energy shortfall, the total MWhs consumed in the winter months may still need to be reduced. Reducing load by shifting energy from peak hours to off-peak hours on the same day would help address transmission costs but would not address energy adequacy concerns over longer periods of days or weeks. More aggressive energy efficiency programs (such as incentivizing customers to install better insulation in their homes/businesses, and/or upgrade appliances and heat pumps, etc.) are among the options that could be considered in order to maintain a 51 GW peak load while still achieving electrification goals.

Public education and involvement may be an important factor in modifying consumer behavior to reduce electricity demand at key times. Consumer awareness of the nature and timing of peak load may help consumers participate in the reduction of peak loads to more manageable levels, which could save billions of dollars in transmission system upgrade costs.

2.2 Targeting and Prioritizing High Likelihood Concerns is Highly Effective

One major outcome of the 2050 Transmission Study was the identification of system concerns that could be resolved through transmission system expansion and could appear under a wide variety of possible future conditions. This wide variety of conditions, detailed in Section 3, include different load levels, different generator locations, and differing rates of load growth at particular substations. This report describes a number of *high-likelihood concerns* that appear to meet these conditions. While this study examined just one of many possible futures for the New England power system, and of that possible future examined only certain hours of the year when electricity consumption is expected to be at its highest, these results can still be used to infer which areas of the transmission system are likely to be most limiting as the system evolves.

Projects that address these high-likelihood concerns are likely to bring the greatest benefit for a wide range of possible future conditions as the clean energy transition accelerates. The assumptions used for future load and generation patterns include a fair amount of uncertainty, but these high-likelihood concerns are likely to appear even under somewhat different future conditions. Targeting these concerns should be considered higher-priority than other potential challenges identified in the 2050 Transmission Study, which would likely occur only if generators interconnect at specific locations or if load grows in specific patterns.

In an effort to identify high-likelihood concerns and other transmission overloads, the locations of new generator interconnections were optimized, within reason. By locating these interconnections so as to minimize transmission overloads observed under peak load conditions, any remaining overloads would likely only be solved through transmission expansion. Concerns that could be alleviated by new generation interconnections (within the bounds of the total amounts of generation in each New England state assumed for this study) are therefore not included in the results because they were resolved by the change of generation interconnection location.

2.3 Incremental Upgrades Can Be Made as Opportunities Arise

Many of the transmission system concerns identified in the 2050 Transmission Study could be addressed by rebuilding existing transmission lines with larger conductors, rather than expanding the transmission system into new locations. In many cases, replacing transmission lines with larger conductors and increasing their power transfer capability would allow the system to serve significantly higher peak loads. This type of conductor replacement, or reconductoring, may also require replacing some or all of a transmission line's structures in order to accommodate heavier, larger conductors. Advanced conductor technologies that may be able to make use of existing structures while still delivering higher ratings and lower losses could also be considered. Additionally, other incremental upgrades could be beneficial; examples include bundling multiple conductors per phase on 115 kV lines (already a common practice on 345 kV lines in New England) or rebuilding transmission lines to allow for a higher operating voltage.

Limiting brand new line construction by taking advantage of line rebuilds could minimize costs, especially in densely populated areas in southern New England. In many areas, expanding existing rights-of-way or constructing new rights-of-way could be difficult, expensive, and environmentally disruptive, and thus maximizing the use of existing rights-of-way is critical to the success of the region's transmission system reliability through the clean energy transition.

While these incremental upgrades should be considered crucial to the improvement of New England's transmission system, it is not necessarily prudent for the region to pursue large numbers of line rebuilds immediately. Many of these line rebuilds are highly dependent on the locations of generator interconnections, the geographic distribution of end-user load, and the locations of new load-serving substations. Since these incremental upgrades can generally be built in a shorter timeframe than new transmission on new rights-of-way, it may be more practical to address these incremental needs via the traditional ten-year reliability planning process rather than the longer-term planning process that prompted this study. This strategy would allow the region to hold off on committing to further transmission system investment until new information is available, and also provide opportunities for more cost-effective "right-sizing" transmission projects.

"Right-sizing" is a term used to describe combining line rebuilds necessitated by increased loads with replacements designed to meet asset condition needs. In New England, asset condition projects are identified by transmission owners when equipment exceeds its useful life. Since a significant portion of New England's transmission system was developed in the mid-20th century, many transmission lines are beginning to reach the end of their life and must be replaced. During such an asset condition replacement project, the incremental cost of upgrading a transmission line to a larger conductor size and stronger structures is relatively low. Many expenses inherent in transmission line rebuilds are unrelated to the line's capacity; costs related to building access roads along a right-of-way, labor for building structures, and financing an ongoing project are not significantly affected by the size of the conductor chosen. Therefore, upgrading the capacity of lines as the opportunity arises, or "right-sizing" asset condition projects when they occur, could be a

financially prudent way for New England to reliably serve increased peak loads. Further discussions between the ISO, the Transmission Owners, and NESCOE on "right-sizing" asset condition projects will continue at the Planning Advisory Committee in 2024 in order to inform the region of the possible economic advantages of these opportunities more fully.

2.4 Generator Locations Matter

The 2050 Transmission Study also found that the specific location of generators can have a significant impact on the transmission upgrades required for reliability. The study attempted to optimize, within reason, new generator locations for offshore wind, solar photovoltaics (PV), and batteries in import-constrained regions to reduce the number and severity of overloads experienced while serving peak loads. As a result, the overloads observed were those that persisted in spite of these optimized generation locations. Locating generators in suboptimal areas would likely significantly worsen the overloads, particularly in import-constrained regions like Boston. Optimizing generation locations is also crucial for determining which lines must be upgraded, since a generator could either push back on heavy flows toward load centers or contribute to even higher loading on transmission lines, depending on the location of its interconnection. Essentially, locating generators closer to large population hubs will help reduce the strain on the transmission system, since the cumulative distance power must flow to reach electricity consumers will be greatly reduced.

Generator location is less important for some of the larger-scale upgrades like new major lines leading from northern New England to southern New England. Whether a generator is placed at one substation in Maine or at a different station 10 miles away matters very little, since the majority of the power from that generator will ultimately flow from Maine into southern New England regardless of the generator's exact location. As long as generators in northern New England are located in the general vicinity of the terminal of a large-scale upgrade, the exact substation where they interconnect is not as critical.

2.5 Transformer Capacity Is Crucial

Increasing electrification results in load growth, which then requires more renewable resources to be added to the New England power system. This increase in load and generation can strain the existing transformer capacity within New England, particularly the 345/115 kV transformers. Transformers must reliably "step down" power from higher to lower transmission voltages, and the 2050 Transmission Study revealed that existing transformers across the system were frequently unable to do so without thermal overloads. Between 2035 and 2050, the assumed load increased significantly across the region, in tandem with the increase in generation located farther from load centers. This trend increases the importance of higher voltage lines such as the 345 kV system to transfer power over long distances. Throughout all snapshot years, transformers created choke points, since the system's existing transformers were not originally designed to handle the large loads assumed in this study.

As described in the previous key takeaway, generator locations matter. When generation location was optimized in order to locate more generation on the 115 kV system closer to the load, rather than on the 345 kV system, transformer overloads were reduced.

Results from the 2050 Transmission Study reveal that the power system is only as reliable as its ability to deliver power through transformers without experiencing overloads. One benefit of higher voltage transmission (in New England, primarily 345 kV) is its increased capacity to transfer

more power across long distances while minimizing losses of power along the way. However, this additional power transferred along higher voltage lines must eventually "step down" to 115 kV via transformers on its way to distribution substations fed by 115 kV lines, and these transformers must be able to support the increase in load and power injection. Results from the studied snapshots show that the existing transformer fleet will not be able to adequately support future power flows from the 345 kV to the 115 kV system. This is not an issue with the transformers themselves, but rather is a predictable consequence of increases in load and the fact that this increased load is originating predominantly from locations far away from the generation.

One of the simplifying assumptions of this study was to model load on the 115 kV system, rather than on the distribution system. As a result, this takeaway applies to transformers with windings at or above 115 kV. Presumably, a large number of additional distribution transformers will be required to step down from 115 kV to individual customers. This distribution infrastructure is beyond the scope of this study, and the related planning responsibility lies with the distribution utilities and their state regulators rather than with the ISO. However, this infrastructure will be necessary to support increasing electrification of transportation and heating.

These results indicate that transformers are a key component in the reliable delivery of bulk power as loads increase. Major challenges in addressing these concerns include the time and expense required to build new, large transformers. Lead times for new transformers are often one to two years, and adding a large number in a short period of time will be difficult. Nonetheless, adding transformers throughout the system could likely relieve thermal overloads and support reliability. Ideally, New England transmission owners would wait to order new transformers until it is determined that they are definitely needed, and the location where they are needed is known; however, due to the long lead times and the large number of transformers needed, it may be prudent to start ordering transformers ahead of time and determining their exact locations later on.

Section 3: High-Likelihood Concerns

In response to stakeholder interest and feedback, the 2050 Transmission Study identified what the ISO has termed high-likelihood concerns, as discussed in Section 2.2. It is helpful to identify the transmission concerns that have a high likelihood of occurring even if the assumptions used in the study do not unfold exactly as predicted. This allows the New England region to prioritize concerns based on their likelihood. The ISO has defined a "high-likelihood concern" as one that satisfies the following three criteria:

1. **The thermal concern must appear at two or more load levels.** This could mean that the concern occurs in the same year, but during both summer and winter peaks, or it could mean that it only appears during the winter peak in two separate years, e.g., 2040 and 2050. Requiring the concern to appear at two or more load levels in study simulations significantly increases the probability that the concern will be realized. For example, if a concern appears at the 2040 43 GW winter peak and also at the 2050 51 GW winter peak, there is a much higher likelihood that the concern will occur whether loads reach the highest studied levels (57 GW) or not. As a counterexample, if a concern only occurs once, at 57 GW of load in the winter, then the likelihood of this concern existing in reality will be much lower. If load growth falls slightly short of the study's highest prediction, then the concern is highly unlikely to occur.
2. **The thermal concern must not rely heavily on specific substation-level generator locations.** Many of the generator locations in this study are hypothetical— particularly for offshore wind, solar PV, and batteries, since many of these generators do not yet exist. In reality, these generators will likely be located in somewhat different locations. It is therefore important to prioritize concerns that are not directly triggered by specific generator locations. If observed overloads are caused by a generator interconnected at a certain substation, and this overload would not be observed if the generator was connected to a substation several miles away, this is not considered a high-likelihood concern. However, if a generator could be located anywhere within a range of substations and still cause a thermal overload, this would be considered a high-likelihood concern, provided that it also meets the other two criteria described in this section.
3. **The thermal concern must not rely heavily on load growth at a particular substation.** The study assumed that load will grow proportionally across all of New England; in reality, load will likely grow faster at some substations than it will at others. It is therefore important to prioritize thermal concerns that are not heavily dependent on the exact location of load. For example, if a substation is fed from a single transmission line, the flow on that line is entirely dependent on the load located at that particular substation, and future loads that fall slightly short of forecasts used in this study would not precipitate a thermal concern. This type of concern is not considered high-likelihood. However, thermal concerns observed on transmission lines that transfer power between New England's subregions are much less dependent on specific load locations, and are therefore considered high-likelihood provided they meet the other two criteria described in this section. If load grows slightly more at one station than another in the same area, or if a new

station is added to that area, roughly the same amount of power will still flow over the major transmission line between areas.

Roadmaps that could address each of these high-likelihood concerns are included in Section 4, along with graphic representations of each roadmap.

3.1 High-Likelihood Concerns: North-South

The Maine-New Hampshire and North-South transmission interfaces connect Maine and New Hampshire to northeastern Massachusetts.[12] The 2050 Transmission Study found that these interfaces are high-likelihood concerns due to a variety of thermal overloads that met the criteria described in the previous section. These concerns were observed primarily during winter peak snapshots and were precipitated by the large volume of offshore wind production flowing from relatively generation-heavy and light-load areas in Maine and New Hampshire into the dense, high-load areas in southern New England. Although less severe than the winter observations, concerns were also observed during the summer daytime peak snapshots, precipitated by large excesses in solar production in northern New England. Transporting this excess power between subregions overloaded a significant number of 345 kV and 115 kV transmission lines connecting northern and southern New England. These overloads increased in severity between the 51 GW and 57 GW load levels during the 2050 winter peak snapshot.

The overloads experienced on the Maine-New Hampshire and North-South interfaces were observed in a number of studied years. Some overloads began in 2035 and extended all the way through 2050. Some overloads were observed in both the winter peak and the summer daytime peak snapshots. Additionally, these observed overloads were not highly dependent on generator location. While the total generation in northern New England is a factor in these overloads, the precise locations of particular generator interconnections in Maine do not affect the probability that the overloads will occur; most of the power generated in this subregion still ultimately flows down through the major lines leading into Massachusetts. The exact load distribution within a subregion also does not heavily influence these major transmission lines since they transfer power between subregions rather than serving one particular substation. Even if the precise load location varies within those subregions, the resulting flow on the major lines would remain relatively similar.

Other ISO studies such as FGRS and EPCET's Market Efficiency Needs Scenario (MENS) have also identified bottlenecks on the interfaces between Maine and southern New England. These studies examined the hourly dispatch of the transmission system on a year-round basis, rather than the peak load snapshots used in this study. While the methodology of these studies differs from a full transmission system study (e.g., FGRS used a "pipe-and-bubble" approach to transmission limits and the EPCET MENS used a nodal model with N-1 contingencies rather than N-1-1 contingency analysis), their results support this study's findings, and transfers across the Maine-New Hampshire and North-South interfaces will increase beyond today's limits over a wide range of future conditions.

Analyzing different state-by-state totals of renewable generation, other than those in the All Options Pathway, was beyond the scope of this transmission study. However, it is possible that offshore wind that the study assumed would interconnect in Maine or New Hampshire could be routed south into Massachusetts instead, alleviating some of the stress on the North-South

[12] An interface is a boundary on the power system across which power flow is measured. For example, the Maine-New Hampshire interface is the sum of the flows on all six transmission lines connecting Maine to New Hampshire.

interface. The precise interconnection locations for offshore wind in the Gulf of Maine will depend on many factors, including the exact location of wind lease areas that have not yet been finalized.

3.2 High-Likelihood Concerns: Boston Import

Since most of the load increases examined in the 2050 Transmission Study were the result of increased electrification in the same locations where load is observed today, this heavily impacted already load-dense areas of the New England region, and the Boston subregion in particular. The Boston subregion is the area bound by the Boston Import interface, and it extends from downtown Boston south to Hyde Park, west to Framingham, and north to Amesbury. The 2050 Transmission Study determined that the Boston Import interface is a high-likelihood concern. There were a variety of thermal overloads observed along this interface that met all three criteria. Across most snapshots studied, current import paths into the Boston area are unable to support increasing load due to high load density and low assumed availability of wind generation in the area under summer peak load conditions. The balance of load and generation within the Boston Import interface affects the degree of overloads in this area, and additional generation within the Boston Import subregion could help to reduce overloads on the import paths.

It should also be noted that a significant number of overloads occurred on underground cables that would be expensive to fix through upgrades. In most situations, increasing the rating of underground cables requires a complete replacement of all underground equipment, resulting in costs that are six to eight times higher than rebuilding existing overhead transmission lines. Table 3-1 displays the overloaded mileage on all lines in the Boston area. There are two categories for each set of results: All Lines (Overhead and Underground Lines) and Underground Lines. The results labeled "pre-optimization" show study results from July 2022, before any work to optimize generator interconnection locations (see Section 2.4). Results marked "post-optimization" show the effects of generator interconnection location optimization on reducing transmission overloads. All results are presented without any representative transmission upgrades included; potential upgrades for this area are described in Section 4, and eliminate all of the transmission overloads shown here.

Table 3-1: Miles of Transmission Lines Overloaded in the Boston Subregion by Snapshot Year/Load

Year Studied	Miles of Transmission Lines Overloaded in the Boston Subregion[13]			
	Pre-Optimization: All Lines	Post-Optimization: All Lines	Pre-Optimization: Underground Lines	Post-Optimization: Underground Lines
2035	77.6	98.3	54.8	62.0
2040	169.4	184.5	103.2	97.1
2050 (51 GW winter peak)	398.8	313.5	202.0	165.4
2050 (57 GW winter peak)	477.3	344.6	205.5	169.6

Results indicated that underground cables were the source of a significant percentage of observed overloads in Boston (see Figure 3-1). These results also illustrate that generation location matters, as described in the key takeaway Section 2.4. When generator relocations were optimized to best suit the 2050 snapshots, the number of miles overloaded were reduced. However, optimizing the generation relocation for 2050 produced more overloaded miles in the 2035 and 2040 snapshots than in the original pre-optimization results. Although the best optimization for 2050 was not optimal for 2035 and 2040 results, the results from all later snapshots showed a decrease in overloaded miles between pre- and post-optimization. This example illustrates potential trade-offs between optimization of the transmission system for the long-term and addressing near-term problems that must be considered as the region tackles the clean energy transition. Boston likely requires more import capability and transmission system improvements to address these high-likelihood concerns, and the roadmaps detailed in Section 4 solve for all concerns observed in all years studied while considering generator point-of-interconnection optimization for 2050.

[13] Numbers in this table are based on N-1-1 results when accounting for single-element second contingencies (loss of line, transformer, etc.) but not multiple-element second contingencies (breaker failures, double-circuit tower contingencies, etc.). Mileage includes both lines fully within the Boston subregion and lines crossing the Boston Import interface, which connect the Boston subregion to the remainder of New England.

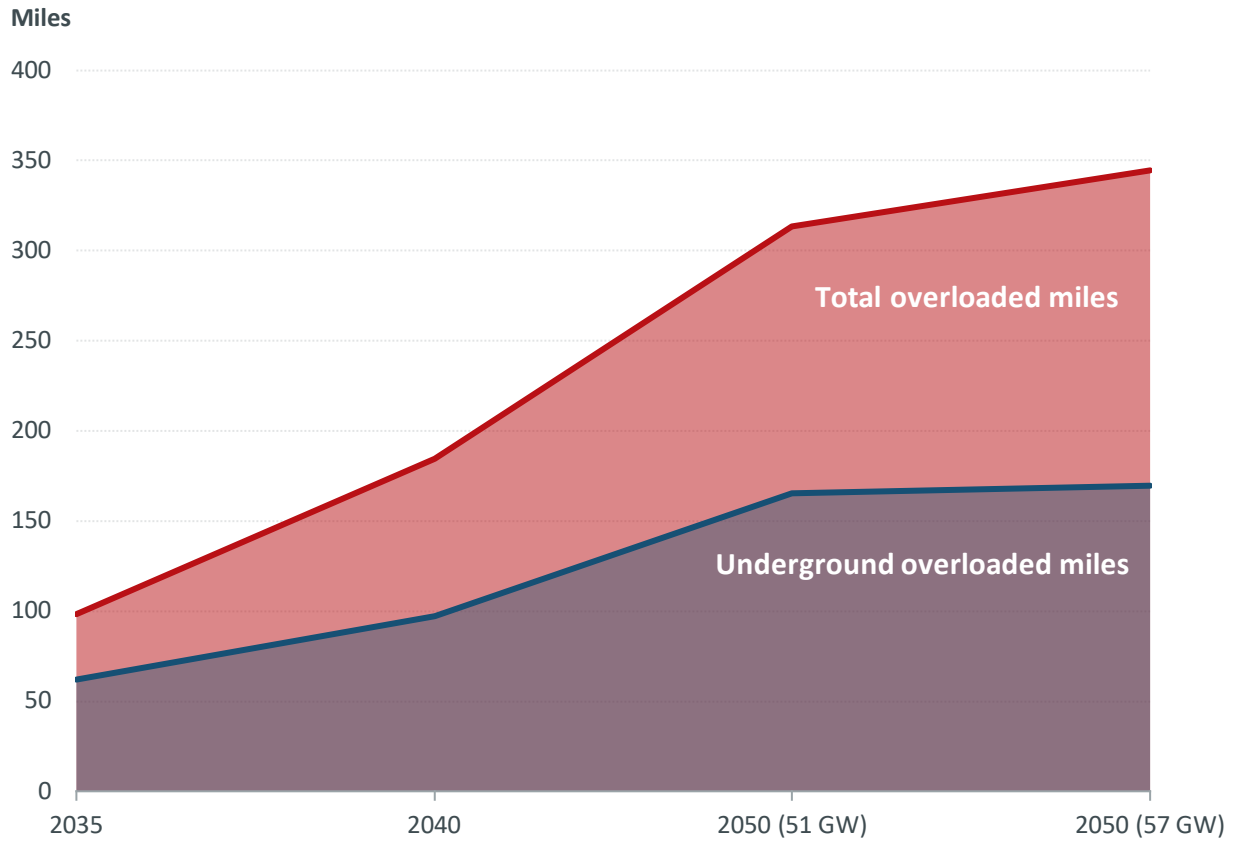

Figure 3-1: Line Mileage Overloaded in Boston with Generator Interconnection Locations Optimized

Alternative approaches that might address these issues yield trade-offs between cost and effectiveness. Moving generator interconnection locations will address some of the identified concerns during peak load conditions, but may be less optimal under off-peak or high-wind-output conditions. Optimizing generator interconnection locations may be more cost-effective than building new transmission, since some interconnection equipment will be needed regardless of the substation where a generator interconnects. However, relocating generator interconnections is not completely cost-free, especially when moving offshore wind interconnections farther from shore, since extra costs associated with cables between offshore and onshore locations may arise. The costs of generator interconnection equipment are also allocated differently than transmission upgrades, potentially complicating the optimization of generator interconnection locations. If there were more generation in load-dense areas, the need to import power into Boston would be less. Bulk power must travel through multiple stations to satisfy load in Boston, and lines may overload along the way due to the large volume of power flow. Locating more generation within the Boston subregion would therefore reduce overloads along this interface under heavy load conditions.

3.3 High-Likelihood Concerns: Northwestern Vermont Import

The 2050 Transmission Study found that importing power into northwestern Vermont is a high-likelihood concern, specifically with regard to the area around Burlington. The study's observed overloads stemmed from the significant amount of forecasted load in the general area without a corresponding amount of local generation, combined with the lack of significant 345 kV transmission lines transferring power into the area. These overloads were observed exclusively in

the winter, when load is expected to be highest, as heating in the region becomes significantly more electrified. Overloads were observed primarily on 115 kV lines around the Burlington area, along with a 115 kV inter-area tie line between Plattsburgh, New York and the Sandbar substation in Milton, Vermont.

While the overloads did not appear in both summer and winter, many of them did appear in 2035, 2040, and 2050, indicating a high probability that they will occur even if load in 2050 is lower than assumed. These overloads were not heavily dependent on generation location, as there is no significant generation located in northwestern Vermont. Some new solar was assumed; however, since the overloads occurred after sunset during the winter peak, solar units were unable to provide power. This region is also not ideal for connecting with larger generators or with significant imports like the HVDC connection with Canada assumed in southern Vermont, because northwestern Vermont does not have a strong connection to the 345 kV transmission system. While more generation could help mitigate some of the concerns in the region, it would not be well-connected to other subregions and thus not particularly useful for exporting to those subregions when load is low in Vermont. With few transmission paths in this part of the state, any new, large generation or HVDC import into the area could require significant transmission upgrades.

The high-likelihood concerns observed in northwestern Vermont are dependent on the overall load growth in the area; however, they are not highly dependent on where that load growth is located station-by-station. As long as the load growth occurs somewhere in the general region, many of these overloads are expected to persist.

3.4 High-Likelihood Concerns: Southwest Connecticut Import

Southwest Connecticut arose as a high-likelihood concern due to its positioning in the power system combined with high load density. Since the area is located in a corner of the New England power system, increases in assumed load there surpassed line ratings and precipitated thermal overloads. There are only two 345 kV paths connecting Southwest Connecticut to the rest of the New England system, which limits the amount of power that can flow over the higher voltage transmission lines. The loss of one or both of these 345 kV paths can lead to high flows on the underlying 115 kV system, and transformers in this area suffered thermal overloads as the load increased on the system across all snapshots studied.

Thermal concerns appeared across all studied load levels due to the total load increase across the substations, but were most severe in the 57 GW snapshot. The location of generator interconnections was optimized to address as many overloads as possible, but this had only a limited effect due to the relatively small amount of generation in the area as compared to peak load. The overall subregion was not very sensitive to changes in load since these concerns persisted across 2035, 2040, and 2050. As long as the load was located within Southwest Connecticut, it generally did not matter on a substation-to-substation level exactly where the load was located.

Section 4: Roadmaps and Representative Transmission Solutions

The term *roadmap* is intended in this study as a high-level plan designed to show generally how transmission-related objectives can be accomplished. The roadmaps provided in this study are not intended as comprehensive or detailed plans for construction. They include conceptual projects specific to the study's input assumptions—projects that could be useful in addressing high-likelihood concerns, including line rebuilds, and lessons learned that could be applied to future long-term transmission studies. Roadmaps were developed for groupings of high-likelihood concerns for North-South, Boston Import, and Northwestern Vermont Import. Roadmaps were not developed for Southwest Connecticut or other high-likelihood concerns, since these concerns had a relatively clear single solution, and any alternatives were much costlier. The North-South and Boston Import roadmaps were combined, since these areas were heavily dependent on each other. The cost assumptions for the representative transmission solutions are described in Section 5.

To develop each roadmap, the ISO first focused on designing solutions to meet the 2050 Summer Peak snapshots along with the 2050 51 GW Winter Peak snapshot. Once those solutions were developed, a subset of those solutions were determined to meet the 2035 and 2040 snapshots such that a smooth path could be developed to move from 2035 to 2040 to 2050 without having to build a solution and then rebuild it in the future. Finally, the study identified additional upgrades on top of the 2050 51 GW Winter Peak snapshot that were required to reach the 2050 57 GW Winter Peak snapshot.

4.1 North-South/Boston Import Roadmaps

Four main roadmaps were developed for solving the high-likelihood concerns observed on the North-South and Boston Import interfaces. These roadmaps were developed to provide the region's stakeholders a variety of examples of how these concerns might be mitigated. The ISO does not recommend any particular roadmap over another; each includes advantages and disadvantages. Collaboration between stakeholders and the region as a whole will help determine the best path forward.

4.1.1 North-South/Boston Import Roadmap #1: AC Roadmap

The first roadmap centers around an AC 345 kV framework. This roadmap consists of a 345 kV line from the Surowiec substation in Pownal, Maine to the Timber Swamp substation in Hampton, New Hampshire, and another 345 kV line from Timber Swamp to the Ward Hill substation in Haverhill, Massachusetts. These two 345 kV lines would primarily be constructed overhead, with short underground sections as needed to address segments where overhead construction is difficult or impossible. An additional 345 kV partially overhead/partially underground line would also be required from Ward Hill to the Wakefield Junction substation in Wakefield, Massachusetts, continuing to the Mystic substation in Everett, Massachusetts. Finally, a third AC cable (in addition to two existing AC cables) from the Stoughton 345 kV substation in Stoughton, Massachusetts to the K Street substation in Boston, Massachusetts would be required to help resolve import issues in the southern and western portions of the Boston sub-region. These upgrades, along with ancillary rebuilds of existing transmission lines, would be sufficient to meet the 51 GW winter peak load. A 57 GW winter peak would require a second 345 kV Timber Swamp-Ward Hill line in addition to the above-mentioned new lines. In addition to the major upgrades described above, this roadmap

would require approximately 666 miles of overhead line rebuilds to reliably serve a 51 GW load and 1,058 miles of overhead line rebuilds to reliably serve a 57 GW load.

This option is somewhat limited in its flexibility due to constrained rights-of-way along much of the path, since lines connecting Maine to Massachusetts should be overhead in order to have enough capacity. While it may be possible to add new 345 kV transmission to existing rights-of-way, there will be expenses associated with reconfiguring existing lines. Additionally, the risk that all lines in a right-of-way may be lost (e.g., due to brush fires) would need to be evaluated further outside of this study. Figure 4-1 represents the general direction of power flow and location of major new transmission lines in this roadmap.

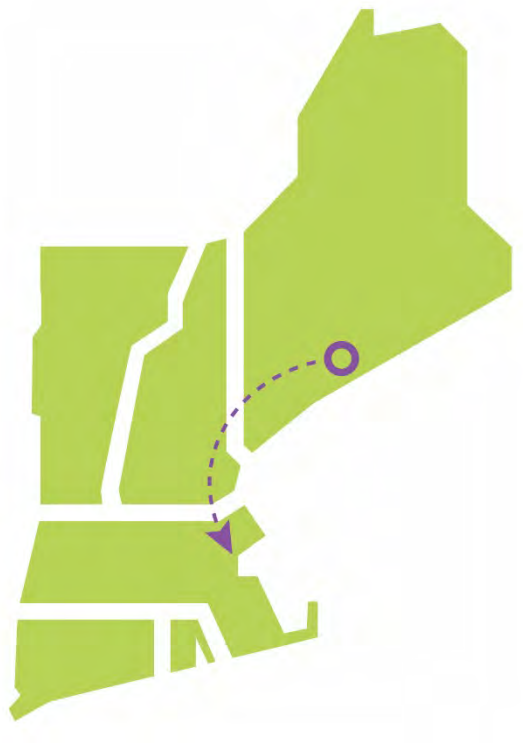

Figure 4-1: North-South/Boston Import AC Roadmap

4.1.2 North-South/Boston Import Roadmap #2: Minimization of New Lines Roadmap

The second roadmap attempts to minimize the number of newly constructed lines, and instead prioritizes rebuilding existing lines with larger conductors. This roadmap would still require the new 345 kV partially overhead/partially underground Ward Hill-Wakefield Junction-Mystic line and the third Stoughton to K St AC cable mentioned in roadmap #1, but it would not require any of the new lines in Maine or New Hampshire. The omission of new ME-NH lines would, however, necessitate approximately 252 miles of additional rebuilds, for a total of 918 miles of rebuilt overhead lines to support a 51 GW winter peak load.

It is important to note that this roadmap is not sufficient to support a 57 GW winter peak load. Additional new lines will be required to support a 57 GW winter peak, and line rebuilds alone cannot address the concerns observed in this study. The study did not determine exactly which new lines would be necessary to serve a 57 GW peak reliably, since this roadmap began to converge on

the same solutions as other roadmaps as more lines were added. If this roadmap is followed, the region could potentially use demand response, energy efficiency, and other measures to achieve 6 GW of load reduction and avoid a 57 GW winter peak. However, these solutions also have associated costs. This roadmap would be easier to site than roadmaps #1 and #3, although building fewer new lines would likely come with disadvantages related to stability and voltage performance that cannot be accurately quantified in this study. The concerns regarding loss of right-of-way described at the end of section 4.1.1 with regard to roadmap #1 would apply to this roadmap as well. Figure 4-2 represents the approximate locations of rebuilds described in this roadmap.



Figure 4-2: North-South/Boston Import Minimization of New Lines Roadmap

4.1.3 North-South/Boston Import Roadmap #3: Point-to-point HVDC Roadmap

The third roadmap centers around a potential point-to-point HVDC framework. It consists of a single 1,200 MW HVDC line from the Surowiec substation in Pownal, Maine to the Mystic substation in Everett, Massachusetts. Additionally, the new AC cable from Stoughton to K Street described in Roadmap #1 would be required to help resolve import issues in the southern and western portions of the Boston sub-region. This roadmap is useful for addressing high-likelihood concerns for all snapshots through 51 GW of load. In order to reliably serve the 57 GW load level in the 2050 winter peak snapshot, an additional 1,200 MW HVDC line would need to be constructed between 2040 and 2050 from the South Gorham substation in Gorham, Maine to the Tewksbury substation in Tewksbury, Massachusetts. The HVDC lines in this roadmap could be constructed overhead, underground, or underwater, offering flexibility for siting. The DC/AC converters at each terminal of the HVDC lines may also have short-circuit and stability benefits that were not quantified by this study. The main disadvantage to this roadmap will likely be related to land availability in Boston for

siting the large DC/AC converter stations needed to terminate these new HVDC lines; although the Tewksbury area likely has enough land availability for this converter station, and Mystic may have enough availability once the existing generation at that location has been retired. In addition to the major upgrades described above, this roadmap would require approximately 624 miles of overhead line rebuilds to reliably serve a 51 GW load and 1,027 miles of overhead line rebuilds to reliably serve a 57 GW load. Figure 4-3 represents the general direction of power flow and location of major new transmission lines in this roadmap.

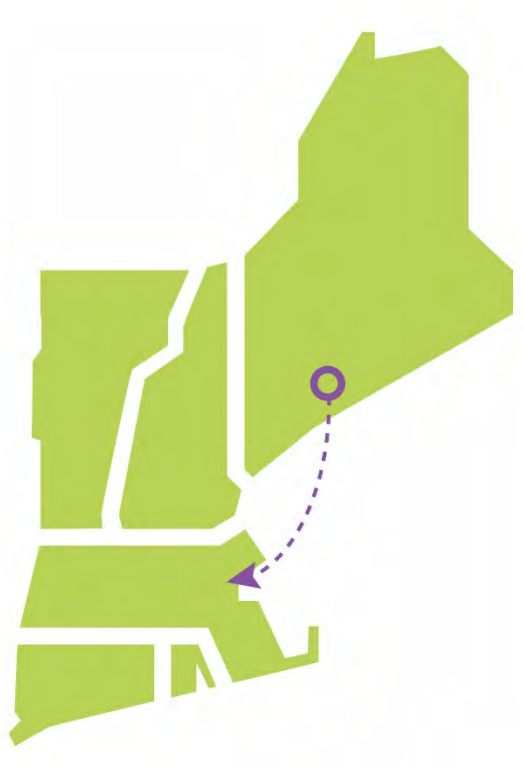

Figure 4-3: North-South/Boston Import Point-to-Point HVDC Roadmap

4.1.4 North-South/Boston Import Roadmap #4: Offshore Grid Roadmap

The final roadmap would make use of an offshore grid framework by connecting up to three offshore wind plants. These would be connected with offshore HVDC cables to form new paths between wind farms. In combination with the cables already built to connect these wind farms to on-shore substations, these offshore connections will enable the transfer of power between various sub-regions in New England. Several different configurations were examined. Initially, the study investigated a grid connecting offshore wind that interconnected in Maine, New Hampshire, and Boston. This solution was not efficient, since offshore grids are most effective when there is excess capacity on the offshore cables, i.e., when wind output is relatively low and more spare capacity is available to transfer power through the cables. The North-South interface was most highly overloaded during the winter peak snapshots, when wind output was at its highest, meaning that each 1,200 MW offshore connection had just ~200 MW of excess capacity available. This made only a minor difference in resolving overloads. Overloads on lines crossing the North-South interface were so high that roughly 10 connections between northern New England and Boston would be required (under the offshore grid framework) to solve the concerns, and there were not enough offshore wind interconnection points to make this feasible. Additionally, such a high number of

offshore connections would lead to significantly higher costs than other roadmaps for North-South transfers.

The offshore grid was much more effective in the summer peak snapshots, when the wind production was low and there was more spare capacity available on the cables. Many of the Boston Import overloads were worse in the summer, when wind injections into Boston dropped. When overloads were observed in winter, they were relatively small. The offshore grid is therefore a good candidate for solving these particular concerns.

Various configurations were examined before this roadmap was finalized. To address concerns related to high Boston Import flows, the roadmap centers on a three-terminal offshore grid between Brayton Point in Somerset, Massachusetts; K Street in Boston, Massachusetts; and Mystic in Everett, Massachusetts by building offshore connections between Brayton Point Wind, K Street Wind, and Mystic Wind.[14] This framework was sufficient for the 2035 and 2040 snapshots. For the 2050 snapshots, two separate connections between pairs of offshore wind farms were required in addition to the three-terminal grid; one between West Farnum Wind (interconnecting in North Smithfield, Rhode Island) and Brighton Wind (interconnecting in Boston, Massachusetts), and another between Montville Wind (interconnecting in Uncasville, Connecticut) and Woburn Wind (interconnecting in Woburn, Massachusetts). These offshore upgrades were sufficient to solve the Boston Import concerns. The study assumed that all interconnected wind plants would be located in the wind lease area off of the southern coast of New England, and thus would be connected together with relatively short underwater cables.

The incremental cost of this offshore grid roadmap is simply the total cost of these offshore-offshore connections, since the study inherently assumed offshore wind generation and thus associated cables to the shore were covered by generation interconnections which were beyond the scope of the 2050 Transmission Study. These offshore – onshore cables would be required to bring wind energy onshore whether the individual wind plants are each connected directly to the shore or as part of a networked offshore system. Any interconnected offshore wind plants would need to be built such that they are compatible with other offshore wind plants in the area, facilitating their connection to a network. For example, any HVDC technology used on the cables would need to be inter-operable between any other wind farms that would eventually be connected together. Solving the remaining North-South interface concerns under this roadmap would require the AC roadmap's North-South upgrades: a new 345 kV line from Surowiec, Maine to Timber Swamp, New Hampshire, and a new 345 kV line from Timber Swamp to Ward Hill in Massachusetts, with this line doubled for the 57 GW winter peak snapshot. The continuation of this line to Wakefield Junction and Mystic would not be necessary, since the Boston Import issues addressed by this continuation in the second roadmap were resolved by the offshore grid in this roadmap. The offshore grid also removes the need for a third 345 kV Stoughton – K Street underground cable. In addition to the major upgrades described above, this roadmap would require approximately 606 miles of overhead line rebuilds to reliably serve a 51 GW load and 1,023 miles of overhead line rebuilds to reliably serve a 57 GW load. Figure 4-4 represents the general location of conceptual wind projects and interconnections in this roadmap.

[14] Capitalized wind project names in this section and in Figure 4-4 are purely hypothetical, and are merely provided as placeholders in order to reduce confusion. These names refer to the onshore substations to which each wind farm connects.

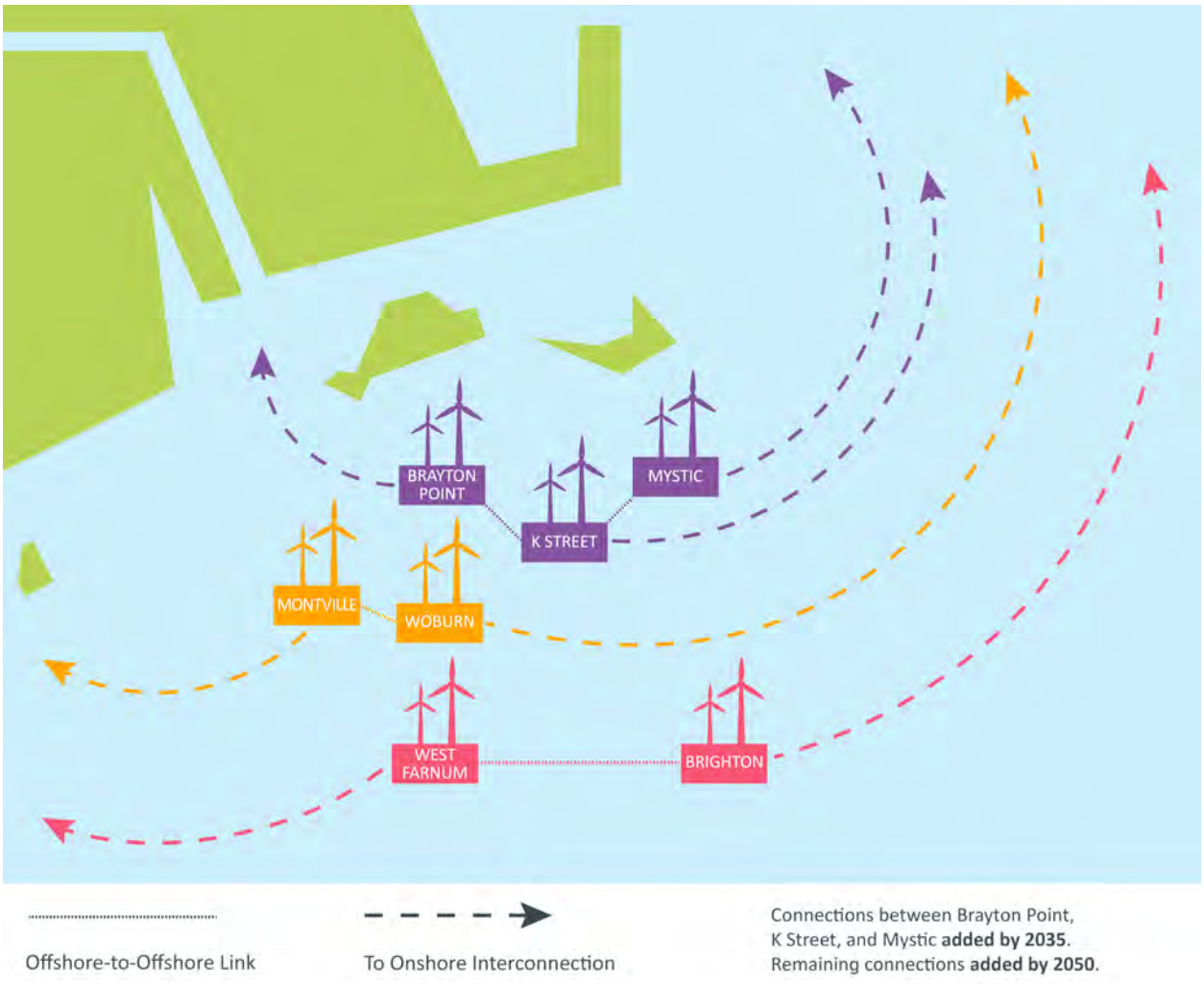

Figure 4-4: Boston Import Offshore Grid Roadmap

4.1.5 Other Projects to Resolve Concerns in Boston

The roadmaps described in previous sections resolve many concerns related to bringing power into the Boston sub-region from elsewhere in New England. However, these roadmaps do not resolve a number of concerns related to moving power around the Boston sub-region. These concerns were caused primarily by the need to bring power from the major 345 kV hubs in Boston to each individual 115 kV substation where power is delivered to the local distribution network. As described previously, relocation of offshore wind interconnections addresses some of these concerns. The remaining concerns, shown in Figure 3-1, are addressed with a combination of the Boston-related portions of the other roadmaps and the following projects.[15]

[15] Replacement of existing pipe-type underground cables in the Boston area for asset condition reasons, as mentioned on slide 13 of a July 2023 presentation regarding upcoming asset condition projects, is not included in this analysis, and the cost is not included in the total costs discussed in Section 5 of this report. When analysis for the 2050 Transmission Study was conducted, sufficient information to model these projects was not available.

The first project includes the conversion of three existing 230 kV lines in the western portion of the greater Boston region to 345 kV standards. These lines would bring power from the West Medway substation, in Medway, Massachusetts, to the Waltham, Sudbury, and Framingham substations, and help bring power to other 115 kV substations nearby. Upgrading these lines to 345 kV would allow them to bring more power into these areas from the southwest, reducing the stress on underground cables west of Boston. The mileage of these rebuilt lines is included in the total overhead line mileage listed for each roadmap above.

The second project includes a new substation in Cambridge, Massachusetts designed to tie together lines serving the Kendall Square area of Cambridge with lines leading towards Brighton and other neighborhoods in the western portion of Boston. This new substation is included in all Boston Import roadmaps in this study in order to eliminate overloads on the cables connecting the 345 kV network at the North Cambridge substation to the Brighton substation.

4.2 Northwestern Vermont Import Roadmaps

Four roadmaps were developed for solving the high-likelihood concerns observed in northwestern Vermont around the city of Burlington. These roadmaps were developed to provide the region's stakeholders with a variety of examples of how these concerns might be mitigated. As with the previous roadmaps, the ISO does not recommend any particular roadmap over another; each includes advantages and disadvantages. Collaboration between stakeholders and the region as a whole will help determine the best path forward.

4.2.1 Northwestern Vermont Import Roadmap #1: PV-20 Upgrade and Doubling of K-43 Roadmap

The first roadmap centers on upgrading the PV-20 line from New York into Vermont from 115 kV to 230 kV, and constructing a new 115 kV overhead line in parallel to the existing K-43 line that runs from the New Haven substation in New Haven, Vermont to the Williston substation just south of the city of Burlington in northern Vermont. The 230 kV conversion of the existing PV-20 line would only require work on the overhead portion of the line, since the underwater portion that runs under Lake Champlain is already capable of operating at 230 kV. The portion of the line that would need to be upgraded to 230 kV is approximately 9.3 miles long. An additional 7.55 miles of overhead line would need to be converted to 230 kV between Vermont and New York, but the cost estimates in this study only cover the portion of the line that is within New England, ending at the overhead-to-submarine transition structure on the eastern shore of Lake Champlain. A new 230/115 kV transformer would also be required at the Sandbar substation north of the city of Burlington. The build of the new 115 kV line in parallel to the existing K-43 line will be similar to the existing 20.8-mile-long line, with the assumption that the existing K-43 line is also rebuilt with larger conductors. This roadmap would also require approximately 120 miles of 115 kV overhead line rebuilds to reliably serve a 51 GW load and 151 miles of 115 kV overhead line rebuilds to reliably serve a 57 GW load. Both of these numbers include the 20.8 mile rebuild of the existing K-43 line mentioned above. In addition to transmission line additions and upgrades, three new 345/115 kV transformers need to be added at existing 345 kV stations in Vermont to reach a 51 GW load, and an additional two new 345/115 kV transformers need to be added at existing 345 kV stations in Vermont to reach a 57 GW load. Figure 4-5 represents the general direction of power flows and location of the new transmission line and the 115-to-230-kV conversion in this roadmap.



Figure 4-5: Northwestern Vermont Import PV-20 Upgrade and Doubling of K-43 Roadmap

4.2.2 Northwestern Vermont Import Roadmap #2: Coolidge-Essex Roadmap

The second roadmap would require the construction of a new 345 kV line from the Coolidge substation north of Ludlow, Vermont, to the Essex substation just outside of the city of Burlington, Vermont. This line would be approximately 90 miles long and would likely require the expansion of existing transmission rights-of-way for the majority of its length. New 345 kV substation equipment, including a 345/115 kV transformer, would be required at the Essex substation, as this station is currently only capable of 115 kV operation. This option would require approximately 105 miles of 115 kV overhead line rebuilds to reliably serve a 51 GW load and approximately 189 miles of 115 kV overhead line rebuilds to reliably serve a 57 GW load. In addition to the new transformer at Essex, one new 345/115 kV transformer would need to be installed at an existing 345 kV substation to reach 51 GW and an additional one 345/115 kV transformer would be needed at an existing 345 kV substation to reach 57 GW. Figure 4-6 represents the general direction of power flow and location of new transmission lines in this roadmap.



Figure 4-6: Northwestern Vermont Import Coolidge-Essex Roadmap

4.2.3 Northwestern Vermont Import Roadmap #3: New Haven-Essex and Granite-Essex Roadmap

The third roadmap would require construction of a new 345 kV line from the New Haven substation in New Haven, Vermont, to the Essex substation just outside of the city of Burlington, in addition to a new 230 kV overhead line from the Granite substation east of Williamstown, Vermont, to the Essex substation.[16] Both of these new lines would require their own new substation equipment at the Essex substation to operate at 345 kV and 230 kV, since the Essex substation is currently only capable of 115 kV operation. This new equipment would include a new 345/115 kV transformer and a new 230/115 kV transformer. The length of the line from New Haven to Essex would be approximately 25 miles and the length of the line from Granite to Essex would be approximately 45 miles. This option would require approximately 79 miles of 115 kV overhead line rebuilds to reliably serve a 51 GW load and approximately 121 miles of 115 kV overhead line rebuilds to reliably serve a 57 GW load. In addition to new transformers at Essex, two new 345/115 kV transformers would need to be installed at existing 345 kV substations to reach a 51 GW load and an additional one 345/115 kV transformer would be needed at an existing 345 kV substation to reach 57 GW. Figure 4-7 represents the general direction of power flows and location of new transmission lines in this roadmap.

[16] It may be prudent to build this line to 345 kV standards in advance, to allow for an eventual conversion of the Vermont and New Hampshire 230 kV systems to 345 kV if necessary.



Figure 4-7: Northwestern Vermont Import New Haven-Essex and Granite-Essex Roadmap

4.2.4 Northwestern Vermont Import Roadmap #4: Minimization of New Lines Roadmap

A variation on the first roadmap was also examined to determine if the Vermont high-likelihood concerns could be resolved without constructing entirely new overhead lines. Results showed that the new line in parallel to the K-43 line could be eliminated if the 0.4 mile underground section of the K-65 line between the North Ferrisburg substation and Charlotte substation, along with the 1.7 mile underground section of the K-65 line between the Shelburne substation and the Queen City substation in southern Burlington, had an additional parallel cable added to each section. The PV-20 upgrade from 115 kV to 230 kV (in both New York and in Vermont), along with the new 230/115 kV transformer, would still be required. This option would require approximately 142 miles of 115 kV overhead line rebuilds to reliably serve a 51 GW load and approximately 192 miles of overhead line rebuilds to reliably serve a 57 GW load. Three new 345/115 kV transformers would need to be installed to reach 51 GW of load, and an additional two 345/115 kV transformers would be needed to reach 57 GW. The choice between the first roadmap and this variation is therefore a choice between building a 20.8 mile overhead line versus doubling up 2.1 miles of underground cables plus rebuilding approximately 41 miles of overhead lines to reliably serve a 57 GW load. However, this approach of minimizing new overhead construction is generally less robust than roadmaps involving additional overhead transmission lines. In addition to the voltage and stability benefits of new transmission lines, new overhead lines also provide more margin for loads higher than those assumed in this study, different load distributions among the substations in Vermont, and other unexpected developments. Rebuilds alone leave very little headroom to operate the system reliably, with many lines loaded very close to their ratings under post-contingency conditions. Figure 4-8 represents the general direction of power flow and location of new transmission lines and the 115-to-230-kV conversion in this roadmap.



Figure 4-8: Northwestern Vermont Import Minimization of New Lines Roadmap

4.3 Southwest Connecticut Import

Like Boston, the Southwest Connecticut area is a densely populated urban area with high demand for power and little space for overhead transmission line corridors. As heating and transportation are electrified between now and 2050, load in this area is anticipated to grow, and additional transmission capacity will be necessary to serve this load reliably. While it may be possible to serve this load by interconnecting generating and storage resources locally, the Energy Pathways study specified relatively low amounts of offshore wind and storage for the state of Connecticut, and there is little land available for utility-scale solar in this area. The 2050 Transmission Study assumed that a new offshore wind farm would connect to the Norwalk substation, and that battery storage facilities would interconnect at Cos Cob (in Greenwich, CT) and Glenbrook (in Stamford, CT). Even with the assumption that these facilities will inject power into the subregion, additional transmission is needed to serve load reliably.

This study found that one set of solutions could address reliability concerns in Southwest Connecticut at a relatively lower cost and impact than other solution alternatives—hence the lack of multiple roadmaps for this subregion. The representative solutions suggested for this area include three new 115 kV underground cables in the Norwalk-Stamford area: one from Norwalk to Glenbrook (in Stamford, CT); one from Ely Avenue to Norwalk Harbor (both in Norwalk, CT); and a third extending an existing cable from its current endpoint at South End (in Stamford, CT) to Cos Cob. The Norwalk-Glenbrook cable would take advantage of a spare 115 kV duct bank in parallel with two existing Norwalk-Glenbrook cables, which would reduce its cost somewhat compared to an underground cable on a brand-new route. In addition to these upgrades, 96 miles of overhead

115 kV lines and 6 miles of underground 345 kV lines must be rebuilt, and two 345/115 kV transformers must be added in order to reliably serve a 51 GW winter peak load.

Additional 345 kV capacity into Southwest Connecticut would be required to serve a 57 GW winter peak load. Today, the region is fed by only two 345 kV paths: one from Long Mountain (in New Milford, CT), and the other from Beseck (in Wallingford, CT). Portions of the path from Long Mountain to Norwalk are underground, leading to lower ratings than a typical 345 kV overhead line. While additional 345 kV overhead lines would provide the capacity needed, these lines would be lengthy and would be difficult to route and site through the densely populated areas of Southwest Connecticut. Instead, this study suggests re-using an unused underground segment of the Long Mountain-Norwalk path, which would allow for more power flow. This cable was originally de-energized due to temporary over-voltage concerns.[17] Additional study would be required to ensure that the cable could be re-energized safely without risking equipment damage; additional substation equipment may be necessary to manage voltage if this cable is placed into service. The costs of this study work and substation equipment would likely be far less than developing a third 345 kV path into Southwest Connecticut. Along with re-energizing this cable, an additional two 345/115 kV transformers, 125 miles of rebuilt overhead 115 kV lines, and 21 miles of rebuilt overhead 345 kV lines would be necessary to reliably serve Southwest Connecticut at the 57 GW winter peak load level. Figure 4-9 represents the general direction of power flows and location of major new transmission lines in this roadmap.



Figure 4-9: Southwest Connecticut Import Transmission Additions

4.4 Transformer Additions

As described in section 2.5, transformer capacity has the potential to create bottlenecks in the power system between today and 2050. A large number of existing PTF transformers, primarily 345/115 kV transformers, were identified as overloaded before representative transmission upgrades were added to the system models. Table 4-1 lists the number of transformer overloads across different snapshots, and illustrates the correlation between transformer overloads and increasing load. The results marked "pre-optimization" show results from July 2022, before the study was redesigned to optimize generator interconnection locations. As described in section 2.4, generator locations have a major impact on power flows and overloads on transformers. Results

[17] Temporary over-voltage is a phenomenon caused by short-circuit conditions and by switching of transmission elements. This phenomena is particularly severe in areas with significant development of underground transmission, including Southwest Connecticut.

marked "post-optimization" show the effects of optimization on reducing transmission overloads. All results in this table are exclusive of any representative transmission upgrades.

Table 4-1: Transformer Overloads by Snapshot Year, Pre- and Post-Optimization

Year Studied	Number of PTF Transformers Overloaded[18]	
	Pre-Optimization Results	Post-Optimization Results
2035 (35 GW Winter Peak)	14	16
2040 (43 GW Winter Peak)	56	43
2050 (51 GW Winter Peak)	86	57
2050 (57 GW Winter Peak)	99	81

While a large number of PTF transformers were overloaded in the initial study results, a smaller number of transformers would be required to address these concerns. In many cases, multiple existing transformers at a single substation are overloaded, and the addition of a single new transformer is sufficient to return the loading on all existing transformers to applicable limits. While the exact number of required transformers varies based on the roadmap chosen for North-South/Boston Import and Northwest Vermont, all combinations of roadmaps require approximately 40 new transformers to address all reliability concerns. Of these 40 transformers, approximately 20 would address high-likelihood concerns. The remaining 20 would be needed to address non-high-likelihood concerns, and in many instances, are only needed to serve load in the 57 GW winter peak snapshot.

Given the long lead times (18-24 months), limited manufacturing capability, and transportation challenges for large power transformers, transformer capacity has the potential to be a significant limiting factor on the evolution of the power system and the electrification of end-user energy consumption.

4.5 Other High-Likelihood Concerns

In addition to the concerns described above, the study revealed a number of other isolated high-likelihood concerns that were not related to consistent trends like those associated with North-South transfers or other named high-likelihood concerns. The following upgrades were considered in order to address these other high-likelihood concerns:

- Upgrade and convert 298 miles of 69 kV lines to 115 kV.
- Rebuild 225 miles of overhead 115 kV lines.
- Rebuild 37 miles of overhead 345 kV lines.
- Build 13 miles of new overhead 115 kV lines.

[18] Numbers in this table are based on N-1-1 results when accounting for single-element second contingencies (loss of line, transformer, etc.) but not multiple-element second contingencies (breaker failures, double-circuit tower contingencies, etc.).

- Build two new overhead 345 kV lines between Brayton Point and Grand Army (both in Somerset, MA), for a total of 3 miles of new construction.
- Increase the rating of the series capacitor on line 3023 in Orrington, ME.

These upgrades are scattered around New England, rather than concentrated in a particular area. Full details on these additional upgrades can be found in the Technical Appendix to this report.

4.6 Non-High-Likelihood Concerns

Finally, many concerns found in this study were not considered high-likelihood concerns, and are mainly related to serving load for the 57 GW winter peak load level. Since they only appear at this load level, they are particularly sensitive to the distribution of load among individual substations. If the evolution of the region's distribution system differs significantly from the assumptions studied, it is possible that new distribution substations will be located in a way that changes the severity and location of these reliability concerns. Therefore, these concerns are not considered high-likelihood.

The upgrades associated with these non-high-likelihood concerns are as follows. While the exact upgrades may vary depending on the location of distribution load-serving substations, this list of upgrades is a reasonable approximation of upgrades that will be required if the region's load grows to a 57 GW winter peak.

- Rebuild 393 miles of overhead 115 kV transmission lines.
- Rebuild 287 miles of overhead 345 kV transmission lines.
- Build 105 miles of new overhead 115 kV transmission lines.
- Build 57 miles of new underground 115 kV cables.
- Replace 10 miles of existing underground 115 kV cables with higher-rated cross-linked polyethylene (XLPE) cables.
- Install 4 new series reactors at various locations throughout New England.
- Install approximately 300 new circuit breakers at various substations throughout New England.
- Separate transmission lines on 10 sections of double-circuit towers.[19]

[19] Double-circuit towers are structures supporting two overhead transmission lines on the same structure. NERC, NPCC, and ISO-NE reliability criteria require the consideration of the loss of both lines on double-circuit towers simultaneously, which is often caused by lightning strikes. Separation of circuits on double-circuit towers involves building new structures for at least one of the two circuits, and depending on the right-of-way layout, may or may not require additional right-of-way width.

4.7 Maps of All Transmission Upgrades and Additions

The maps in this section show the full set of transmission upgrades identified as conceptual roadmaps in this study. Rebuilds of existing transmission lines are shown in purple and new transmission lines are shown in red.

The maps below should not be considered authoritative lists of all line rebuilds; due to the scale of the maps and approximations of substation locations, some lines are difficult or impossible to distinguish from each other. All transmission lines are represented as straight lines between endpoints, and thus do not reflect actual line routes or locations of rights-of-way. This study examined four different northwestern Vermont roadmaps and four different North – South/Boston Import roadmaps. The northwestern Vermont roadmaps were far enough away from the North – South/Boston Import roadmaps that they can be considered to be independent from each other. The maps below show one northwestern Vermont roadmap paired with one North – South/Boston Import roadmap each, but these could be paired in any combination, rather than being limited to the ones shown below. A full list of rebuilt transmission lines for each roadmap may be found in the Technical Appendix to this report.



Figure 4-10: Transmission Upgrades and Additions for the Coolidge -Essex Roadmap and the AC Roadmap



Figure 4-11: Transmission Upgrades and Additions for the Minimization of New Lines Roadmaps



Figure 4-12: Transmission Upgrades and Additions for the PV-20 Roadmap and the DC Roadmap



Figure 4-13: Transmission Upgrades and Additions for the New Haven - Essex Roadmap and the Offshore Grid Roadmap

Section 5: Cost of Transmission System Upgrades

One of the major goals of the 2050 Transmission Study was to provide a rough estimate of the costs required to develop the transmission system of 2050. The projects proposed as conceptual roadmaps in this study are not intended to constitute a transmission plan, and the region's transmission system will likely develop differently from the system envisioned in this study. However, the identified upgrades are still useful for providing an order-of-magnitude estimate of future transmission system costs. These estimated costs are intended to inform consumers, industry stakeholders, and policy makers of the costs inherent in maintaining reliable transmission service through the clean energy transition.

The ISO's estimates of costs for these representative transmission projects were developed from two sources. The first, used for more complex projects, was Electrical Consultants, Inc. (ECI), a consultant with extensive experience in project management and transmission system construction. ECI's cost estimates were primarily made up of materials, labor, and right-of-way costs. These cost estimates did not include some aspects of transmission costs, such as financing costs (allowance for funds used during construction, or AFUDC), contingency costs for unexpected difficulties during construction, and engineering, permitting, and indirect costs. ECI did include permitting fees and filing costs, but these costs did not reflect the extensive labor typical of permitting large projects in New England. To account for these and to ensure ECI's calculated costs were easily comparable to actual project costs in New England, a 95% adder was applied. This adder was calculated as follows:

- 10% adder for financing costs: Recent transmission projects in New England have incurred financing costs in the range of 5-14% of the total labor, materials, and right-of-way costs. A 10% adder approximates the midpoint of this range.
- 20% adder for engineering, permitting, and indirect costs: These costs have varied widely on recent transmission projects, from 2% to 32% of the total labor, materials, and right-of-way costs. Larger projects, especially those involving underground transmission, tend to be near the higher end of this range. A 20% adder is slightly higher than the midpoint of this range.
- 50% adder for contingency: ISO-NE Planning Procedure 4 (PP4), Attachment D specifies a contingency adder of 30-50% for projects with cost estimates in the "Proposed" stage of project development.[20] ECI's estimates were "desktop" estimates made without field visits or detailed analysis of local site conditions. Consequently, the high end of this 30-50% range is appropriate to reflect the possibility of significant extra costs as projects proceed.
- The 50% contingency is applied to the material/labor/right-of-way cost, financing, and engineering/permitting/indirect costs; this leads to a final cost of 130% (the financing and engineering/permitting/indirect adder) times 150% (the contingency adder), or a total of 195% (95% above the original materials/labor/right-of-way cost).

The second source of cost data was a set of assumptions based on recently-observed project costs in New England. The ISO analyzed cost data from reliability projects in both the Regional System Plan (RSP) Project List and asset condition projects from the Asset Condition List (ACL). These projects were used to develop per-mile assumptions for new or substantially rebuilt transmission lines, and for additions to existing substations such as new transformers and circuit breakers.

[20] PP4 Attachment D is available on ISO-NE's website at https://www.iso-ne.com/static-assets/documents/rules_proceds/isone_plan/pp04_0/pp4_0_attachment_d.pdf.

These cost assumptions were used for rebuilds of existing lines and other less complex projects. Because of the sheer number of transmission projects included in this study, this approach provided a more cost-effective method for estimating costs. Conducting detailed cost analysis for these transmission line rebuilds and other simpler projects would be expensive, time-consuming, and unlikely to add significant precision. Some projects will likely exceed the costs calculated using these assumptions, and other projects will be less expensive than the assumptions, but the ISO's expectation is that the aggregated cost of the full list of these projects will be within an order-of-magnitude range of accuracy. The cost assumptions developed are shown in Table 5-1.

Table 5-1: Cost Assumptions for 2050 Transmission Study Upgrades

Project Type	Assumed Cost
69/115 kV – rebuild of existing overhead lines	$5M per mile
69/115 kV – new overhead line construction	$7M per mile
230/345 kV – rebuild of existing overhead lines	$6M per mile
230/345 kV – new overhead line construction	$8M per mile
New 115/69 kV transformer	$10M per transformer
New 345/115 kV transformer	$10M per transformer
New 69/115 kV circuit breaker	$2M per breaker
New 230/345 kV circuit breaker	$2M per breaker
New/replaced underground line construction (any voltage level)	$35M per mile

In addition to the costs listed above, this study uses representative cost assumptions for components of offshore grids. These costs were developed as part of the National Renewable Energy Laboratory (NREL)'s Atlantic Offshore Wind Transmission Study, and presented as part of a progress update on that study on July 27, 2023. These costs are illustrated in Table 5-2.

Table 5-2: Cost Assumptions for Offshore Grid Components

Component	Assumed Cost
HVDC Circuit Breaker	$37.5M per breaker
"End" platform (wind farm connection to one other wind farm)	$112.5M per platform
"Middle" platform (wind farm connection to two other wind farms)	$142.5M per platform
HVDC Cable	$10.5M per mile

The costs provided by the NREL team include engineering, permitting, indirect, and financing costs; however, they do not include any allowance for contingency. As a result, a 50% adder above the materials and labor costs were applied to these estimates. This 50% adder is included in the costs.

A number of caveats must be applied to the cost estimates included in this report. First, they include only a subset of the total costs of transitioning the electric delivery system to a low-emissions future. The costs of upgrades related to voltage performance, transient stability performance, short-circuit performance, and other aspects of transmission planning that are beyond the scope of this study are not included here. Other transmission upgrades, such as new load-serving substations and required generator interconnection upgrades, are also not included. Second, significant upgrades to distribution systems will be needed in order to accommodate a 2050 peak load that is roughly double what New England has historically experienced. These distribution system upgrades will form a substantial portion of the cost of the clean energy transition. However, this is beyond the scope of the 2050 Transmission Study, and beyond the ISO's jurisdiction and expertise.

It should also be noted that all costs quoted in this report are expressed in present-day (2023) dollars. No adjustments to account for inflation, increases in equipment prices, or other long-term trends were applied. As New England and other regions of the United States and the world are undergoing energy transitions simultaneously, it is difficult to predict long-term trends in electrical equipment costs, and these long-term trends could significantly affect the costs quoted in this report.

5.1 Estimated Costs by Roadmap and Year

The following section lays out the total costs estimated by the 2050 Transmission Study, and categorizes those costs by type of rebuild. All costs are subject to the caveats noted previously. Costs are provided for each roadmap and are broken down by the year studied (2035, 2040, and 2050) to illustrate the degree to which costs might possibly be deferred to later dates in the energy transition. Two sets of costs are included for 2050: one to accommodate a winter peak of 51 GW (a reduced peak load, as described in Section 2.1), and one to accommodate the 57 GW peak load assumed in the Energy Pathways to Deep Decarbonization report.

Costs illustrated in Table 5-3 and Figure 5-1 are associated with the North-South/Boston Import roadmaps. These costs will be affected by the choice of four roadmaps detailed in Section 4.1. Figure 5-2 and Figure 5-3 categorize the costs by rebuild type for both the 51 GW and 57 GW winter peak load snapshots.

Table 5-3: Estimated Cumulative Costs for North-South/Boston Import Roadmaps

Year/Load Level	AC Roadmap	Minimization of New Lines Roadmap	Point-to-Point HVDC Roadmap	Offshore Grid Roadmap
2035	$4.4 Billion	$2.8 Billion	$5.0 Billion	$4.0 Billion
2040	$6.2 Billion	$5.0 Billion	$6.5 Billion	$5.8 Billion
2050 (51 GW winter peak)	$7.6 Billion	$7.5 Billion	$7.9 Billion	$7.9 Billion
2050 (57 GW winter peak)	$10.2 Billion	Not Achievable*	$12.8 Billion	$10.7 Billion

*As described previously, the Minimization of New Lines roadmap is not capable of reliably serving a 57 GW peak load.



Figure 5-1: Estimated Cumulative Costs for North-South/Boston Import Roadmaps

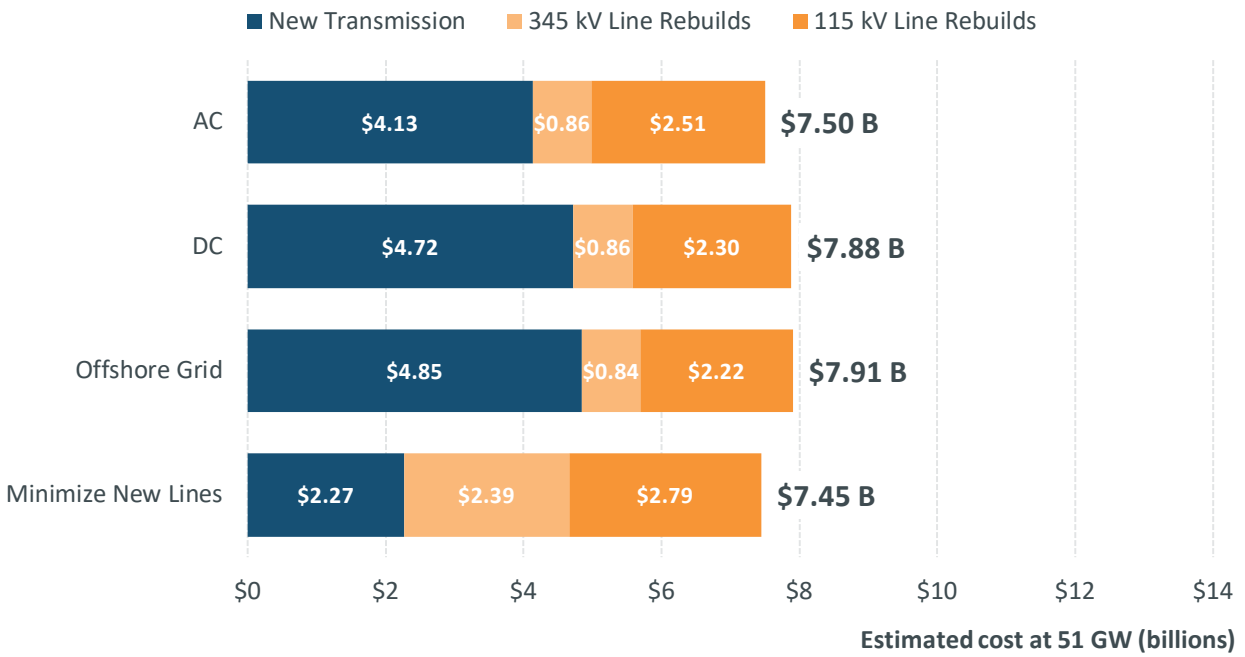

Figure 5-2: Cost Categories for North-South/Boston Import Roadmaps: 51 GW Winter Peak

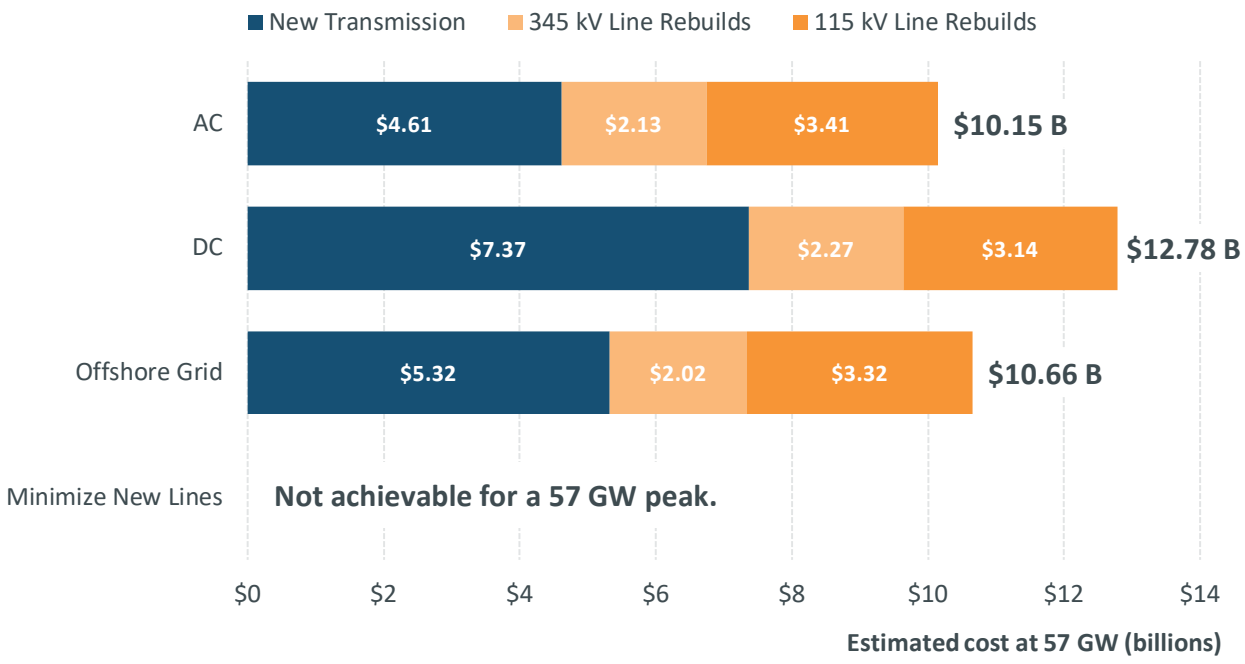

Figure 5-3: Cost Categories for North-South/Boston Import Roadmaps: 57 GW Winter Peak

Costs illustrated in Table 5-4 and Figure 5-4 are associated with the Northwest Vermont roadmaps. As with North-South/Boston Import costs above, multiple roadmaps were developed for this high-likelihood concern and detailed in Section 4.2. Figure 5-5 and Figure 5-6 categorize the costs by rebuild type for both the 51 GW and 57 GW winter peak load snapshots.

Table 5-4: Estimated Cumulative Costs for Northwestern Vermont Import Roadmaps

Year/Load Level	PV-20 Upgrade and Doubling of K-43 Roadmap	Coolidge – Essex Roadmap	New Haven – Essex and Granite – Essex Roadmap	Minimization of New Lines Roadmap
2035	$0.7 Billion	$1.1 Billion	$1.1 Billion	$0.6 Billion
2040	$0.8 Billion	$1.3 Billion	$1.1 Billion	$0.8 Billion
2050 (51 GW winter peak)	$0.9 Billion	$1.5 Billion	$1.2 Billion	$0.9 Billion
2050 (57 GW winter peak)	$1.2 Billion	$2.0 Billion	$1.4 Billion	$1.2 Billion



Figure 5-4: Estimated Cumulative Costs for Northwestern Vermont Import Roadmaps

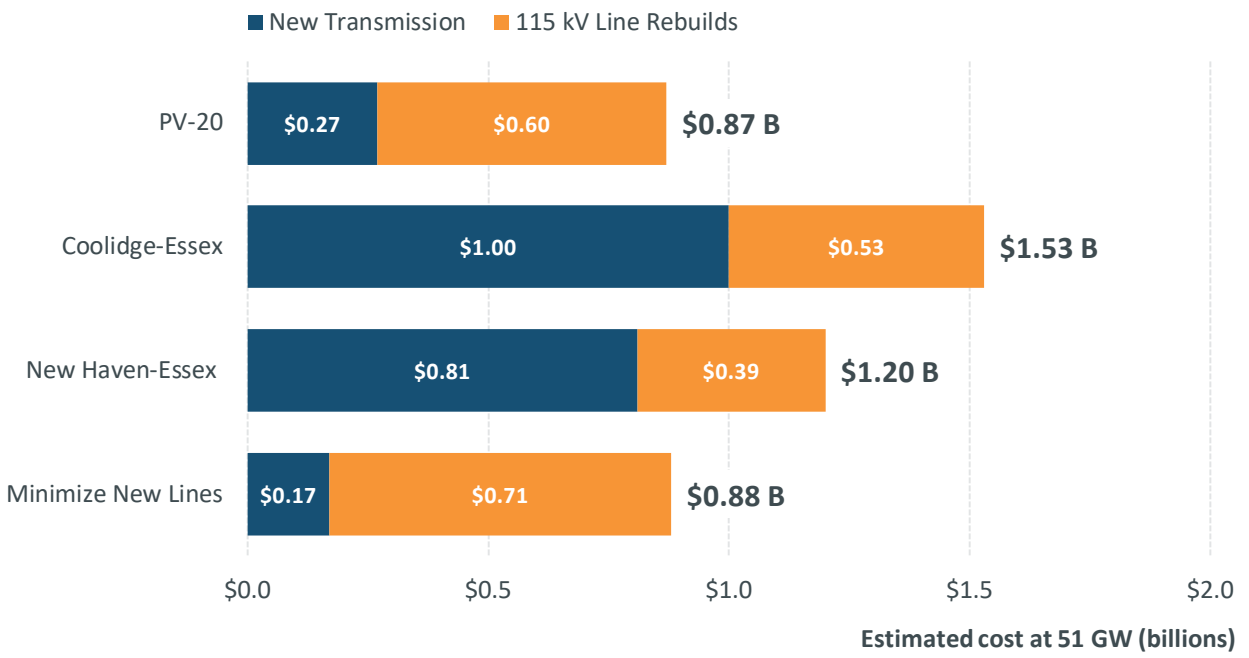

Figure 5-5: Cost Categories for NWVT Import Roadmaps: 51 GW Winter Peak

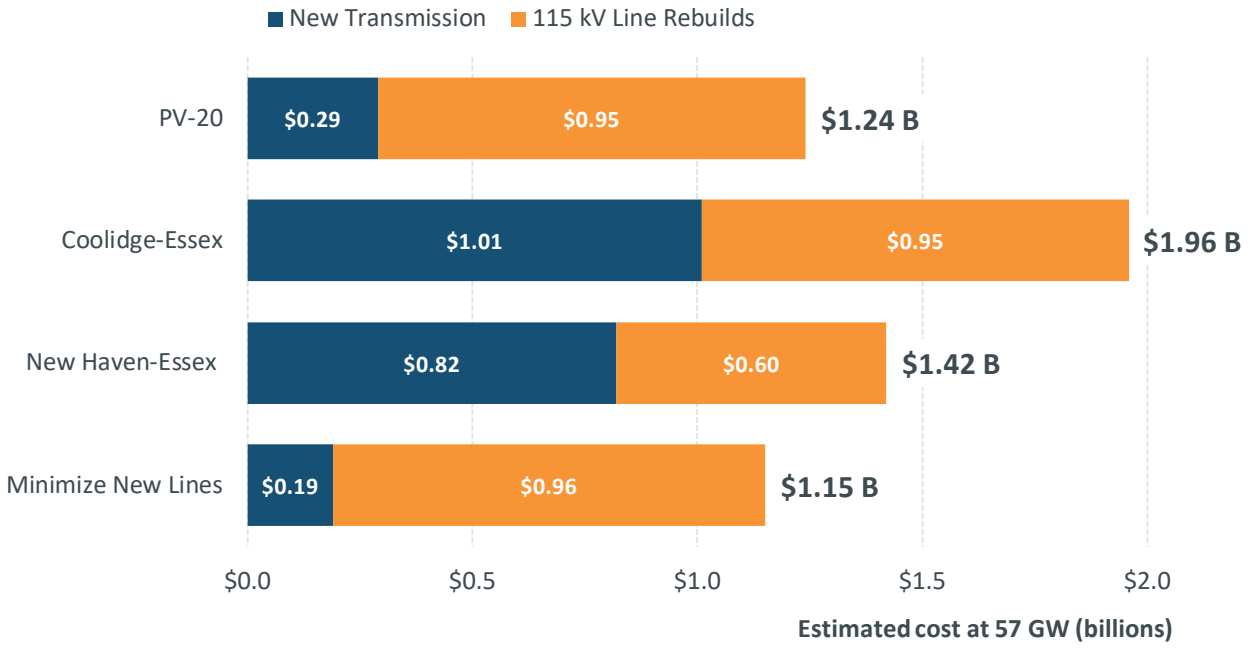

Figure 5-6: Cost Categories for NWVT Import Roadmaps: 57 GW Winter Peak

Costs illustrated in Table 5-5 are associated with the Southwest Connecticut Import high-likelihood concern.

Table 5-5: Estimated Cumulative Costs for Southwest Connecticut Import

Year/Load Level	Southwest Connecticut Import
2035	$0.5 Billion
2040	$0.7 Billion
2050 (51 GW winter peak)	$0.8 Billion
2050 (57 GW winter peak)	$1.6 Billion

Costs illustrated in Table 5-6 are associated with miscellaneous high-likelihood concerns.

Table 5-6: Estimated Cumulative Costs for Miscellaneous High-Likelihood Concerns

Year/Load Level	Miscellaneous High-Likelihood Concerns
2035	$1.7 Billion
2040	$2.8 Billion
2050 (51 GW winter peak)	$3.1 Billion
2050 (57 GW winter peak)	$3.1 Billion

Table 5-7 shows the costs associated with addressing non-high-likelihood concerns:

Table 5-7: Estimated Cumulative Costs for Non-High-Likelihood Concerns

Year/Load Level	Non-High-Likelihood Concerns
2035	$0.4 Billion
2040	$1.4 Billion
2050 (51 GW winter peak)	$3.2 Billion
2050 (57 GW winter peak)	$6.6 Billion

Table 5-8 totals the costs associated with each year in the tables above and provides a range of costs for each year studied, while Figure 5-7 illustrates how those costs change by year studied and maximum load served.

Table 5-8: Estimated Cumulative Costs by Year Studied

Year/Load Level	Maximum Load Served (MW)	Total Cost Range	Cost Breakdown	
2035	35,000	**$6-9 Billion**	$2.8-5.0 Billion	N-S/Boston
			$0.6-1.1 Billion	NWVT
			$0.5 Billion	SWCT
			$1.7 Billion	Misc. HLC
			$0.4 Billion	Non-HLC
2040	43,000	**$11-13 Billion**	$5.0-6.5 Billion	N-S/Boston
			$0.8-1.3 Billion	NWVT
			$0.7 Billion	SWCT
			$2.8 Billion	Misc. HLC
			$1.4 Billion	Non-HLC
2050 (51 GW winter peak)	51,000	**$16-17 Billion**	$7.5-7.9 Billion	N-S/Boston
			$0.9-1.5 Billion	NWVT
			$0.8 Billion	SWCT
			$3.1 Billion	Misc. HLC
			$3.2 Billion	Non-HLC
2050 (57 GW winter peak)	57,000	**$23-26 Billion**	$10.2-12.8 Billion	N-S/Boston
			$1.2-2.0 Billion	NWVT
			$1.6 Billion	SWCT
			$3.1 Billion	Misc. HLC
			$6.6 Billion	Non-HLC

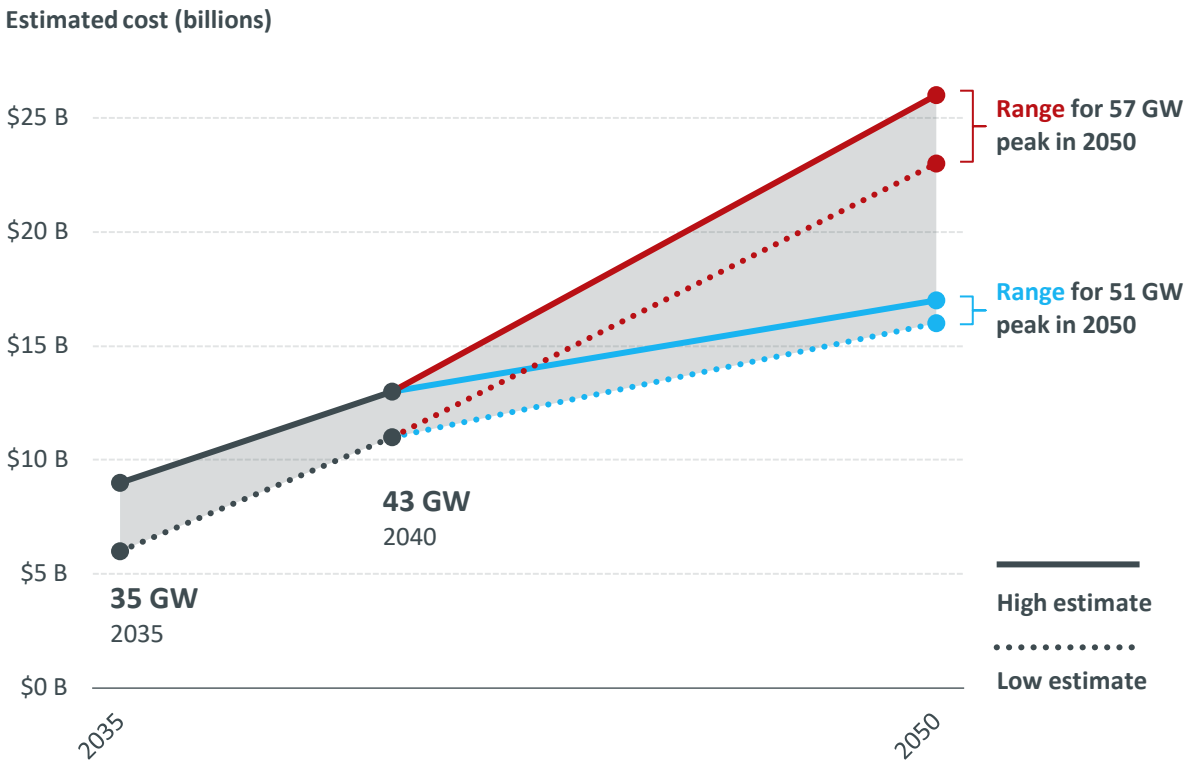

Figure 5-7: Total Costs by Year Studied

Note that these costs are only part of the required total investment in the transmission system. Other costs include asset condition projects unrelated to this study, and costs required to meet voltage, stability, and short-circuit needs. While these costs appear to be quite large, they should be viewed in the context of typical transmission system expenditures in New England on a yearly basis. The spending on these projects will be spread out over a 26-year period between now and 2050, so the total cost of $16-$17 billion to serve a 51 GW winter peak load is approximately $0.62-$0.65 billion per year. Similarly, the total cost of $23-$26 billion to serve a 57 GW winter peak load results in average spending of approximately $0.88-$1.00 billion per year. By way of comparison, total transmission project spending between 2002 and 2023 on both reliability-based projects and asset condition projects totaled $15.3 billion, or an average of approximately $0.73 billion per year. Similarly, the forecasted combined spending on reliability and asset condition projects in the upcoming five-year period, from December 2023 through December 2028, is a total of approximately $3.85 billion, or an average of $0.77 billion per year.[21] Many of the line rebuilds proposed in this study will also overlap with asset condition needs, and any one project could address both system expansion and aging equipment.

[21] Source: RSP Project List and Asset Condition List June 2023 Update, https://www.iso-ne.com/static-assets/documents/2023/06/final_project_list_presentation_june_2023.pdf

Section 6: Future Work

The 2050 Transmission Study is the first longer-term transmission study conducted for New England. Results revealed many important lessons about the future development of New England's transmission system, and many opportunities for similar studies in the future. As time passes, the assumptions regarding generator types, sizes, and locations used in this study will be replaced with real-life data, providing more precision around the transmission system upgrades that will be required in the future.

One potential area of focus for future longer-term transmission studies is the addition of analysis beyond steady-state thermal analysis. As mentioned in Section 1.1.4, the scope of this study was limited to steady-state thermal analysis, due in part to uncertainties about the detailed characteristics of future generators. More detailed models of future generation projects will allow future studies to include analysis of transmission system voltage, which will shed light on certain substation upgrades that may be required to maintain acceptable voltage and avoid equipment damage. In addition, these models may permit the ISO to analyze transient stability and electromagnetic transient (EMT) performance. These types of analyses examine the performance of the system in the milliseconds to seconds following an unexpected event like a lightning strike or tree contact on a transmission line, ensuring that generators can continue supplying power through the event and that the system can recover to a new operating condition. Finally, future longer-term transmission studies may leverage the findings of the ISO's economic studies to examine conditions other than summer and winter peak loads. Analysis from economic studies will predict likely system conditions for off-peak periods (including load levels, renewable energy output, and the types of generators likely to be operating in a given hour), and can highlight periods of particular stress on the transmission system. This data can then be used in a future longer-term transmission study to examine the transmission system's performance during these periods of interest.

At the time of this report's publication, the longer-term transmission study process is purely informational. However, the ISO began stakeholder discussions on Phase II of the longer-term transmission study process in October 2023. This second phase is designed to create a process in the ISO New England Open Access Transmission Tariff by which NESCOE can choose transmission system concerns to address, conduct a Request for Proposals to solicit transmission project proposals, and then advance those proposals towards construction and operation. Depending on the timing of these changes to the Tariff, the results of this study or other future longer-term transmission studies may inform this solution development process.

Another key topic related to the future of the New England power system is the expansion of the distribution system. Plans for the distribution system are outside the ISO's jurisdiction and area of expertise but could be a key input for further transmission studies. With more granular data on plans to meet customer load, future longer-term transmission studies can include better data on the location and sizes of substations that transfer electricity from the transmission system to local distribution systems, and eventually to individual customers. This will allow for more precise modeling of the future transmission system and a more accurate view of the region's future power system.

Section 7: Conclusion

As the clean energy transition accelerates, power flows across New England's transmission system will eclipse all previous highs. The "best case" 51 GW winter peak load snapshot analyzed in this study is more than double the highest winter peak ever recorded in New England, January 2004's 23GW level, and the "worst case" 57 GW winter peak load snapshot is almost 150% higher. Assuming increased build-outs of renewables continue, and electrification of heating and transportation proceeds as expected, the region's aging transmission system has the potential to become a significant bottleneck to progress if it does not keep pace with changes to other elements of the power system.

In 2021, NESCOE and the ISO recognized that the traditional 10-year planning horizon was no longer sufficient to adequately analyze a transmission system undergoing such immense change. The 2050 Transmission Study is an unprecedented look at the future of New England's transmission system, and the results produced by this study will assist stakeholders and the ISO in making important decisions about improvements and pathways forward. Processes developed and lessons learned in this study also pave the way for future studies, as the ISO continues to meet its commitment to overseeing a reliable and cost-effective regional transmission system. With the addition of the Longer-Term Transmission Planning process to the ISO New England Open Access Transmission Tariff, studies like this one will be conducted periodically to re-assess the long-term evolution of the transmission system and associated costs.

Although the roadmaps provided in this study are not intended as comprehensive plans, and overloads and issues associated with the high-likelihood concerns may not occur in exactly the way this study has outlined, these big-picture observations represent a large step towards meeting the challenges that lie ahead for New England's transmission system. Ensuring the reliable, economic delivery of electricity that customers have come to expect will require innovative solutions, and most importantly, collaboration and communication between stakeholders, the states, transmission owners, and the ISO.

Targeted approaches to problem-solving, like optimizing generator locations or right-sizing asset condition projects, could become particularly crucial as the region moves towards upgrading an aging system in the most cost-effective manner. Such targeted problem-solving requires cooperation and collaboration. The ISO will continue to provide the forward-looking analysis presented in this study in future studies, and will continue to focus on longer-term transmission planning studies in collaboration with stakeholders to help identify the best paths forward.

Appendix 2-2: NEP “Transmission System Impact Study Results for Group 3 of Distributed Energy Resources (DER) Additions in Western Massachusetts” (“Group 3 Cluster Study”)

This document has been redacted for Critical Energy/ Electric Infrastructure Information (CEII). 2/25/2025

Transmission System Impact Study Results for Group 3 of Distributed Energy Resource (DER) Additions in Western Massachusetts

June 2022

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nationalgrid

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1 EXECUTIVE SUMMARY

This document provides the transmission system impact study results for Group 3 of National Grid's Western MA DER interconnection cluster study. Group 3 consists of the third stage of proposed Distributed Energy Resources (DER) additions applying for interconnection into the National Grid distribution system in Western MA. Groups 1 and 2 (previously approved) consisted of 314 MW of DER in Western Massachusetts, after accounting for all project attrition. None of Group 1 and 2 DER can charge from the transmission grid. Group 3 consists of an additional 252 MW of DER in Western MA, of which 121 MW can charge from the transmission system.

The following table shows the Group 3 DER broken down by Generation type.

Table 1 - Group 3 DER by Generation Type

Generation Type	Group 3 Total PV + BESS Discharging Limit[1] (kW)	Group 3 Total BESS Charging Limit[2] (kW)
PV Only	9,998	N/A
BESS Only	164,750	113,550
PV+DC BESS*	51,681	6,150
PV+AC BESS**	25,448	1,000
Grand Total	**251,877**	**120,700**

*With DC coupled PV+BESS, the PV and BESS share the same inverter
** With AC coupled PV+BESS, the PV and BESS are each equipped with dedicated inverters

Results of the steady state analysis indicate the the following Transmission upgrades need to be made to accommodate the integration of the Group 3 DER,

- **A1/B2 line rebuild/reconductor:** The A1/B2 69 kV transmission lines were found to overload following the addition of Group 3 DER. These overloads will be eliminated following the rebuild of both lines that is already planned due to asset condition issues. The lines will be rebuilt using 795 ACSS conductor. The refurbishment is scheduled to be completed in 2027.

- **Royalston Breaker Additions**: Voltage problems were identified at several substations along the A1/B2 lines following the addition of Group 3 DER. 69 kV breaker additions at Royalston substation, already planned as part of the A1/B2 rebuild project, will resolve these high voltage problems.

[1] Discharging limit imposed by distribution system constraints
[2] Charging limit imposed by distribution system constraints

- **Vernon 69 kV substation rebuild**: A-1 and B-2 69 kV terminal equipment at Vernon substation were found to overload following the addition of Group 3 DER. There is presently an asset condition project planned to rebuild Vernon station (to be renamed "Huntington" substation) which will eliminate the overloads. The rebuild is scheduled to be completed in 2026.

- **E5/F6 line rebuild/reconductor:** The E-5/F-6 69 kV transmission lines were found to overload following the addition of Group 3 DER if [redacted] Solar (QP1031) is built These overloads will be eliminated following the rebuild of both E5/F6 lines, already scheduled to address asset condition issues on the lines. The lines will be rebuilt using 795 ACSS conductor. The rebuild project is scheduled to be completed in 2030. Note that if QP1031 is withdrawn, Group 3 DER alone does not cause the E5/F6 lines to become overloaded.

Transient stability, short circuit, and PSCAD analyses were also conducted during this study, and no issues were identified.

2 INTRODUCTION

This document provides the system impact study results for the interconnection of 252 MW of Distributed Energy Resources (DER), greater than 1 MW, into the Western Massachusetts distribution system, owned by National Grid, over the years 2022 to 2025. Below are some additional characteristics of the Group 3 DER:

- None of the additional DER will be directly connected to the transmission system.
- All the DER will be mixed with distribution load.
- None of the additional DER will control voltage.
- All DER was set to a power factor of unity in the study.
- All the DER will respond to frequency deviations.

2.1 Study Objective

The objective of this study is to identify the transmission upgrades, if any, required to integrate the proposed DER without resulting in any significant adverse impact on the reliability, stability, and operating characteristic of the New England bulk power transmission system and National Grid transmission system.

2.2 Project Description

252 MW of DER (>1 MW) have applied to interconnect to the National Grid distribution system in Western MA by 2025.

2.3 Study Area

The transmission system geographic map and one-line diagram of the study area are shown in the following figures, with the DER project locations identified.

Figure 1 - Proposed DER Locations - Geographic Map

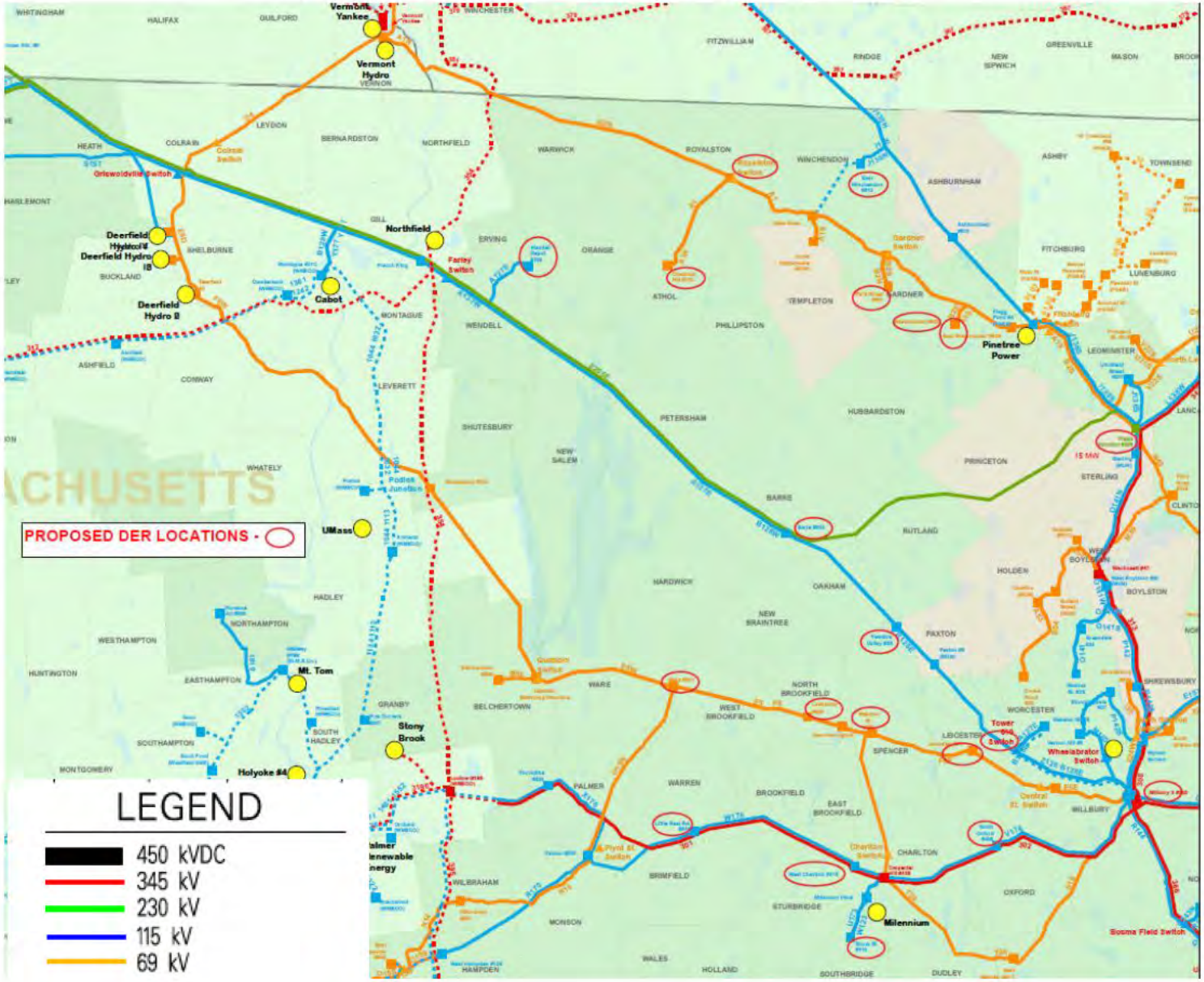
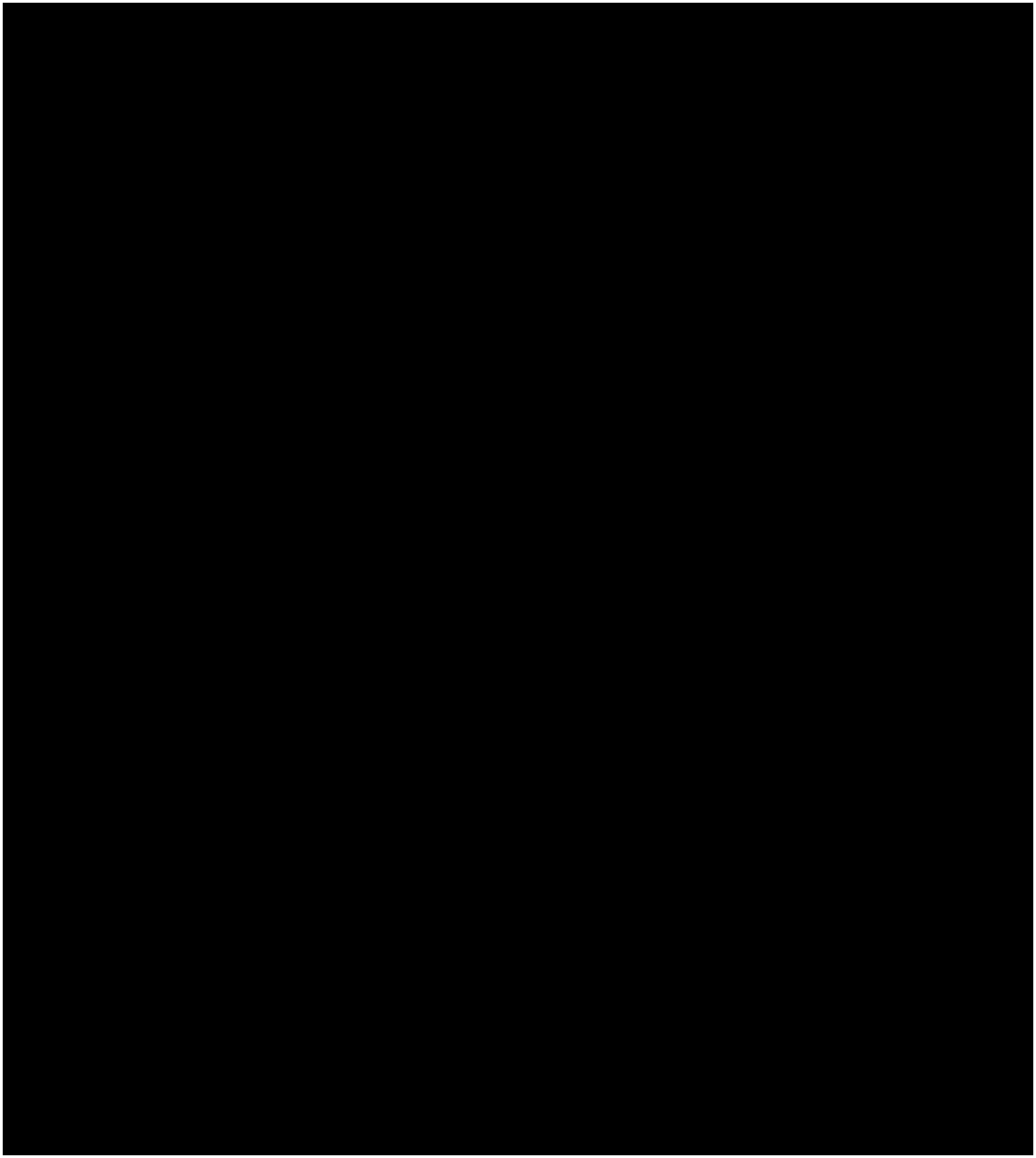


Figure 2 - Proposed DER locations for Group 3 - One Line Diagram



3 STUDY APPROACH

DER additions 1 MW and below, did not need to be added to the base cases for this study. The base cases utilized for this study already modeled DER 1 MW and below, via negative loads (with "PD" identifiers) that model the forecasted PV, 1 MW and below, out to year 2025. This DER, 1 MW and below, is distributed proportionally across the load busses in Western Massachusetts. Therefore, only DER additions that exceed 1 MW, were added to the cases utilized for this study. All 252 MW associated with Group 3 is greater than 1 MW.

3.1 Group 3 Totals by Substation

The Group 3 total amounts to 252 MW of new DER, and constitutes the third increment of National Grid DER studied in Western MA. The DER totals for Group 3 are shown in the following table for each substation.

Table 2 - Group 3 Total DER by Substation

Substation	Generation Type	Group 3 Total PV + BESS Discharging Limit[3] (kW)	Group 3 Total BESS Charging Limit[4] (kW)
BARRE SUBSTATION	Battery only	8,000	8,000
	DC coupled	4,400	3,150
Crystal Lake SUBSTATION	Battery only	8,000	5,200
E. WESTMINSTER SUBSTATION	DC coupled	4,990	3,000
E. WINCHENDON SUBSTATION	Battery only	14,900	8,800
	PV Only	4,999	N/A
LASHAWAY SUBSTATION	Battery only	15,000	12,000
LITTLE REST RD SUBSTATION	AC Coupled	3,000	0
	DC coupled	2,800	0
MEADOW STREET 552 SUBSTATION	DC coupled	8,800	0
	PV Only	4,999	N/A
MILLBURY SUBSTATION	AC Coupled	2,750	0
	Battery only	10,000	3,500
N. OXFORD SUBSTATION	Battery only	13,600	11,200
	DC coupled	4,400	0
PRATTS JUNC. SUBSTATION	Battery only	11,000	7,000
ROYALSTON SUBSTATION	AC Coupled	7,500	0
SNOW ST. SUBSTATION	AC Coupled	4,998	1,000
	Battery only	18,250	14,750
STAFFORD ST SUBSTATION-New	Battery only	10,000	10,000
	DC coupled	12,500	0
TREASURE VALLEY SUBSTATION	Battery only	10,000	5,000
W. CHARLTON SUBSTATION	Battery only	20,000	8,500
WARE SUBSTATION	DC coupled	11,000	0
WENDELL DEPOT SUBSTATION	AC Coupled	7,200	0
	Battery only	18,000	15,200
	DC coupled	2,791	0
LAUREL CIRCLE SUBSTATION	Battery only	8,000	4,400
Grand Total		**251,877**	**120,700**

[3] Discharging Limits imposed by distribution system constraints
[4] Charging Limits imposed by distribution system constraints

The total DER studied for the Group 3 Western MA Cluster study amounts to 252 MW. This DER is incremental to the DER in Groups 1 and 2 of the Western Massachusetts Cluster, which amounted to 314 MW, after accounting for all project attrition within the clusters. No DER in Groups 1 and 2 can charge from the transmission system. The totals for Groups 1 and 2 are shown in the following table for each substation.

Table 3 – Group 1 + 2 DER Totals by Substation, Post Attrition

Substation for Groups 1 + 2	Total MW
ADAMS SUBSTATION	11
ASHBURNHAM SUBSTATION	5
BARRE SUBSTATION	12.4
BEAR SWAMP UPPER YARD SUBSTATION	2.5
BELCHERTOWN SUBSTATION	8
CHESTNUT HILL 702 SUBSTATION	3.3
Crystal Lake SUBSTATION	24.7
E. WEBSTER SUBSTATION	5
E. WESTMINSTER SUBSTATION	8
E. WINCHENDON SUBSTATION	3.9
EAST LONGMEADOW SUBSTATION	9
FIVE CORNERS SUBSTATION	3
LASHAWAY SUBSTATION	13.7
LEICESTER SUBSTATION	2.6
LITCHFIELD ST SUBSTATION	10
LITTLE REST RD SUBSTATION	6
MEADOW STREET 552 SUBSTATION	13.4
MILLBURY SUBSTATION	14.4
N. OXFORD SUBSTATION	8.7
PALMER 503 SUBSTATION	18
PONDVILLE SUBSTATION	4.9
SHUTESBURY	20
SNOW ST. SUBSTATION	24.7
THORNDIKE SUBSTATION	12.5
TREASURE VALLEY SUBSTATION	2.2
W. CHARLTON SUBSTATION	17
WARE SUBSTATION	13.3
WENDELL DEPOT SUBSTATION	15
West Hampden 139 SUBSTATION	13.2
WESTMINSTER SUBSTATION	4.9
WILBRAHAM SUBSTATION	4
Total	**314**

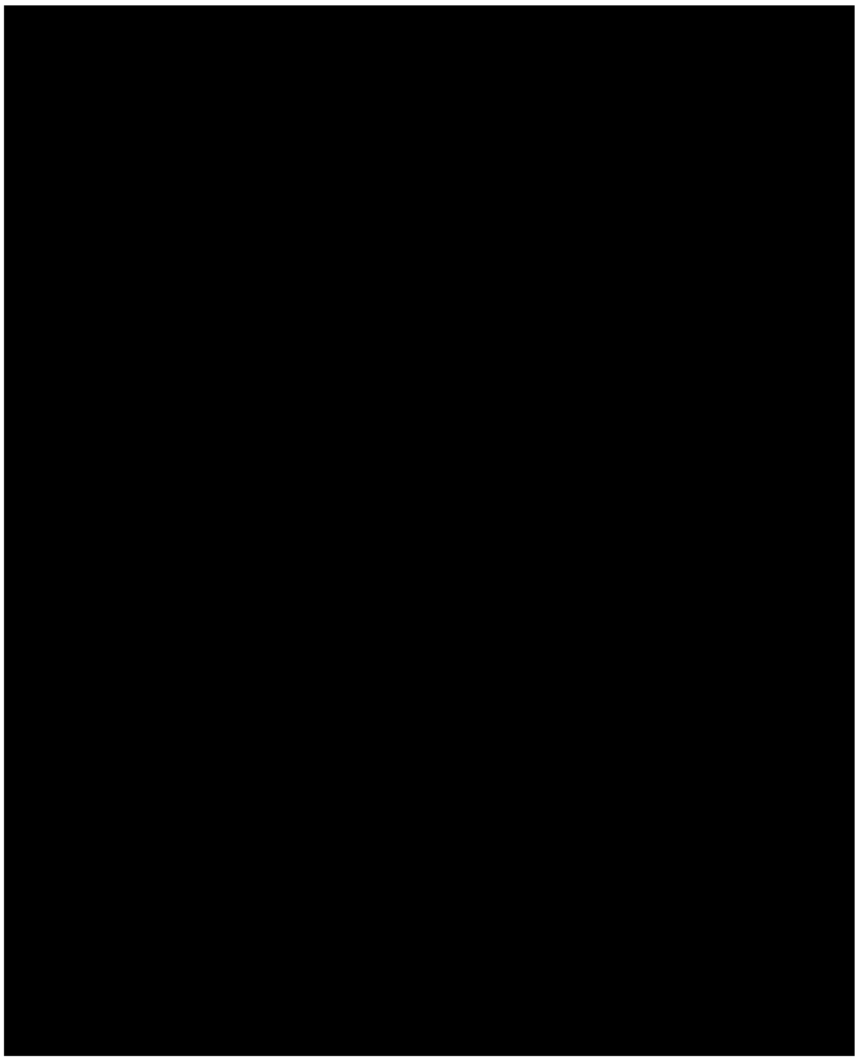
3.2 Distribution Substation Upgrades

Several distribution substation upgrades will need to be built in order to accommodate the interconnection of the Group 3 DER into the Western MA Distribution system:

Wendel Depot Substation

A second 115/13.8 kV transformer [redacted] will be installed, as well as the replacement of the existing 115/13.8 kV transformer [redacted]

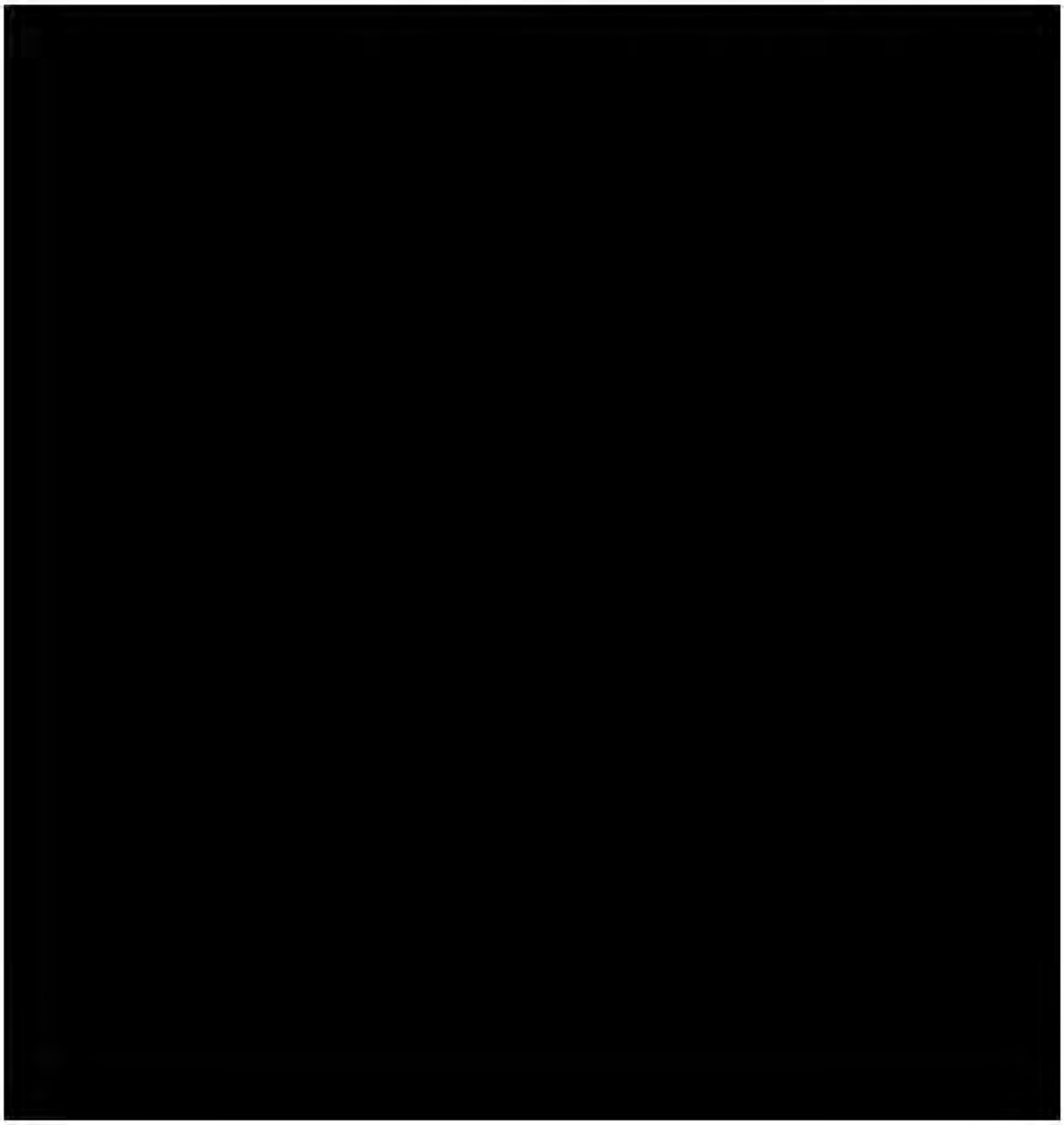
Figure 3 – Wendel Depot Substation Upgrades



E Winchendon Substation

Replace existing 115/13.8 kV transformer with a [redacted]

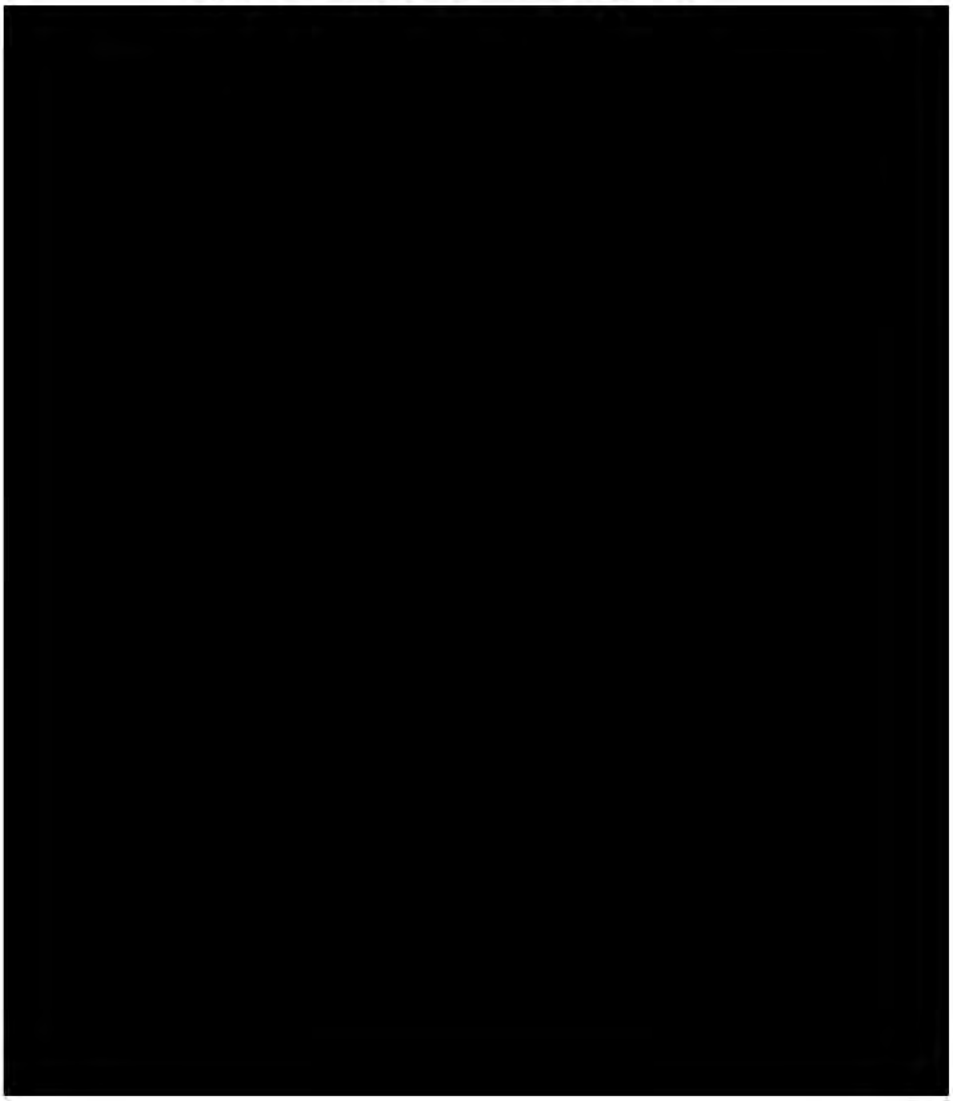
Figure 4 – E Winchendon Substation Upgrades



Barre Substation

Replace both existing 115/13.8 kV transformers with [redacted]

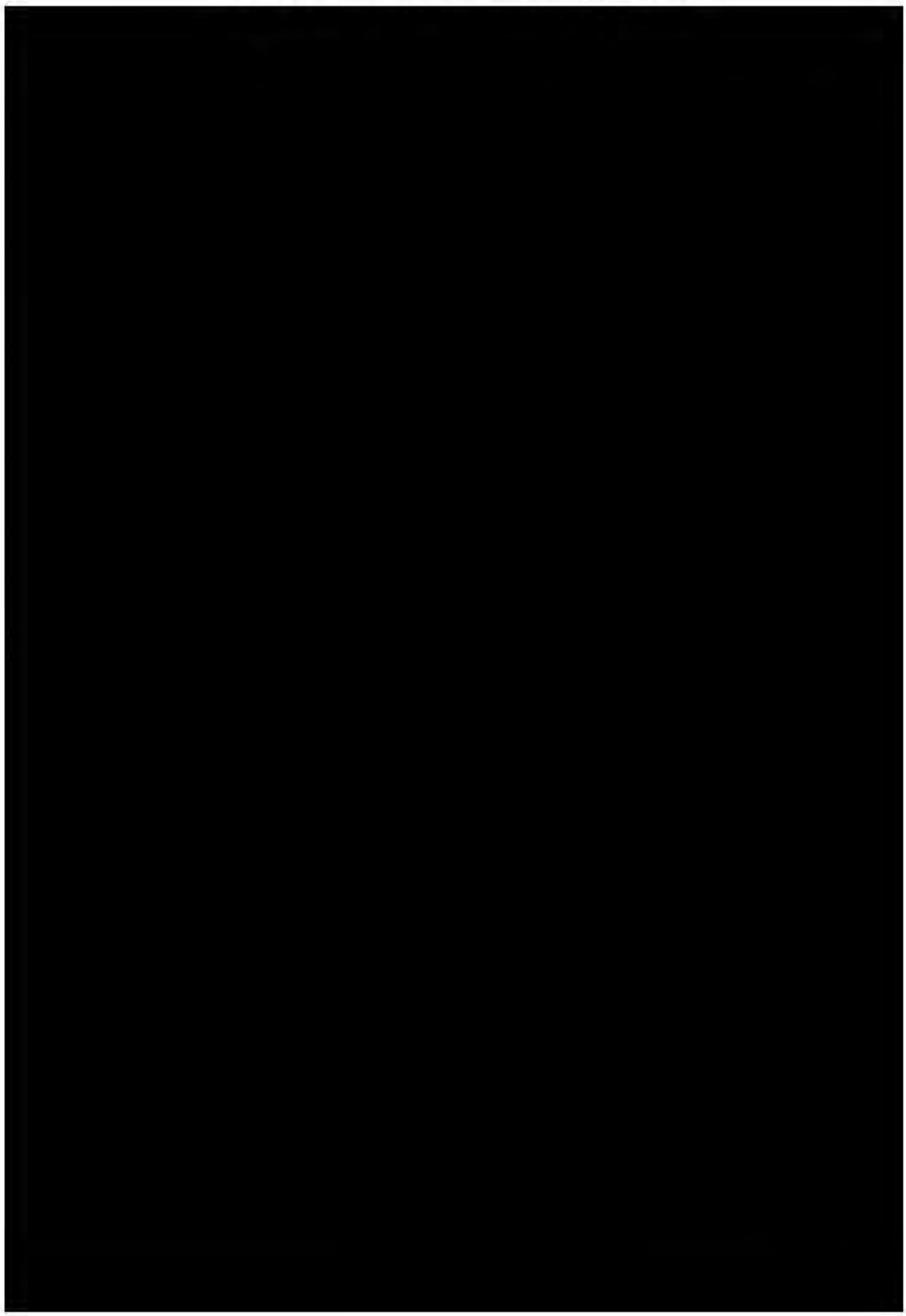
Figure 5 – Barre Substation Upgrades



Ware Substation

Replace existing 69/23 kV transformer with 69/13.8 kV [redacted].

Figure 6 – Ware Substation Upgrades



Meadow St Substation

Install a second 69/13.2 kV transformer ([redacted] and install 69 kV breaker.

Figure 7 – Meadow St Substation Upgrades



Lashaway Substation

Replace the existing 69/13.2 kV transformer with a [redacted] unit, and replace the existing 69/23kV transformer with a 69/13.2 kV transformer ([redacted]

Figure 8 – Lashaway Substation Upgrades

[redacted]

Leicester 69/13.8kV substation - Retire

3.3 Study Assumptions

- DER was dispatched as follows in both the steady state base cases, as well as the stability base cases:
    - All the Group 1, 2, and 3 DER in this study, greater than 1 MW, were added to the cases, and dispatched at 100% nameplate, at all load levels. This DER is modeled with negative load[5] at each distribution bus for the substations listed in Table 3. No distribution feeder impedance is assumed.
    - For the purposes of describing the treatment of existing and forecasted PV in the study, PV is placed into three categories:
        - All existing Category 1 PV (existing or PPA approved PV facilities greater than or equal to 5 MW) in the 2025 base case representation provided by ISO-NE, was dispatched at 100 % output for all load levels.
        - All existing Category 2 PV (existing PV facilities greater than 1 MW and less than 5 MW) provided by ISO-NE with the 2025 base cases, is dispatched at 100 % output at the peak load level only. No Category 2 PV was modeled in the light load and intermediate load cases.
        - All existing Category 3 PV (Existing facilities less than or equal to 1 MW and all future forecasted solar PV for which locational information is not available) provided by ISO-NE with the 2025 base cases, is dispatched at 100 % output at the peak load level only. Note that the "future" solar PV greater than 1 MW and less than 5 MW is carved out of the Category 3 PV to avoid double counting of the new DER for which this study is being conducted. No Category 3 PV was modeled in the light load and intermediate load cases.

.

- None of the DER additions were modeled in voltage control mode, since all of the new DER will be mixed with distribution load (i.e., no DER will be installed on dedicated feeders)
- All of the Group 3 DER will be operated in frequency response mode (per the new Source Requirements Document (SRD) developed for Group 3). None of the Group 1 and Group 2 DER will be operated in frequency response mode (per the previous SRD in place during the Group 1 and Group 2 studies). Therefore, the DER additions for each group were modeled accordingly in the stability study.
- No transmission ring busses are required for any DER additions that are mixed with distribution load, or will be mixed with distribution load in the future.
- Starting from the original base cases developed for this study, and prior to testing any contingencies, the Group 1, 2 and 3 DER was dispatched (at 100% output) against existing (and PPA approved) non-DER generation in Connecticut. This maintained the same transfer levels (pre vs post DER additions) of interfaces relevant to this study (i.e., E-W and NY-NE).

[5] DER was modeled as generators in the load flow base cases utilized for the stability testing

- Treatment of transmission overloads above 100 kV in study:
  - [redacted]
  - [redacted]
  - [redacted]
- Treatment of transmission overloads below 100 kV in study:
  - [redacted]
  - [redacted]

[6] This is consistent with the Mininum Interconnection Standard (MIS) outlined by FERC Order 2003.

Table 4 - Generators Available for Redispatch to Prevent [redacted] 69 kV Overloads

PSSE Bus number	Generator Name
109296	Sears Wind_E
109297	Sears Wind_W
109403	Drfld East G
109404	Drfld West G
109503	Harriman G3
109504	Harriman G2
109505	Harriman G1
109517	Sears Hydro
109529	Vernon Hyd A
109530	Vernon Hyd B
109531	Vernon Hy T1
109532	Vernon Hy T2
113098	Deerfield 2g
113099	Deerfield 3g
113100	Deerfield G4
113101	Deerfield G5
113102	Fife Brook
113104	Sherman Hyd
113123	Hoosac Clr1
113125	Hoosac Clr2
113096	Bearswamp G1
913096	Bearswamp P1
113097	Bearswamp G2
913097	Bearswamp P2

- No DER generation can be redispatched between contingencies to eliminate 69 kV [redacted] overloaded elements.
- It is assumed that [redacted] involving 69 kV double circuit towers, or 69 kV breaker failures will not cause a significant adverse impact outside the local area ([redacted], and therefore were not tested.

- Hydro Generation that is defined as "Daily Cycle Pondage" or "Weekly Cycle" in the CELT report can be ramped up to nameplate capability, according to the ISO-NE Planning Technical Guide, between [redacted] and [redacted] contingencies to prevent post [redacted] contingency thermal overloads or voltage violations. However, this generation can't be assumed to ramp up between contingencies post Group 3, if ramping up solves [redacted] voltage or thermal problems that did not exist prior to Group 3 going in-service (Per ISO-NE PP5-6 document, section 3.4: "No Increase in Conditional Dependence").

Table 5 - Hydro Generation Available to Ramp Up between Contingencies

RESOURCE NAME	GEN TYPE ID	PRIM FUEL TYPE	FUEL GEN TYPE DESC	STATE	RSP AREA	NAMEPLATE (MW)	WINTER SCC (MW) Jan 1, 2019	ACTUAL WINTER PEAK SCC (MW) Jan 21, 2019	EXPECTED SUMMER PEAK SCC (MW) JUL 1, 2019
BELLOWS FALLS	HDP	WAT	HYDRO (DAILY CYCLE - PONDAGE)	VT	VT	45.900	47.216	47.216	47.216
COBBLE MOUNTAIN	HW	WAT	HYDRO (WEEKLY CYCLE)	MA	WMA	23.100	27.431	27.431	31.989
DEERFIELD 5	HDP	WAT	HYDRO (DAILY CYCLE - PONDAGE)	MA	WMA	17.550	13.990	13.990	13.965
HARRIMAN	HW	WAT	HYDRO (WEEKLY CYCLE)	VT	WMA	33.600	38.471	38.471	40.798
JACKMAN	HW	WAT	HYDRO (WEEKLY CYCLE)	NH	NH	3.200	3.459	3.459	3.600
DEERFIELD 2 LWR DRFIELD	HDP	WAT	HYDRO (DAILY CYCLE - PONDAGE)	MA	WMA	9.600	18.667	18.667	18.580
SEARSBURG	HDP	WAT	HYDRO (DAILY CYCLE - PONDAGE)	VT	WMA	4.500	4.567	4 567	4.451
SHERMAN	HW	WAT	HYDRO (WEEKLY CYCLE)	MA	WMA	8.100	6.220	6 220	6.154
VERNON	HDP	WAT	HYDRO (DAILY CYCLE - PONDAGE)	VT	WMA	34.560	32.000	32.000	32.000
WILDER	HW	WAT	HYDRO (WEEKLY CYCLE)	VT	VT	35.640	40.674	40.674	40.920
CABOT TURNERS FALLS	HDP	WAT	HYDRO (DAILY CYCLE - PONDAGE)	MA	WMA	61.920	61.800	61.800	61.800
CABOT TURNERS FALLS	HDP	WAT	HYDRO (DAILY CYCLE - PONDAGE)	MA	WMA	6.400	6.400	6.400	6.400

- Pumped Storage Generation in the study area (Northfield and Bear Swamp) can be ramped up to 1/2 nameplate capability (two units at Northfield and 1 unit at Bear Swamp) between [redacted] and [redacted] contingencies to prevent post [redacted] contingency thermal overloads or voltage violations. Note that this can only be assumed if the units are off or in generating mode in the base case[redacted] If units are in pumping mode in the base case, it cannot be assumed that units can be ramped up into generating mode between contingencies.

- "Smart Capacitor" Control Additions in Western Massachusetts, required for the addition of the Group 1 DER interconnections, were assumed in-service for the Group 3 analysis. These "smart capacitor" controls automatically switch off distribution feeder capacitors during light load and minimum load conditions. These "smart capacitor" automation schemes are itemized in the following table.

Table 6 - "Smart Capacitor" Control Additions in Western Massachusetts

Substation Bus	[redacted]
E Winchendon1 13.8	
Crystal Lk1 13.8	
Crystal Lk2 13.8	
E Wstmstr T1 13.8	
E Wstmstr T2 13.8	
E Longmeadow 1 13.2	
N Hampden T1 13.2	
Palmer 13.2	
Wilbraham 13.2	
Lashaway 13.2	
W Charlton 13.2	
Litl Rest Rd 13.2	
Thorndike 13.2	
Treasure Vly 13.8	
Chesnut Hl T1 13.8	
Chesnut Hl T2 13.8	
Total	

Presently, in the existing system, the feeder capacitors listed in the preceding table are fixed capacitors; meaning that they are not switched automatically, and are in service all the time unless switched out manually in the field. After the automatic switching schemes are installed, these feeder capacitors will be switched out automatically if the feeder loading becomes less than 45% of peak feeder load. From a loadflow perspective, switching out these capacitors during light load and minimum load conditions is modeled by placing an equivalent amount of [redacted] lagging load at each the substation busses listed in the table. These smart capacitor controls will be installed before Group 1 of the DER cluster goes into service. The new smart capacitors will have radios for status monitoring and control. The system operators will have the ability to put the capacitors in manual operation to either open or close as needed.

- H-134 115 kV project (RSP #951) (E Winchendon to Otter River) not in-service (PPA withdrawn)
- The Ware 69 kV breaker addition project, completing the O-15N 69 kV bay, as required for interconnection of Group 2 DER of the Western MA cluster, assumed in-service.
- New Stafford St 115/13.8 kV substation in Leicester MA, which will sectionalize the A-127, B-128 and Z-126 115 kV lines near the existing Tower 510 structure, assumed in-service.
- Reconductor of A-1/B-2 69 kV lines with 795 ACSS scheduled for 2027 in-service date. Since the Group 3 DER is scheduled to be in-service between 2022 and 2025, the reconductor of A-1/B-2 was not included in the base cases for this study.
- All the transmission and generation projects with approved PPA's were included in the base cases for this study. Additionally, the following relevant generators in the ISO-NE Interconnection Queue were modeled in each base case. Note that some of these projects that were withdrawn during the course of this study were placed out of service in the base cases.

- QP 660 ("Vernon Solar" 20 MW PV unit connecting directly to D-4 69 kV line between Deerfield 4 and Vernon), withdrawn.

- QP-651 Alps Berkshire Phase Shifting Transformer Not In-Service (Withdrawn).

- QP697 (5.97 MW) and QP698 (8.04 MW), both connected at the E Winchendon 13.8 kV, in-service

- QP 797 [redacted] Solar – Meadow St) in-service

- QP 754 [redacted] Solar – connected to I-135N 115 kV line) Not In-Service (Withdrawn)

- QP 1105 ([redacted] Battery Storage Project – off A-127 115kV line) not-in-service (withdrawn from ISO-NE study queue)

- QP 1112 ([redacted] Storage Project – off B-128 115 kV line between Barre and French King substation) not-in-service (but tested as a sensitivity in study)

- QP 1031 ([redacted] Solar Project – off F-6W 69 kV line between Ware and Belchertown substations) not-in-service (but tested as a sensitivity in the study)

- Millbury 115 kV IEC61850 project – In-service. Project will replace the following [redacted] circuit breakers and associated Bushing Current Transformers (BCTs) with [redacted] circuit breakers:

    - B128, A127, Z126, M165, 27-302, 65-74, V174.
    - Replacing breakers 65-74 and V-174 will increase V-174 thermal rating [redacted]

4 STUDY CRITERIA

This analysis is conducted in accordance with the following criteria.

- NERC Transmission Planning Standards TPL-001-4, "*Transmission System Planning Performance Requirements"*,
- [redacted]
- ISO New England Planning Procedure #3 (PP3) – "*Reliability Standards for the New England Area Bulk Power System*".
- ISO New England Planning Procedure #5 (PP5) – "Proposed Plan Application Procedure".
- National Grid Transmission Group Procedure (TGP) #28 – "*Transmission Planning Guide for the National Grid USA Service Company*".

5 STEADY STATE ANALYSIS

The following tables identify the steady state voltage criteria that were applied in the study:

Table 7 - Steady State Voltage Limits

Facility Owner	Voltage Level	Bus Voltage Limits (Per-Unit)	
		Pre-Contingency	Post-Contingency
National Grid	230 kV and above	0.98 to 1.05	0.95 to 1.05
	115 kV and below	0.95 to 1.05	0.90 to 1.05[7]
Eversource	115 kV and above	0.95 to 1.05	0.90 to 1.05 (before system adjustments) 0.95 to 1.05 (after system adjustments)
GMP	115 kV and below	0.95 to 1.05	0.90 to 1.10
VELCO	230 kV and above	0.98 to 1.05	0.95 to 1.05
	115 kV and below	0.95 to 1.05	0.95 to 1.05

Table 8 - Maximum Percent Voltage Variation at Delivery Points

CONDITION	345 & 230 kV (%)	115 kV[1] & Below (%)
Post Contingency & Automatic Actions	5.0	10.0
Switching of Reactive Sources or Motor Starts (All elements in service)	2.0 *	2.5 *
Switching of Reactive Sources or Motor Starts (One element out of service)	4.0 *	5.0 *

* These limits are maximums which do not include frequency of operation. Actual limits were considered on a case-by-case basis and will include consideration of frequency of operation and impact on customer service in the area.

Notes on two preceding Tables:

a. Voltages apply to facilities which are still in-service post-contingency.
b. Site specific operating restrictions may override these ranges.
c. These limits do not apply to automatic voltage regulation settings which may be more stringent.

[7] National Grid Buses that are part of the bulk power system, and other buses deemed critical by Network Operations, shall meet requirements for 345 kV and 230 kV buses

The following table identifies the thermal criteria that is applied in the study.

Table 9 - Thermal Criteria Applied in Study

SYSTEM CONDITION	TIME FRAME	MAXIMUM ALLOWABLE FACILITY LOADING
Pre-contingency (All lines in)	Continuous	Normal Rating
Post-contingency	Less than 15 minutes after contingency occurs	STE Rating
	More than 15 minutes after contingency occurs	LTE Rating

5.1 Steady State Solution Parameters

The steady state analysis is performed with pre-contingency solution parameters that allowed adjustment of load tap-changing transformers (LTCs), static VAR devices (SVDs including automatically switched capacitors. Post-contingency solution parameters were locked, and the area interchange control is disabled. The following table shows the pre- and post-contingency solution parameters that were used in this study.

Table 10 - Steady State Study Solution Parameters

Case	Area Interchange	Transformer LTCs	Phase Angle Regulators	Switched Shunts
Base	Disabled	Stepping	Locked	Regulating
Post Contingency	Disabled	Locked	Locked	Locked

5.2 Steady State Base Case Development

In order to investigate the impact of the proposed projects to the New England transmission system, a total of seven base cases were developed representing various load levels and interface transfer levels.

Study Year Tested

Since Group 3 of the DER will be installed by 2025, the year 2025 ISO-NE base cases, released in September 2020, were used for the steady state assessment.

Load Levels Tested

Four load levels were tested for steady state analysis. These cases are based on the loads contained in the CELT 2020 forecast.

1. Summer Peak Load
2. Shoulder Peak Load
3. Light Load
4. Minimum Load (8000 MW)

Interface Transfer Levels Tested

For each of the three load levels – Summer Peak Load, Shoulder Peak Load and Light Load, two base cases were developed for steady state testing:

1. High East to West Stress (3500 MW), with High NE-NY transfers (1200 MW), High Sandy Pond HVDC Import

2. High West to East Stress (3000 MW), with High NY-NE transfers (1600 MW), Low Sandy Pond HVDC Import

For Minimum Load level, one base case is developed for steady state testing.

The following table summarizes the interface levels and generation dispatches for the steady state base cases prior to the dispatch of Group 1,2 and 3 DER in the cases. More detailed case summaries are included in Appendix A.

To test the impact of the DER, both Group 1, 2 and 3 DER were added to each case and dispatched against Millstone 2 in Connecticut.

Table 11 - Steady State Base Case Summaries (before dispatching Group 1, 2, and 3 DER)

Base Case Load Flows (MW)							
Name	25pk-ew-100%-PV*	25pk-we-100%-PV*	25sh-ew+pump	25sh-we	25ll-ew+pump	25ll-we	Min-load
Year/Load Level	2025 Summer peak		2025 Shoulder peak		2025 Light Load		2025 Min Load
Bias	East-West	West-East	East-West	West-East	East-West	West-East	
Total Load	25697		18066		12518		8901
Scaling Load	31252		16673		11412		7858
Non-Scaling Load	556		556		556		556
DR passive	0		0		0		0
DR active	0		0		0		0
EE	-4756		0		0		0
Cat 2 and 3 PV	-2089		0		0		0
NON CELT MFG LOAD	301		301		301		301
New England Transmission Interface Transfers (MW)							
Sandy Pd HVDC Import	2000	1000	2000	1000	2000	1000	0
E-W	3512	-2996	3506	-3036	3543	-3002	65
NY-NE	-1231	1600	-1220	1599	-1204	1602	-34
North-South	4395	2212	3100	2841	3078	1584	2467
CT Export	-1190	-571	-64	-163	-763	336	165
Area Generation (MW)							
Northfield (MA) – 1180 MW (Max)	0	1180	-1100	1180.0	-1100	0	0
Bear Swamp 666 MW (Max)	0	666	-666	666	-666	0	0
Altresco (MA) – 164 MW (Max)	0	164	73	164	164	164	0
Cabot Hydro (MA) – 65 MW (Max)	11 (minimum)	65	11 (minimum)	65	11 (minimum)	65	11 (minimum)
Harriman Hydro (VT) – 41 MW (Max)	5 (minimum)	41	5 (minimum)	41	5 (minimum)	41	5 (minimum)
Vernon Hydro (VT) – 32 MW (Max)	5 (minimum)	32	5 (minimum)	32	5 (minimum)	32	5 (minimum)
Deerfield Hydro 2+3 +4 (20 MW Max)	5 (minimum)	20	5 (minimum)	20	5 (minimum)	20	5 (minimum)
Harrington St Solar (10 MW Max)	10	10	0	10	10	10	10
Warren Solar (Little Rest Rd) (14 MW Max)	14	14	0	14	14	14	14
Treasure Valley Solar (16 Max)	16	16	0	16	16	16	16
Millennium	0	360	361	0	361	360	0
Stony Brook	0	483	0	483	483	483	0
Bellows Falls	49	49	0	49	0	0	0
QP697&QP698 (14MW PV at E. Winchendon)	14	14	0	14	14	14	14

*Per the direction provided by ISO-NE, all existing PV in western MA (zone 41), modeled in peak load base case was scaled up from 26% output to 100% output. This PV was modeled as negative load (with "PD" and "PV" load identifiers) in the peak load cases. Note that the negative load with "PD" identifiers includes all existing PV less than 1 MW, as well as all future forecasted PV greater than 1 MW but less than 5 MW which does not have location based data associated with it. To avoid double counting of the "PD" load that includes the future forecasted PV between 1 and 5 MW, this portion of the "PD" was stripped out of the peak load base cases. The percent of "PD" load that includes the future forecasted PV for the Western MA zone 41 is 41.9%, per ISO-NE.

Sensitivity bases cases were also developed at peak load, with all DER in the study area at 26% output (of nameplate). The following tables summarize the interface levels and generation dispatches for the steady state base cases. Again, to test the impact of the DER, Group 1, 2 and 3 DER were added to each case and dispatched against Millstone 2 in Connecticut.

Table 12 - Steady State Base Case Summaries: Sensitivity to DER = 26% Output (Prior to dispatching Group 1, 2, and 3 DER)

Base Case Load Flows (MW)		
Name	25pk-ew-26%	25pk-we-26%
Year/Load Level	2025 Summer peak	
Bias	East-West	West-East
Total Load	26338	26282
Total Losses	966	683
Total Generation	27670	24419
Scaling Load	31227	
Non-Scaling Load	556	
DR passive	0	
DR active	0	
EE	-4756	
Station Service	678	621
NON CELT LOAD	301	
New England Transmission Interface Transfers (MW)		
Sandy Pd HVDC Import	2000	1000
E-W	3521	-2987
NY-NE	-1188	1641
North-South	4506	2321
CT Export	-742	-97
Area Generation (MW)		
Northfield (MA) – 1180 MW (Max)	0	1180
Bear Swamp 666 MW (Max)	0	666
Altresco (MA) – 164 MW (Max)	0	164
Cabot Hydro (MA) – 65 MW (Max)	11* (minimum)	65
Harriman Hydro (VT) – 41 MW (Max)	5* (minimum)	41
Vernon Hydro (VT) – 32 MW (Max)	5* (minimum)	32
Deerfield Hydro 2+3 +4 (20 MW Max)	5* (minimum)	20
Harrington St Solar (10 MW Max)	10	10
Warren Solar (Little Rest Rd) (14 MW Max)	14	14
Treasure Valley Solar (16 Max)	16	16
Millenium	0	360
Stony Brook	0	483
Bellows Fall	49	49
QP697&QP698 (14MW PV at E. Winchendon)	14	14

5.3 Study Matrix for Steady State Analysis

To test the impact of the DER, Group 1,2 and 3 DER were added to each case, according to the following table, and dispatched against Millstone 2 in Connecticut. Dispatching the DER against Millstone 2 will maintain the same East-West, and NY-NE transfer levels, compared to the pre-DER base cases.

Table 13 – Proposed Study Matrix for Steady State Analysis

		Group 3 DER		Group 1 and 2 DER	Pre-Group 1 and 2 DER	FERC BESS projects under Study	
Load Level	**Bias**	**BESS output**	**PV output**	**PV output**	**PV output**		**Comments**
Peak Summer load	E-W	100% discharging	100%	100%	100%	Sensitivity analysis was conducted for [redacted] (QP1031) and [redacted] (QP1112)	
	W-E						
	E-W	100% Charging	26%	26%	26%		
	W-E						
Shoulder Peak Load	E-W +pump	100% Charging	0% (peak load night/morning - before 8am)	0% (peak load night - before 8am)	0% (peak load night - before 8am)		This case represents a peak load night. BESS could be charging (7am) before Bear Swamp Pumps shut off. PV assumed to 0 MW in case.
	W-E	100% discharging	100% (no pump case (day)	100% for PV 5 MW and above. 100% for PV under 5 MW	0%		
Light Load	E-W +pump	100% discharging	100%	100% for PV 5 MW and above. 100% for PV under 5 MW	0%		
	W-E						
					0%		
Min Load	none	100% discharging	100%	100% for PV 5 MW and above. 100% for PV under 5 MW	0%		

5.4 Steady State Contingency Analysis

N-1 and N-1-1 contingency conditions were tested in steady state analysis on the load flow base cases with and without the new DER added to the cases.

5.4.1 N-1 Contingency List

The N-1 Contingency list is shown in the table below.

Table 14 - N-1 Steady State Contingency List

CONTINGENCY NAME	kV	DESCRIPTION
HVDC Facilities		
Sandy Pond HVDC Phase II	-	Sandy Pond HVDC Converter – 2000 MW Maximum
345 kV Transmission Lines		
301/302	345	Millbury – Carpenter Hill – Ludlow
308	345	Wachusett – Millbury
312	345	Berkshire – Northfield (Post Alps-Berkshire ETU)
393	345	Alps – Berkshire (Post Alps-Berkshire ETU)
313	345	Wachusett – Millbury
314	345	Sandy Pond – Wachusett
326	345	Scobie – Sandy Pond
320	345	Lake Rd – Card St
343	345	Sandy Pond – Wachusett
354	345	Northfield – Ludlow
367	345	Amherst – Fitzwilliam
3195	345	Amherst – Eagle
380	345	Eagle – Scobie Pd
368	345	Manchester – Card St
379	345	Vernon – Fitzwilliam
381	345	Vernon – Northfield
398	345	Long Mt – Pleasant Valley (NY)
3340	345	Vernon – Vermont Yankee
3381	345	Vernon – Vermont Yankee
3271	345	Lake Rd – Card St
330	345	Lake Rd – Card St
3348	345	Lake Rd – Killingly
341	345	Lake Rd – W Farnum
368	345	Card St - Manchester
345 kV Transformers		
Wachusett T5	345/115	Wachusett Transformer #5
Wachusett T6	345/115	Wachusett Transformer #6
Wachusett T7	345/115	Wachusett Transformer #7
Fitzwilliam T1	345/115	Fitzwilliam Transformer #1
Ludlow T2	345/115	Ludlow Transformer #2
Ludlow T3	345/115	Ludlow Transformer #3
Northfield T1	345/115	Northfield Transformer #1 (post Pittsfield-Greenfield upgrades)
Berkshire T1	345/115	Berkshire Transformer #1
Carpenter Hill T1	345/115	Carpenter Hill Transformer #1
Agawam T1	345/115	Agawam T1
Agawam T2	345/115	Agawam T2
345 kV Line End Open Contingencies		
301 Millbury	345	Millbury – Carpenter Hill
302 Ludlow	345	Ludlow – Carpenter Hill
312 Northfield	345	Northfield – Berkshire
345 kV Breaker Open Contingencies		
393 Alps	345	Berkshire - Alps
345 kV Breaker Failures		
Fitzwilliam 3791 BF	345	379 + Fitz T1
Fitzwilliam 671 BF	345	367 + Fitz T1

CONTINGENCY NAME	kV	DESCRIPTION
Wachusett 7T BF	345	308 + Wachusett T7
Wachusett 6T BF	345	313 + Wachusett T6
Wachusett43-6T BF	345	343 + Wachusett T6
Wachusett 14-7T BF	345	314 + Wachusett T7
Ludlow 1T BF	345	334 + Ludlow T2
Ludlow 2T BF	345	334 + Ludlow T3
Ludlow 3T BF	345	Ludlow T3
Ludlow 4T BF	345	354 + Ludlow T2
Ludlow 5T BF3t19	345	3196 + 354
Ludlow 6T BF	345	3196
Ludlow 7T BF	345	301/302 + Ludlow T2+ Carpenter Hill Auto
Ludlow 8T BF	345	3419 + 301/302 + Ludlow T2+ Carpenter Hill Auto
Ludlow 9T BF	345	3419
Millbury 308+302 BF	345	301/302 + 308
Northfield 2T BF	345	312 + Northfield G1 + G2 (post Pittsfield-Greenfield upgrades)
Northfield 5T BF	345	354 + Northfield G3 + G4 (post Pittsfield-Greenfield upgrades)
Vernon 3TB4-B1 BF	345	381 + Vernon Reactor
Vernon 3TB3-B1 BF	345	379 + 3381
Vernon 3TB1-B1 BF	345	3320 + 3340
Vernon 3TB2-B1 BF	345	340 + Vernon T1
Vermont Yankee 1T	345	Vermont Yankee GSU
Vermont Yankee 381	345	3381 + Vermont Yankee Auto
Vermont Yankee 81-1T	345	3381 + Vermont Yankee GSU
Vermont Yankee 79-40	345	3340 + Vermont Yankee Auto
345 kV Double Ckt Towers		
-	-	-
230 kV Transmission Lines		
E-205E	230	Bear Swamp – Pratts Jct.
E-205W	230	Bear Swamp – Eastover Rd (NY)
38	230	Rotterdam (NY) – Eastover Rd (NY)
230 kV Double Ckt Towers		
-	-	-
230/115 kV Transformers		
Bear Swamp T4	230/115	Bear Swamp Transformer #4
Bear Swamp T5	230/115	Bear Swamp Transformer #5
PrattsJct T8 + T8A	230/115	PrattsJct Transformer #8 + 8A
Eastover Rd T1	230/115	Eastover Rd Transformer #1
Eastover Rd T2	230/115	Eastover Rd Transformer #2
230 kV Breaker Failures		
Bear Swamp 2205E BF	230	Bear Swamp G2 + T4 (230-115 kV) + E-205E
Bear Swamp 2205W BF	230	Bear Swamp G2 + T4 (230-115 kV) + E-205W
Bear Swamp 1205E BF	230	Bear Swamp G1 + T5 (230-115 kV) + E-205E + 115 kV Cap
Bear Swamp 1205W BF	230	Bear Swamp G1 + T5 (230-115 kV) + E-205W + 115 kV Cap
Eastover Rd RE205 BF	230	E-205W + Eastover Rd T1
Eastover Rd RE215 BF	230	E-205W + Eastover Rd T2
Eastover Rd R38 BF	230	38 + Eastover Rd T1
Eastover Rd R48 BF	230	38 + Eastover Rd T2
115 kV Transmission Lines		
1242	115	Montague – Berkshire
1361	115	Montague – Cumberland (post Pittsfield-Greenfield upgrades)
1231	115	Berkshire – Cumberland
1551	115	Doreen – Berkshire
1662	115	Doreen – Berkshire
PV20	115	Plattsburg – South Hero
K6	115	Bennington – Hoosick (NY)
K7	115	Whitehall – Bliss Ville
A-127E	115	Millbury- Webster St – Erving (post Erving substation)
A-127W	115	Erving – Harriman (post Erving substation)
B-128	115	Harriman – Millbury
E-131	115	Bear Swamp – Harriman – Adams
F-132	115	Adams – Doreen
I-135	115	Fitzwilliam – Flagg Pd
I-135S	115	Flagg Pd – PrattsJct
J-136S	115	Flagg Pd – Litchfield Tap – PrattsJct
J-136N	115	Bellows Falls – Flagg Pd

CONTINGENCY NAME	kV	DESCRIPTION
O-141	115	Greendale – Nashua St
O-141N	115	PrattsJct – Wachussett
O-141S	115	Nashua St – Millbury
O-141W	115	Wachusett– Greendale
P-142	115	W Boylston – Rolfe Ave
P-142N	115	PrattsJct – Wachusett
P-142S	115	Rolfe Ave – Millbury
P142W	115	Wachusett – W Boylston
Q-117	115	Adams – Bennington
R-170	115	Palmer – W Hampden
1205	115	W Hampden - Ludlow
1976	115	W Hampden - Scitico
S-197	115	Bear Swamp – Deerfield
V-174W	115	Carpenter Hill – N Oxford
V-174	115	N Oxford – Millbury
W-175	115	Carpenter Hill – Palmer
X-176	115	Palmer – Ludlow
Y-177	115	Harriman – Montague (NU)
Z-126	115	Millbury – Tower 510 – Webster St
115 kV Double Ckt Towers		
1161+1211 DCT	115	1161 + 1211 + 1662
1231+1242 DCT	115	1231 + 1242
1551+1662 DCT	115	1551 + 1662 + 1211
1715+1816 DCT	115	1715 + 1816 + Altresco Gen
A127E+B128 DCT	115	A-127E + B-128 (Millbury – Erving) (post Erving substation)
A127W+B128 DCT	115	A-127W + B-128 (Erving – Harriman) (post Erving substation)
141W+142 DCT	115	O-141W + P-142
O141S+P142 DCT	115	O-141S + P-142
O141N+P142N DCT	115	O-141N + P-142N
O141S+142S DCT	115	O-141S + P-142S
O141W+P142W DCT	115	O-141W + P-142W
I135S+J136S DCT	115	I-135S + J-136S
I135N+J136N DCT		I-135N + J-136N
I135+J136N DCT		I-135 + J-136N
115/69 kV Transformers		
Millbury T1	115/69	Millbury Transformer #1 (56 MVA)
Millbury T2	115/69	Millbury Transformer #2 (56 MVA)
Millbury T3	115/69	Millbury Transformer #3 (45 MVA) + 63 Mvar Cap Bank
Pratts Jct T5 +T6 + T7	115/69	PrattsJct Transformer bank #1
PrattsJct T3+T4	115/69	PrattsJct Transformer bank #2
Deerfield 4 T3 + T4	115/69	Deerfield4 transformer #3 + T4
Adams Autotransformer	115/69	Adams Autotransformer
Bennington T69	115/69	Bennington VT 115-69 kV transformer
Harriman Autotransformer	115/69	Harriman Autotransformer
Palmer Transformer bank #1	115/69	Palmer T3 + T5
Palmer Transformer bank #1	115/69	Palmer T4 + T6
W Hampden T1	115-69	West Hampden T1
115 kV Breaker Failures		
Adams 731 BF	115	E-131 + Q-117 (Post Adams Upgrade)
Adams 217 BF	115	F-132 + Q-117 (Post Adams Upgrade)
Adams T3T BF	115	F-132 + Adams Auto (Post Adams Upgrade)
Adams T5T BF	115	E-131 + Adams Auto (Post Adams Upgrade)
Bear Swamp 131 BF	115	E-131 + Bear Swamp T4 + Bear Swamp GSU #1
Bear Swamp 197 BF	115	S-197 + Bear Swamp T4 + Bear Swamp GSU #1
Bear Swamp T31 BF	115	E-131 + Bear Swamp Fut Xfmr + Bear Swamp 115 kV Cap + Bear Swamp GSU #2 (Post Bear Swamp Upgrade)
Bear Swamp T97 BF	115	S-197 + Bear Swamp Fut Xfmr + Bear Swamp 115 kV Cap + Bear Swamp GSU #2 (Post Bear Swamp Upgrade)
Bennington K4 BF	115	Q-117 + Bennington 115 kV Cap #1
Bennington KT1 BF	115	Bennington Auto + Bennington 115 kV Cap #2
Berkshire 12T BF	115	1551 + Berkshire T2
Berkshire 13T BF	115	1551 + 1231
Berkshire 16T BF	115	1662 +1242
Doreen 6T BF	115	1161 + 1662
Doreen 7T BF	115	1211 + 1662
Doreen 8T BF	115	1211 + 1551
Doreen 9T BF	115	1551 + 1816

CONTINGENCY NAME	kV	DESCRIPTION
Doreen 12T BF	115	1715 + F-132
Erving A BF	115	A-127W + A-127E open ended + Northfield T1
Erving B BF	115	A-127E + A-127W open ended + Northfield T1
Erving C BF	115	A-127E + A-127W + Northfield T1
Harriman A127 BF	115	A-127W + B-128 open ended
Harriman B128 BF	115	A-127W open ended + B-128
Harriman E131 BF	115	E-131 + Y177 open ended + Harriman G1 + G2 +G3
Harriman Y177 BF	115	E-131 open ended + Y177 + Harriman G1 + G2 +G3
Harriman TIE BF	115	A-127W open ended + B-128 open ended + E-131 open ended + Y177 open ended + Harriman G1 + G2 +G3
Montague 1T BF	115	1632 + Cabot Gen
Montague 3T BF	115	1044 + Y-177 open ended
Montague 7T BF	115	1361 + A-127W open ended
Montague 8T BF	115	1361 + 1242
Montague 10T BF	115	1242 + Cabot Gen
PrattsJct O141 BF	115	Pratts T3 + T4 115-69 kV autos + O-141N + Pratts 63 MVAR capacitor
PrattsJct 801 BF	115	Pratts T3 + T4 115-69 kV autos + E-205E + Pratts 63 MVAR capacitor
PrattsJct I135 BF	115	Pratts T3 + T4 115-69 kV autos + I-135S + Pratts 63 MVAR capacitor
PrattsJct 1110 BF	115	Pratts T3 + T4 115-69 kV autos + Pratts 63 MVAR capacitor
PrattsJct P142 BF	115	Pratts T3 + T4 115-69 kV autos + P-142N + Pratts 63 MVAR capacitor
PrattsJct 802 BF	115	Pratts T5 + T6 + T7 115-69 kV autos + E-205E + J-136 (PJ – Litch Tap)
PrattsJct L138 BF	115	Pratts T5 + T6 + T7 115-69 kV autos + L-138 + J-136 (PJ – Litch Tap)
PrattsJct K137 BF	115	Pratts T5 + T6 + T7 115-69 kV autos + K-137 + J-136 (PJ – Litch Tap)
PrattsJct J136 BF	115	Pratts T5 + T6 + T7 115-69 kV autos + J-136S
PrattsJct 2110 BF	115	Pratts T5 + T6 + T7 115-69 kV autos + J-136 (PJ – Litch Tap)
PrattsJct 38-42 BF	115	L-138W + P-142N
PrattsJct 37-41 BF	115	K-137W + O-141N
115 kV Capacitor Banks		
Bear Swamp Cap #1	115	Bear Swamp 63 Mvar Cap Bank
Bear Swamp Cap #2	115	Bear Swamp 63 Mvar Cap Bank
115 kV Line-End Open Contingencies		
1242 Mont-open	115	Montague – Berkshire
1242 Berk-open	115	Montague – Berkshire
1231 Berk-open	115	Berkshire – Cumberland
1231 Cumb-open	115	Berkshire – Cumberland
A-127 Millb-open	115	A-127 (Millbury – Tower 510)
B-128 Millb-open	115	B-128 (Millbury – Tower 510)
I135 Flagg-open	115	I-135 (Flagg Pd – Chinook)
I-135 Fitz-open	115	I-135 (Fitzwilliam – Chinook)
J136S Flagg-open	115	J-136S (Flagg Pd – Litchfield St Tap)
O141N Wach-open	115	O-141N (Wachusett – Sterling)
O141N Pratts-open	115	O-141N (PrattsJct – Sterling)
P142N Wach-open	115	P-142N (Wachusett – Sterling)
P142N Pratts-open	115	P-142N (Pratts Jct – Sterling)
P142S Milb-open	115	P-142S (Millbury – Wyman Gordon)
P142S Bloom-open	115	P-142S (Rolfe Ave. – Bloomingdale Tap)
P142S Rolfe-open	115	P-142S (Rolfe Ave – Bloomingdale Tap)
E131 Bear-open	115	E-131 (Bear Swamp – Bear Swamp Jct)
E131 Adams-open	115	E-131 (Adams – Bear Swamp Jct)
F132 Doreen-open	115	F-132 (Doreen – Partridere)
W-175 Carp-open	115	W-175 (Carpenter Hill – W Charlton)
W-175 Palm-open	115	W-175 (Palmer – Little Rest Rd)
X-176 Palm-open	115	X-176 (Palmer – Thorndike)
X-176 Ludlow-open	115	X-176 (Ludlow – Thorndike)
115 kV Breaker Open Contingencies		
A127W Harriman	115	Harriman - Cabot Jct
J136S Pratts	115	Pratts Jct – Litchfield tap
I135N-Bellows	115	Bellows Falls – Fitzwilliam Tap
J136N-Bellows	115	Bellows Falls – E Winchendon
E131-harriman	115	Harriman – Bear Swamp Jct
B128-harriman	115	Harriman – Cabot Jct
Y177-harriman	115	Harriman – Sherman
Harriman T3 115 kV	115	Harriman T3 115 kV winding - Midpoint
115 kV Bus Faults		

CONTINGENCY NAME	kV	DESCRIPTION
Harriman Bus #1	115	A-127 open ended + B128 open ended + GSU # 1 + #2 (Post-Harriman Tie breaker)
Harriman Bus #2	115	E-131 open ended + Y-177 open ended + T3 open ended (Post-Harriman Tie breaker)
Pratts Bus #1	115	
Pratts Bus #2	115	
69 kV Transmission Lines		
A-1	69	Otter River – Chestnut Hill
A-1N	69	Chestnut Hill – Vernon
A-1S	69	PrattsJct – Otter River
B-2N	69	Park St – Vernon
B-2S	69	PrattsJct – Park St (Gardner)
D-4N	69	Vernon – QP660
D-4S	69	QP660- Deerfield 4
E-5	69	Meadow St. – Ware
E-5D	69	Shutesbury – Deerfield 4
E-5E	69	Millbury – Meadow St
E-5W	69	Ware – Shutesbury
F-6	69	Meadow St. – Ware
F-6E	69	Millbury – Meadow St
F-6W	69	Ware – Deerfield 4
J-10	69	Adams – Deerfield 5
M-39	69	Fitch Rd – Wachusett
N-40	69	Fitch Rd – PrattsJct
N-14	69	Palmer – E Longmeadow
O-15N	69	Palmer – Ware
O-15S	69	W Hamden - E Longmeadow
Y-25N-1	69	Searsburg – Searsburg Wind
Y-25N-2	69	Bennington – Deerfield Wind
Y-25S	69	Deerfield 5 – Harriman – Searsburg
69 kV Breaker Failures		
Pratts A1S BF	69	A-1S + U-21S + N-40 + open end 69 kV side of Pratts 115/69 kV transformer bank #1
Pratts B2S BF	69	B-2S + V-22S + open 69 kV side of Pratts 115/69 kV transformer bank #2
Pratts 160 BF	69	Pratts 115/69 kV transformer bank #2 + Open end A-1S + N-40 + U-21S
Pratts 260 BF	69	Pratts 115/69 kV transformer bank #2 + Open end B-2S + V-22S
Pratts Tie BF	69	PrattsJct 69 kV busses #1 and #2 (open all lines and transformers at PrattsJct 69 kV)
Pratts U21 BF	69	U-21S + N-40 + open end 69 kV side of Pratts 115/69 kV transformer bank #1 + open end A-1S
Pratts V22 BF	69	V-22S + open end B-2S + open 69 kV side of Pratts 115/69 kV transformer bank #2
Deerfield #4 540	69	E-5D + Deerfield 69 kV bus (open end all other facilities out of Deerfield 69 kV)
Deerfield #4 640	69	F-6W + Deerfield 69 kV bus (open end all other facilities out of Deerfield 69 kV)
Crystal Lake B2S BF	69	B-2S + Crystal Lake T1 (69/13kV)
Crystal Lake B2N BF	69	B-2N + Crystal Lake T2 (69/13kV)
Searsburg Y25 BF	69	Y-25N-1 + Y25S
Deerfield Wind Y25-1 BF	69	Searsburg Wind + Y-25N-1 + Y-25N-2 open ended
Deerfield Wind Y25-2 BF	69	Searsburg Wind + Y-25N-2 + Y-25N-1 open ended
Deerfield Wind Y25-Tie BF	69	Searsburg Wind + Y-25N-1 + Y-25N-2
Adams 360 BF	69	Adams 115/69kV Autotransformer + J-10
Chestnut Hill 230 BF	69	A-1N + A-1 open ended + T2
Chestnut Hill 130 BF	69	A-1 + A-1N open ended + T1
Otter River A1 BF	69	A-1 + A-1S open ended
Otter River A1S BF	69	A-1S + A-1 open ended
Harriman 3810 BF	69	Y-25S + Harriman G3 + Harriman 115/69kV Autotransformer
Vernon A1 BF	69	A-1N + GSU #1
Vernon B2 BF	69	B-2N + D-4 open ended + GSU #2
Vernon D4 BF	69	B-2N + D-4 open ended + GSU #2
Vernon Tie BF	69	All lines (A-1N, B-2N, D-4) open ended + GSU #1 & #2
Bennington Y25 BF	69	Y-25N-2 + Benn 115/69kV Autotransformer + Benn Cap #2
69 kV Line-End Open Contingencies		
E-5E Mill-open	69	Millbury – Pondville
E-5 Meadow-open	69	Meadow St – Harrington St
E-5W Ware-open	69	Ware - Shutesbury
F-6E Mill-open	69	Millbury - Pondville
F-6 Meadow-open	69	Meadow St. – Lashaway
F-6W Ware-open	69	Ware – Belchertown

CONTINGENCY NAME	kV	DESCRIPTION
69 kV Breaker Open Contingencies		
A-1 Otter River	69	Royalston – Otter River
A-1S Otter River	69	Otter River – E Westminster
A1 Chestnut Hill	69	Chestnut Hill – Royalston
A1S Pratts Jct	69	Pratts Jct – E Westminster
B2S Pratts Jct	69	Pratts Jct – E Westminster
B-2S Crystal Lake	69	Crystal Lake - Westminster
B-2N Crystal Lake	69	Crystal Lake – Otter River
E5D Deerfield 4	69	Deerfield 4 – Deerfield 3
F6 Meadow St	69	Meadow St - Lashaway
F6 Shutesbury	69	Shutesbury – Deerfield 2
F6W Deerfield 4	69	Deerfield 4 – Deerfield 3
Harriman T3 69 kV	69	Harriman T3 69 kV winding - Midpoint
Y25 Searsburg	69	Searsburg North bus - Searsburg South bus
Y25 Deerfield 5	69	Deerfield 5 – Hoosic Wind Tap
69 kV Bus Faults		
Pratts Bus #1	69	
Pratts Bus #2	69	
Vernon #1	69	A-1 open ended at Vernon + GSU #1
Vernon #2	69	B-2 and D-4 open ended at Vernon + GSU #2
Deerfield #4	69	All lines open ended at Deerfield 4 (E-5, F-6, D-4)
69 kV Double Ckt Towers		
A1S+B2S	69	
A1S+B2N	69	
A1+B2N	69	
A1N+B2N	69	
E5E+F6E DCT	69	
E5+F6 DCT	69	
E5W+F6W DCT	69	
E5D+F6W DCT	69	
Generators/GSU		
Harriman Hydro (VT)	115/6.9	GSU 1
Harriman Hydro (VT)	115/6.9	GSU 2
Harriman Hydro (VT)	115/6.9	GSU 3
Cabot Hydro (MA)	115/13.8	Cabot GSU
Northfield (MA)	345/13.8	GSU #1 Unit 1 + Unit 2
Northfield (MA)	345/13.8	GSU #2 Unit 3 + Unit 4
Altresco (MA)	115/13.8	Unit 1 + Unit 2
Altresco (MA)	115/13.8	Unit 3 + Unit 4
Vernon Hydro #1 (VT)	69/13.8	GSU #1
Vernon Hydro #2 (VT)	69/13.8	GSU #2
Seabrook	345	
Bear Swamp G1/P1	230 kV	Bear Swamp Generator/Pump #1
Bear Swamp G2/P2	230 kV	Bear Swamp Generator/Pump #2
Millenium GT + ST	115 kV	Millennium Gas Turbine + Steam Turbine Unit

5.4.2 N-1-1 Contingency List

The following table lists the contingencies that was tested as the first line out in N-1-1 contingency analysis. In each line-out case, all contingencies described in previous section is tested as the second contingency.

Table 15 - N-1-1 Contingency List

Initial facility out (N-1), one at a time	Second Contingency (N-1-1)
Each transmission circuit (69 kV and above) tested in N-1 analysis Each transmission transformer (115/69 kV and above) tested in N-1 analysis Each Generator (connected to 69 kV and above) tested in N-1 Analysis Loss of Seabrook G1 Loss of Sandy Pond HVDC Pole 1 Loss of Sandy Pond HVDC Pole 2 Shunt Device	All contingencies listed in Table 14 except: Non BPS* Double Circuit Towers Non BPS* Breaker Failures Non BPS* Bus sections Line-End-Open Contingencies

*** Non BPS equipment is defined as any line or device that is not terminated at a BPS station**

Steady State Results

5.4.3 N-0 Thermal and Voltage Results

N-0 Thermal Results

Simulation results indicate that addition of the Group 3 DER, incemental to the Groups 1+2 DER, results in several transmission facility overloads during all-lines-in conditions as shown in table below.

Table 16 - N-0 Thermal Overloads

Worst case Loading at or above 100% of LTE Rating				Base case
Overloaded Facility	KV	Summer Normal Rating	Loading (% LTE)	
B-2 [Pratts Jct – E Westminster] (2/0 Cu O/H line)	69	[redacted]	[redacted]	25pk-we-pv=100% + BESS discharge
				25sh-we_ PV=100% + BESS discharge
				25ll-we_ PV=100% + BESS discharge
				25sh-ew+pump PV=0% BESS Charging
B-2 [E Westminster - Westminster] (2/0 Cu O/H line)	69			25pk-we-pv=100% + BESS discharge
				25sh-we_ PV=100% + BESS discharge
B-2 [Westminster – Crystal Lake] (2/0 Cu O/H line)	69			25sh-we_ PV=100% + BESS discharge

N-0 Voltage Results

No N-0 voltage violations were found for any of the conditions tested.

N-1 Thermal and Voltage Results

N-1 Thermal Results

Simulation results indicate that addition of the Group 3 DER, incremental to the Groups 1+2 DER, results in several transmission facility overloads following N-1 contingencies as shown in table below.

Table 17 - N-1 Thermal Overloads

Worst case Loading at or above 100% of LTE Rating				Base case	CONTINGENCY (Loss of)
Overloaded Facility	KV	LTE Rating	Loading (% LTE)		
B-2 [Pratts Jct – E Westminster] (2/0 Cu O/H line)	69			25pk-we-pv=100% + BESS discharge 25sh-we_ PV=100% + BESS discharge 25ll-we_ PV=100% + BESS discharge 25sh-ew+pump PV=0% BESS Charging	
				25sh-we_ PV=100% + BESS discharge	
				25pk-we-pv=100% + BESS discharge	
				25pk-we-pv=100% + BESS discharge 25sh-we_ PV=100% + BESS discharge 25sh-ew+pump PV=0% BESS Charging	
B-2 [E Westminster - Westminster] (2/0 Cu O/H line)	69			25sh-we_ PV=100% + BESS discharge	
				25sh-we_ PV=100% + BESS discharge	
				25sh-we_ PV=100% + BESS discharge	
B-2 [Westminster – Crystal Lake] (2/0 Cu O/H line)	69			25sh-we_ PV=100% + BESS discharge	
				25sh-we_ PV=100% + BESS discharge	
				25sh-we_ PV=100% + BESS discharge	
				25sh-we_ PV=100% + BESS discharge	
A-1 [Otter River - Royalston] (2/0 Cu O/H line)	69			25sh-we_ PV=100% + BESS discharge	
				25sh-we_ PV=100% + BESS discharge	

If QP1031 [redacted] goes forward, the addition of Group 3 DER results in the following additional N-1 overloads.

Table 18 – Additional N-1 Thermal Overloads

(w/ [redacted] (QP1031) and [redacted] (QP1112) In-service)

Worst case Loading at or above 100% of LTE Rating				Base case	CONTINGENCY (Loss of)
Overloaded Facility*	KV	LTE Rating	Loading (% LTE)		
E-5 [Meadow St- Leicester] (477 ACSR)	69	[redacted]	[redacted]	25pk-we-pv=100% + BESS discharge	[redacted]
F-6 [Meadow St- Leicester] (477 ACSR)	69			25pk-we-pv=100% + BESS discharge	
E-5 [Leicester - Pondville] (477 ACSR)	69			25pk-we-pv=100% + BESS discharge	
F-6 [Leicester - Pondville] (477 ACSR)	69			25pk-we-pv=100% + BESS discharge	
E-5 [Meadow St – Harrington St] (477 ACSR)	69			25pk-we-pv=100% + BESS discharge	

*All additional Overload facilities are due to the inclusion of QP1031 [redacted] only, not QP1112 [redacted].

N-1 Voltage Results

Simulation results indicate that the addition of the Group 3 DER (With or without QP1031 or QP 1112), results in several high and low voltage violations along the A1/B2 69 kV transmission circuits for several N-1 contingencies. These overloads are shown in the following table.

Table 19 - N-1 Voltage Violations

BUSSES W/ VOLTAGE VIOLATIONS		Voltage	BASE CASE	CONTINGENCY
Bus	KV	Pu		(Loss of)
E Westminster (A1)	69	1.07	25min pv=100% + BESS discharge	[redacted]
		0.88	25sh-ew+pump PV=0% BESS Charging	
E Westminster (B2)	69	1.06	25min pv=100% + BESS discharge	
Westminster (B2)	69	1.06	25sh-we pv=100% + BESS discharge	
Vernon (A1/B2)	69	1.056	25min pv=100% + BESS discharge	
Otter River (A1)	69	1.06	25min pv=100% + BESS discharge	
		0.88	25sh-ew+pump PV=0% BESS Charging	
Royalston (A1)	69	1.059	25min pv=100% + BESS discharge	
		0.890	25sh-ew+pump PV=0% BESS Charging	
Chestnut Hill (A1)	69	1.053	25min pv=100% + BESS discharge	
		0.89	25sh-ew+pump PV=0% BESS Charging	
Crystal Lake (B2)	69	1.07	25sh-we pv=100% + BESS discharge	
		1.054	25sh-we pv=100% + BESS discharge	

Appendix D provides the full N-0 and N-1 thermal and steady state voltage results.

5.4.4 N-1-1 Steady State Results

N-1-1 Thermal Results:

One additional thermal overload on the A-1 circuit (over and above that found for N-1 contingencies) was identified for N-1-1 contingencies. This occurs with or without [redacted] (QP1031) or [redacted] (QP1112) In-service.

Table 20 – N-1-1 Thermal Overloads (Incremental to N-1 Overloads)

Worst case Loading at or above 100% of LTE Rating				Base case	1st CONTINGENCY (Loss of)	2nd CONTINGENCY (Loss of)
Overloaded Facility	KV	LTE Rating	Loading (% LTE)			
A-1S [Pratts Jct – E Westminster] (2/0 Cu O/H line)	69	[redacted]	[redacted]	25sh-ew+pump PV=0% BESS Charging	[redacted]	

Two additional thermal overloads (over and above that found for N-1 contingencies) were identified on the E-5/F-6 circuits with [redacted] (QP1031) in place.

Table 21 – Additional N-1-1 Thermal Overloads

(w/ [redacted] (QP1031) In-service)

Worst case Loading at or above 100% of LTE Rating				Base case	1st CONTINGENCY (Loss of)	2nd CONTINGENCY (Loss of)
Overloaded Facility*	KV	LTE Rating	Loading (% LTE)			
E-5E [Millbury- Pondville] (477 ACSR)	69	[redacted]	[redacted]	25ll-we-pv=100% + BESS discharge 25pk-we-pv=100% + BESS discharge	[redacted]	
F-6E [Millbury- Pondville] (477 ACSR)	69			25ll-we-pv=100% + BESS discharge 25pk-we-pv=100% + BESS discharge		

*All additional Overload facilities are due to the inclusion of QP1031 [redacted] only, not QP1112 [redacted].

N-1-1 Voltage Results:

No additional voltage problems (over and above those found for N-1 contingencies) were identified for N-1-1 contingencies. This is true with or without [redacted] (QP1031) or [redacted] (QP1112) In-service.

Transmission Upgrades Required for Group 3 DER

- **A1/B2 line rebuild/reconductor:** The thermal overloads identified on the A1/B2 69 kV transmission lines will be eliminated by an asset condition project already scheduled for the A1/B2 lines which involves the complete rebuild of the lines using 795 ACSS conductor (ISD 2027)

- **Royalston Breaker Additions**: 69 kV breaker additions at Royalston substation are needed to eliminate voltage violations along the A1/B2 lines caused by the Group 3 DER after the A1/B2 rebuild is complete. These breaker additions are already required as part of the asset condition project to rebuild of the A1/B2 lines. Note that with the Royalston breakers in place, along with the rebuilt A1/B2 lines, the Chestnut Hill 69 kV substation will be supplied via two radial taps from A1 and B2 (unlike the existing supply to Chestnut Hill substation, which involves a loop through of the A-1 line). This new arrangement is shown in the following one-line diagram. The Chestnut Hill substation is also scheduled to be rebuilt in 2026 due to asset condition issues.

- **Vernon 69 kV substation rebuild**: 69 kV equipment at Vernon substation must be upgraded to eliminate overloads on the A-1N and B-2N 69 kV circuits. These overloads occur when both DER Group 3 is connected, and the A1/B2 are reconductored (decreases impedance). There is an asset condition project already planned to rebuild Vernon station (which will be named "Huntington" substation) in 2026, which will eliminate the overloads.

- **E5/F6 line rebuild/reconductor:** The thermal overloads on the E5/F6 69 kV transmission lines caused by the combination of [redacted] (QP1031) and Group 3 DER will be eliminated by the rebuild of both E5/F6 lines and reconductor with 795 ACSS conductor. The rebuild of both E5/F6 lines is already planned due to asset condition issues, and will be completed by year 2030. Note that if QP1031 is withdrawn, Group 3 DER does not cause the E5/F6 lines to become overloaded.

Figure 9 – Asset Condition Projects Planned for A1/B2 69 kV Corridor



5.5 Group 3 DER that Can't Connect until Transmission Upgrades are Built

The following Group 3 DER can't interconnect until the A-1/B-2 69 kV transmission lines are rebuilt, the Royalston Breakers installed, and the Vernon substation is rebuilt:

PPA ID	ISO QP Number	NGrid Case Number	Developer/Project Name	Substation
NEP-22-G03-036	1174	290747	[redacted]	Crystal Lake
NEP-22-G03-037	1175	301762		East Westminster
NEP-22-G03-041	1183	318176		Royalston

If [redacted] (QP1031) goes in-service, the following Group 3 DER can't interconnect until the E5/F6 69 kV line rebuild is completed:

PPA ID	ISO QP Number	NGrid Case Number	Developer/Project Name	Substation
NEP-22-G03-028	1177	281385	[redacted]	Lashaway
NEP-22-G03-029	1177	283873		Lashaway
NEP-22-G03-032	1179	178171		Meadow Street
NEP-22-G03-031	1179	178483		Meadow Street
NEP-22-G03-030	1179	193213		Meadow Street
NEP-22-G03-022	1188	178170		Ware
NEP-22-G03-023	1188	191401		Ware
NEP-22-G03-024	1188	191403		Ware
NEP-22-G03-025	1188	191405		Ware

6 TRANSIENT STABILITY ANALYSIS

Stability testing was performed with all Group 1, 2 and 3 DER in-service, along with the transmission upgrades required for the interconnection of Group 3 DER, described in the previous sections. The stability testing was performed according to all applicable reliability standards. The purpose of the testing is to verify that the addition of the Group 3 DER and associated transmission upgrades do not cause significant adverse impact on the stability of the New England transmission system.

PSS/E Rev 34 was used to conduct the stability simulations.

6.1 Stability Performance Criteria

Normal Contingency (NC) Criteria

- Both system wide stability and individual unit stability must be maintained for all normal design contingencies. Individual generating units ≥ 5 MW or any set of units totaling more than 20 MW shall not lose synchronism or trip off due to voltage, frequency or other protection, except for the units that are tripped for fault clearing.
- A 53% reduction in the magnitude of system oscillations must be observed over four periods of the oscillation.

Bulk Power System (BPS) Testing

BPS testing is performed to determine the impact of the Project on facilities classified as part of the Bulk Power System (BPS), in accordance with revision 2 of the NPCC Document A-10, dated March 27, 2020, "Classification of Bulk Power System Elements". The criteria for BPS testing are as follows.

Acceptable BPS Reponses

- A 53% reduction in the magnitude of system oscillations observed over four periods.
- Loss of source up to 1200 MW

Unacceptable BPS Reponses

- Transiently unstable, with wide spread system collapse.
- Transiently stable, with undamped or sustained power system oscillations.
- Loss of source greater than 1200 MW.

NEPOOL Voltage SAG Guidelines

For Normal Contingenciess, the minimum post-fault positive sequence voltage sag must remain above 70% of nominal voltage and must not exceed 250 milliseconds below 80% of nominal voltage within 10 seconds following a fault. These limits are supported by the typical sag tolerances shown in IEEE Standard 1346-1998.

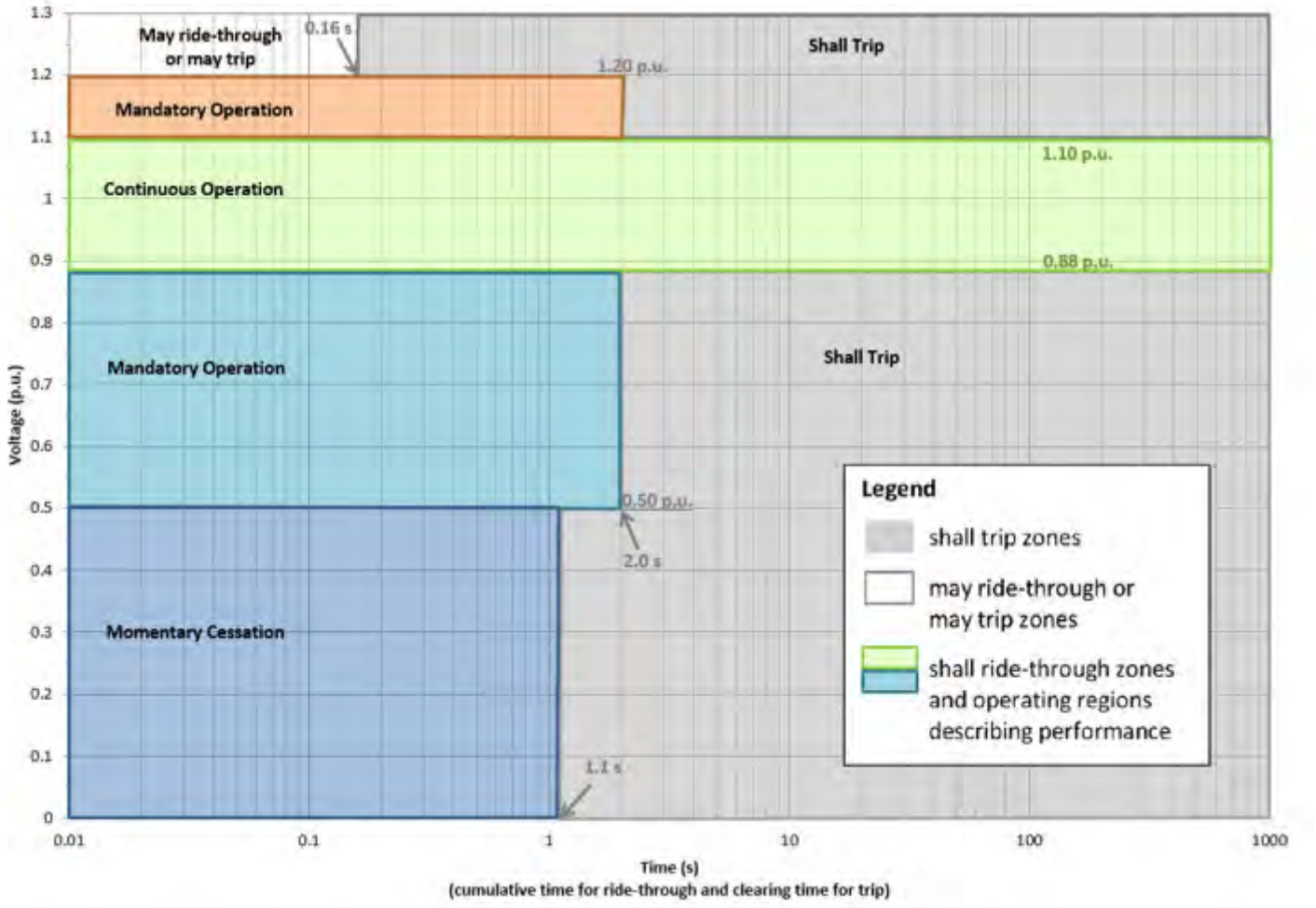
6.2 Voltage and Frequency Ride-Through Capability of DER

Groups 1, 2 and 3 DER do not have the same ride-through requirements. Groups 1 and 2 had an earlier version "Source Requirements Document" (SRD) applied to their interconnection requirements compared to the SRD applied to Group 3.

6.2.1 Voltage Ride-Through Capability for Groups 1 and 2 DER

The Voltage Ride-Through capability of Groups 1 and 2 DER were modeled according to the SRD that was applied to their interconnection, which is shown below.

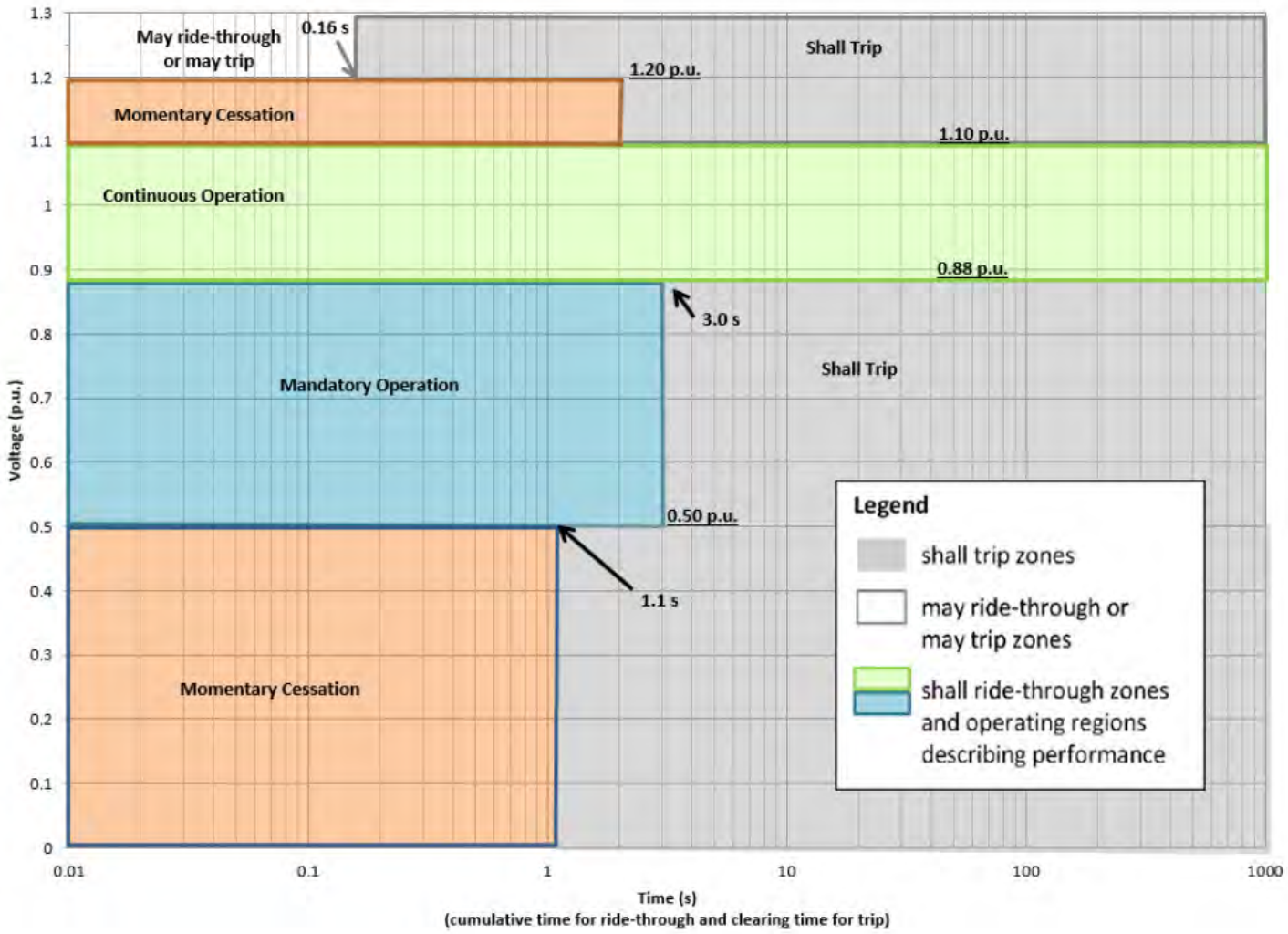
Figure 10 - Groups 1 and 2 Voltage Ride-Through Capability Curve



6.2.2 Voltage Ride-Through Capability for Group 3 DER

The Voltage Ride-Through capability of Group 3 DER is shown below. Note that the SRD was revised for Group 3 of the Western MA Cluster DER. Note that the only change pertaining to voltage ride-through in the revised SRD is that it extends the "Mandatory Operation" region from 2.0 seconds to 3.0 seconds. All Group 3 DER were modeled according to this voltage ride through curve.

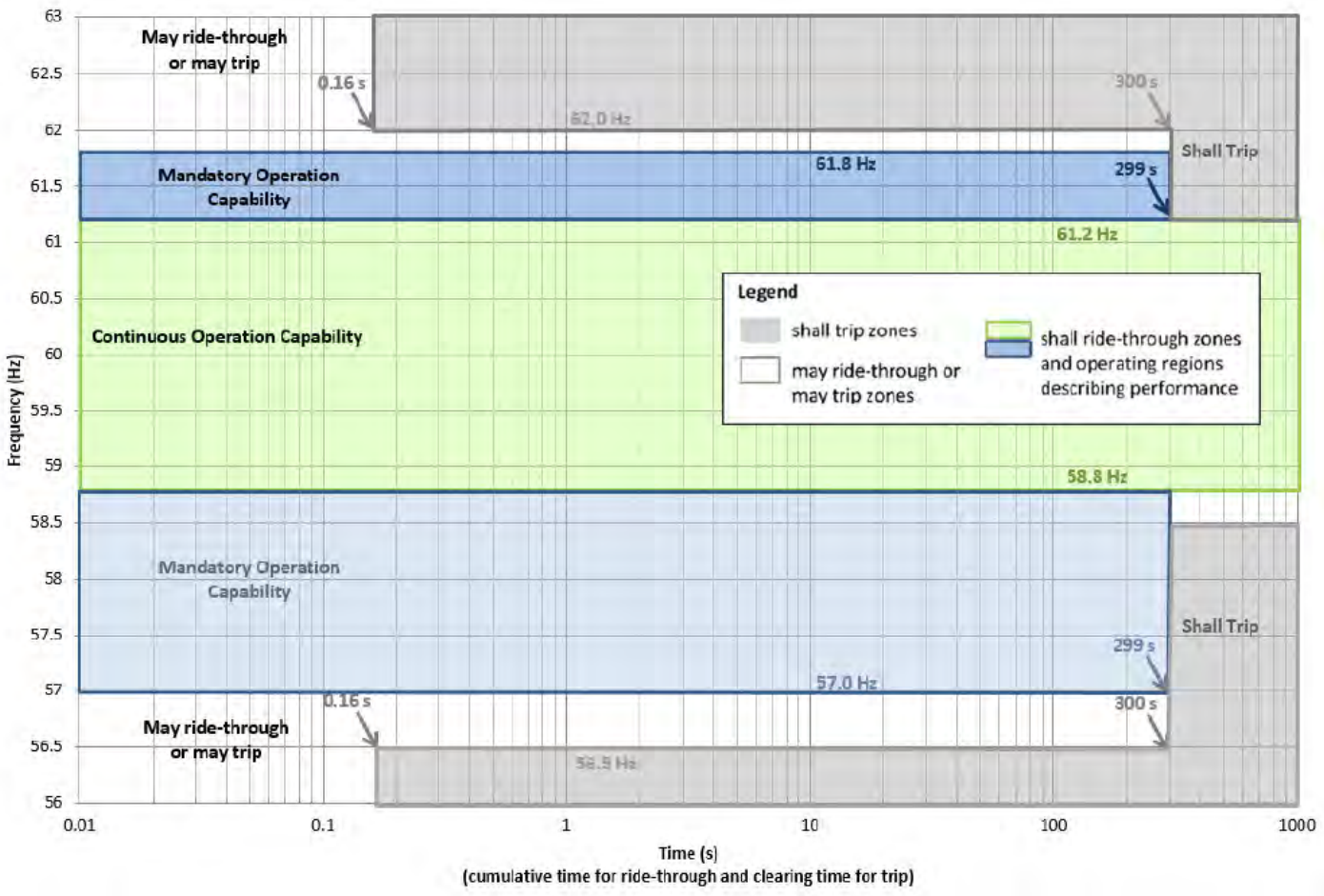
Figure 11 - Group 3 Voltage Ride-Through Capability Curve



6.2.3 Frequency Ride-Through Capability for Group 1, 2 and 3 DER

The Frequency Ride-Through requirement in the revised SRD for Group 3 is the same as in the SRD applied to Group 1 and 2. This frequency ride-through requirement curve is shown below. It was applied to all DER in Group 1, 2, and 3.

Figure 12 – Groups 1, 2, and 3 Frequency Ride-Through Curve



6.3 Frequency Response Requirement for Group 3 DER

The revised SRD for Group 3 requires that this DER respond to frequency deviations via a droop characteristic. No such requirement applies to Groups 1 and 2. Group 3 DER therefore was modeled with frequency response enabled in the stability simulations. Below are the Frequency-Droop control settings specified in the revised SRD for Group 3 DER.

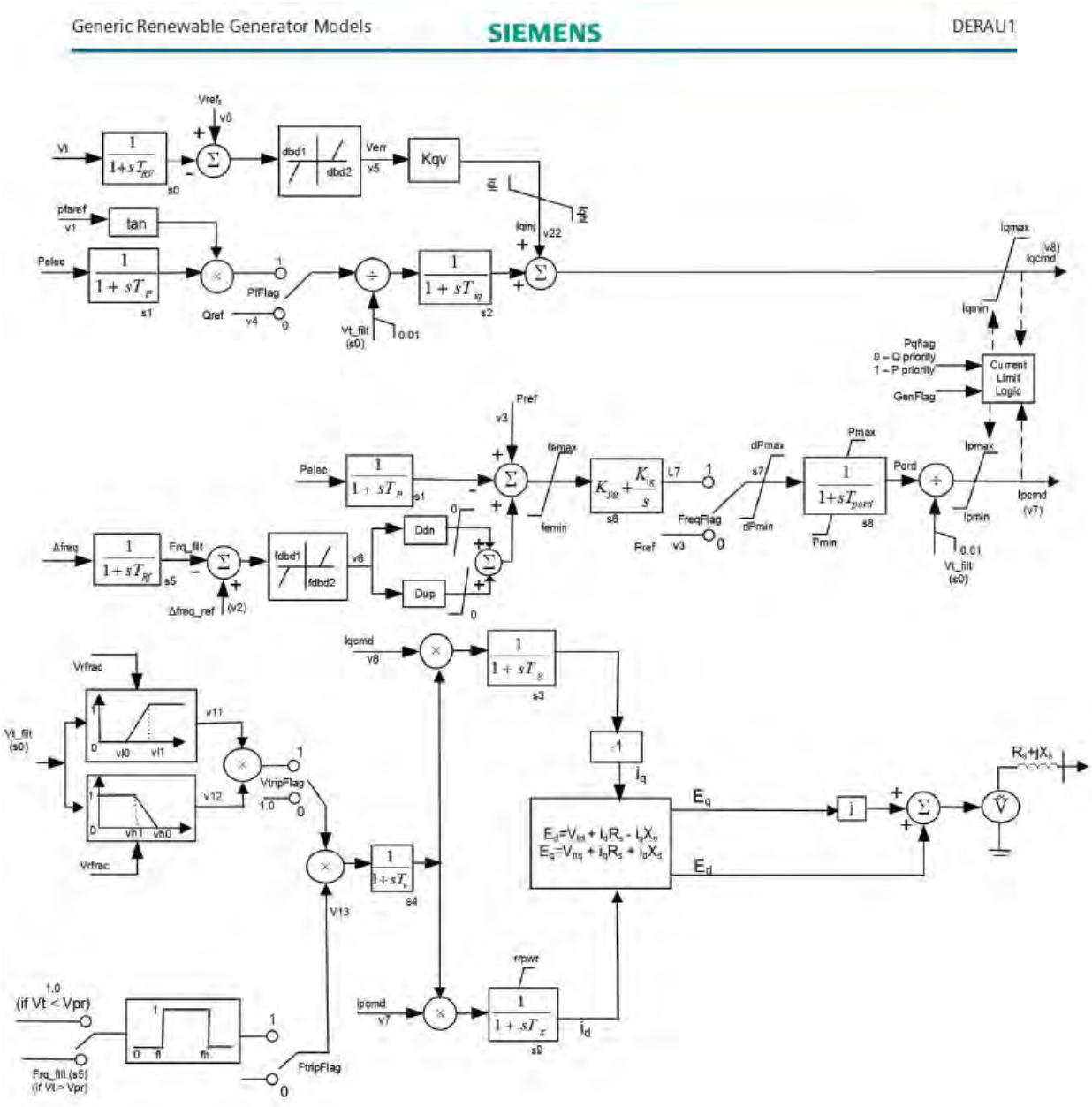
Frequency-Droop Control Settings required for Group 3 DER

Parameter	Inverter
dbOF, dbUF (Hz)	0.036
kOF, kUF (Droop)	0.05
T-response (small-signal) (s)	5

6.4 Stability Models for Group 1, 2, and 3 DER Between 1MW and 5MW

For Group 1, 2 and 3 DER greater than 1 MW, and less than 5 MW, this generation was modeled with the DER_A model. The block diagram of the DER_A model is shown in the following figure.

Figure 13 - DER_A Model Block Diagram



The input data that was used for the DER_A model is shown below. The parameters related to inverter dynamics characteristics are selected based on the latest guideline document from NERC.[8] The parameters related to voltage and frequency trip settings are selected such that the inverter complies with the voltage and frequency ride-through requirement of National Grid SRD.

Table 22 - DER_A Model Parameters Assumed for Study

Parameters	Value		Notes
	Group 1 and 2 DER	Group 3 DER	
trv	0.02	0.02	Voltage Transducer Time constant (default)
trfs	0.02	0.02	Frequency measurement transducer time constant (not in NERC guidance document, but assumed 0.02, same as Voltage Transducer Time constant)
dbd1	-99	-99	No voltage control will be modeled (default)
dbd2	99	99	No voltage control will be modeled (default)
kqv	0	0	No voltage control will be modeled (default)
vref0	0	0	No voltage control will be modeled (default)
tp	0.02	0.02	Power Transducer Time constant (default)
tiq	0.02	0.02	Q control Transducer Time constant (default)
ddn	0	20	reciprocal of droop for over-frequency conditions
dup	0	0 or 20	reciprocal of droop for under-frequency conditions (0 for solar and wind units. 20 for storage device)
fdbd1	-99	-0.0006	deadband (default)
fdbd2	99	0.0006	deadband (default)
femax	0	99	Freq error up limit (default)
femin	0	-99	Freq error low limit (default)
pmax	1	1	1 for wind, solar and battery units
pmin	0 or -1	0 or -1	0 for wind, solar units. -1 for battery units
dpmax	99	99	Power reference max ramp rate (default)
dpmin	-99	-99	Power reference min ramp rate (default)
tpord	0.02	5	Power Filter Open loop time constant (default)
kpg	0	0.1	Not mappable to interconnection standards (0, for no frequency control)
kig	0	10	Not mappable to interconnection standards (0, for no frequency control)
imax	1.2	1.2	Maximum converter current (typical inverter max output)
vl0	0.50	0.50	Voltage at head of feeder at which DER at head of feeder starts tripping.
vl1	0.55	0.55	Voltage at head of feeder at which DER at tail of feeder trips. Assume 5% voltage drop across Feeder. Amount of DER dropped will follow a linearly increasing amount until vl0, when all will be dropped
vh0	1.15	1.15	Voltage at head of feeder at which DER at tail of feeder trips. Assume 5% voltage drop across feeder
vh1	1.1	1.1	Voltage at head of feeder at which DER at head of feeder starts tripping. Amount of DER dropped will follow a linearly increasing amount until vh0, when all will be dropped

[8] https://www.nerc.com/comm/PC_Reliability_Guidelines_DL/Reliability_Guideline_DER_A_Parameterization.pdf

Parameters	Value		Notes
	Group 1 and 2 DER	Group 3 DER	
tvl0	1.1	1.1	low voltage cut-out timer corresponding to voltage vl0
tvl1	1.1	1.1	low voltage cut-out timer corresponding to voltage vl1
tvh0	2.0	2.0	High voltage cut-out timer corresponding to voltage vh0
tvh1	2.0	2.0	High voltage cut-out timer corresponding to voltage vh1
vrfrac	1	1	Per unit of DER that comes back after tripping (1 = 100% of DER comes back online if terminal voltage recovers above vlo (0.5 pu) within 1.1 seconds; 0 = 100% of DER is tripped permanently if terminal voltage does not recover above vlo (0.5 pu) within 1.1 seconds). The same logic holds true for voltages that exceed vh1.
fltrp	57.0	57.0	Frequency trip settings per National Grid SRD
fhtrp	62.0	62.0	
tfl	0.16	0.16	
tfh	0.16	0.16	
tg	0.02	0.02	† current control time constant (inner control loops) (default)
rrpwr	2.0	2.0	Ramp rate for real power increase following a fault (pu/S) as per 1547-2018 to achieve 80% recovery in 0.4 sec
tv	0.02	0.02	time constant on the output of the multiplier (time delay for partial tripping) (default value)
vpr	0.7	0.7	Low voltage inhibit on frequency tripping (due to spurious spikes that occur in positive sequence stability models) - **NOTE: all frequency tripping during simulations should be double checked for tripping due to spurious frequency spikes**
iqh1	0	0	No voltage control
iql1	0	0	No voltage control
pfflag	1	1	Constant power factor (based on initial value from steady state model)
frqflag	0	1	Freq control (1 to enable, 0 to disable)
pqflag	1	1	Active current (P) priority (during large disturbances)
Genflag	1 or 0	1 or 0	1 for Generator (0 is for storage device)
vtripflag	1	1	Enables voltage trip logic
ftripflag	1	1	Enables frequency trip logic

Note that all Group 3 DER will respond to frequency deviations, while all Group 1 and 2 DER will not, due to differences in the SRD between the groups.

All DER greater than 1 MW, but less than 5 MW, is modeled aggregately as a single equivalent generator, at the distribution bus of each substation to which it is connected. The MW size of the single equivalent generator, at a specific substation, is equal to the total amount of DER (greater than 1 MW but less than 5 MW) to be connected to that substation. No distribution feeder impedance is modeled between the equivalent generator and the distribution bus to which it is connected.

6.5 Stability Models of Group 1 and 2 DER Equal to 5MW and Greater

The Group 1 and 2 DER, equal to, or greater than 5 MW, were modeled with the same PSS/E library models as used for the Group 2 study.

These generators were modeled as individual generators combined with their equivalent collection system and GSU at the low side of the substation to which they will be connected through.

These generators were modeled with a standard PSS/E library model set consisting of the following modules:

REGCA – Renewable Energy Generator/Converter Model
REECA – Renewable Energy Electrical Model
REPCA – Plant Controller model

The following projects below exceeded 5 MW for Group 2.

Table 23 - Group 2 DER Greater than 5MW

Substation	Size (MW)
Shutesbury	10.0

The following projects below exceeded 5 MW for Group 1.

Table 24 - Group 1 DER Greater than 5MW

Substation	Size (MW)
Belchertown	8
Lashaway	6
Snow Street	12
Wendell Depot	5

6.6 Stability Models for Group 3 DER Equal to 5MW and Greater

The Group 3 DER, equal to, or greater than 5 MW, were modeled with the following library models for inverter based resources available in PSS/E Rev34.

1.) Renewable Energy Generator/Converter Model: REGC_B
2.) Renewable Energy Electrical Model: REEC_D
3.) Plant Controller model: REPCA

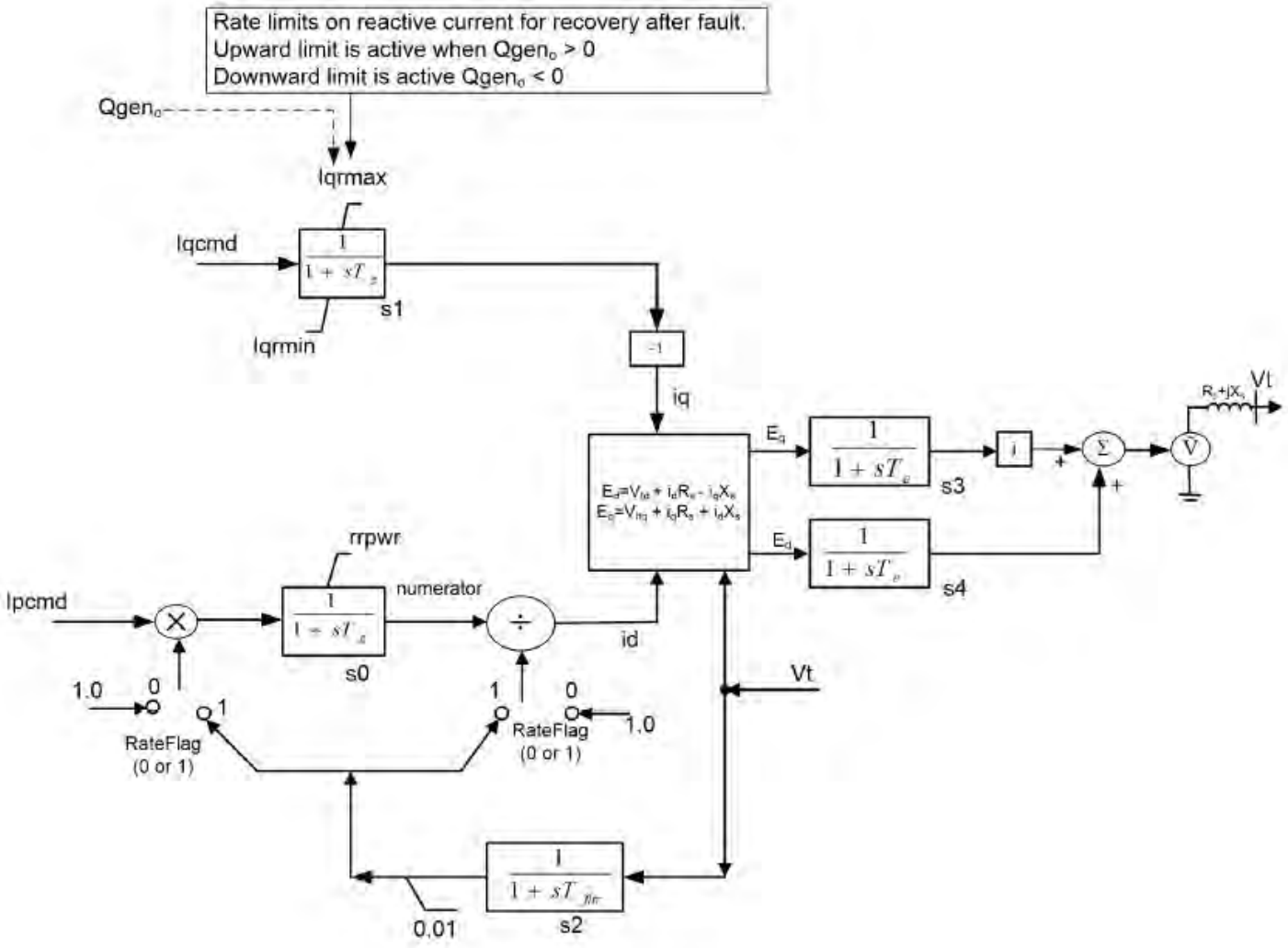
The following projects below exceeded 5 MW for Group 3.

Table 25 - Group 3 DER Greater than 5MW

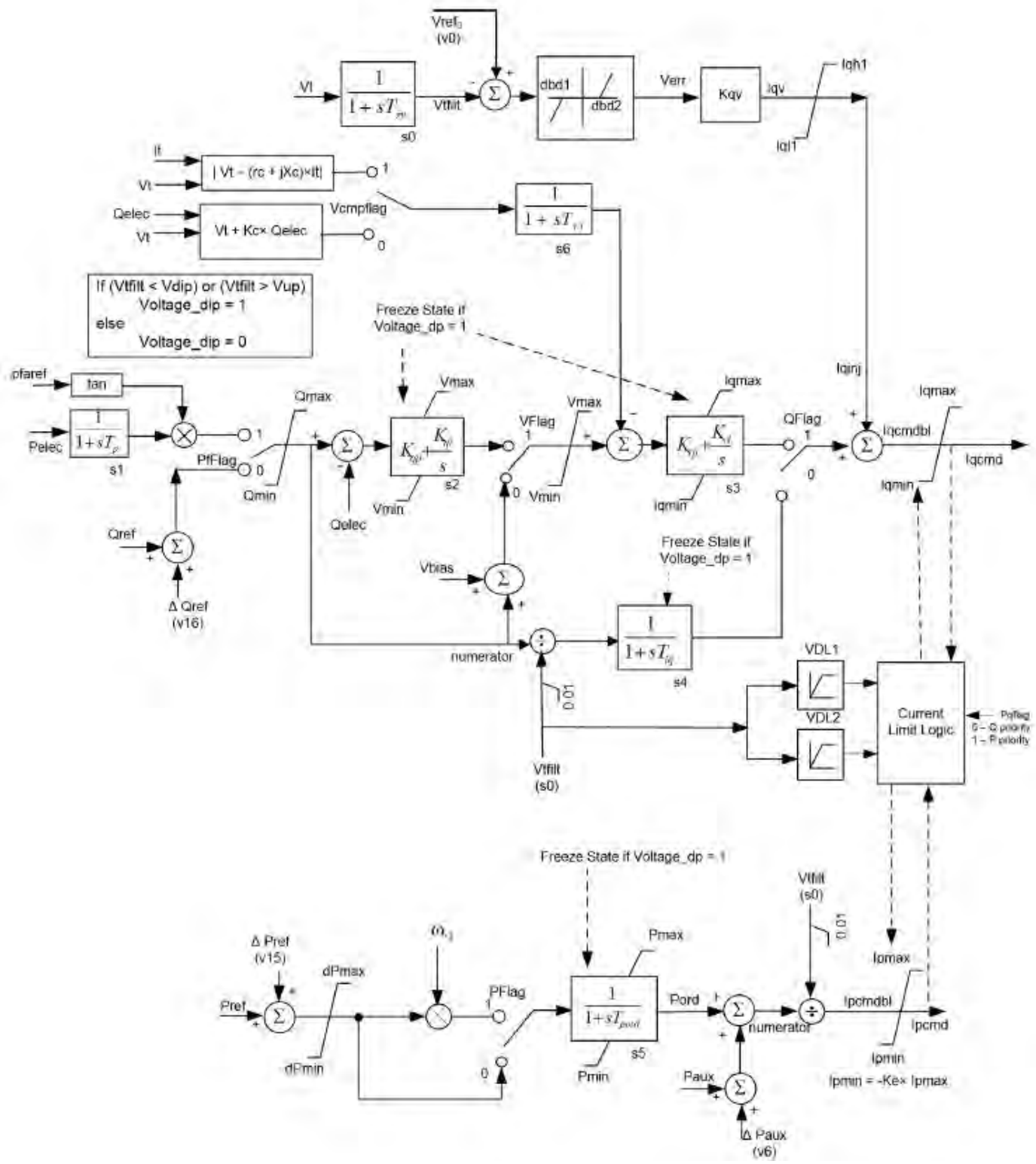
PPA ID	Substation	Type	Size (MW)	
			Discharging Limit	Charging Limit
NEP-22-G03-034	Barre	BESS only	8	8
NEP-22-G03-036	Crystal Lake	BESS only	8	5.2
NEP-22-G03-038	East Winchendon	BESS only	9.4	4.6
NEP-22-G03-039	East Winchendon	BESS only	5.5	4.2
NEP-22-G03-029	Lashaway	BESS only	10	7
NEP-22-G03-008	Laurel Circle	BESS only	8	4.4
NEP-22-G03-009	Millbury	BESS only	10	3.5
NEP-22-G03-011	North Oxford	BESS only	8	6.4
NEP-22-G03-013	North Oxford	BESS only	5.6	4.8
NEP-22-G03-006	Pratts Junction	BESS only	6	4.5
NEP-22-G03-041	Royalston	AC Coupled	5	0
NEP-22-G03-015	Snow St	BESS only	5	2.5
NEP-22-G03-016	Snow St	BESS only	5	2.5
NEP-22-G03-017	Snow St	BESS only	5.5	6.5
NEP-22-G03-001	Stafford St	DC Coupled	5	5
NEP-22-G03-033	Treasure Valley	BESS only	10	5
NEP-22-G03-020	West Charlton	BESS only	5	4.5
NEP-22-G03-021	West Charlton	BESS only	10	4
NEP-22-G03-044	Wendell Depot	BESS only	8	7.2
NEP-22-G03-043	Wendell Depot	BESS only	10	8

The block diagrams for these models are shown in the following figures.

REGC_B Block Diagram [Source: PSS/E]

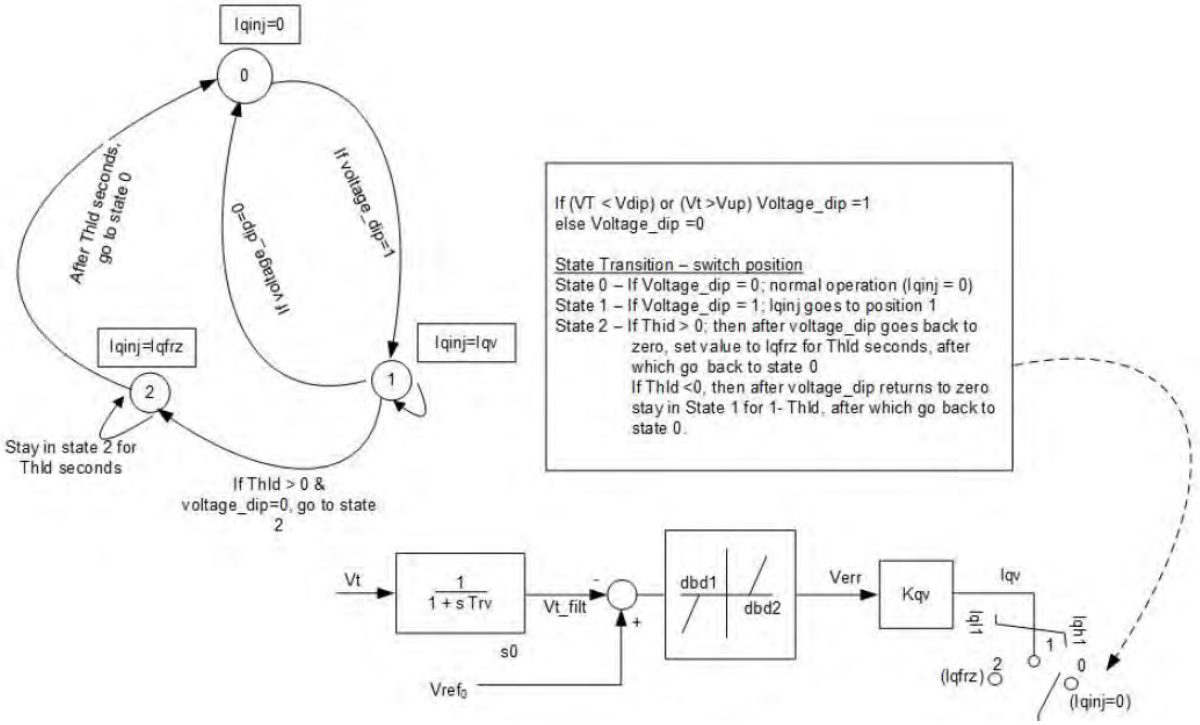


REEC_D Block Diagram [Source: PSS/E]

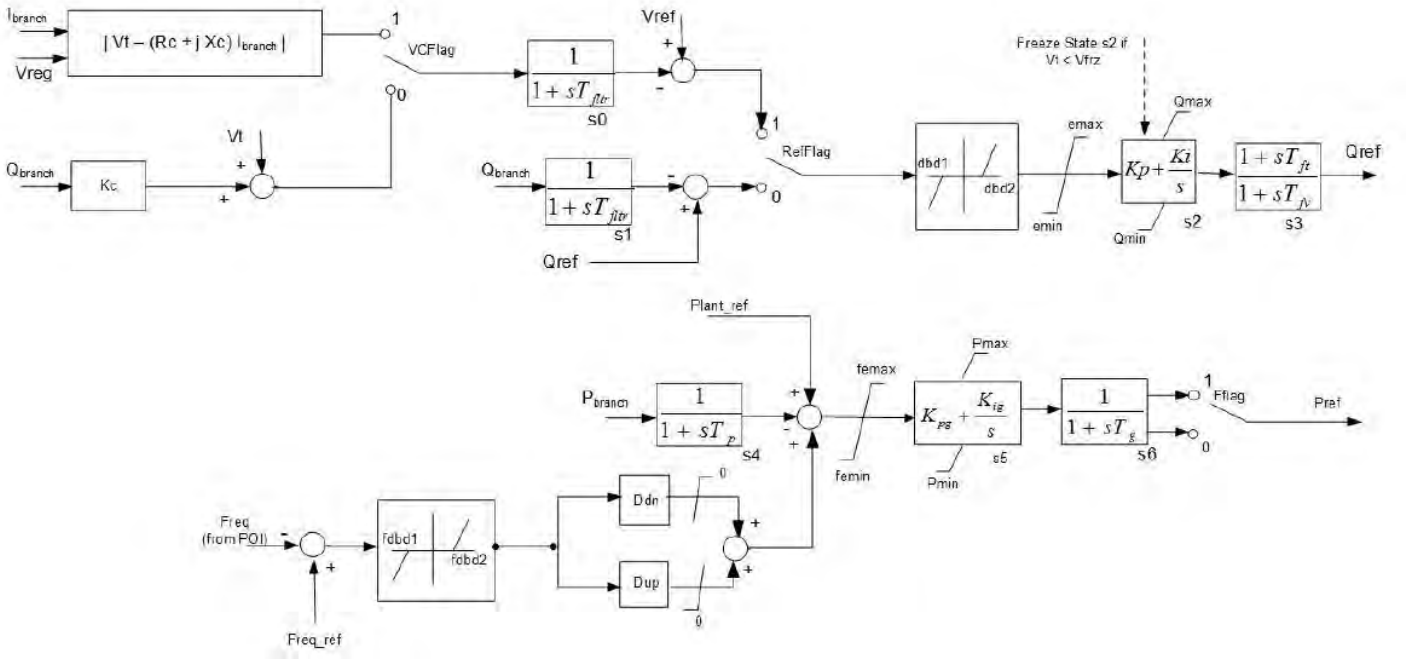


REEC_D Block Diagram – Continued:

REEC_D Block Diagram continued:
State Transition Diagram for dynamic voltage support during high or low voltage conditions



REPC_A Block Diagram [Source: PSS/E]



6.7 Stability Analysis Case Development

In order to investigate the impact of the proposed Group 3 DER on the New England transmission system, two base cases representing the 2026 summer peak load levels and two base cases representing the 2026 light load levels, were developed for this study.

Four base cases derived from the 2026 light load levels were also developed to determine if any existing substations, that are not part of the NPCC Bulk Power System (BPS) become part of the BPS as a result of the addition of Group 3 DER.

Year 2026 ISO-NE dynamics cases (PSS/E Rev 34), released in April 2021, were used for this transient stability assessment.

6.8 Stability Case Summaries

The following table summarizes the interface levels and generation dispatches for the stability base cases that includes Group 1,2 and 3 DER.

Table 26 - Stability Case Summaries for Design Contingency Testing

Interface Name	Interface Flows (MW)			
	Peak Load Case		Light Load Cases	
	23pk-ew	23pk-we	23ll-ew	23ll-we
NB-NE	808	1017	1013	1013
ORR_SOUTH	1375	1189	1326	1326
SURW_SOUTH	1359	1183	1611	1667
ME-NH	1996	1203	1978	2035
EAST-WEST	3104	-3072	3917	-2527
NE-NY	1290	-1467	1223	-1303
NNE-SCOB+394	3658	2961	3021	1697
NORTH-SOUTH	3724	2826	4060	1682
SEMA/RI – NE	2746	-2559	1121	-1255
HIGHGATE_IMP	224	224	224	224
SNDYPD_IMP	2000	2000	2000	0
CT IMPORT	3412	309	563	-144
Cross sound cable Export to NY	101	101	101	101
Bear Swamp	666	666	-666	0
Northfield	1180	1180	-1000	0
Altresco	197	197	197	197
Millennium	412	412	OOS	285

Table 27 - Stability Light Load Case Summaries for BPS Simulations

Interface Name	Interface Flows (MW)			
	WMAVT	BOS	ME_C	SEMA
NB-NE	1013	1013	1013	1013
SURW_SOUTH	1663	896	1252	897
ME-NH	1437	1255	1609	1256
EAST-WEST	-1578	3790	3867	4179
NE-NY	1054	1210	1279	1429
NNE-SCOB+394	3176	2678	3089	2447
NORTH-SOUTH	2980	2559	3237	2066
SEMA/RI - NE	-1816	2367	1743	3174
HIGHGATE_IMP	224	224	224	224
SNDYPD_IMP	0	2000	2000	2000
CT IMPORT	401	1100	1100	1148
Cross sound cable Export to NY	101	101	101	101
Bear Swamp	666	-666	-666	-666
Northfield	1180	-1100	-1100	-1100
Alresco	197	197	197	197
Millenium	412	0	0	0

6.9 Stability Study Matrix

To test the impact of the DER, Group 1,2 and 3 DER were added to each case, according to the following table, and dispatched against generation in Connecticut. Dispatching the DER against Connecticut will maintain the same East-West, and NY-NE transfer levels, compared to the pre-DER base cases.

Table 28 – Study Matrix for Stability Analysis

Load Level	Bias	Group 3 DER		Group 1 and 2 DER	Pre Group 1 and 2 DER	FERC BESS projects under Study	Comments
		BESS output	PV output	PV output	PV output		
Summer Peak load	E-W	100% Charging	26%	26%	only ≥5MW projects in WMA already modeled in the basecases were turned on	[redacted] (QP1031) and [redacted] (QP1112) were modeled in the study	All 1-5MW projects were modeled using DER_A model using parameters based on the latest guideline document from NERC. All ≥ 5 MW projects were modeled using standard renewable energy models parametrized by individual project developers
	W-E	100% discharging	100%	100%			
Light Load	E-W	100% charging	26%	26%			
	W-E	100% discharging	100%	100%			
BPS	WMAVT	100% discharging	100%	100%			
	BOS						
	ME-C						
	SEMA						

6.10 BPS Contingencies

The following simulations were conducted to determine if any existing substations become classified as Bulk Power System (BPS) substations as a result of the addition of Group 3 DER. Further, whether any of the new stations, required to accommodate the interconnection of the Group 3 DER, need to meet BPS design requirements.

Table 29 - Bulk Power System (BPS) Contingencies

Contingency Name	Type	kV	Location	Clearing Times (cycles)	Protection Groups	Light Load Results			
						BOS	ME_C	SEMA	WMAVT
BS-230-BPS	BPS	230	Bear Swamp	[redacted]					
BS-115-BPS	BPS	115	Bear Swamp						
PJ-115-BPS	BPS	115	Pratts Jct						

Contingency Name	Type	kV	Location	Clearing Times (cycles)	Protection Groups	Light Load Results			
						BOS	ME_C	SEMA	WMAVT
PJ-230-BPS	BPS	230	Pratts Jct	[redacted]					
Palmer-115-BPS	BPS	115	Palmer						
Carp-115-BPS	BPS	115	Carpenter Hill						
Flagg-115-BPS	BPS	115	Flagg Pd						
Stafford-115-BPS	BPS	115	Stafford St (new)						

6.11 N-1 Stability Contingencies

Several Breaker Failure (BF) contingencies were tested. These Breaker Failures were first tested with a 3-phase initiating fault, which is categorized as an Extreme Contingency. If this test failed the performance requirements outlined in ISO-NE PP-3, a corresponding design contingency is tested (Breaker failure with single line to ground imitating fault); otherwise, no corresponding design contingency is tested.

Table 30 - N-1 Breaker Failure Contingencies

Contingency Name	Type	kV	Location/ Description	Clearing Times (cycles)	Protection Groups	Light Load Results		Peak Load Results	
						EW	WE	EW	WE
BS-1205E-BF	EC	230	[redacted]						
BS-T97-BF	EC	115							

Contingency Name	Type	kV	Location/ Description	Clearing Times (cycles)	Protection Groups	Light Load Results		Peak Load Results	
						EW	WE	EW	WE
ML-0802-BF	EC	345	[redacted]						
WM-105-BF	EC	345							
SP-3521-BF	EC	345							
CH-321-BF	EC	345							
CH-174W-BF	EC	115							
CH-175-BF	EC	115							

Contingency Name	Type	kV	Location/ Description	Clearing Times (cycles)	Protection Groups	Light Load Results		Peak Load Results	
						EW	WE	EW	WE
PJ-69kV-TIE-BF	EC	69`	[redacted]						
NFLD-2T-BF	EC	345							
PALM-X176-BF	EC	115							
AD-3T5T-BF	EC	115							
STAFF-2728E-BF	EC	115							
STAFF-B128E-BF	EC	115							
STAFF-2728W-BF	EC	115							

Contingency Name	Type	kV	Location/ Description	Clearing Times (cycles)	Protection Groups	Light Load Results		Peak Load Results	
						EW	WE	EW	WE
			[redacted]						

Several design contingencies were tested on the transmission system facilities located along the Western and Central Massachusetts transmission corridor.

Table 31 - N-1 Stability Design Contingencies

Contingency Name	Type	kV	Location/ Description	Clearing times (cycles)	Protection Groups	Light Load Results		Peak Load Results	
						EW	WE	EW	WE
V174-CH	NC	115	[redacted]						
V174-ML	NC	115							
E205E-PJ	NC	230							
E205W-BS	NC	230							
354-NFld	NC	345							
354-Ludlow	NC	345							
S197-BS	NC	115							

Contingency Name	Type	kV	Location/ Description	Clearing times (cycles)	Protection Groups	Light Load Results		Peak Load Results	
						EW	WE	EW	WE
E131-BS	NC	115	[redacted]						
Z126-WEB	NC	115							
E5-WARE	NC	69							
E5-F6E-DCT-Millbury	NC	69							
A1S-B2S-DCT-Gardner	NC	69							
A1N-B2N-DCT-Royalston	NC	69							
D4-Vernon	NC	69							
J136N-BELFS	NC	115							

Contingency Name	Type	kV	Location/ Description	Clearing times (cycles)	Protection Groups	Light Load Results		Peak Load Results	
						EW	WE	EW	WE
O15N- PALM	NC	69	[redacted]						
A127-ERV	NC	115							
A127-ST	NC	115							
I135-FP	NC	115							
I135-CHINK	NC	115							
X176E-PALM	NC	115							
X176-LUD	NC	115							
W175W-PALM	NC	115							

Contingency Name	Type	kV	Location/ Description	Clearing times (cycles)	Protection Groups	Light Load Results		Peak Load Results	
						EW	WE	EW	WE
SP-HVDC Bipole	NC	450	[redacted]						
STAFF-2728E-BF-SLG	NC	115							
STAFF-B128E-BF-SLG	NC	115							
STAFF-2728W-BF-SLG	NC	115							
PJ-69kV-TIE-BF-SLG	NC	69`							
BS-1205E-BF-SLG	NC	230							
BS-1205W-BF-SLG	NC	230							

Contingency Name	Type	kV	Location/ Description	Clearing times (cycles)	Protection Groups	Light Load Results		Peak Load Results	
						EW	WE	EW	WE
BS-T97-BF-SLG	NC	115	[redacted]						
BS-T31-BF-SLG	NC	115							
AD-3T5T-BF-SLG	NC	115							

6.12 N-1-1 Stability Contingencies

Several design contingencies were tested with an initial element out of service as shown in the table below. Any generation backdown that is required between contingencies were found not to exceed existing limits.

Table 32 - N-1-1 Stability Design Contingencies

Initial N-1	Post N-1	N-1-1 Contingency Name	Type	kV	Location/ Description	Clearing Times (cycles)	Protection Groups	Light Load Results		Peak Load Results	
Line Out	System Adjustments							EW	WE	EW	WE
301/302 345 kV [Ludlow-Millbury]	None	E205E-PJ	NC	230	[redacted]						
		Z126-WEB	NC	115							
		S197-BS	NC	115							
		V174-ML	NC	115							
		NFLD-2T-BF-SLG	NC	345							

Initial N-1	Post N-1	N-1-1 Contingency Name	Type	kV	Location/ Description	Clearing Times (cycles)	Protection Groups	Light Load Results		Peak Load Results	
Line Out	System Adjustments							EW	WE	EW	WE
					[redacted]						
		NFLD-9T-BF-SLG	NC	345							
		Ludlow-5T-BF-SLG	NC	345							
		CH-174W-BF-SLG	NC	115							
		381-NFLD	NC	345							
		FITZ-3791-BF-SLG	NC	345							
		SP-HVDC Bipole	NC	450							

Initial N-1	Post N-1	N-1-1 Contingency Name	Type	kV	Location/ Description	Clearing Times (cycles)	Protection Groups	Light Load Results		Peak Load Results	
Line Out	System Adjustments							EW	WE	EW	WE
		BS-T97-BF-SLG	NC	115	[redacted]						
Northfield 345-115 kV auto	none	A127-ST	NC	115							
Fitzwilliam 345-115 kV auto	none	I135-FP	NC	115							
S-197 115 kV line [Bear Swamp-Deerfield]	None	B2S-PJ	NC	69							
A-1S from Pratts to Otter River	None	B2S-CL	NC	69							
E-5E from Millbury – Meadow St	None	O15N-Ware	NC	69							

7 SHORT CIRCUIT ANALYSIS

ASPEN Version 14 was used to conduct the short circuit simulations for this study.

7.1 Short Circuit Models

ISO-NE's N+5 (five year out) short circuit case, dated January 1st,2020 was used for this study. Group 1 and 2 DER were already included in this case. The Group 3 DER was modeled at each substation, in an aggregate fashion, with a single equivalent generator at the low side of each substation to which the DER will be connected. The MW size of the single equivalent generator, equaled the total amount of DER (greater than 1 MW) to be connected to that substation.

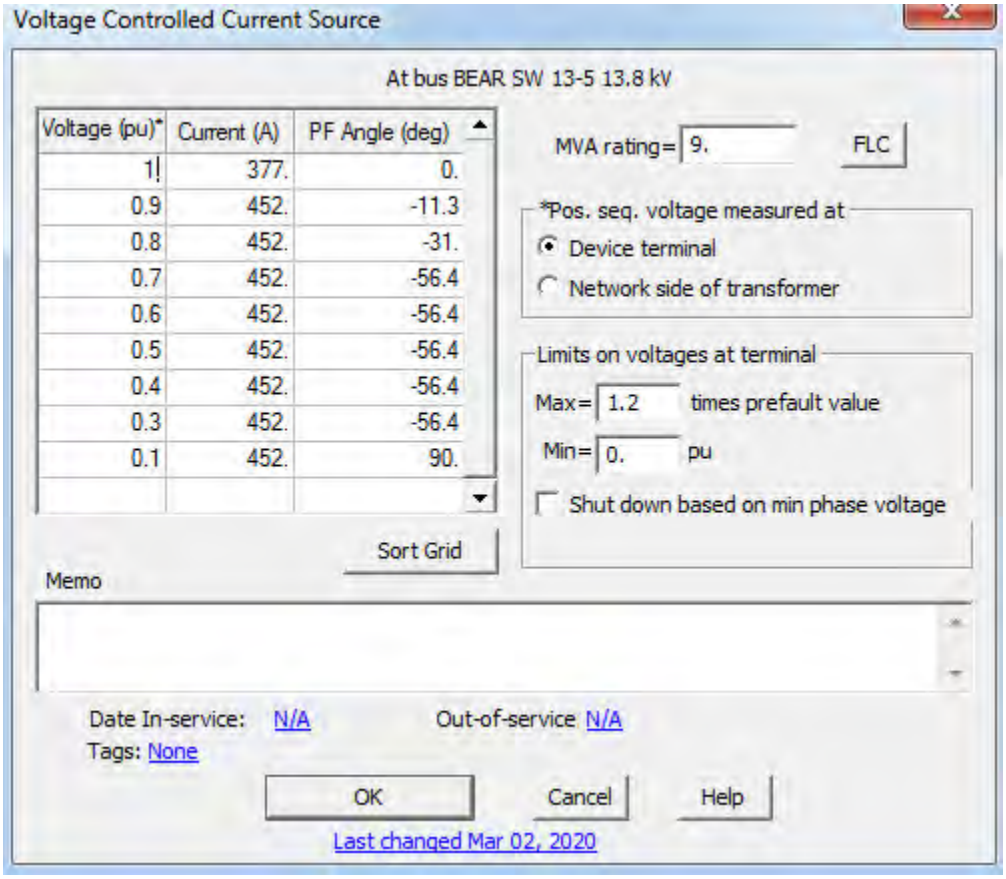
7.2 Methodology and Criteria

The modeling assumptions and short circuit performance criteria, including settings used in Aspen's breaker rating module, are per National Grid's TGP34 'Circuit Breaker Fault Current Assessment Guide' and its associated TGP34 Technical Guidelines.

The aggerate MWs for Group 3 DER was combined with the aggregate MWs for Group 1 and 2 DER, to come up with a single aggerate generator at each substation, as applicable.

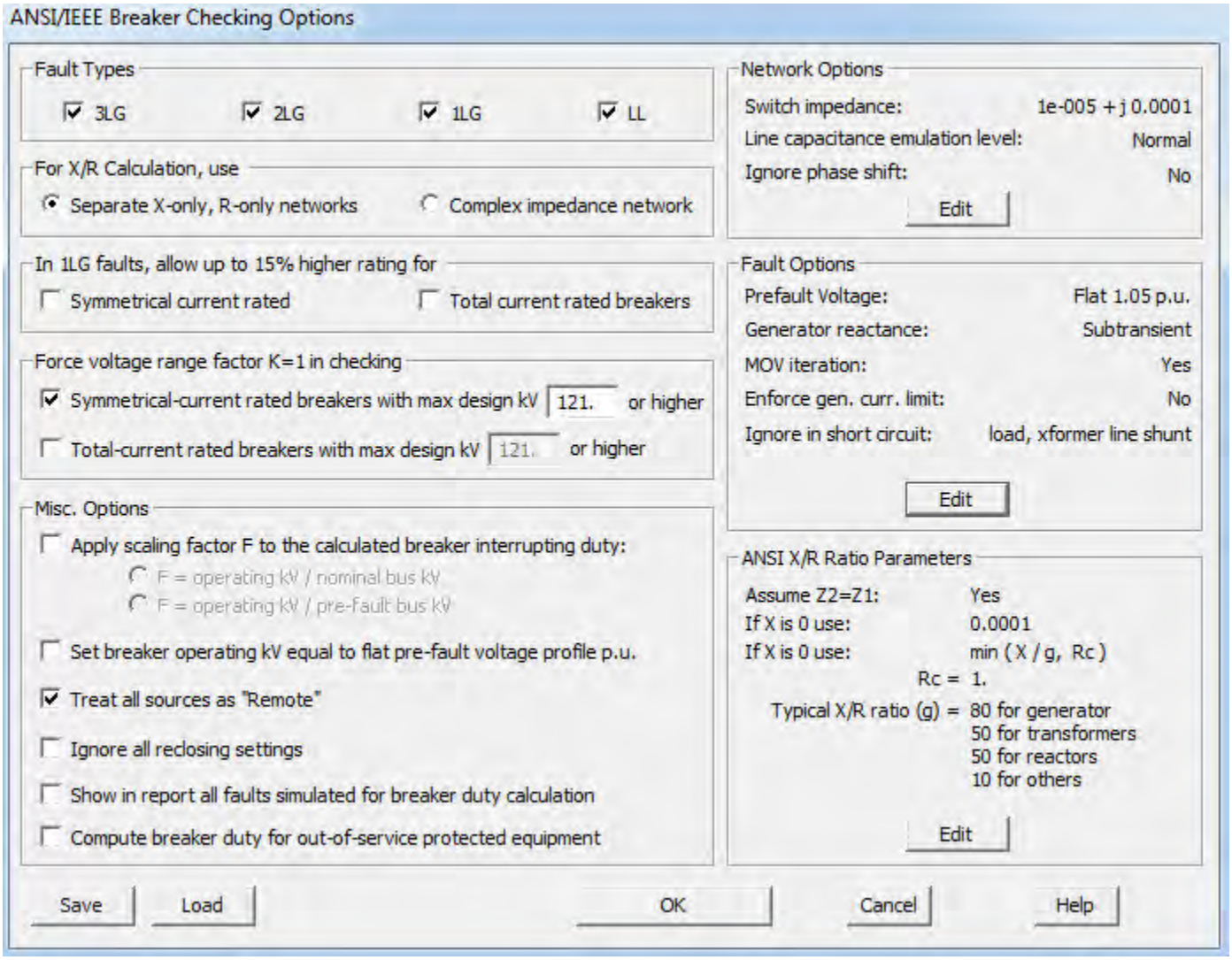
Voltage Controlled Current Source (VCCS) models were used for all PV inverters in Groups 3, as were for Groups 1 and 2. The VCCS models were assumed to deliver up to 1.2 p.u. of its nameplate current during fault conditions. Distinct Power Factor (PF) angles were modeled for several different voltage levels for each inverter. The PF Angle (degrees) for each DER terminal voltage was calculated based on recommendations provided in the ASPEN "Technical Bulletin on Modeling Type-4 Wind Plants and Solar Plants". The following figure is an example of an ASPEN model that was used for a 9 MW aggregate unit.

Figure 14 - Sample VCCS model



The figure below shows the ASPEN solution options assumed for the short circuit analysis. Note that current limits were not enforced for inverter-based generation modeled with current limited synchronous generators. This is a slightly conservative assumption, but not overly conservative since there is very little, if any inverter-based generators modeled with current limited synchronous generators in the study area.

Figure 15 - ASPEN Solution Options Assumed for short circuit analysis



7.3 Results

The following table shows the short circuit duty at each National Grid transmission substation (69 kV and above) in Western Massachusetts, following the additional of all 252 MW of DER associated with Group 3. The table includes the maximum short circuit current in Percentage (Duty_P) and Momentary Breaker Duty in Percentage (M_Duty_P) generated by the ASPEN breaker rating module for all 69 kV and above circuit breakers in Western Massachusetts.

The results show that the short circuit currents are less than 95% of the interrupting capability for all transmission breakers in the study area. Therefore, the PV inverters in Group 3 do not cause any breaker in the system to become overdutied.

Table 33 - ASPEN short circuit Results – Post Group 1 + 2 +3 DER

BUS	Breaker	DUTY A (Maximum short ckt Amps)	BKR_CAPA (Amps)	DUTY P (%)	M DUTY A (Amps)	M BKR CAPA (Amps)	M DUTY P (%)	3LG_AMPS	1LG_AMPS	2LG_AMPS	LL_AMPS
AYER 115kV	AYER 137	16030.5	40000	40.1	23886	64000	37.3	20311	15181.8	19305.5	17526.4
BEAR SWAMP 115.kV	BEAR SWP 131	24167.9	50000	48.3	36869.3	80000	46.1	23019.6	21923.4	22604.4	18959.1
BEAR SWAMP 115.kV	BEAR SWP 197	24167.9	50000	48.3	36869.3	80000	46.1	23019.6	21923.4	22604.4	18959.1
BEAR SWAMP 230.kV	BEARSW 1205E	14306.9	63000	22.7	20816.3	100800	20.7	14204.7	14236.7	14491.6	11345.2
BEAR SWAMP 230.kV	BEARSW 2205E	14306.9	63000	22.7	20816.3	100800	20.7	14204.7	14236.7	14491.6	11345.2
[redacted]											
CHESTNUT HIL 69.kV	Proxy - 69kv	2823.6	40000	7.1	2954.2	64000	4.6	2823.6	1680.5	2617.2	2474.3
Crystal Lake 69.kV	Proxy - 69kv	4104.1	31500	13	4509	50400	8.9	4104.1	2437.6	3802.6	3571.2
DEERFIELD 4 69.kV	Proxy - 69kv	10090.3	40000	25.2	13825.8	64000	21.6	10090.3	8435.9	9693.4	8466.7
E LONGMDW 14 69.kV	Proxy - 69kv	3229.6	40000	8.1	3868.5	64000	6	3229.6	1590.7	2922.4	2821
E LONGMDW 15 69.kV	Proxy - 69kv	4170.9	40000	10.4	6073.4	64000	9.5	4170.9	3698.4	4046.1	3592.7
FLAGG POND 115.kV	1135	17165.8	20000	85.8	23407.7	32000	73.1	17165.8	12456	15487	14501.6
FLAGG POND 115.kV	1136	17165.8	20000	85.8	23407.7	32000	73.1	17165.8	12456	15487	14501.6
FLAGG POND 115.kV	1235	12722.7	20924.4	60.8	17137.7	33479.1	51.2	17165.8	12456	15487	14501.6
FLAGG POND 115.kV	1236	12722.7	36444.4	34.9	17137.7	58311.1	29.4	17165.8	12456	15487	14501.6
FLAGG POND 115.kV	2135	12722.7	18884.4	67.4	17137.7	30215.1	56.7	17165.8	12456	15487	14501.6
FLAGG POND 115.kV	2136	17165.8	20000	85.8	23407.7	32000	73.1	17165.8	12456	15487	14501.6

BUS	Breaker	DUTY A (Maximum short ckt Amps)	BKR_CAPA (Amps)	DUTY P (%)	M DUTY A (Amps)	M BKR CAPA (Amps)	M DUTY P (%)	3LG_AMPS	1LG_AMPS	2LG_AMPS	LL_AMPS
HARRIMAN 69.kV	Proxy - 69kv	7396.6	40000	18.5	11298	64000	17.7	7278.6	7354.7	7396.6	6184.9
HARRIMAN 115.kV	115BT	15632.9	40000	39.1	22648.3	64000	35.4	15632.9	11759.7	14439.4	13195.1
HARRIMAN 115.kV	HARRIM 3810	14752.8	40000	36.9	21206.6	64000	33.1	15632.9	11759.7	14439.4	13195.1
HARRIMAN 115.kV	HARRIM A127	13721.1	40000	34.3	20070.4	64000	31.4	15632.9	11759.7	14439.4	13195.1
HARRIMAN 115.kV	HARRIM B128	14514.7	40000	36.3	21166.7	64000	33.1	15632.9	11759.7	14439.4	13195.1
HARRIMAN 115.kV	HARRIM Y177	13919.7	40000	34.8	20216.5	64000	31.6	15632.9	11759.7	14439.4	13195.1
Harrington 69.kV	Proxy - 69kv	9010.6	40000	22.5	11228.6	64000	17.5	9010.6	5774.6	8186	7596.7
MEADOW ST 69.kV	Proxy - 69kv	10415.2	31500	33.1	13036.9	50400	25.9	10415.2	5931.4	9178.1	8711.6

[redacted]

BUS	Breaker	DUTY A (Maximum short ckt Amps)	BKR_CAPA (Amps)	DUTY P (%)	M DUTY A (Amps)	M BKR CAPA (Amps)	M DUTY P (%)	3LG_AMPS	1LG_AMPS	2LG_AMPS	LL_AMPS
[redacted]											
MILLBURY5 B1 69.kV	Proxy - 69kv	20323	31500	64.5	30826.8	50400	61.2	20323	19321.5	19873.1	17228.9
[redacted]	[redacted]										
OTTER RIV 1 69.kV	Proxy - 69kv	3143.9	22000	14.3	3275.3	35200	9.3	3143.9	2051.3	2886	2759.1
PALMER 69.kV	Proxy - 69kv	14900.8	31500	47.3	22943	50400	45.5	14900.8	13192.6	14155.5	12659.6
PALMER 115 115.kV	PALMER 176T	15499.7	40000	38.7	22992.3	64000	35.9	15499.7	11411.5	14107	13187.4
PALMER 115 115.kV	PALMER 7075	12114.1	40000	30.3	18031.3	64000	28.2	15499.7	11411.5	14107	13187.4
PALMER 115 115.kV	PALMER R170	15499.7	40000	38.7	22992.3	64000	35.9	15499.7	11411.5	14107	13187.4
PALMER 115 115.kV	PALMER W175	15499.7	40000	38.7	22992.3	64000	35.9	15499.7	11411.5	14107	13187.4
PALMER 115 115.kV	PALMER X176	15337.5	40000	38.3	22778	64000	35.6	15499.7	11411.5	14107	13187.4
PRATTS 115 115 kV	PRATTSJ 1110	31827.2	40000	79.6	45641.3	64000	71.3	31827.2	24873.2	29884.6	27369.1
PRATTS 115 115 kV	PRATTSJ 2110	31827.2	40000	79.6	45641.3	64000	71.3	31827.2	24873.2	29884.6	27369.1
PRATTS 115 115 kV	PRATTSJ 3741	29129.3	40000	72.8	41420.6	64000	64.7	31827.2	24873.2	29884.6	27369.1
PRATTS 115 115 kV	PRATTSJ 3842	28691.1	40000	71.7	40622	64000	63.5	31827.2	24873.2	29884.6	27369.1
PRATTS 115 115 kV	PRATTSJ 4A	31827.2	40000	79.6	45641.3	64000	71.3	31827.2	24873.2	29884.6	27369.1
PRATTS 115 115 kV	PRATTSJ 801	31827.2	40000	79.6	45641.3	64000	71.3	31827.2	24873.2	29884.6	27369.1

BUS	Breaker	DUTY A (Maximum short ckt Amps)	BKR_CAPA (Amps)	DUTY P (%)	M DUTY A (Amps)	M BKR CAPA (Amps)	M DUTY P (%)	3LG_AMPS	1LG_AMPS	2LG_AMPS	LL_AMPS
PRATTS 115 115 kV	PRATTSJ 802	31827.2	40000	79.6	45641.3	64000	71.3	31827.2	24873.2	29884.6	27369.1
PRATTS 115 115 kV	PRATTSJ I135	31300.6	40000	78.3	44923.4	64000	70.2	31827.2	24873.2	29884.6	27369.1
PRATTS 115 115 kV	PRATTSJ J136	31317	40000	78.3	44947	64000	70.2	31827.2	24873.2	29884.6	27369.1
PRATTS 115 115 kV	PRATTSJ K137	31827.2	40000	79.6	45641.3	64000	71.3	31827.2	24873.2	29884.6	27369.1
PRATTS 115 115 kV	PRATTSJ L138	31827.2	40000	79.6	45641.3	64000	71.3	31827.2	24873.2	29884.6	27369.1
PRATTS 115 115 kV	PRATTSJ O141	31827.2	40000	79.6	45641.3	64000	71.3	31827.2	24873.2	29884.6	27369.1
PRATTS 115 115 kV	PRATTSJ P142	31827.2	40000	79.6	45641.3	64000	71.3	31827.2	24873.2	29884.6	27369.1
PRATTS 230 230 kV	Pratts E205E	7383.7	50000	14.8	11329.1	80000	14.2	9289.3	8252.5	8974	7953.1
PRATTS JCT 1 69.kV	Proxy - 69kv	26782.7	31500	85	39834.9	50400	79	26782.7	25112.5	26254.5	22989.3
SEARSBURG 69.kV	Proxy - 69kv	5746.1	40000	14.4	8268.6	64000	12.9	5746.1	4584.6	5382.2	4928.6
SHUTESBRY E5 69.kV	Proxy - 69kv	4237.8	31500	13.5	5114.8	50400	10.1	4237.8	2281.2	3687.6	3548.6
Stafford st 115.kV	Proxy	18799.6	40000	47	25829.4	64000	40.4	18799.6	11232.1	17131.6	16204.3
VERNON 115.kV	K186	26529.4	40000	66.3	41305.5	64000	64.5	25824.7	25137.7	25990.5	21146.5
VERNON 115.kV	K40	26529.4	40000	66.3	41305.5	64000	64.5	25824.7	25137.7	25990.5	21146.5
VERNON 115.kV	KT1	26529.4	40000	66.3	41305.5	64000	64.5	25824.7	25137.7	25990.5	21146.5
VERNON 115.kV	KTB1-B1	23286.6	40000	58.2	35581.9	64000	55.6	25824.7	25137.7	25990.5	21146.5
VERNON 115.kV	KTB2-B1	26529.4	40000	66.3	41305.5	64000	64.5	25824.7	25137.7	25990.5	21146.5
VERNON 1 69.kV	Proxy - 69kv	5764.3	40000	14.4	7680	64000	12	5233.2	5535.9	5764.3	4425.4
WARE 69.kV	Proxy - 69kv	10293	31500	32.7	13232.8	50400	26.3	10293	5170	8897.3	8638.9
West Hampden 115.kV	1205	14358.4	40000	35.9	21013.7	64000	32.8	14358.4	10683.9	13280.9	12185.6
West Hampden 115.kV	1976	14358.4	40000	35.9	21013.7	64000	32.8	14358.4	10683.9	13280.9	12185.6
West Hampden 115.kV	3T-05	14331.8	40000	35.8	20974.8	64000	32.8	14358.4	10683.9	13280.9	12185.6
West Hampden 115.kV	70-76	11870.2	40000	29.7	17336.8	64000	27.1	14358.4	10683.9	13280.9	12185.6
West Hampden 115.kV	Proxy 1	14358.4	40000	35.9	21013.7	64000	32.8	14358.4	10683.9	13280.9	12185.6
West Hampden 115.kV	R170	14358.4	40000	35.9	21013.7	64000	32.8	14358.4	10683.9	13280.9	12185.6

BUS	Breaker bus name and nominal kV
BREAKERS	Breaker name
RATINGTYPE	Breaker rating type: S for symmetrical current rated; T for total current rated
DUTY_P	Interrupting duty in percent
DUTY_A	Interrupting current in amps
BKR_CAPA	Calculated interrupting capacity in amps
M_DUTY_P	Momentary duty for total-current rated breakers and close-and-latch duty for symmetrical-current rated breakers in percent
M_DUTY_A	Momentary duty for total-current rated breakers and close-and-latch duty for symmetrical-current rated breakers in amps
M_BKR_CAPA	Calculated momentary capacity of total current rated breakers and close-and-latch capacity for symmetrical current rated breakers in amps
MAX_SC_CASE	Fault with maximum short circuit interrupting current
ISC	Breaker short circuit current in amps
ANSI_X/R	ANSI X/R ratio
FLAG	Rating flag, interrupting duty
FLAG_M	Rating flag, momentary (close-and-latch) duty
3LG_AMPS	Maximum 3LG fault current at breaker bus
3LG_X/R	ANSI X/R ratio in 3LG fault at breaker bus
2LG_AMPS	Maximum 2LG fault current at breaker bus
2LG_X/R	ANSI X/R ratio in 2LG fault at breaker bus
1LG_AMPS	Maximum 1LG fault current at breaker bus
1LG_X/R	ANSI X/R ratio in 1LG fault at breaker bus
LL_AMPS	Maximum LL fault current at breaker bus
LL_X/R	ANSI X/R ratio in LL fault at breaker bus

This appendix has been redacted for Critical Energy/ Electric Infrastructure Information (CEII).

Appendix A - Steady State Base Case Summaries

Note:
Base Case Summaries in Appendix A are for the transmission system prior to the dispatch of Group 1,2 and 3 DER

This appendix has been redacted for Critical Energy/ Electric Infrastructure Information (CEII).

Appendix B – Stability Case Summaries

Appendix C - Stability Models (IDEV + DYR files) for Group 3 DER Greater Than or Equal To 5MW

IDV File – 100% PV + BESS Discharging

```
//NEP-22-G03-034:
BAT_SPLT,113082,930822,'BARRE-GSU', 13.8
BAT_BRANCH_CHNG,113082,930822,'1',,,,,,,0.030789,0.024765,,,,,,,,,,,,,;
BAT_SPLT,930822,930821,'BARRE-INV', 0.6
BAT_BUS_CHNG_3,930821,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,930822,930821,'2',1,930822,600,0,0,0,33,0,930822,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
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BAT_MBIDBRN,930821,930822,'2','1'
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//NEP-22-G03-036:
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BAT_BUS_CHNG_3,933961,2,,,,,,,,,,,;
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1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933961,933962,'2',,,,,,,,,,,,,,2,, 0.009450, 0.056720, 8.0,,,,,,,,,,,,,,,,,,,,,," "," "
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BAT_MBIDBRN,933961,933962,'2','1'
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BAT_BUS_CHNG_3,933951,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933952,933951,'2',1,933952,600,0,0,0,33,0,933952,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
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//NEP-22-G03-039:
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BAT_SPLT,993952,993951,'EWINC2-INV', 0.6
BAT_BUS_CHNG_3,993951,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,993952,993951,'2',1,993952,600,0,0,0,33,0,993952,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,993951,993952,'2',,,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.5,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,993951,993952,'1'
BAT_MBIDBRN,993951,993952,'2','1'
BAT_PLANT_DATA,993951,0, 1.0, 100.0
BAT_MACHINE_DATA_2,993951,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,993951,'D3',,,,,,1, 5.5,,0.0,0.0, 5.5,-4.2, 5.5,,0.1,,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-029:
BAT_SPLT,113070,930702,'LASHA-GSU', 13.2
BAT_BRANCH_CHNG,113070,930702,'1',,,,,,,0.005257,0.002957,,,,,,,,,,,,,;
BAT_SPLT,930702,930701,'LASHA-INV', 0.6
BAT_BUS_CHNG_3,930701,2,,,,,,,,,,,;
```

BAT_TWO_WINDING_DATA_4,930702,930701,'2',1,930702,600,0,0,0,33,0,930702,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,930701,930702,'2',,,,,,,,,,,,,,2,, 0.009450, 0.056720, 10.0,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,930701,930702,'1'
BAT_MBIDBRN,930701,930702,'2','1'
BAT_PLANT_DATA,930701,0, 1.0, 100.0
BAT_MACHINE_DATA_2,930701,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,930701,'D3',,,,,,1, 10.0,,0.0,0.0, 10.0,-7.0, 10.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-008:
BAT_SPLT,113377,933772,'LAURL-GSU', 13.8
BAT_BRANCH_CHNG,113377,933772,'1',,,,,,,0.010658,0.008573,,,,,,,,,,,,,;
BAT_SPLT,933772,933771,'LAURL-INV', 0.6
BAT_BUS_CHNG_3,933771,2,,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933772,933771,'2',1,933772,600,0,0,0,33,0,933772,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933771,933772,'2',,,,,,,,,,,,,,2,, 0.009450, 0.056720, 8.0,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933771,933772,'1'
BAT_MBIDBRN,933771,933772,'2','1'
BAT_PLANT_DATA,933771,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933771,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933771,'D3',,,,,,1, 8.0,,0.0,0.0, 8.0,-4.4, 8.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-009:
BAT_SPLT,113392,933922,'MILLB-GSU', 13.8
BAT_BRANCH_CHNG,113392,933922,'1',,,,,,,0.004054,0.00228,,,,,,,,,,,,,;
BAT_SPLT,933922,933921,'MILLB-INV', 0.6
BAT_BUS_CHNG_3,933921,2,,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933922,933921,'2',1,933922,600,0,0,0,33,0,933922,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933921,933922,'2',,,,,,,,,,,,,,2,, 0.009450, 0.056720, 10.0,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933921,933922,'1'
BAT_MBIDBRN,933921,933922,'2','1'
BAT_PLANT_DATA,933921,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933921,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933921,'D3',,,,,,1, 10.0,,0.0,0.0, 10.0,-3.5, 10.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-011:
BAT_SPLT,113388,933882,'NOXFO1-GSU', 13.2
BAT_BRANCH_CHNG,113388,933882,'1',,,,,,,0.003861,0.003106,,,,,,,,,,,,,;
BAT_SPLT,933882,933881,'NOXFO1-INV', 0.6
BAT_BUS_CHNG_3,933881,2,,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933882,933881,'2',1,933882,600,0,0,0,33,0,933882,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933881,933882,'2',,,,,,,,,,,,,,2,, 0.009450, 0.056720, 8.0,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933881,933882,'1'
BAT_MBIDBRN,933881,933882,'2','1'
BAT_PLANT_DATA,933881,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933881,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933881,'D3',,,,,,1, 8.0,,0.0,0.0, 8.0,-6.4, 8.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-013:
BAT_SPLT,113388,993882,'NOXFO2-GSU', 13.2
BAT_BRANCH_CHNG,113388,993882,'1',,,,,,,0.008745,0.007034,,,,,,,,,,,,,;
BAT_SPLT,993882,993881,'NOXFO2-INV', 0.6
BAT_BUS_CHNG_3,993881,2,,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,993882,993881,'2',1,993882,600,0,0,0,33,0,993882,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,993881,993882,'2',,,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.6,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,993881,993882,'1'
BAT_MBIDBRN,993881,993882,'2','1'
BAT_PLANT_DATA,993881,0, 1.0, 100.0
BAT_MACHINE_DATA_2,993881,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,993881,'D3',,,,,,1, 5.6,,0.0,0.0, 5.6,-4.8, 5.6,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-006:
BAT_SPLT,113383,933832,'PRATT-GSU', 13.8
BAT_BRANCH_CHNG,113383,933832,'1',,,,,,,0.020017,0.011259,,,,,,,,,,,,,;

BAT_SPLT,933832,933831,'PRATT-INV', 0.6
BAT_BUS_CHNG_3,933831,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933832,933831,'2',1,933832,600,0,0,0,33,0,933832,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933831,933832,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 6.0,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933831,933832,'1'
BAT_MBIDBRN,933831,933832,'2','1'
BAT_PLANT_DATA,933831,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933831,'D3',1,600,0,0,0,0,0,0,0,0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933831,'D3',,,,,,1, 6.0,,0.0,0.0, 6.0,-4.5, 6.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-041:
BAT_SPLT,113084,930842,'ROYAL-GSU', 13.8
BAT_BRANCH_CHNG,113084,930842,'1',,,,,,,0.00271,0.00152,,,,,,,,,,,,,;
BAT_SPLT,930842,930841,'ROYAL-INV', 0.6
BAT_BUS_CHNG_3,930841,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,930842,930841,'2',1,930842,600,0,0,0,33,0,930842,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,930841,930842,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.0,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,930841,930842,'1'
BAT_MBIDBRN,930841,930842,'2','1'
BAT_PLANT_DATA,930841,0, 1.0, 100.0
BAT_MACHINE_DATA_2,930841,'D3',1,600,0,0,0,0,0,0,0,0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,930841,'D3',,,,,,1, 5.0,,0.0,0.0, 5.0,0.0, 5.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-015:
BAT_SPLT,113389,933892,'SNOW1-GSU', 13.2
BAT_BRANCH_CHNG,113389,933892,'1',,,,,,,0.0119375,0.003094,,,,,,,,,,,,,;
BAT_SPLT,933892,933891,'SNOW1-INV', 0.6
BAT_BUS_CHNG_3,933891,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933892,933891,'2',1,933892,600,0,0,0,33,0,933892,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933891,933892,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.0,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933891,933892,'1'
BAT_MBIDBRN,933891,933892,'2','1'
BAT_PLANT_DATA,933891,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933891,'D3',1,600,0,0,0,0,0,0,0,0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933891,'D3',,,,,,1, 5.0,,0.0,0.0, 5.0,-2.5, 5.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-016:
BAT_SPLT,113389,993892,'SNOW2-GSU', 13.2
BAT_BRANCH_CHNG,113389,993892,'1',,,,,,,0.01416,0.00797,,,,,,,,,,,,,;
BAT_SPLT,993892,993891,'SNOW2-INV', 0.6
BAT_BUS_CHNG_3,993891,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,993892,993891,'2',1,993892,600,0,0,0,33,0,993892,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,993891,993892,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.5,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,993891,993892,'1'
BAT_MBIDBRN,993891,993892,'2','1'
BAT_PLANT_DATA,993891,0, 1.0, 100.0
BAT_MACHINE_DATA_2,993891,'D3',1,600,0,0,0,0,0,0,0,0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,993891,'D3',,,,,,1, 5.5,,0.0,0.0, 5.5,-6.5, 5.5,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-017:
BAT_SPLT,113389,983892,'SNOW3-GSU', 13.2
BAT_BRANCH_CHNG,113389,983892,'1',,,,,,,0.0119375,0.003094,,,,,,,,,,,,,;
BAT_SPLT,983892,983891,'SNOW3-INV', 0.6
BAT_BUS_CHNG_3,983891,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,983892,983891,'2',1,983892,600,0,0,0,33,0,983892,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,983891,983892,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.0,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,983891,983892,'1'
BAT_MBIDBRN,983891,983892,'2','1'
BAT_PLANT_DATA,983891,0, 1.0, 100.0
BAT_MACHINE_DATA_2,983891,'D3',1,600,0,0,0,0,0,0,0,0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,983891,'D3',,,,,,1, 5.0,,0.0,0.0, 5.0,-2.5, 5.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-001:

BAT_SPLT,113363,933632,'STAFF-GSU', 13.8
BAT_BRANCH_CHNG,113363,933632,'1',,,,,,,0.00301169,0.00893508,,,,,,,,,,,,,;
BAT_SPLT,933632,933631,'STAFF-INV', 0.6
BAT_BUS_CHNG_3,933631,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933632,933631,'2',1,933632,600,0,0,0,33,0,933632,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933631,933632,'2',,,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.0,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933631,933632,'1'
BAT_MBIDBRN,933631,933632,'2','1'
BAT_PLANT_DATA,933631,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933631,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933631,'D3',,,,,,1, 5.0,,0.0,0.0, 5.0,-5.0, 5.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-033:
BAT_SPLT,113368,933682,'TREAS-GSU', 13.8
BAT_BRANCH_CHNG,113368,933682,'1',,,,,,,0.002457,0.001382,,,,,,,,,,,,,;
BAT_SPLT,933682,933681,'TREAS-INV', 0.6
BAT_BUS_CHNG_3,933681,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933682,933681,'2',1,933682,600,0,0,0,33,0,933682,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933681,933682,'2',,,,,,,,,,,,,,2,, 0.009450, 0.056720, 10.0,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933681,933682,'1'
BAT_MBIDBRN,933681,933682,'2','1'
BAT_PLANT_DATA,933681,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933681,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933681,'D3',,,,,,1, 10.0,,0.0,0.0, 10.0,-5.0, 10.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-020:
BAT_SPLT,113390,933902,'WCHAR-GSU', 13.2
BAT_BRANCH_CHNG,113390,933902,'1',,,,,,,0.005624,0.003164,,,,,,,,,,,,,;
BAT_SPLT,933902,933901,'WCHAR-INV', 0.6
BAT_BUS_CHNG_3,933901,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933902,933901,'2',1,933902,600,0,0,0,33,0,933902,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933901,933902,'2',,,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.0,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933901,933902,'1'
BAT_MBIDBRN,933901,933902,'2','1'
BAT_PLANT_DATA,933901,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933901,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933901,'D3',,,,,,1, 5.0,,0.0,0.0, 5.0,-4.5, 5.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-021:
BAT_SPLT,113390,993902,'WCHAR2-GSU', 13.2
BAT_BRANCH_CHNG,113390,993902,'1',,,,,,,0.00691,0.003887,,,,,,,,,,,,,;
BAT_SPLT,993902,993901,'WCHAR2-INV', 0.6
BAT_BUS_CHNG_3,993901,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,993902,993901,'2',1,993902,600,0,0,0,33,0,993902,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,993901,993902,'2',,,,,,,,,,,,,,2,, 0.009450, 0.056720, 10.0,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,993901,993902,'1'
BAT_MBIDBRN,993901,993902,'2','1'
BAT_PLANT_DATA,993901,0, 1.0, 100.0
BAT_MACHINE_DATA_2,993901,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,993901,'D3',,,,,,1, 10.0,,0.0,0.0, 10.0,-4.0, 10.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-044:
BAT_SPLT,113085,930852,'WENDE1-GSU', 13.8
BAT_BRANCH_CHNG,113085,930852,'1',,,,,,,0.002625,0.001477,,,,,,,,,,,,,;
BAT_SPLT,930852,930851,'WENDE1-INV', 0.6
BAT_BUS_CHNG_3,930851,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,930852,930851,'2',1,930852,600,0,0,0,33,0,930852,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,930851,930852,'2',,,,,,,,,,,,,,2,, 0.009450, 0.056720, 8.0,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,930851,930852,'1'
BAT_MBIDBRN,930851,930852,'2','1'
BAT_PLANT_DATA,930851,0, 1.0, 100.0
BAT_MACHINE_DATA_2,930851,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,930851,'D3',,,,,,1, 8.0,,0.0,0.0, 8.0,-7.2, 8.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

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//NEP-22-G03-043:
BAT_SPLT,113085,990852,'WENDE2-GSU', 13.8
BAT_BRANCH_CHNG,113085,990852,'1',,,,,,0.00271,0.001524,,,,,,,,,,,,,;
BAT_SPLT,990852,990851,'WENDE2-INV', 0.6
BAT_BUS_CHNG_3,990851,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,990852,990851,'2',1,990852,600,0,0,0,33,0,990852,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,990851,990852,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 10.0,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,990851,990852,'1'
BAT_MBIDBRN,990851,990852,'2','1'
BAT_PLANT_DATA,990851,0, 1.0, 100.0
BAT_MACHINE_DATA_2,990851,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,990851,'D3',,,,,,1, 10.0,,0.0,0.0, 10.0,-8.0, 10.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0
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IDV File – 26% PV + BESS Charging

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//NEP-22-G03-034:
BAT_SPLT,113082,930822,'BARRE-GSU', 13.8
BAT_BRANCH_CHNG,113082,930822,'1',,,,,,,0.030789,0.024765,,,,,,,,,,,,,;
BAT_SPLT,930822,930821,'BARRE-INV', 0.6
BAT_BUS_CHNG_3,930821,2,,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,930822,930821,'2',1,930822,600,0,0,0,33,0,930822,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,930821,930822,'2',,,,,,,,,,,,,,2,, 0.009450, 0.056720, 8.0,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,930821,930822,'1'
BAT_MBIDBRN,930821,930822,'2','1'
BAT_PLANT_DATA,930821,0, 1.0, 100.0
BAT_MACHINE_DATA_2,930821,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,930821,'D3',,,,,,1, -8.0,,0.0,0.0, 8.0,-8.0, 8.0,,0.1,,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-036:
BAT_SPLT,113396,933962,'Cryst-GSU', 13.8
BAT_BRANCH_CHNG,113396,933962,'1',,,,,,,0.011195,0.006297,,,,,,,,,,,,,;
BAT_SPLT,933962,933961,'Cryst-INV', 0.6
BAT_BUS_CHNG_3,933961,2,,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933962,933961,'2',1,933962,600,0,0,0,33,0,933962,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933961,933962,'2',,,,,,,,,,,,,,2,, 0.009450, 0.056720, 8.0,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933961,933962,'1'
BAT_MBIDBRN,933961,933962,'2','1'
BAT_PLANT_DATA,933961,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933961,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933961,'D3',,,,,,1, -5.2,,0.0,0.0, 8.0,-5.2, 8.0,,0.1,,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-038:
BAT_SPLT,113395,933952,'EWINC-GSU', 13.8
BAT_BRANCH_CHNG,113395,933952,'1',,,,,,,0.002457,0.001382,,,,,,,,,,,,,;
BAT_SPLT,933952,933951,'EWINC-INV', 0.6
BAT_BUS_CHNG_3,933951,2,,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933952,933951,'2',1,933952,600,0,0,0,33,0,933952,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933951,933952,'2',,,,,,,,,,,,,,2,, 0.009450, 0.056720, 9.4,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933951,933952,'1'
BAT_MBIDBRN,933951,933952,'2','1'
BAT_PLANT_DATA,933951,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933951,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933951,'D3',,,,,,1, -4.6,,0.0,0.0, 9.4,-4.6, 9.4,,0.1,,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-039:
BAT_SPLT,113395,993952,'EWINC2-GSU', 13.8
BAT_BRANCH_CHNG,113395,993952,'1',,,,,,,0.001785,0.001004,,,,,,,,,,,,,;
BAT_SPLT,993952,993951,'EWINC2-INV', 0.6
BAT_BUS_CHNG_3,993951,2,,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,993952,993951,'2',1,993952,600,0,0,0,33,0,993952,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,993951,993952,'2',,,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.5,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,993951,993952,'1'
BAT_MBIDBRN,993951,993952,'2','1'
BAT_PLANT_DATA,993951,0, 1.0, 100.0
BAT_MACHINE_DATA_2,993951,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,993951,'D3',,,,,,1, -4.2,,0.0,0.0, 5.5,-4.2, 5.5,,0.1,,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-029:
BAT_SPLT,113070,930702,'LASHA-GSU', 13.2
BAT_BRANCH_CHNG,113070,930702,'1',,,,,,,0.005257,0.002957,,,,,,,,,,,,,;
BAT_SPLT,930702,930701,'LASHA-INV', 0.6
BAT_BUS_CHNG_3,930701,2,,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,930702,930701,'2',1,930702,600,0,0,0,33,0,930702,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,930701,930702,'2',,,,,,,,,,,,,,2,, 0.009450, 0.056720, 10.0,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,930701,930702,'1'
BAT_MBIDBRN,930701,930702,'2','1'
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BAT_PLANT_DATA,930701,0, 1.0, 100.0
BAT_MACHINE_DATA_2,930701,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,930701,'D3',,,,,,1, -7.0,,0.0,0.0, 10.0,-7.0, 10.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-008:
BAT_SPLT,113377,933772,'LAURL-GSU', 13.8
BAT_BRANCH_CHNG,113377,933772,'1',,,,,,,0.010658,0.008573,,,,,,,,,,,,,,;
BAT_SPLT,933772,933771,'LAURL-INV', 0.6
BAT_BUS_CHNG_3,933771,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933772,933771,'2',1,933772,600,0,0,0,33,0,933772,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933771,933772,'2',,,,,,,,,,,,,,2,, 0.009450, 0.056720, 8.0,,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933771,933772,'1'
BAT_MBIDBRN,933771,933772,'2','1'
BAT_PLANT_DATA,933771,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933771,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933771,'D3',,,,,,1, -4.4,,0.0,0.0, 8.0,-4.4, 8.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-009:
BAT_SPLT,113392,933922,'MILLB-GSU', 13.8
BAT_BRANCH_CHNG,113392,933922,'1',,,,,,,0.004054,0.00228,,,,,,,,,,,,,,;
BAT_SPLT,933922,933921,'MILLB-INV', 0.6
BAT_BUS_CHNG_3,933921,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933922,933921,'2',1,933922,600,0,0,0,33,0,933922,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933921,933922,'2',,,,,,,,,,,,,,2,, 0.009450, 0.056720, 10.0,,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933921,933922,'1'
BAT_MBIDBRN,933921,933922,'2','1'
BAT_PLANT_DATA,933921,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933921,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933921,'D3',,,,,,1, -3.5,,0.0,0.0, 10.0,-3.5, 10.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-011:
BAT_SPLT,113388,933882,'NOXFO1-GSU', 13.2
BAT_BRANCH_CHNG,113388,933882,'1',,,,,,,0.003861,0.003106,,,,,,,,,,,,,,;
BAT_SPLT,933882,933881,'NOXFO1-INV', 0.6
BAT_BUS_CHNG_3,933881,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933882,933881,'2',1,933882,600,0,0,0,33,0,933882,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933881,933882,'2',,,,,,,,,,,,,,2,, 0.009450, 0.056720, 8.0,,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933881,933882,'1'
BAT_MBIDBRN,933881,933882,'2','1'
BAT_PLANT_DATA,933881,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933881,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933881,'D3',,,,,,1, -6.4,,0.0,0.0, 8.0,-6.4, 8.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-013:
BAT_SPLT,113388,993882,'NOXFO2-GSU', 13.2
BAT_BRANCH_CHNG,113388,993882,'1',,,,,,,0.008745,0.007034,,,,,,,,,,,,,,;
BAT_SPLT,993882,993881,'NOXFO2-INV', 0.6
BAT_BUS_CHNG_3,993881,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,993882,993881,'2',1,993882,600,0,0,0,33,0,993882,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,993881,993882,'2',,,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.6,,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,993881,993882,'1'
BAT_MBIDBRN,993881,993882,'2','1'
BAT_PLANT_DATA,993881,0, 1.0, 100.0
BAT_MACHINE_DATA_2,993881,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,993881,'D3',,,,,,1, -4.8,,0.0,0.0, 5.6,-4.8, 5.6,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-006:
BAT_SPLT,113383,933832,'PRATT-GSU', 13.8
BAT_BRANCH_CHNG,113383,933832,'1',,,,,,,0.020017,0.011259,,,,,,,,,,,,,,;
BAT_SPLT,933832,933831,'PRATT-INV', 0.6
BAT_BUS_CHNG_3,933831,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933832,933831,'2',1,933832,600,0,0,0,33,0,933832,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933831,933832,'2',,,,,,,,,,,,,,2,, 0.009450, 0.056720, 6.0,,,,,,,,,,,,,,,,,,,,,,," "," "

BAT_PURGBRN,933831,933832,'1'
BAT_MBIDBRN,933831,933832,'2','1'
BAT_PLANT_DATA,933831,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933831,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933831,'D3',,,,,,1, -4.5,,0.0,0.0, 6.0,-4.5, 6.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-041:
BAT_SPLT,113084,930842,'ROYAL-GSU', 13.8
BAT_BRANCH_CHNG,113084,930842,'1',,,,,,0.00271,0.00152,,,,,,,,,,,,,;
BAT_SPLT,930842,930841,'ROYAL-INV', 0.6
BAT_BUS_CHNG_3,930841,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,930842,930841,'2',1,930842,600,0,0,0,33,0,930842,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,930841,930842,'2',,,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.0,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,930841,930842,'1'
BAT_MBIDBRN,930841,930842,'2','1'
BAT_PLANT_DATA,930841,0, 1.0, 100.0
BAT_MACHINE_DATA_2,930841,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,930841,'D3',,,,,,1, 0.0,,0.0,0.0, 5.0,0.0, 5.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-015:
BAT_SPLT,113389,933892,'SNOW1-GSU', 13.2
BAT_BRANCH_CHNG,113389,933892,'1',,,,,,,0.0119375,0.003094,,,,,,,,,,,,,;
BAT_SPLT,933892,933891,'SNOW1-INV', 0.6
BAT_BUS_CHNG_3,933891,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933892,933891,'2',1,933892,600,0,0,0,33,0,933892,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933891,933892,'2',,,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.0,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933891,933892,'1'
BAT_MBIDBRN,933891,933892,'2','1'
BAT_PLANT_DATA,933891,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933891,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933891,'D3',,,,,,1, -2.5,,0.0,0.0, 5.0,-2.5, 5.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-016:
BAT_SPLT,113389,993892,'SNOW2-GSU', 13.2
BAT_BRANCH_CHNG,113389,993892,'1',,,,,,,0.01416,0.00797,,,,,,,,,,,,,;
BAT_SPLT,993892,993891,'SNOW2-INV', 0.6
BAT_BUS_CHNG_3,993891,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,993892,993891,'2',1,993892,600,0,0,0,33,0,993892,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,993891,993892,'2',,,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.5,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,993891,993892,'1'
BAT_MBIDBRN,993891,993892,'2','1'
BAT_PLANT_DATA,993891,0, 1.0, 100.0
BAT_MACHINE_DATA_2,993891,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,993891,'D3',,,,,,1, -6.5,,0.0,0.0, 5.5,-6.5, 5.5,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-017:
BAT_SPLT,113389,983892,'SNOW3-GSU', 13.2
BAT_BRANCH_CHNG,113389,983892,'1',,,,,,,0.0119375,0.003094,,,,,,,,,,,,,;
BAT_SPLT,983892,983891,'SNOW3-INV', 0.6
BAT_BUS_CHNG_3,983891,2,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,983892,983891,'2',1,983892,600,0,0,0,33,0,983892,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,983891,983892,'2',,,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.0,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,983891,983892,'1'
BAT_MBIDBRN,983891,983892,'2','1'
BAT_PLANT_DATA,983891,0, 1.0, 100.0
BAT_MACHINE_DATA_2,983891,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,983891,'D3',,,,,,1, -2.5,,0.0,0.0, 5.0,-2.5, 5.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-001:
BAT_SPLT,113363,933632,'STAFF-GSU', 13.8
BAT_BRANCH_CHNG,113363,933632,'1',,,,,,,0.00301169,0.00893508,,,,,,,,,,,,,;
BAT_SPLT,933632,933631,'STAFF-INV', 0.6
BAT_BUS_CHNG_3,933631,2,,,,,,,,,,,;

BAT_TWO_WINDING_DATA_4,933632,933631,'2',1,933632,600,0,0,0,33,0,933632,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933631,933632,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.0,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933631,933632,'1'
BAT_MBIDBRN,933631,933632,'2','1'
BAT_PLANT_DATA,933631,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933631,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933631,'D3',,,,,,1, -5.0,,0.0,0.0, 5.0,-5.0, 5.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-033:
BAT_SPLT,113368,933682,'TREAS-GSU', 13.8
BAT_BRANCH_CHNG,113368,933682,'1',,,,,,,0.002457,0.001382,,,,,,,,,,,,,;
BAT_SPLT,933682,933681,'TREAS-INV', 0.6
BAT_BUS_CHNG_3,933681,2,,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933682,933681,'2',1,933682,600,0,0,0,33,0,933682,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933681,933682,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 10.0,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933681,933682,'1'
BAT_MBIDBRN,933681,933682,'2','1'
BAT_PLANT_DATA,933681,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933681,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933681,'D3',,,,,,1, -5.0,,0.0,0.0, 10.0,-5.0, 10.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-020:
BAT_SPLT,113390,933902,'WCHAR-GSU', 13.2
BAT_BRANCH_CHNG,113390,933902,'1',,,,,,,0.005624,0.003164,,,,,,,,,,,,,;
BAT_SPLT,933902,933901,'WCHAR-INV', 0.6
BAT_BUS_CHNG_3,933901,2,,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,933902,933901,'2',1,933902,600,0,0,0,33,0,933902,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,933901,933902,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 5.0,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,933901,933902,'1'
BAT_MBIDBRN,933901,933902,'2','1'
BAT_PLANT_DATA,933901,0, 1.0, 100.0
BAT_MACHINE_DATA_2,933901,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,933901,'D3',,,,,,1, -4.5,,0.0,0.0, 5.0,-4.5, 5.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-021:
BAT_SPLT,113390,993902,'WCHAR2-GSU', 13.2
BAT_BRANCH_CHNG,113390,993902,'1',,,,,,,0.00691,0.003887,,,,,,,,,,,,,;
BAT_SPLT,993902,993901,'WCHAR2-INV', 0.6
BAT_BUS_CHNG_3,993901,2,,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,993902,993901,'2',1,993902,600,0,0,0,33,0,993902,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,993901,993902,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 10.0,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,993901,993902,'1'
BAT_MBIDBRN,993901,993902,'2','1'
BAT_PLANT_DATA,993901,0, 1.0, 100.0
BAT_MACHINE_DATA_2,993901,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,993901,'D3',,,,,,1, -4.0,,0.0,0.0, 10.0,-4.0, 10.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-044:
BAT_SPLT,113085,930852,'WENDE1-GSU', 13.8
BAT_BRANCH_CHNG,113085,930852,'1',,,,,,,0.002625,0.001477,,,,,,,,,,,,,;
BAT_SPLT,930852,930851,'WENDE1-INV', 0.6
BAT_BUS_CHNG_3,930851,2,,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,930852,930851,'2',1,930852,600,0,0,0,33,0,930852,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,930851,930852,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 8.0,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,930851,930852,'1'
BAT_MBIDBRN,930851,930852,'2','1'
BAT_PLANT_DATA,930851,0, 1.0, 100.0
BAT_MACHINE_DATA_2,930851,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,930851,'D3',,,,,,1, -7.2,,0.0,0.0, 8.0,-7.2, 8.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

//NEP-22-G03-043:
BAT_SPLT,113085,990852,'WENDE2-GSU', 13.8
BAT_BRANCH_CHNG,113085,990852,'1',,,,,,,0.00271,0.001524,,,,,,,,,,,,,;

BAT_SPLT,990852,990851,'WENDE2-INV', 0.6
BAT_BUS_CHNG_3,990851,2,,,,,,,,,,;
BAT_TWO_WINDING_DATA_4,990852,990851,'2',1,990852,600,0,0,0,33,0,990852,0,1,0,1,1,1,0.0, 0.0001, 100.0, 1.0,0.0,0.0, 1.0,0.0,0.0,0.0,0.0,0.0, 1.0,
1.0, 1.0, 1.0,0.0,0.0, 1.1, 0.9, 1.1, 0.9,0.0,0.0,0.0," "," "
BAT_TWO_WINDING_CHNG_4,990851,990852,'2',,,,,,,,,,,,,2,, 0.009450, 0.056720, 10.0,,,,,,,,,,,,,,,,,,,,,," "," "
BAT_PURGBRN,990851,990852,'1'
BAT_MBIDBRN,990851,990852,'2','1'
BAT_PLANT_DATA,990851,0, 1.0, 100.0
BAT_MACHINE_DATA_2,990851,'D3',1,600,0,0,0,0,0.0,0.0, 9999.0,-9999.0, 9999.0,-9999.0, 100.0,0.0, 1.0,0.0,0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0
BAT_MACHINE_CHNG_2,990851,'D3',,,,,,1, -8.0,,0.0,0.0, 10.0,-8.0, 10.0,,0.1,,,,,,,,;
BAT_FDNS,1,0,0,1,1,0,0,0

```
///NEP-22-G03-034
930821 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/930821 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

930821 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

993082101 'VTGTPAT' 930821 930821 D3 -1 1.2 0.16 0.0 /
993082102 'VTGTPAT' 930821 930821 D3 -1 1.1 2 0.0 /
993082103 'VTGTPAT' 930821 930821 D3 0.5 5 1.1 0.0 /
993082104 'VTGTPAT' 930821 930821 D3 0.88 5 3 0.0 /
993082105 'FRQTPAT' 930821 930821 D3 56.5 100 0.16 0.0 /
993082106 'FRQTPAT' 930821 930821 D3 58.5 100 300 0.0 /
993082107 'FRQTPAT' 930821 930821 D3 -100 61.2 300 0.0 /
993082108 'FRQTPAT' 930821 930821 D3 -100 62 0.16 0.0 /

///NEP-22-G03-036
933961 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/933961 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

933961 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

993396101 'VTGTPAT' 933961 933961 D3 -1 1.2 0.16 0.0 /
993396102 'VTGTPAT' 933961 933961 D3 -1 1.1 2 0.0 /
993396103 'VTGTPAT' 933961 933961 D3 0.5 5 1.1 0.0 /
993396104 'VTGTPAT' 933961 933961 D3 0.88 5 3 0.0 /
993396105 'FRQTPAT' 933961 933961 D3 56.5 100 0.16 0.0 /
993396106 'FRQTPAT' 933961 933961 D3 58.5 100 300 0.0 /
993396107 'FRQTPAT' 933961 933961 D3 -100 61.2 300 0.0 /
993396108 'FRQTPAT' 933961 933961 D3 -100 62 0.16 0.0 /

///NEP-22-G03-038
933951 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/933951 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

933951 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
```

0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

993395101 'VTGTPAT' 933951 933951 D3 -1 1.2 0.16 0.0 /
993395102 'VTGTPAT' 933951 933951 D3 -1 1.1 2 0.0 /
993395103 'VTGTPAT' 933951 933951 D3 0.5 5 1.1 0.0 /
993395104 'VTGTPAT' 933951 933951 D3 0.88 5 3 0.0 /
993395105 'FRQTPAT' 933951 933951 D3 56.5 100 0.16 0.0 /
993395106 'FRQTPAT' 933951 933951 D3 58.5 100 300 0.0 /
993395107 'FRQTPAT' 933951 933951 D3 -100 61.2 300 0.0 /
993395108 'FRQTPAT' 933951 933951 D3 -100 62 0.16 0.0 /

///NEP-22-G03-039
993951 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/993951 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

993951 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

999395101 'VTGTPAT' 993951 993951 D3 -1 1.2 0.16 0.0 /
999395102 'VTGTPAT' 993951 993951 D3 -1 1.1 2 0.0 /
999395103 'VTGTPAT' 993951 993951 D3 0.5 5 1.1 0.0 /
999395104 'VTGTPAT' 993951 993951 D3 0.88 5 3 0.0 /
999395105 'FRQTPAT' 993951 993951 D3 56.5 100 0.16 0.0 /
999395106 'FRQTPAT' 993951 993951 D3 58.5 100 300 0.0 /
999395107 'FRQTPAT' 993951 993951 D3 -100 61.2 300 0.0 /
999395108 'FRQTPAT' 993951 993951 D3 -100 62 0.16 0.0 /

///NEP-22-G03-029
930701 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/930701 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

930701 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

993070101 'VTGTPAT' 930701 930701 D3 -1 1.2 0.16 0.0 /
993070102 'VTGTPAT' 930701 930701 D3 -1 1.1 2 0.0 /
993070103 'VTGTPAT' 930701 930701 D3 0.5 5 1.1 0.0 /
993070104 'VTGTPAT' 930701 930701 D3 0.88 5 3 0.0 /
993070105 'FRQTPAT' 930701 930701 D3 56.5 100 0.16 0.0 /
993070106 'FRQTPAT' 930701 930701 D3 58.5 100 300 0.0 /
993070107 'FRQTPAT' 930701 930701 D3 -100 61.2 300 0.0 /
993070108 'FRQTPAT' 930701 930701 D3 -100 62 0.16 0.0 /

///NEP-22-G03-008
933771 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/933771 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

```
933771 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

993377101 'VTGTPAT' 933771 933771 D3 -1 1.2 0.16 0.0 /
993377102 'VTGTPAT' 933771 933771 D3 -1 1.1 2 0.0 /
993377103 'VTGTPAT' 933771 933771 D3 0.5 5 1.1 0.0 /
993377104 'VTGTPAT' 933771 933771 D3 0.88 5 3 0.0 /
993377105 'FRQTPAT' 933771 933771 D3 56.5 100 0.16 0.0 /
993377106 'FRQTPAT' 933771 933771 D3 58.5 100 300 0.0 /
993377107 'FRQTPAT' 933771 933771 D3 -100 61.2 300 0.0 /
993377108 'FRQTPAT' 933771 933771 D3 -100 62 0.16 0.0 /

///NEP-22-G03-009
933921 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/933921 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

933921 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

993392101 'VTGTPAT' 933921 933921 D3 -1 1.2 0.16 0.0 /
993392102 'VTGTPAT' 933921 933921 D3 -1 1.1 2 0.0 /
993392103 'VTGTPAT' 933921 933921 D3 0.5 5 1.1 0.0 /
993392104 'VTGTPAT' 933921 933921 D3 0.88 5 3 0.0 /
993392105 'FRQTPAT' 933921 933921 D3 56.5 100 0.16 0.0 /
993392106 'FRQTPAT' 933921 933921 D3 58.5 100 300 0.0 /
993392107 'FRQTPAT' 933921 933921 D3 -100 61.2 300 0.0 /
993392108 'FRQTPAT' 933921 933921 D3 -100 62 0.16 0.0 /

///NEP-22-G03-011
933881 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/933881 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

933881 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

993388101 'VTGTPAT' 933881 933881 D3 -1 1.2 0.16 0.0 /
993388102 'VTGTPAT' 933881 933881 D3 -1 1.1 2 0.0 /
993388103 'VTGTPAT' 933881 933881 D3 0.5 5 1.1 0.0 /
993388104 'VTGTPAT' 933881 933881 D3 0.88 5 3 0.0 /
993388105 'FRQTPAT' 933881 933881 D3 56.5 100 0.16 0.0 /
993388106 'FRQTPAT' 933881 933881 D3 58.5 100 300 0.0 /
993388107 'FRQTPAT' 933881 933881 D3 -100 61.2 300 0.0 /
993388108 'FRQTPAT' 933881 933881 D3 -100 62 0.16 0.0 /
```

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///NEP-22-G03-013
993881 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/993881 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

993881 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

999388101 'VTGTPAT' 993881 993881 D3 -1 1.2 0.16 0.0 /
999388102 'VTGTPAT' 993881 993881 D3 -1 1.1 2 0.0 /
999388103 'VTGTPAT' 993881 993881 D3 0.5 5 1.1 0.0 /
999388104 'VTGTPAT' 993881 993881 D3 0.88 5 3 0.0 /
999388105 'FRQTPAT' 993881 993881 D3 56.5 100 0.16 0.0 /
999388106 'FRQTPAT' 993881 993881 D3 58.5 100 300 0.0 /
999388107 'FRQTPAT' 993881 993881 D3 -100 61.2 300 0.0 /
999388108 'FRQTPAT' 993881 993881 D3 -100 62 0.16 0.0 /

///NEP-22-G03-006
933831 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/933831 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

933831 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

993383101 'VTGTPAT' 933831 933831 D3 -1 1.2 0.16 0.0 /
993383102 'VTGTPAT' 933831 933831 D3 -1 1.1 2 0.0 /
993383103 'VTGTPAT' 933831 933831 D3 0.5 5 1.1 0.0 /
993383104 'VTGTPAT' 933831 933831 D3 0.88 5 3 0.0 /
993383105 'FRQTPAT' 933831 933831 D3 56.5 100 0.16 0.0 /
993383106 'FRQTPAT' 933831 933831 D3 58.5 100 300 0.0 /
993383107 'FRQTPAT' 933831 933831 D3 -100 61.2 300 0.0 /
993383108 'FRQTPAT' 933831 933831 D3 -100 62 0.16 0.0 /

///NEP-22-G03-041
930841 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8
 0       0
 0.0200        0.0200        99.000        -99.000        10.000
 0.0100        1.0000/


930841 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
 0       0      0      0      0       0
 0.8800        1.2000        0.0200       -0.1000        0.1000
 1.0000        1.0000       -1.0000        0.0000        0.0000
 0.0000        0.0000        0.0100        0.0000        0.0000
 1.1000        0.9000        0.3000        5.0000        0.5000
 0.0000        0.0000        0.0200        99.000       -99.000
 1.0000       -1.0000        1.2000        0.0200
 0.01 0.01  0.499 0.01  0.5 1.0  0.6 1.0  0.9 1.0  1.0 1.0  1.1 1.0  1.2 1.0  1.201 0.01  1.3 0.01
 0.01 0.01  0.499 0.01  0.5 1.0  0.6 1.0  0.9 1.0  1.0 1.0  1.1 1.0  1.2 1.0  1.201 0.01  1.3 0.01
 0.0000        0.0000        0.0000        0.0000        1.0000
 0.5000        1.1000        0.0000/
```

```
993084101 'VTGTPAT' 930841 930841 D3 -1 1.2 0.16 0.0 /
993084102 'VTGTPAT' 930841 930841 D3 -1 1.1 2 0.0 /
993084103 'VTGTPAT' 930841 930841 D3 0.5 5 1.1 0.0 /
993084104 'VTGTPAT' 930841 930841 D3 0.88 5 3 0.0 /
993084105 'FRQTPAT' 930841 930841 D3 56.5 100 0.16 0.0 /
993084106 'FRQTPAT' 930841 930841 D3 58.5 100 300 0.0 /
993084107 'FRQTPAT' 930841 930841 D3 -100 61.2 300 0.0 /
993084108 'FRQTPAT' 930841 930841 D3 -100 62 0.16 0.0 /

///NEP-22-G03-015
933891 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/933891 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

933891 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

993389101 'VTGTPAT' 933891 933891 D3 -1 1.2 0.16 0.0 /
993389102 'VTGTPAT' 933891 933891 D3 -1 1.1 2 0.0 /
993389103 'VTGTPAT' 933891 933891 D3 0.5 5 1.1 0.0 /
993389104 'VTGTPAT' 933891 933891 D3 0.88 5 3 0.0 /
993389105 'FRQTPAT' 933891 933891 D3 56.5 100 0.16 0.0 /
993389106 'FRQTPAT' 933891 933891 D3 58.5 100 300 0.0 /
993389107 'FRQTPAT' 933891 933891 D3 -100 61.2 300 0.0 /
993389108 'FRQTPAT' 933891 933891 D3 -100 62 0.16 0.0 /

///NEP-22-G03-016
993891 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/993891 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

993891 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

999389101 'VTGTPAT' 993891 993891 D3 -1 1.2 0.16 0.0 /
999389102 'VTGTPAT' 993891 993891 D3 -1 1.1 2 0.0 /
999389103 'VTGTPAT' 993891 993891 D3 0.5 5 1.1 0.0 /
999389104 'VTGTPAT' 993891 993891 D3 0.88 5 3 0.0 /
999389105 'FRQTPAT' 993891 993891 D3 56.5 100 0.16 0.0 /
999389106 'FRQTPAT' 993891 993891 D3 58.5 100 300 0.0 /
999389107 'FRQTPAT' 993891 993891 D3 -100 61.2 300 0.0 /
999389108 'FRQTPAT' 993891 993891 D3 -100 62 0.16 0.0 /

///NEP-22-G03-017
983891 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/983891 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/
```

```
983891 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

998389101 'VTGTPAT' 983891 983891 D3 -1 1.2 0.16 0.0 /
998389102 'VTGTPAT' 983891 983891 D3 -1 1.1 2 0.0 /
998389103 'VTGTPAT' 983891 983891 D3 0.5 5 1.1 0.0 /
998389104 'VTGTPAT' 983891 983891 D3 0.88 5 3 0.0 /
998389105 'FRQTPAT' 983891 983891 D3 56.5 100 0.16 0.0 /
998389106 'FRQTPAT' 983891 983891 D3 58.5 100 300 0.0 /
998389107 'FRQTPAT' 983891 983891 D3 -100 61.2 300 0.0 /
998389108 'FRQTPAT' 983891 983891 D3 -100 62 0.16 0.0 /

///NEP-22-G03-001
     933631 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8
          @!/ -------- ICONS ------
          @!/ 1.RateFlag   2.PQpriority
                    0          0
          @!/ -------- CONS ------
          @!/ 1.Tg        2.Tflt      3.Iqrmax     4.Iqrmin   5.rrpwr
                    0.006       0.006       30.00       -30.00      10.00
          @!/ 6.Te        7.Imax
                    0.006       1.00/
@!/-------------------------------------------------------------------------------------------------
  933631 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
          @!/ -------- ICONS ------
          @!/ 1.PFflag       2.Vflag        3.Qflag       4.Pflag     5.PQflag     6.VcmpFlag
                    0             0             0             0                                    0          0
          @!/ -------- CONS ------
          @!/ 1.Vdip         2.Vup          3.Trv          4.dbd1       5.dbd2
                    0.8500         1.4000         0.0060        -0.001        0.001
          @!/ 6.Kqv          7.Iqh1         8.Iql1         9.Vref0      10.Iqfrz
                    2.0000         2.0000        -2.0000         0.0000       0.0000
          @!/ 11.Thld        12.Thld2       13.Tp          14.QMax      15.QMin
                    0.0000                        0.0000                    0.0060         1.0000      -1.0000
          @!/ 16.Vmax        17.Vmin        18.Kqp         19.Kqi       20.Kvp
                    1.2000        -1.2000         1.0000         5.0000       1.0000
          @!/ 21.Kvi         22.Vbias       23.Tiq         24.dPmax     25.dPmin
                    5.0000         0.0000                    0.0060         30.000      -30.000
          @!/ 26.Pmax        27.Pmin        28.Imax        29.Tpord     30.Vq1
                    1.0000        -1.0000         1.2000         0.0250       0.1000
          @!/ 31.Iq1         32.Vq2         33.Iq2         34.Vq3       35.Iq3
                    1.0000         1.1000         1.0000         0.0000       0.0000
          @!/ 36.Vq4         37.Iq4         38.Vq5         39.Iq5       40.Vq6
     0.0000         0.0000         0.0000         0.0000       0.0000
          @!/ 41.Iq6         42.Vq7         43.Iq7         44.Vq8       45.Iq8
     0.0000         0.0000         0.0000         0.0000       0.0000
          @!/ 46.Vq9         47.Iq9         48.Vq10        49.Iq10      50.Vp1
     0.0000         0.0000         0.0000         0.0000       0.1000
          @!/ 51.Ip1         52.Vp2         53.Ip2         54.Vp3       55.Ip3
     1.0000         1.1000         1.0000         0.0000       0.0000
          @!/ 56.Vp4         57.Ip4         58.Vp5         59.Ip5       60.Vp6
     0.0000         0.0000         0.0000         0.0000       0.0000
          @!/ 61.Ip6         62.Vp7         63.Ip7         64.Vp8       65.Ip8
     0.0000         0.0000         0.0000         0.0000       0.0000
          @!/ 66.Vp9         67.Ip9         68.Vp10        69.Ip10      70.Rc
     0.0000         0.0000         0.0000         0.0000       0.0000
          @!/ 71.Xc          72.Tr1         73.Kc          74.Ke        75.Vblkl
     0.0000         0.0060         0.0000         1.0000       0.5000
          @!/ 76.Vblkh       77.Tblk
     1.1000         0.0000/

993363101 'VTGTPAT' 933631 933631 D3 -1 1.2 0.16 0.0 /
993363102 'VTGTPAT' 933631 933631 D3 -1 1.1 2 0.0 /
993363103 'VTGTPAT' 933631 933631 D3 0.5 5 1.1 0.0 /
993363104 'VTGTPAT' 933631 933631 D3 0.88 5 3 0.0 /
993363105 'FRQTPAT' 933631 933631 D3 56.5 100 0.16 0.0 /
993363106 'FRQTPAT' 933631 933631 D3 58.5 100 300 0.0 /
```

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993363107 'FRQTPAT' 933631 933631 D3 -100 61.2 300 0.0 /
993363108 'FRQTPAT' 933631 933631 D3 -100 62 0.16 0.0 /

///NEP-22-G03-033
933681 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/933681 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

933681 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
0.4 1.3 0.02 -0.10 0.10 1 1.0 -1.0 0.00 0
0 0 0.01 0 0 1.05 0.95 0.9 0.9 0.9 0.9
0 0.02 99 -99 1 -1 1.2 0.02
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.499 0.01 0.5 1 0.6 1 0.9 1 1 1 1.1 1 1.2 1 1.201 0.01 1.3 0.01
0.01 0.01 0.02 0.01 1 0.5 1.1 0.04/

993368101 'VTGTPAT' 933681 933681 D3 -1 1.2 0.16 0.0 /
993368102 'VTGTPAT' 933681 933681 D3 -1 1.1 2 0.0 /
993368103 'VTGTPAT' 933681 933681 D3 0.5 5 1.1 0.0 /
993368104 'VTGTPAT' 933681 933681 D3 0.88 5 3 0.0 /
993368105 'FRQTPAT' 933681 933681 D3 56.5 100 0.16 0.0 /
993368106 'FRQTPAT' 933681 933681 D3 58.5 100 300 0.0 /
993368107 'FRQTPAT' 933681 933681 D3 -100 61.2 300 0.0 /
993368108 'FRQTPAT' 933681 933681 D3 -100 62 0.16 0.0 /

///NEP-22-G03-020
933901 'USRMDL' D3 'REGCBU1' 101 1 2 7 5 8 0 1
0.02 0.02 99 -99 10.0 0.01 1.0/

/933901 'REPCA1' D3
/1111 101 1111 '1' 1 0 1
/0.02 0 0 0 0.02 0 0 0 0 999 -999 0 0
/0 0 0.5 0.25 0.02 -0.0006 0.0006 999 -999 1 -1 0.02 20 20/

933901 'USRMDL' D3 'REECDU1' 102 0 6 77 7 20
0 1 0 0 1 0
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0 0.02 99 -99 1 -1 1.2 0.02
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This appendix has been redacted for Critical Energy/ Electric Infrastructure Information (CEII).

Appendix D – N-0 and N-1 Thermal and Voltage Results

This appendix has been redacted for Critical Energy/ Electric Infrastructure Information (CEII).

Appendix E – Stability Analysis Plots

WMA Group 3 cluster stability plots_pdf.zip

This appendix has been redacted for Critical Energy/ Electric Infrastructure Information (CEII).

Appendix F – PSCAD Analysis Report

Western MA DER Group 3 PSCAD Report 5_20_2022.pdf

Appendices

Application to Support the Petition before the Energy Facilities Siting Board

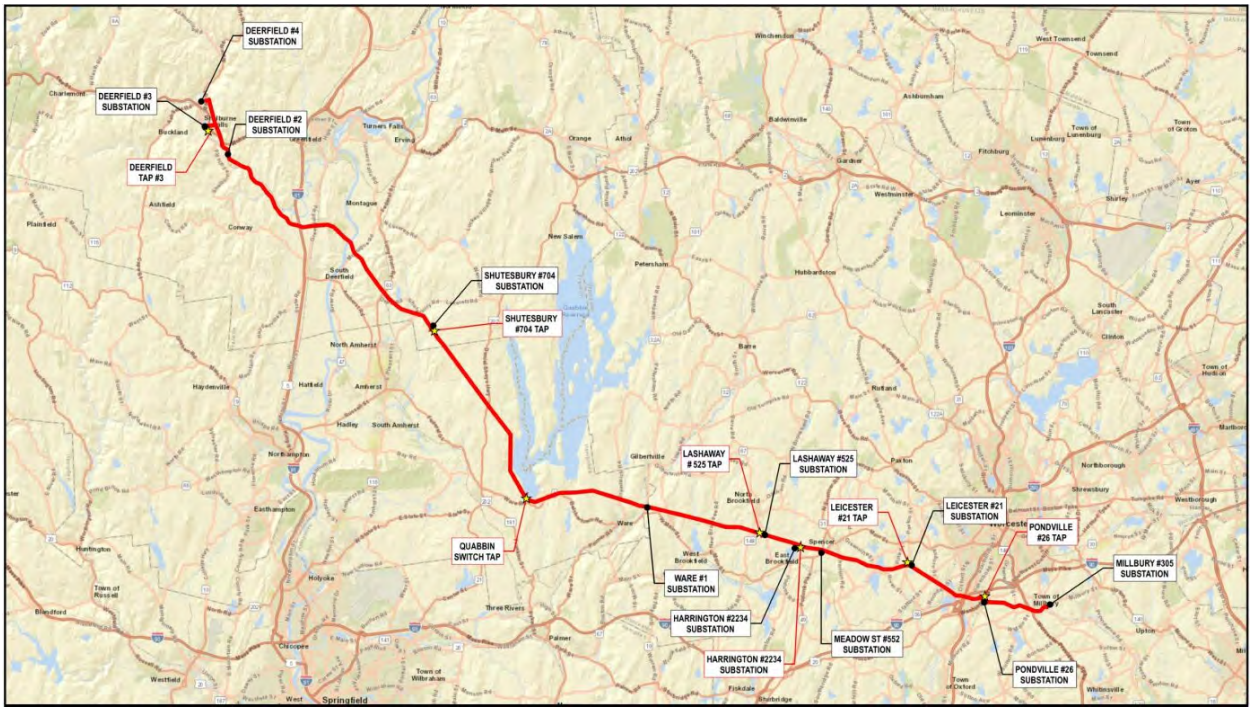
Central to Western Massachusetts Energy Improvement Project

Appendix 4-1: Routing Selection Process - Supporting Information

Appendix 4-1: Routing Selection Process - Supporting Information

Central to Western Massachusetts Energy Improvement Project

Route Selection Process - Supporting Information
Appendix 4-1



Prepared for:
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Appendix 4-1

Table A: Electric Transmission Line Corridors

ROW	Operating Company	Approximate Location
ROW 1	NEP A127/B128	This is an estimated 125-to-250-foot-wide transmission ROW that runs approximately 61.2 miles NW/SE through the northern corner of the Study Area. The corridor passes through the towns of Auburn, Barre, Colrain, Erving, Gill, Greenfield, Leicester, Millbury, New Salem, Oakham, Paxton, Petersham, Rutland, Shelburne, Spencer, and Wendell. The ROW contains 115 kV overhead transmission lines (A127 and B128). A portion of the ROW contains 230 kV NEP overhead transmission line (E205E) in addition to the 115 kV lines. NEP controls majority of this ROW in fee or easement.
ROW 2	NEP V174	This is an estimated 200-to-250-foot-wide transmission ROW that runs approximately 15.6 miles E/W through the eastern corner of the Study Area. The corridor passes through the towns of Auburn, Charlton, Millbury, Oxford, and Sutton. The ROW contains 115 kV overhead transmission line (V174). A portion of the ROW contains 315 kV NEP overhead transmission line (302) in addition to the 115 kV line. NEP controls majority of this ROW in fee or easement.
ROW 3	NEP 301	This is an estimated 200-foot-wide transmission ROW that runs approximately 25.8 miles E/W through the south-eastern corner of the Study Area. The corridor passes through the towns of Belchertown, Brimfield, Brookfield, Charlton, Ludlow, Palmer, Sturbridge, and Warren. The ROW contains 345 kV overhead transmission line (301). A portion of the ROW contains 115 kV NEP overhead transmission line (W175/X176) in addition to the 345 kV line. NEP controls majority of this ROW in fee or easement.
ROW 4	NEP O15N	This is an estimated 80-to-130-foot-wide transmission ROW that runs approximately 8.9 miles N/S through the southern corner of the Study Area. The corridor passes through the towns of Palmer, Ware, and West Brookfield. The ROW contains 69 kV overhead transmission line (O15N). A portion of the ROW contains 115 kV NEP overhead transmission line (X176) in addition to the 69 kV line. NEP controls majority of this ROW in fee or easement.
ROW 5	NEP T20	This is an estimated 70-to-100-foot-wide transmission ROW that runs approximately 8.4 miles N/S through the south-eastern corner of the Study Area. The corridor passes through the towns of Charlton and Spencer. The ROW contains 69 kV overhead transmission line (T20). NEP controls majority of this ROW in fee or easement.
ROW 6	NEP D4	This is an estimated 100-foot-wide transmission ROW that runs approximately 3.7 miles N/S through Charlemont substation in the western corner of the Study Area. The corridor passes through the towns of Colrain and Shelburne. The ROW contains 69 kV overhead transmission line (D4). NEP controls majority of this ROW in fee or easement.
ROW 7	NEP A127, Y177	This is an estimated 200-foot-wide transmission ROW that runs approximately 2.7 miles N/S through the north-western corner of the Study Area. The corridor passes through the towns of Greenfield and Montague. The ROW contains 115 kV overhead transmission lines (A127 and Y177). NEP controls majority of this ROW in fee or easement.
ROW 8	Eversource 354	This is an estimated 140-to-200-foot-wide transmission ROW that runs approximately 30.3 miles N/S through the center of the Study. The corridor passes through the towns of Amherst, Belchertown, Erving, Granby, Leverett, Ludlow, Montague, Pelham, Shutesbury, and Wendell. The ROW contains 345 kV overhead transmission line (354). A portion of the ROW contains 115 kV NEP overhead transmission lines (1394 and 1515) in addition to the 354 kV line. Eversource controls majority of this ROW in fee or easement.

ROW 9	Eversource 312	This is an estimated 130-to-200-foot-wide transmission ROW that runs approximately 20 miles E/W through the western corner of the Study Area. The corridor passes through the towns of Ashfield, Conway, Deerfield, Erving, Montague, and Shelburne. The ROW contains 345 kV overhead transmission line (312). A portion of the ROW contains 115 kV NEP overhead transmission lines (1231 and 1242) in addition to the 354 kV line. Eversource controls majority of this ROW in fee or easement.
ROW 10	Eversource 1242	This is an estimated 100-to-140-foot-wide transmission ROW that runs approximately 3.6 miles NE/SW through the western corner of the Study Area. The corridor passes through the towns of Deerfield, Greenfield, and Montague. The ROW contains 115 kV overhead transmission line (1242). Eversource controls majority of this ROW in fee or easement.
ROW 11	Eversource 1044, 1113	This is an estimated 130-to-200-foot-wide transmission ROW that runs approximately 31.1 miles N/S through the central-western of the Study Area. The corridor passes through the towns of Amherst, Chicopee, Granby, Leverett, Montague, South Hadley, and Sunderland. The ROW contains 115 kV overhead transmission lines (1044 and 1113). Eversource controls majority of this ROW in fee or easement.
ROW 12	Eversource 1428	This is an estimated 150-to-250-foot-wide transmission ROW that runs approximately 12 miles N/S through the south-western corner of the Study Area. The corridor passes through the town of Chicopee, Easthampton, Holyoke, South Hadley, and West Springfield. The ROW contains 115 kV overhead transmission lines (1428). A portion of the ROW contains 115 kV overhead transmission line (Eversource 1327, 1702, 1314 and NEP 1819) in addition to the 115 kV lines. Eversource controls the majority of this ROW in fee or easement.
ROW 13	Eversource 3196	This is an estimated 150-to-200-foot-wide transmission ROW that runs approximately 9.6 miles E/W through the south-western corner of the Study Area. The corridor passes through the town of Chicopee and Ludlow. The ROW contains a 345 kV overhead transmission line (3196). A portion of the ROW contains 115 kV Eversource overhead transmission lines (1601, 1314, 1803, 1481, 1552) in addition to the 115 kV lines. Eversource controls majority of this ROW in fee or easement.
ROW 14	NEP B69	This is an estimated 100-foot-wide transmission ROW that runs approximately 2 miles NW/SE through the center of the Study Area. The corridor passes through the town of Belchertown. The ROW contains 69 kV overhead transmission line (B69). NEP controls majority of this ROW in fee or easement.

Appendix 4-1

Table B: Railroad Corridors

Railroad/Operating Company	Status	Approximate Location
CSX Boston Subdivision Railroad/CSX	Active	The CSX Boston Subdivision Railroad runs approximately 53 miles east-west through the eastern corner of the Study Area. Some of the towns which intersect this railroad within the Study Area include Palmer, Brimfield, Warren, West Brookfield, Brookfield, East Brookfield, Spencer, Charlton, Oxford, Leicester, Rochdale, and Auburn. The CSX Boston Subdivision intersects local lines including North Brookfield and Webster Branch in the eastern corner of the Study Area, and East Brookfield and Spencer Branch in the eastern corner of the Study Area.
Ware River Branch Railroad/MassDOT	Active	The Ware River Branch Line runs approximately 38 miles south-west to north-east through the east-central corner of the Study Area. Some of the towns which intersect this railroad within the Study Area include Palmer, Ware, Hardwick, New Braintree, and Barre. The Ware River Branch Line intersects the Central Mass Railroad and Central Vermont Railroad.
Central Vermont Railroad/NECR	Active	The Central Vermont Line runs approximately 48.5 miles north-south through the central portion of the Study Area. Some of the towns which intersect this railroad within the Study Area include Erving, Montague, Sunderland, Leverett, Amherst, Belchertown, and Palmer. The Ware River Branch Line intersects the Patriot Corridor and Central Mass Railroad, along with a few local lines.
Guilford Yard Railroad/ Pan Am Railways, Inc ("PAR")	Active	The Guilford Yard Line runs approximately 2 miles north-south through the southern corner of the Study Area. Study Area. Some of the towns which intersect this railroad within the Study Area include Holyoke. The Guilford Yard Line intersects the Connecticut River Main Line.
Connecticut River Main Line Railroad/ Pan Am Southern ("PAS")	Active	The Connecticut River Main Line runs approximately 67 miles north-south through the south through north-eastern corner of the Study Area. Some of the towns which intersect this railroad within the Study Area include Greenfield, Deerfield, Whately, Hatfield, Northampton, Holyoke, and Chicopee. The Conn River Main Line intersects the Patriot Corridor, Turner Fall Branch, East Deerfield Loop, Central Mass, Holyoke Branch, and a few local lines.
Greenfield Running Railroad/ Pan Am Southern ("PAS")	Active	The Greenfield Running Line runs approximately 4 miles east-west through the north-western corner of the Study Area. Some of the towns which intersect this railroad within the Study Area include Greenfield and Deerfield. The Greenfield Running Line intersects the Conn River Main Line Railroad, Turner Fall Branch, and Patriot Corridor.
Patriot Corridor Railroad/ Pan Am Southern ("PAS")	Active	The Patriot Corridor Line runs approximately 49 miles east-west through the western corner of the Study Area. Some of the towns which intersect this railroad within the Study Area include Buckland, Shelburne, Conway, Deerfield, Greenfield, Montague, and Erving. The Patriot Corridor Line intersects the Connecticut River Main Line, Central Vermont Railroad, Greenfield Running, Freight Mainline, and Turner Fall Branch.
Holyoke Branch Railroad/ Pioneer Valley ("PV")	Active	The Holyoke Branch Line runs approximately 11 miles north-south through the southern corner of the Study Area. Some of the towns which intersect this railroad within the Study Area include Holyoke. The Holyoke Branch Line intersects the Conn River Main Line Railroad.
Norwich and Worcester Railroad/Providence and Worcester ("P&W")	Active	The Norwich and Worcester Line runs approximately 6 miles north-south through the eastern corner of the Study Area. Some of the towns which intersect this railroad within the Study Area include Oxford and Auburn.

Providence and Worcester Railroad/ Genesee and Wyoming ("G&W")	Active	The Providence and Worcester Line runs approximately 4 miles north-south through the eastern corner of the Study Area. Some of the towns which intersect this railroad within the Study Area include Milbury.
Northampton Running Railroad/ Pan Am Railways, Inc ("PAR")	Active	The Northampton Running Line runs approximately 2 miles north-south through the southern corner of the Study Area. Some of the towns which intersect this railroad within the Study Area include Northampton. The Northampton Running Line intersects a few local lines.
Old Northbound Railroad/ Pan Am Railways, Inc ("PAR")	Active	The Old Northbound Line runs approximately 2 miles north-south through the southern corner of the Study Area. Some of the towns which intersect this railroad within the Study Area include Northampton. The Old Northbound Line intersects a few local lines.
East Deerfield Loop Railroad/ Pan Am Southern ("PAS")	Active	The East Deerfield Loop Line runs approximately 1 mile east-west through the north-central corner of the Study Area. Some of the towns which intersect this railroad within the Study Area include Deerfield. The East Deerfield Loop Line intersects the Patriot Corridor and Connecticut River Main Line.
Easthampton Branch Railroad/ Local	Active	The Easthampton Branch Line runs approximately 0.7 miles north-south through the southern corner of the Study Area. Some of the towns which intersect this railroad within the Study Area include Easthampton. The Easthampton Branch Line intersects the Connecticut River Main Line Railroad and Old Northbound.
East Brookfield & Spencer Railroad ("EB&S")/CSX Boston Subdivision	Active, ROW Public Own	The East Brookfield and Spencer Line runs approximately 2 miles east-west through the eastern portion of the Study Area. Some of the towns which intersect this railroad within the Study Area include Spencer and East Brookfield. The East Brookfield and Spencer Line intersects the CSX Boston Subdivision Line.
Webster Branch Railroad/ Boston and Albany Railroad Company	Abandoned	The Webster Branch Line runs approximately 5 miles north-south through the eastern portion of the Study Area. Some of the towns which intersect this railroad within the Study Area include Auburn and Oxford. The Webster Branch Line intersects the CSX Boston Subdivision Line.
Central Mass Railroad/Boston and Maine Railroad/ Pan Am Railways, Inc ("PAR")	Abandoned	The Central Mass Line runs approximately 58 miles southwest-northeast through the central portion of the Study Area. Some of the towns which intersect this railroad within the Study Area include Northampton, Hadley, Amherst, Belchertown, Ware, Barre, New Braintree, Gilbertville, Hardwick, and Palmer. The Central Mass Line intersects the Ware River Branch, and local lines.
Turner Fall Branch/ Pan Am Railways, Inc ("PAR")	Abandoned	The Turner Fall Branch Line runs approximately 0.2 miles north-south through the central-west portion of the Study Area. Some of the towns which intersect this railroad within the Study Area include Deerfield, Greenfield, and Montague. The Turner Fall Branch Line intersects the Shelburne Falls Line, Conn River Main Line, Patriot Corridor, and local lines.
Palmer Industrial Park/New England Central Railroad ("NECR")	Abandoned	The Palmer Industrial Park runs approximately 1 mile east-west through the southern portion of the Study Area. Some of the towns which intersect this railroad within the Study Area include Belchertown and Palmer.
North Brookfield Railroad/Local	Abandoned, ROW Publicly Owned	The North Brookfield Line runs approximately 5 miles east-west through the eastern portion of the Study Area. Some of the towns which intersect this railroad within the Study Area include North Brookfield and East Brookfield. The North Brookfield Line intersects the CSX Boston Subdivision Line.
Spencer Branch Railroad/Local	Abandoned, ROW Publicly Owned	The Spencer Branch Line runs approximately 2.6 miles north-south through the eastern portion of the Study Area. Some of the towns which intersect this railroad within the Study Area include Spencer. The Spencer Branch Line intersects the CSX Boston Subdivision Line.

Millbury Branch Railroad/Local	Abandoned, ROW Publicly Owned	The Milbury Branch Line runs approximately 1 mile north-south through the eastern portion of the Study Area. Some of the towns which intersect this railroad within the Study Area include Milbury. The Milbury Branch Line intersects the CSX Boston Subdivision Line.
Williamsburg Branch Railroad/Local	Abandoned, ROW Publicly Owned	The Williamsburg Branch Line runs approximately 7 miles east-west through the western portion of the Study Area. Some of the towns which intersect this railroad within the Study Area include Northampton. The Williamsburg Branch intersects the Shelburne Falls Line and Northampton Running.
SA&N Railroad/ New England Central Railroad ("NECR") and CSX	Abandoned, ROW Publicly Owned	The SA&N Line runs approximately 41 miles north-south through the southern portion of the Study Area. Some of the towns which intersect this railroad within the Study Area include Ludlow, Palmer, Belchertown, Ware, New Salem, and Petersham.
Shelburne Falls Railroad/ New England Central Railroad ("NECR") and CSX	Abandoned, ROW Publicly Owned	The Shelburne Falls Line runs approximately 24.5 miles north-south through the western portion of the Study Area. Some of the towns which intersect this railroad within the Study Area include Conway, Deerfield, Whately, Hatfield, and Northampton.

Appendix 4-1

Table C: Highway and Major Roadway Corridors

Highway and Roadway	Description
Interstate Route I-90 ("I-90")	I-90 is located in the western portion of the Study Area and runs north-south through the towns of Greenfield, South Deerfield, and Holyoke.
Interstate Route I-91 ("I-91")	I-91 is located in the western portion of the Study Area and runs north-south through the towns of Greenfield, South Deerfield, and Holyoke.
Interstate Route I-290 ("I-290")	I-290 is located in the south-eastern portion of the Study Area and runs north-south through the town of Auburn.
Interstate Route I-291 ("I-291")	I-291 is located in the south-western portion of the Study Area and runs north-south through the town of Springfield.
Interstate Route I-391 ("I-391")	I-391 is located in the south-western portion of the Study Area and runs north-south through the towns of Holyoke and Chicopee.
Interstate Route I-395 ("I-395")	I-395 is located in the south-eastern portion of the Study Area and runs north-south through the town of Auburn.
US Highway Route 202	Route202 is a state highway located in the central and southwest corner of the Study Area and runs north-western through the towns of Holyoke, Belchertown and New Salem.
US Highway Route 5	Route 5 is a state highway located in the western portion of the Study Area and runs north-south through the towns of Greenfield, South Deerfield, and Holyoke.
US Highway Route 20	Route 20 is a state highway located in the southern portion of the Study Area and runs east-west through the towns of Auburn, Sturbridge, Fiskdale, East Brimfield, Brimfield, Palmer, and Chicopee.
State Route 2/2A	Route 2/2A is located in the north-western corner of the Study Area and runs east-west through the towns of Greenfield, and Erving.
State Route 9	Route 9 is located in the central portion of the Study Area and runs east-west through the towns of Leicester, Spence, Brookfield, Ware, Amherst, and Northampton.
State Route 10	Route 10 is located in the southwestern corner of the Study Area and runs north-south through the town of Northampton.
State Route 12	Route 12 is located in the southeastern corner of the Study Area and runs north-south through the towns of Auburn, Worcester, Sterling, Leominster, Ashburnham, and Winchendon.
State Route 19	Route 19 is located in the southern area of the Study Area and runs north-south through the towns of Warren, and Brimfield.
State Route 21	Route 21 is located in the southwestern corner of the Study Area and runs north-south through the towns of Ludlow and Belchertown.
State Route 31	Route 31 is located in the southeastern corner of the Study Area and runs north-south through the towns of Spencer and Charlton.
State Route 32	Route 32 is located in the southern area of the Study Area and runs north-south through the towns of Ware, Gilbertville, and Wheelwright.
State Route 33	Route 33 is located in the southwestern corner of the Study Area and runs north-south through the town of Chicopee.
State Route 47	Route 47 is located in the western area of the Study Area and runs north-south through the town of Sunderland, Hadley, and South Hadley.
State Route 49	Route 49 is located in the south-eastern corner of the Study Area and runs north-south and connects MA Route 9 and US State Highway 20.
State Route 56	Route 56 is located in the south-eastern corner of the Study Area and runs north-south through the towns of North Oxford, Rochdale, and Leicester.
State Route 63	Route 63 is located in the northwestern corner of the Study Area and runs north-south through the towns of Montague, Millers Falls, and Erving.
State Route 67	Route 67 is located in the eastern area of the Study Area and runs north-south through the towns of North Brookfield and Barre Plains.

State Route 112	Route 112 is located in the western area of the Study Area and runs north-south through the towns of Ashfield, Buckland, and Shelburne Falls.
State Route 116	Route 116 is located in the western area of the Study Area and runs east-west through the towns of Holyoke, South Amherst, Amherst, North Amherst, South Deerfield, Conway, and Ashfield.
State Route 141	Route 141 is located in the south-western corner of the Study Area and runs northwest-southeast through the towns of Easthampton, Holyoke and Ludlow.
State Route 146	Route 146 is located in south-eastern corner of the Study Area and runs north-south through the town of Millbury.
State Route 148	Route 148 is located in the eastern corner of the Study Area and runs north-south through the towns of Fiskdale, Town of Brookfield, North Brookfield and Oakham.
State Route 169	Route 169 is located in the south-eastern corner of the Study Area and runs north-south through the town of Southbridge and Charlton City.
State Route 181	Route 181 is located in the southern area of the Study Area and runs north-south through the town of Three Rivers, and Belchertown.
State Route 32/32A	Route 32/32A is located in eastern area of the Study Area and runs north-south through the towns of Palmer, Ware, Gilbertville, Petersham, and Athol.
State Route 122/122A	Route 122/122A is located in south-eastern corner of Study Area and runs north-south through the town of Millbury.

Appendix 4-1

Table D: Electric Transmission Corridors Eliminated from Further Consideration

Route	Explanation for elimination
Portion of ROW 1	• The portion of this corridor that runs east-west through the towns of Colrain, Greenfield, Gill, Erving, Wendell, New Salem, Petersham, Barre, Oakham, Rutland, and Paxton in the north-western portion of the Study Area does not provide access to the intermediate substations along the Existing Lines. Therefore, ROW does not maintain system function and operation, as there is no practical connection to the intermediate substations along the Existing Lines. • In addition, ROW 1, extends east-west from the Milbury #305 Substation, resulting in a longer route to the Deerfield #4 Substation.
ROW 2	• ROW does not maintain system function and operation, as there is no practical connection to the intermediate substations along the Existing Lines. • ROW 2, in combination with ROW 5 and the Project Route (E5/F6 Line), extends south-west from the Milbury #305 Substation, resulting in a longer route to the Deerfield # 4 Substation. • This corridor passes adjacent to or through DCR properties and state properties such as the Wendell State Forest, Quabbin Reservoir Watershed Area, Ware River Watershed, and other open space recreational areas, potentially requiring the release of conservation lands in Wendell, New Salem and Oakham via the Article 97 land disposition process through the Legislature of the Commonwealth, land acquisition, and additional easement rights. This would result in additional social/environmental impacts as compared to the Project Route (E5/F6 Line). • This corridor also passes through several wetlands, streams, and outstanding resource waters, adjacent to multiple public water supply resource areas, along with NHESP Priority Habitat areas in town of Petersham and Barre. This would result in additional environmental impacts as compared to the Project Route (E5/F6 Line).
ROW 3	• ROW does not maintain system function and operation, as there is no practical connection to the intermediate substations along the Existing Lines. • ROW 3, in combination with ROW 8 and the Project Route (E5/F6 Line), extends south-west from the Milbury #305 Substation, resulting in a longer route to the Deerfield # 4 Substation. • In addition, Eversource controls this ROW in fee or easement. Working within other utility corridors can result in access restrictions, working space constraints, safety concerns, traffic disruptions, and restrictive work hours.
Portion of ROW 4	• The portion of this corridor that runs north-south through the towns of Belchertown, Granby, Ludlow, Wilbraham, and East Longmeadow in the south-east of the Study Area does not provide access to the intermediate substation along the Existing Lines. • ROW 4 extends north-south from Ware #1 Substation, resulting in no feasible route options. • This corridor passes adjacent to or through several state properties such as the West Brookfield, Palmer Wildlife Management Area, Coy Hill Wildlife Management Area, and other open space recreational areas, potentially requiring the release of conservation lands in West Brookfield, Ware, Warren, and Palmer. This would result in additional social/environmental impacts as compared to the Project Route (E5/F6 Line). • This corridor also passes through several NHESP Priority Habitat areas in the town of Palmer. This would result in additional environmental impacts as compared to the Project Route (E5/F6 Line).

ROW 5	• ROW does not maintain system function and operation, as there is no practical connection to the intermediate substations along the Existing Lines. • ROW 5 extends north-south from Meadow St #552 Substation, resulting in no feasible route options.
ROW 6	• ROW does not maintain system function and operation, as there is no practical connection to the intermediate substations along the Existing Lines. • ROW 6 extends north-south from Deerfield #4 Substation, resulting in no feasible route options.
ROW 7	• ROW does not maintain system function and operation, as there is no practical connection to the intermediate substations along the Existing Lines. • ROW 7, in combination with ROW 10, ROW 9, and the Project Route (E5/F6 Line) extends north-south from Deerfield #4 Substation, resulting in a longer route to the Deerfield #4 Substation.
Portion of ROW 8	• The portion of this corridor that runs east-west through the towns of Belchertown, Granby, and Ludlow in the south portion of the Study Area does not provide access to the intermediate substations along the Existing Lines. Therefore, ROW 8 does not maintain system function and operation, as there is no practical connection to the intermediate substations along the Existing Lines. • ROW 8, extends south from Shutesbury #704 Substation, resulting in a longer route to the Deerfield Substation.
ROW 9	• ROW does not maintain system function and operation, as there is no practical connection to the intermediate substations along the Existing Lines. ROW 9, in combination with the Project Route (E5/F6 Line) extends north-south from Deerfield # 4 Substation, resulting in no feasible route option. • In addition, Eversource controls this ROW in fee or easement. Working within other utility corridors can result in access restrictions, working space constraints, safety concerns, traffic disruptions, and restrictive work hours.
ROW 10	• ROW does not maintain system function and operation, as there is no practical connection to the intermediate substations along the Existing Lines. • ROW 10, in combination with ROW 9 and the Project Route (E5/F6 Line) extends north-south from Deerfield #4 Substation, resulting in a longer route to the Deerfield #4 Substation. • In addition, Eversource controls this ROW in fee or easement. Working within other utility corridors can result in access restrictions, working space constraints, safety concerns, traffic disruptions, and restrictive work hours.
ROW 11	• ROW does not maintain system function and operation, as there is no practical connection to the intermediate substations along the Existing Lines. • ROW 11, in combination with ROW 10, ROW 9, and the Project Route (E5/F6 Line) extends north-east from Deerfield #4 Substation, resulting in a longer route to the Deerfield #4 Substation. • ROW 11 passes through areas with varying degrees of residential land use (high, medium, low, and very low density and multi-family residential).
ROW 12	• ROW does not maintain system function and operation, as there is no practical connection to the intermediate substations along the Existing Lines. • ROW 12, in combination with ROWs 2, 3, 11, 13 and the Project Route (E5/F6 Line), extends south-west from Milbury #305 Substation, resulting in a longer route to Deerfield # 4 Substation. • In addition, Eversource controls this ROW in fee or easement. Working within other utility corridors can result in access restrictions, working space constraints, safety concerns, traffic disruptions, and restrictive work hours.

	• ROW 12 passes through areas with varying degrees of residential land uses (high, medium, low, and very low density and multi-family residential). • This corridor passes through nine EJ areas, as opposed to the six intersected by the Project Route (E5/F6 Line). This would result in additional social/environmental impacts as compared to the Project Route (E5/F6 Line).
ROW 13	• ROW does not maintain system function and operation, as there is no practical connection to the intermediate substations along the Existing Lines. • ROW 13, in combination with ROWs 2, 3, 11, 12 and the Project Route (E5/F6 Line), extends south-west from Milbury #305 Substation, resulting in a longer route to Deerfield #4 Substation. • In addition, Eversource controls this ROW in fee or easement. Working within other utility corridors can result in access restrictions, working space constraints, safety concerns, traffic disruptions, and restrictive work hours. • This corridor passes through nine EJ areas, as opposed to the six intersected by the Project Route (E5/F6 Line). This would result in additional social/environmental impacts as compared to the Project Route (E5/F6 Line).

Table E: Railroad Corridors Eliminated from Further Consideration

Route	Description	Easement (feet)	Explanation for elimination
Portion of the CSX Boston Subdivision Railroad/CSX	Active Railroad	85-210	• The portion of this corridor that runs north-south through the towns of East Brookfield, Brookfield, West Brookfield, Warren, and Palmer in the southern corner of the Study Area does not provide access to an intermediate substation. • Easement rights would be required from rail owners to collocate facilities along rail corridor. • Restrictions on working near an active rail line would impact construction and maintenance costs and emergency response. • This corridor passes adjacent to or through DCR properties and state properties such as the Spencer State Forest, Bennett Wildlife Management Area, and other open space recreational areas, potentially requiring the release of conservation lands in Spencer via the Article 97 land disposition process through the Legislature of the Commonwealth, land acquisition, and additional easement rights. This would result in additional social/environmental impacts as compared to the Project Route (E5/F6 Line). • This corridor also passes through several outstanding resource waters, adjacent to multiple public water supply resource areas, along with NHESP Priority Habitat areas in the town of Brookfield and Rochdale. This would result in additional environmental impacts as compared to the Project Route (E5/F6 Line). • Land acquisition and construction restrictions on working near active rail lines would increase costs.
Ware River Branch Railroad/MassDOT	Active Railroad	50-280	• This corridor runs south-west to north-east through the towns of Palmer, Ware, Hardwick, New Braintree, and Barre, in the east-central corner of the Study Area. This corridor does not provide access to intermediate substations. • Easement rights would be required from rail owners to collocate facilities along railroad ROW. • Restrictions on working near an active rail line would impact construction and maintenance costs and emergency response. • This corridor passes through several riverfront areas, water bodies and streams, as well as vernal pools and rare species habitat. This would result in additional social/environmental impacts as compared to the Project Route (E5/F6 Line). • Land acquisition and construction restrictions associated with working near active rail line would increase costs.
Central Vermont Railroad/NECR	Active Railroad	35-300	• This corridor runs north-south through the towns of Erving, Montague, Sunderland, Leverett, Amherst, Belchertown, and Palmer, in the central portion of the Study Area. This corridor does not provide access to intermediate substations. • Easement rights would be required from rail owners to collocate facilities along railroad ROW. • Restrictions on working near an active rail line would impact construction and maintenance costs and emergency response.

			• This corridor passes through several riverfront areas, water bodies and streams, as well as vernal pools and rare species habitat, and EJ areas. This would result in additional social/environmental impacts as compared to the Project Route (E5/F6 Line). • Land acquisition and construction restrictions associated with working near active rail line would increase costs.
Guilford Yard Railroad/ PAR	Railroad	Not available	• This corridor runs north-south through the town of Holyoke, in the southern portion of the Study Area. This corridor does not provide access to intermediate substations. • Easement rights would be required from rail owners to collocate facilities along railroad ROW. • Restrictions on working near an active rail line would impact construction and maintenance costs and emergency response. • Land acquisition and construction restrictions associated with working near active rail line would increase costs.
Conn River Main Line Railroad/ PAS	Railroad	40-235	• This corridor runs north-south through the towns of Greenfield, Deerfield, Whately, Hatfield, Northampton, Holyoke, and Chicopee, in the north-west corner of the Study Area. This corridor does not provide access to intermediate substations. • Easement rights would be required from rail owners to collocate facilities along rail corridor. Land acquisition and construction restrictions on working near active rail lines would increase costs. • Restrictions on working near an active rail line would impact construction and maintenance costs and emergency response. • Land acquisition and construction restrictions associated with working near active rail line would increase costs.
Greenfield Running Railroad/ PAS	Railroad	70-200	• This corridor runs east-west through the town of Greenfield in the western portion of the Study Area. This corridor does not provide access to s intermediate substation. • Easement rights would be required from rail owners to collocate facilities along railroad ROW. • Restrictions on working near an active rail line would impact construction and maintenance costs and emergency response. • Land acquisition and construction restrictions associated with working near active rail line would increase costs.
Patriot Corridor Railroad/ PAS	Railroad	45-260	• This corridor runs east-west through the towns of Buckland, Shelburne, Conway, Deerfield, Greenfield, Montague, and Erving in the western corner of the Study Area. This corridor does not provide access to intermediate substations. • Easement rights would be required from rail owners to collocate facilities along railroad ROW. • Restrictions on working near an active rail line would impact construction and maintenance costs and emergency response. • Land acquisition and construction restrictions associated with working near active rail line would increase costs.

Holyoke Branch Railroad/ PV	Railroad	30-215	• This corridor runs north-south through the town of Holyoke, in the southern corner of the Study Area. This corridor does not provide access to intermediate substations. • Easement rights would be required from rail owners to collocate facilities along rail corridor. • Restrictions on working near an active rail line would impact construction and maintenance costs and emergency response. • Land acquisition and construction restrictions associated with working near active rail line would increase costs.
Norwich and Worcester Railroad/P&W	Railroad	65-100	• This corridor runs north-south through the towns of Oxford and Auburn in the eastern corner of the Study Area. This corridor does not provide access to intermediate substation. • Easement rights would be required from rail owners to collocate facilities along railroad ROW. • Restrictions on working near an active rail line would impact construction and maintenance costs and emergency response. • Land acquisition and construction restrictions associated with working near active rail line would increase costs.
Portion of the Providence and Worcester Railroad/P&W	Railroad	55-150	• The portion of this corridor that runs north-south through the town of Millbury in the eastern corner of the Study Area does not provide access to intermediate substations. • Easement rights would be required from rail owners to collocate facilities along railroad ROW. • Restrictions on working near an active rail line would impact construction and maintenance costs and emergency response. • Land acquisition and construction restrictions associated with working near active rail line would increase costs.
Northampton Running Railroad/ PAR	Railroad	60-160	• This corridor runs north-south through the town of Northampton, in the southern portion of the Study Area. This corridor does not provide access to intermediate substations. • Easement rights would be required from rail owners to collocate facilities along railroad ROW. • Restrictions on working near an active rail line would impact construction and maintenance costs and emergency response. • Land acquisition and construction restrictions associated with working near active rail line would increase costs.
Old Northbound Railroad/ PAR	Railroad	40-400	• This corridor runs north-south through the town of Northampton in the southern corner of the Study Area. This corridor does not provide access to s intermediate substation. • Easement rights would be required from rail owners to collocate facilities along railroad ROW. • Restrictions on working near an active rail line would impact construction and maintenance costs and emergency response. • Land acquisition and construction restrictions associated with working near active rail line would increase costs.
East Deerfield Loop Railroad/ PAS	Railroad	40-170	• This corridor runs approximately east-west through the town of Deerfield in the north-central corner of the Study Area. This corridor does not provide access to intermediate substations. • Easement rights would be required from rail owners to collocate facilities along railroad ROW. • Restrictions on working near an active rail line would impact construction and maintenance costs and emergency response. • Land acquisition and construction restrictions associated with working near active rail line would increase costs.

Easthampton Branch Railroad/ Local	Railroad	105	• This corridor runs north-south through the town of Easthampton in the southern portion of the Study Area. This corridor does not provide access to intermediate substations. • Easement rights would be required from rail owners to collocate facilities along rail corridor. • Restrictions on working near an active rail line would impact construction and maintenance costs and emergency response. • Land acquisition and construction restrictions associated with working near active rail line would increase costs.
East Brookfield & Spencer Railroad ("EB&S")/CSX Boston Subdivision	Railroad	250	• This corridor runs east-west through the towns of Spencer and East Brookfield in the eastern portion of the Study Area. This corridor does not provide access to intermediate substations. • Easement rights would be required from rail owners to collocate facilities along rail corridor. • Restrictions on working near an active rail line would impact construction and maintenance costs and emergency response. • Land acquisition and construction restrictions associated with working near active rail line would increase costs.
Webster Branch Railroad/ Boston and Albany Railroad Company	Railroad	77	• This corridor runs north-south through the towns of Auburn, and Oxford in the eastern portion of the Study Area. This corridor does not provide access to intermediate substations. • Easement rights would be required from rail owners to collocate facilities along rail corridor. • Restrictions on working near an active rail line would impact construction and maintenance costs and emergency response. • Land acquisition and construction restrictions associated with working near active rail line would increase costs.
Central Mass Railroad/Boston and Maine Railroad/ PAR	Railroad	45-200	• This corridor runs southwest-northeast through the towns of Northampton, Hadley, Amherst, Belchertown, Ware, Barre, New Braintree, and Palmer in the central portion of the Study Area. This corridor does not provide access to intermediate substations. • Easement rights would be required from rail owners to collocate facilities along railroad ROW. • Restrictions on working near an active rail line would impact construction and maintenance costs and emergency response. • Land acquisition and construction restrictions associated with working near active rail line would increase costs. • This corridor passes through densely developed residential and commercial areas with many crossroads and driveways in Amherst which might increase potential to contribute to visual and noise impacts.
Turner Fall Branch Railroad/ PAR	Railroad	50-360	• This corridor runs north-south through the towns Deerfield, Greenfield, and Montague in the central-west portion of the Study Area. This corridor does not provide access to intermediate substations. • Easement rights would be required from rail owners to collocate facilities along railroad ROW. • Restrictions on working near an active rail line would impact construction and maintenance costs and emergency response. • Land acquisition and construction restrictions associated with working near active rail line would increase costs.

Palmer Ind Park Railroad/ NECR	Railroad	35-50	• This corridor runs east-west through the towns of Belchertown and Palmer in the southern portion of the Study Area. This corridor does not provide access to intermediate substations. • Easement rights would be required from rail owners to collocate facilities along railroad ROW. • Restrictions on working near an active rail line would impact construction and maintenance costs and emergency response. • Land acquisition and construction restrictions associated with working near active rail line would increase costs.
Portion of North Brookfield Railroad/Local	Railroad	93	• The portion of this corridor that runs north-south through the town of North Brookfield in the eastern corner of the Study Area does not provide access to s intermediate substations. • Easement rights would be required from rail owners to collocate facilities along railroad ROW. • Restrictions on working near an active rail line would impact construction and maintenance costs and emergency response. • Land acquisition and construction restrictions associated with working near active rail line would increase costs.
Spencer Branch Railroad/Local	Railroad	150	• This corridor runs north-south through the town of Spencer in the eastern portion of the Study Area. This corridor does not provide access to intermediate substations. • Easement rights would be required from rail owners to collocate facilities along railroad ROW. • Restrictions on working near an active rail line would impact construction and maintenance costs and emergency response. • Land acquisition and construction restrictions associated with working near active rail line would increase costs.
Millbury Branch Railroad/Local	Railroad	150	• This corridor runs north-south through the town of Milbury in the eastern portion of the Study Area. This corridor does not provide access to intermediate substations. • Easement rights would be required from rail owners to collocate facilities along railroad ROW. • Restrictions on working near an active rail line would impact construction and maintenance costs and emergency response. • Land acquisition and construction restrictions associated with working near active rail line would increase costs.
Williamsburg Branch Railroad/Local	Railroad	100	• This corridor runs east-west through the town of Northampton in the western portion of the Study Area. This corridor does not provide access to s intermediate substation. • Easement rights would be required from rail owners to collocate facilities along rail corridor. • Restrictions on working near an active rail line would impact construction and maintenance costs and emergency response. • Land acquisition and construction restrictions associated with working near active rail line would increase costs.
SA&N Railroad/ NECR and CSX	Railroad	110	• This corridor runs north-south through the towns of Ludlow, Palmer, Belchertown, Ware, New Salem, and Petersham in the southern portion of the Study Area. This corridor does not provide access to intermediate substations. • Easement rights would be required from rail owners to collocate facilities along rail corridor.

			• Restrictions on working near an active rail line would impact construction and maintenance costs and emergency response. • Land acquisition and construction restrictions associated with working near active rail line would increase costs.
Shelbourne Falls Railroad/ NECR and CSX	Railroad	30-160	• This corridor runs north-south through the towns of Conway, Deerfield, Whately, Hatfield, and Northampton in the western portion of the Study Area. This corridor does not provide access to intermediate substations. • Easement rights would be required from rail owners to collocate facilities along rail corridor. • Restrictions on working near an active rail line would impact construction and maintenance costs and emergency response. • Land acquisition and construction restrictions associated with working near active rail line would increase costs.

Appendix 4-1

Table F: Highway and Major Roadway Corridors Eliminated from Further Consideration

Route	Description	Easement (feet)	Explanation for elimination
I-91	Highway	300-830	• I-191 runs north-south through the towns of Greenfield, Deerfield, Whately, Hatfield, and Northampton in the western portion of the Study Area. This corridor does not provide access to intermediate substations. • Rights/Agreements would be required from the Massachusetts Department of Transportation ("MassDOT") to occupy the I-91 corridor, which are not likely to be acquired due to the availability of the existing E5/F6 corridors. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • This corridor also passes through several NHESP Priority Habitat areas in the town of Whately and Hatfield. This would result in additional environmental impacts as compared to the Project Route (E5/F6 Line).
I-291	Highway	300-1500	• I-291 runs north-south through the town of Auburn in the western portion of the Study Area. This corridor does not provide access to intermediate substations. • Rights/Agreements would be required from the MassDOT to occupy the I-291 corridor, which are not likely to be acquired due to the availability of the existing E5/F6 and Tap Line corridors. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines.
I-391	Roadway	190-1080	• I-391 runs north-south through the towns of Chicopee and Holyoke in the southern portion of the Study Area. This corridor does not provide access to intermediate substations. • Rights/Agreements would be required from the MassDOT to occupy the I-391 corridor, which are not likely to be acquired due to the availability of other viable alternatives. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Route I-391 passes through densely developed residential and commercial areas with many crossroads and driveways in Holyoke which might increase potential to contribute to visual and noise impacts.
I-395	Highway	360-540	• I-395 runs north-south through the towns of Auburn in the eastern portion of the Study Area. This corridor does not provide access to intermediate substations.

			• Rights/Agreements would be required from the MassDOT to occupy the I-395 corridor, which are not likely to be acquired due to the availability of other viable alternatives. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Additional easement rights and/or land acquisition would be necessary along the ROW.
US Highway Route 202	Highway	40-1150	• US Highway 202 runs north-south through the towns of New Salem, Shutesbury, Pelham, Belchertown, Granby, and South Hadley in the center of the Study Area. This corridor does not provide access to intermediate substations. • Rights/Agreements would be required from the MassDOT to occupy the US Highway 202 corridor, which are not likely to be acquired due to the availability of other viable alternatives. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Additional easement rights and/or land acquisition would be necessary along the ROW. • This corridor also passes through the Quabbin Revervoir Watershed area, several public water supply areas, along with NHESP Priority Habitat areas in town of New Salem, Shutesbury, Pelham, and Granby. This would result in additional environmental impacts as compared to the Project Route (E5/F6 Line).
US Highway Route 5	Highway	45-930	• US Highway 5 runs north-south through the towns of Greenfield, Deerfield, Whately, Hatfield, and Northampton in the western portion of the Study Area. This corridor does not provide access to intermediate substations. • Rights/Agreements would be required from the MassDOT to occupy the US Highway Route 5 corridor, which are not likely to be acquired due to the availability of other viable alternatives. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Additional easement rights and/or land acquisition would be necessary along the ROW.
State Route 10	Major Roadway	60-165	• Rights/Agreements would be required from the MassDOT to occupy the Route 10 corridor, which are not likely to be acquired due to the availability of other viable alternatives. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Additional easement rights and/or land acquisition would be necessary along the ROW.
State Route 12	Major Roadway	60-1040	• Rights/Agreements would be required from the MassDOT to occupy the Route 12 corridor, which are not likely to be acquired due to the availability of other viable alternatives.

			• Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Additional easement rights and/or land acquisition would be necessary along the ROW.
State Route 19	Major Roadway	40-120	• Rights/Agreements would be required from the MassDOT to occupy the Route 19 corridor, which are not likely to be acquired due to the availability of other viable alternatives. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Additional easement rights and/or land acquisition would be necessary along the ROW.
State Route 21	Major Roadway	50-180	• Rights/Agreements would be required from the MassDOT to occupy the Route 21 corridor, which are not likely to be acquired due to the availability of other viable alternatives. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Additional easement rights and/or land acquisition would be necessary along the ROW.
State Route 31	Major Roadway	35-200	• Rights/Agreements would be required from the MassDOT to occupy the Route 31 corridor, which are not likely to be acquired due to the availability of other viable alternatives. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Additional easement rights and/or land acquisition would be necessary along the ROW.
State Route 32/32A	Major Roadway	40-430	• Rights/Agreements would be required from the MassDOT to occupy the Route 32/32A corridor, which are not likely to be acquired due to the availability of other viable alternatives. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Additional easement rights and/or land acquisition would be necessary along the ROW.
State Route 33	Major Roadway	50-625	• Rights/Agreements would be required from the MassDOT to occupy the Route 33 corridor, which are not likely to be acquired due to the availability of other viable alternatives. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Additional easement rights and/or land acquisition would be necessary along the ROW.

State Route 47	Major Roadway	40-270	• Rights/Agreements would be required from the MassDOT to occupy the Route 47 corridor, which are not likely to be acquired due to the availability of other viable alternatives. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Additional easement rights and/or land acquisition would be necessary along the ROW.
State Route 49	Major Roadway	300-755	• Rights/Agreements would be required from the MassDOT to occupy the Route 49 corridor, which are not likely to be acquired due to the availability of other viable alternatives. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Additional easement rights and/or land acquisition would be necessary along the ROW.
State Route 63	Major Roadway	50-250	• Rights/Agreements would be required from the MassDOT to occupy the Route 63 corridor, which are not likely to be acquired due to the availability of other viable alternatives. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Additional easement rights and/or land acquisition would be necessary along the ROW.
State Route 66	Major Roadway	55-130	• Rights/Agreements would be required from the MassDOT to occupy the Route 66 corridor, which are not likely to be acquired due to the availability of other viable alternatives. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Additional easement rights and/or land acquisition would be necessary along the ROW.
State Route 112	Major Roadway	45-300	• Rights/Agreements would be required from the MassDOT to occupy the Route 112 corridor, which are not likely to be acquired due to the availability of other viable alternatives. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Additional easement rights and/or land acquisition would be necessary along the ROW.

State Route 116	Major Roadway	45-200	• Rights/Agreements would be required from the MassDOT to occupy the Route 116 corridor, which are not likely to be acquired due to the availability of other viable alternatives. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Additional easement rights and/or land acquisition would be necessary along the ROW. • Route 116 passes through densely developed residential and commercial areas with many crossroads and driveways in Holyoke which might increase potential to contribute to visual and noise impacts.
State Route 141	Major Roadway	45-1060	• Rights/Agreements would be required from the MassDOT to occupy the Route 141 corridor, which are not likely to be acquired due to the availability of other viable alternatives. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Additional easement rights and/or land acquisition would be necessary along the ROW.
State Route 169	Major Roadway	65-255	• Rights/Agreements would be required from the MassDOT to occupy the Route 169 corridor, which are not likely to be acquired due to the availability of other viable alternatives. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Additional easement rights and/or land acquisition would be necessary along the ROW.
State Route 181	Major Roadway	55-265	• Rights/Agreements would be required from the MassDOT to occupy the Route 181 corridor, which are not likely to be acquired due to the availability of other viable alternatives. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Additional easement rights and/or land acquisition would be necessary along the ROW.
All other Major Roadways running perpendicular to the E5/F6 and Tap Line ROWs and/or are far removed from the Existing Lines.			

Table G: Natural Gas Pipeline Corridor Eliminated from Further Consideration

Corridor	Explanation for elimination
Tennessee Gas Pipeline (TGP)	• ROW does not maintain system function and operation, as there is no practical connection to the intermediate substations along the Existing Lines. • Collocation with natural gas pipeline corridor can present safety concerns during construction and maintenance of a new transmission line, and these routes are generally avoided if a more feasible route is available.

Table H: Status of Remaining Potential Route Variations after Secondary Screening

Corridor Type	Potential Route Variation	Reason for Elimination
Electric Transmission Corridor	Portion of ROW 8 (Eversource 354)	• Eversource controls this ROW in fee or easement. This ROW, in combination with Route 2/2A, extends north-west from Shutesbury #704 Substation, resulting in a longer route to the Deerfield #4 Substation. • Use of this corridor would require an arrangement between National Grid and Eversource for the construction and operation of the transmission line. The exact details of this arrangement would need to be developed with Eversource. Working within other utility corridors can result in access restrictions, working space constraints, safety concerns, traffic disruptions, and restrictive work hours. • This corridor passes adjacent to DCR properties such as the Wendell State Forest, Montague State Forest, and other open space recreational areas, potentially requiring the release of conservation lands in Wendell, Montague, and Leverett via the Article 97 land disposition process through the Legislature of the Commonwealth. This would result in additional social/environmental impacts as compared to the Project Route (E5/F6 Line).
	Portion of ROW 1 (National Grid A127/B128)	• This ROW, combined with segments of US Highway 20 and MA State Route 56, extends south-east and results in a longer route to the Millbury #305 Substation. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines.
	Portion of ROW 4 (National Grid O15N)	• This ROW, combined with segments of MA State Route 9, and MA State Route 148, extends east-west from Quabbin Switch Tap, resulting in a longer route to the Ware #1 Substation. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • This corridor passes through state open space and recreational areas primarily owned by the Department of Fish and Game, potentially requiring acquisition of land and additional easement rights. This would result in additional social/environmental impacts as compared to the Project Route (E5/F6 Line).
Major Highway and Roadways	U.S. Highway Route 20	• Rights/agreements would be required from the MassDOT to occupy the U.S. Highway Route 20 corridor, which are not likely to be acquired due to the availability of the existing E5/F6 and Tap Line corridors. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • This corridor passes several public water supply sources area, as opposed to the public water supply source area intersected by the Project Route (E5/F6 Line). This would result in additional social/environmental impacts as compared to the Project Route (E5/F6 Line).

Corridor Type	Potential Route Variation	Reason for Elimination
	Interstate I-90	• Rights/agreements would be required from the MassDOT to occupy the Interstate Route I-9E corridor, which are not likely to be acquired due to the availability of the existing E5/F6 corridor. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Additional easement rights and/or land acquisition would be necessary along the ROW. • This corridor passes through 12 EJ communities, as opposed to six intersected by the Project Route (E5/F6 Line). This would result in additional social/environmental impacts as compared to the Project Route (E5/F6 Line).
	Interstate 1-290	• Rights/agreements would be required from the MassDOT to occupy the Interstate I-290W corridor, which are not likely to be acquired due to the availability of the existing E5/F6 corridor. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Additional easement rights and/or land acquisition would be necessary along the ROW.
	State Route 2/2A	• Rights/agreements would be required from the MassDOT to occupy the State Route 2/2A corridor, which are not likely to be acquired due to the availability of the existing E5/F6 corridor. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • This corridor passes through 12 EJ communities, as opposed to six intersected by the Project Route (E5/F6 Line). This would result in additional social/environmental impacts as compared to the Project Route (E5/F6 Line).
	State Route 32	• Rights/agreements would be required from the MassDOT to occupy the State Route 32 corridor, which are not likely to be acquired due to the availability of the existing E5/F6 corridor. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Additional easement rights and/or land acquisition would be necessary along the ROW.
	State Route 9	• Rights/agreements would be required from the MassDOT to occupy the State Route 9 corridor, which are not likely to be acquired due to the availability of the existing E5/F6 corridor. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Additional easement rights and/or land acquisition would be necessary along the ROW. • This corridor passes through 18 EJ communities, as opposed to six intersected by the Project Route (E5/F6 Line), along with several rare species areas. This would result in additional social/environmental impacts as compared to the Project Route (E5/F6 Line).
	State Route 67	• Rights/agreements would be required from the MassDOT to occupy the State Route 67 corridor, which are not likely to be acquired due to the availability of the existing E5/F6 corridor.

Corridor Type	Potential Route Variation	Reason for Elimination
		• Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Additional easement rights and/or land acquisition would be necessary along the ROW.
	State Route 56	• Rights/agreements would be required from the MassDOT to occupy the State Route 56 corridor, which are not likely to be acquired due to the availability of the existing E5/F6 corridor. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Additional easement rights and/or land acquisition would be necessary along the ROW.
	State Route 122A	• Rights/Agreements would be required from the MassDOT to occupy the State Route 122A corridor, which are not likely to be acquired due to the availability of the existing E5/F6 corridor. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Additional easement rights and/or land acquisition would be necessary along the ROW.
	State Route 146	• Rights/agreements would be required from the MassDOT to occupy the State Route 146 corridor, which are not likely to be acquired due to the availability of the existing E5/F6 corridor. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Additional easement rights and/or land acquisition would be necessary along the ROW.
	State Route 148	• Rights/agreements would be required from the MassDOT to occupy the State Route 148 corridor, which are not likely to be acquired due to the availability of the existing E5/F6 corridor. • Significant construction and improvement efforts would be required to create the general accessibility necessary for construction and future maintenance of the relocated lines. • Additional easement rights and/or land acquisition would be necessary along the ROW.

Corridor Type	Potential Route Variation	Reason for Elimination
Railroad Corridor	Portion of CSX Boston Subdivision Railroad	• Easement rights would be required from rail owners to collocate facilities along railroad ROW. • Restrictions on working near an active rail line would impact construction and maintenance costs and emergency response. • Land acquisition and construction restrictions associated with working near active rail lines would increase costs. • This corridor passes adjacent to or through DCR properties and state properties such as the Spencer State Forest, Bennett Wildlife Management Area, and other open space recreational areas, potentially requiring the release of conservation lands via the Article 97 land disposition process through the Legislature of the Commonwealth, land acquisition, and additional easement rights. This would result in additional social/environmental impacts as compared to the Project Route (E5/F6 Line). • This corridor also passes through several outstanding resource waters, adjacent to multiple public water supply resource areas, along with NHESP Priority Habitat areas in towns of East Brookfield and Leicester. This would result in additional environmental impacts as compared to the Project Route (E5/F6 Line).
	Portion of North Brookfield Railroad (Local)	• Easement rights would be required from rail owners to collocate facilities along railroad ROW. • Restrictions on working near an active rail line would impact construction and maintenance costs and emergency response. • Land acquisition and construction restrictions associated with working near active rail line would increase costs.
	Portion of Providence and Worcester Railroad ("P&W")	• Easement rights would be required from rail owners to collocate facilities along railroad ROW. • Restrictions on working near an active rail line would impact construction and maintenance costs and emergency response. • Land acquisition and construction restrictions associated with working near active rail lines would increase costs. • This corridor passes through several EJ, state conservation areas, and NHESP Priority Habitat areas in the town of Millbury. This would result in additional social/environmental impacts as compared to the Project Route (E5/F6 Line).

Appendices

Application to Support the Petition before the Energy Facilities Siting Board

Central to Western Massachusetts Energy Improvement Project

Appendix 5-1: Map Book: USGS Site Location Maps, Environmental Resource Maps, Land Use Maps and Environmental Justice Maps

Appendix 5-2: National Grid's ROW Access, Maintenance and Construction Best Management Practices ("EG-303NE")

Appendix 5-3: Typical ROW Cross Sections

Appendix 5-4: Visual Simulations

Appendix 5-5: Electric and Magnetic Field Report ("EMF Report")

Appendix 5-1: Map Book: USGS Site Location Maps, Environmental Resource Maps, Land Use Maps and Environmental Justice Maps

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Central to Western Massachusetts Energy Improvement Project

USGS Site Location Map

Shelburne, Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn & Millbury, MA

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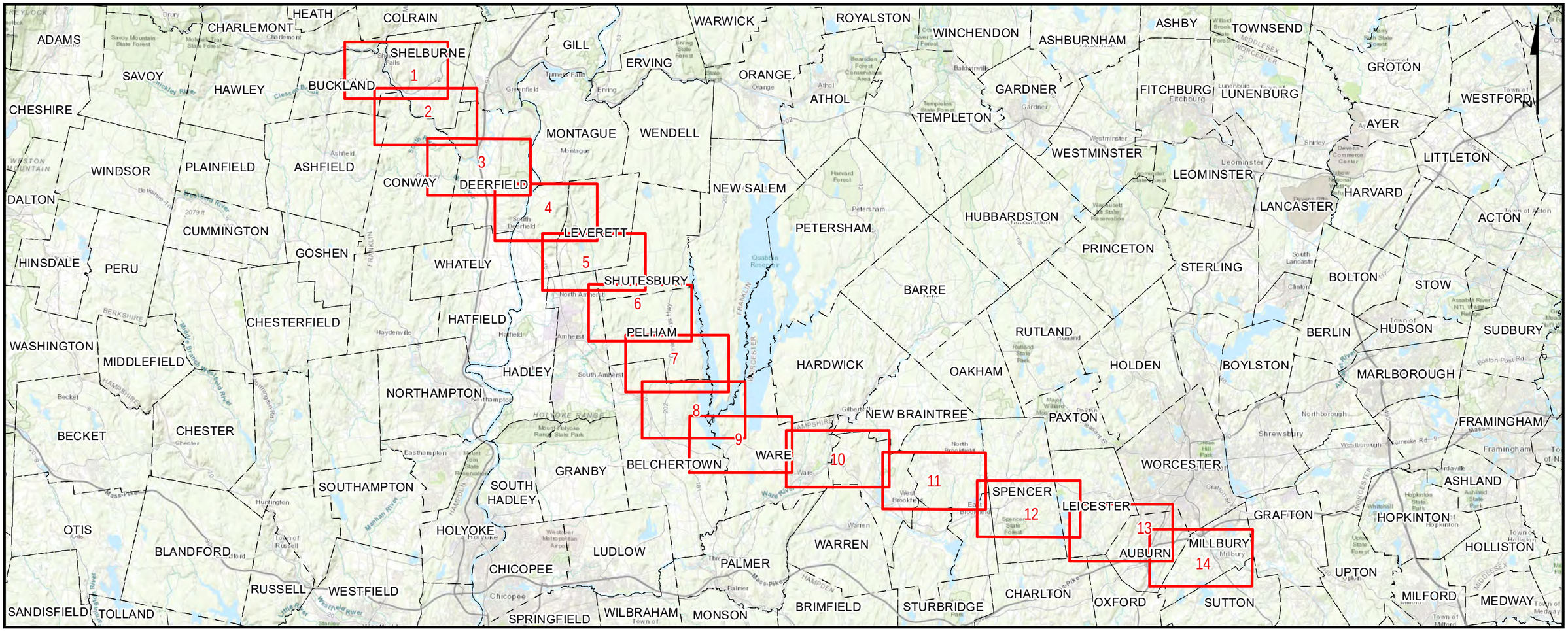

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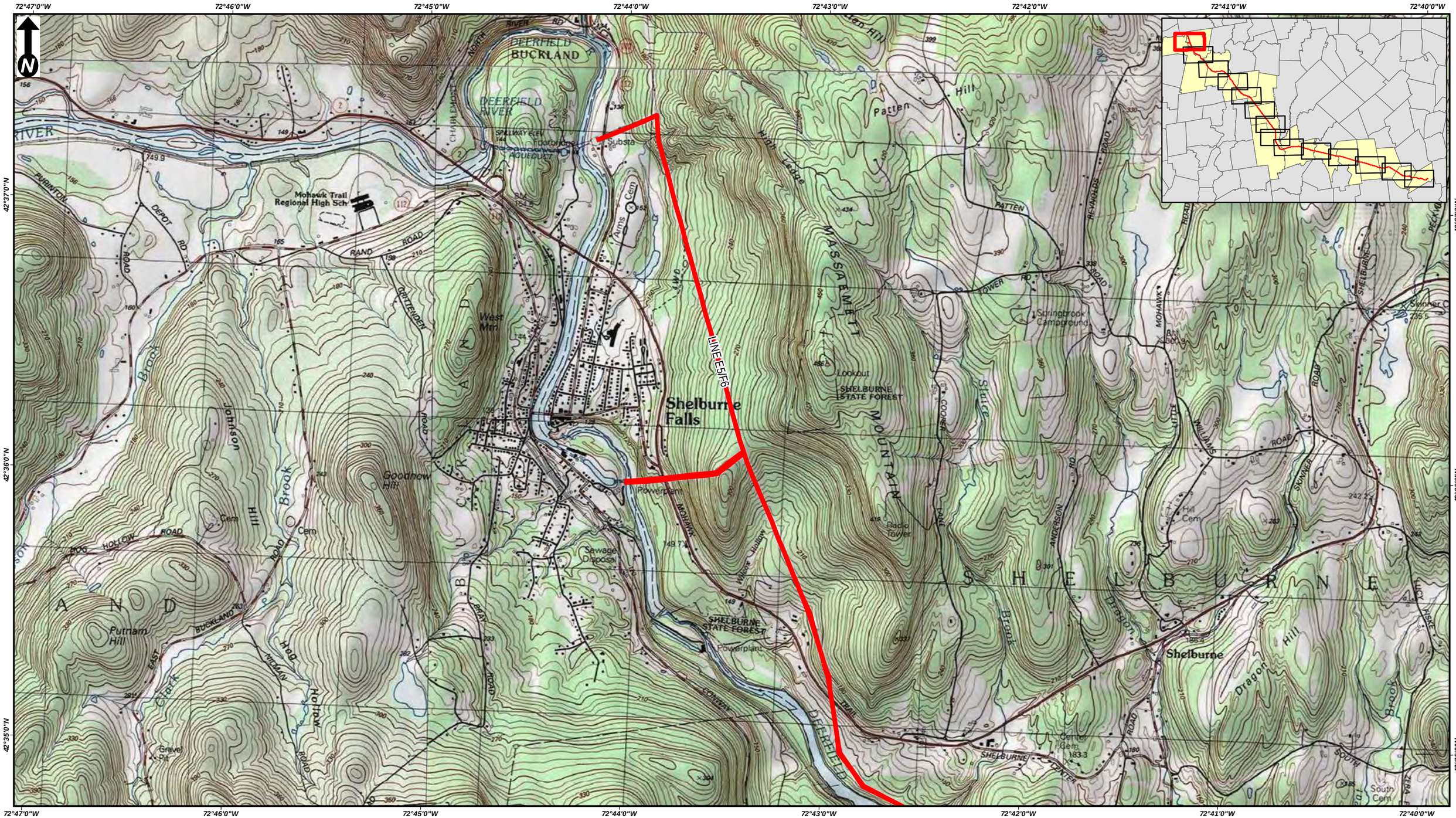

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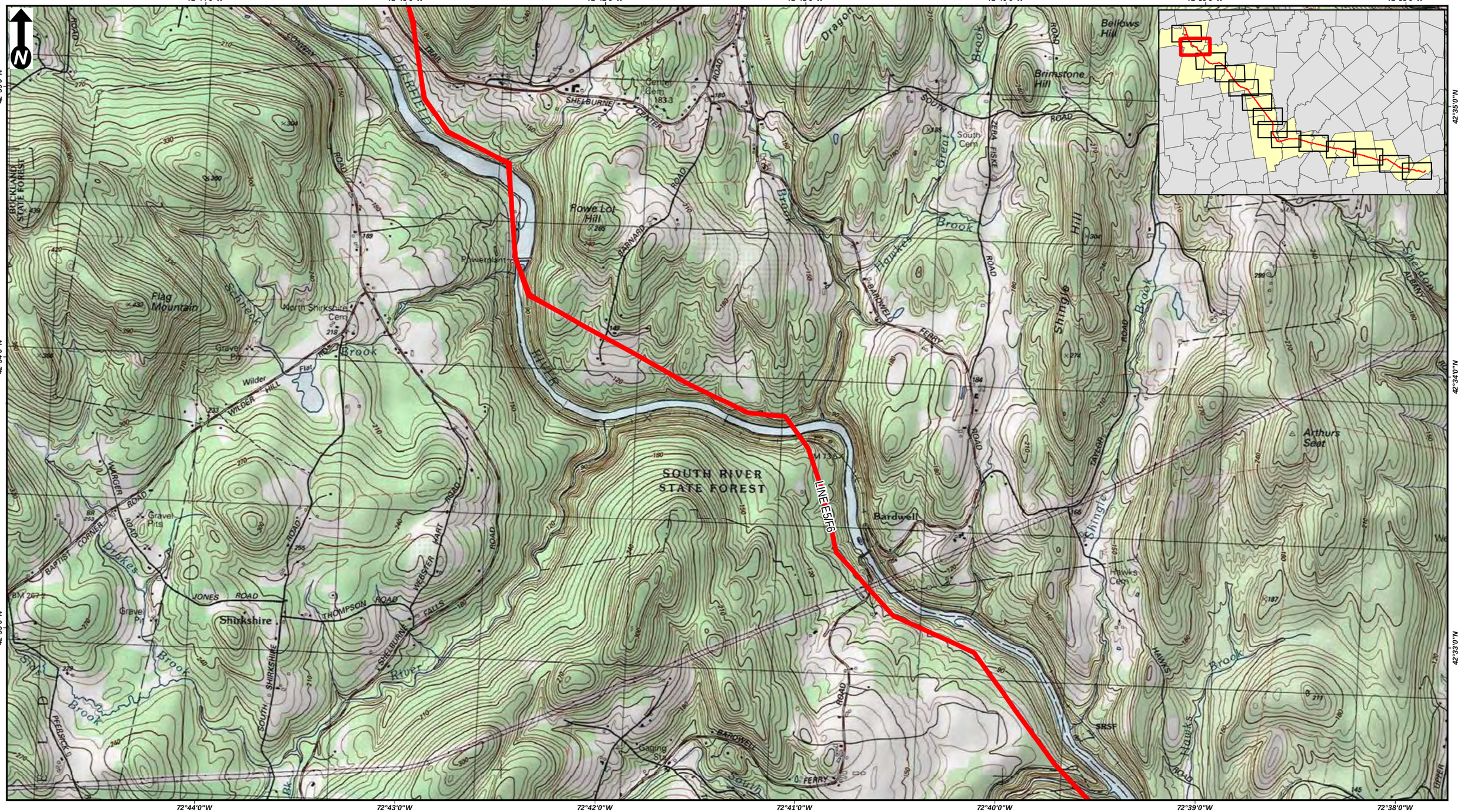

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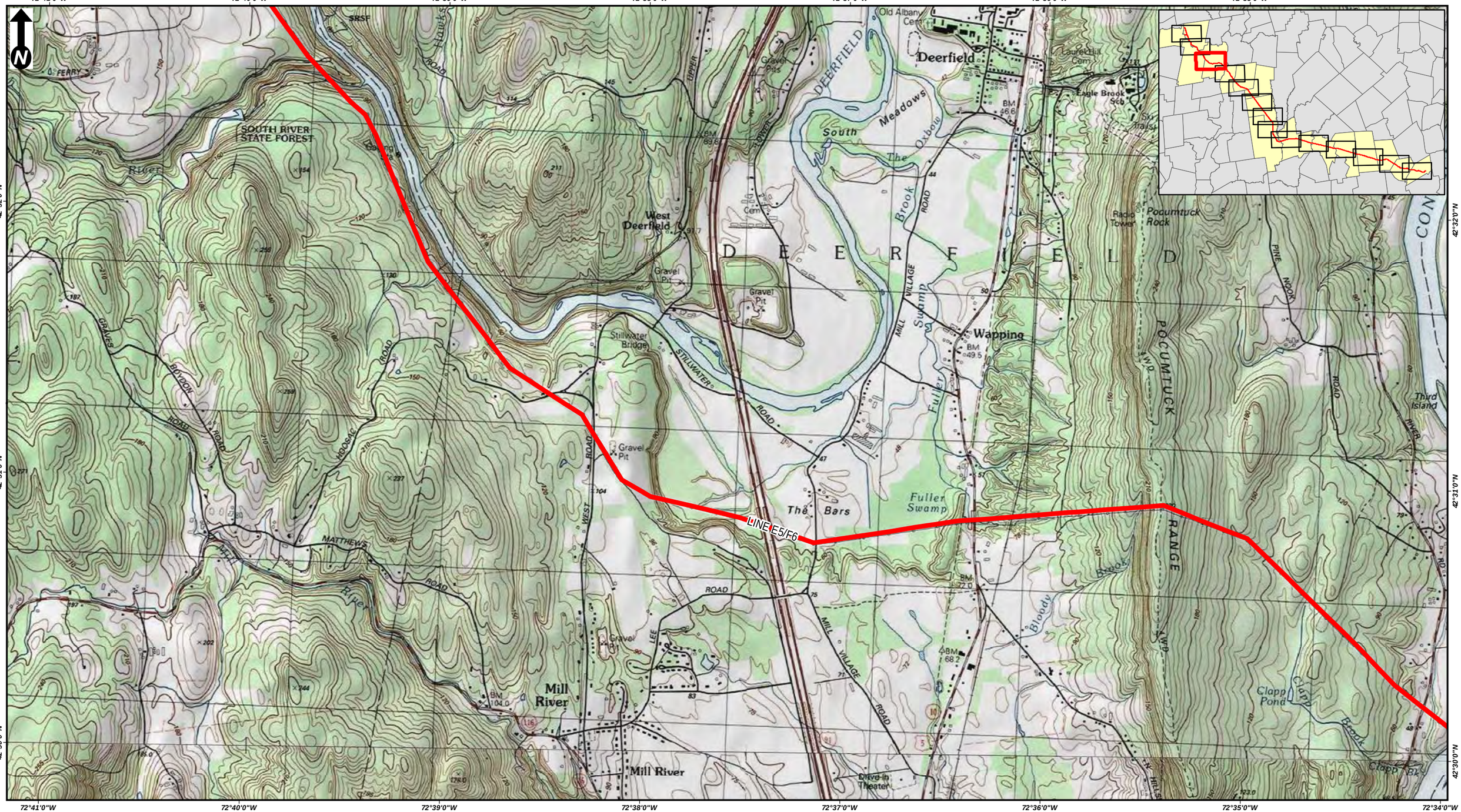

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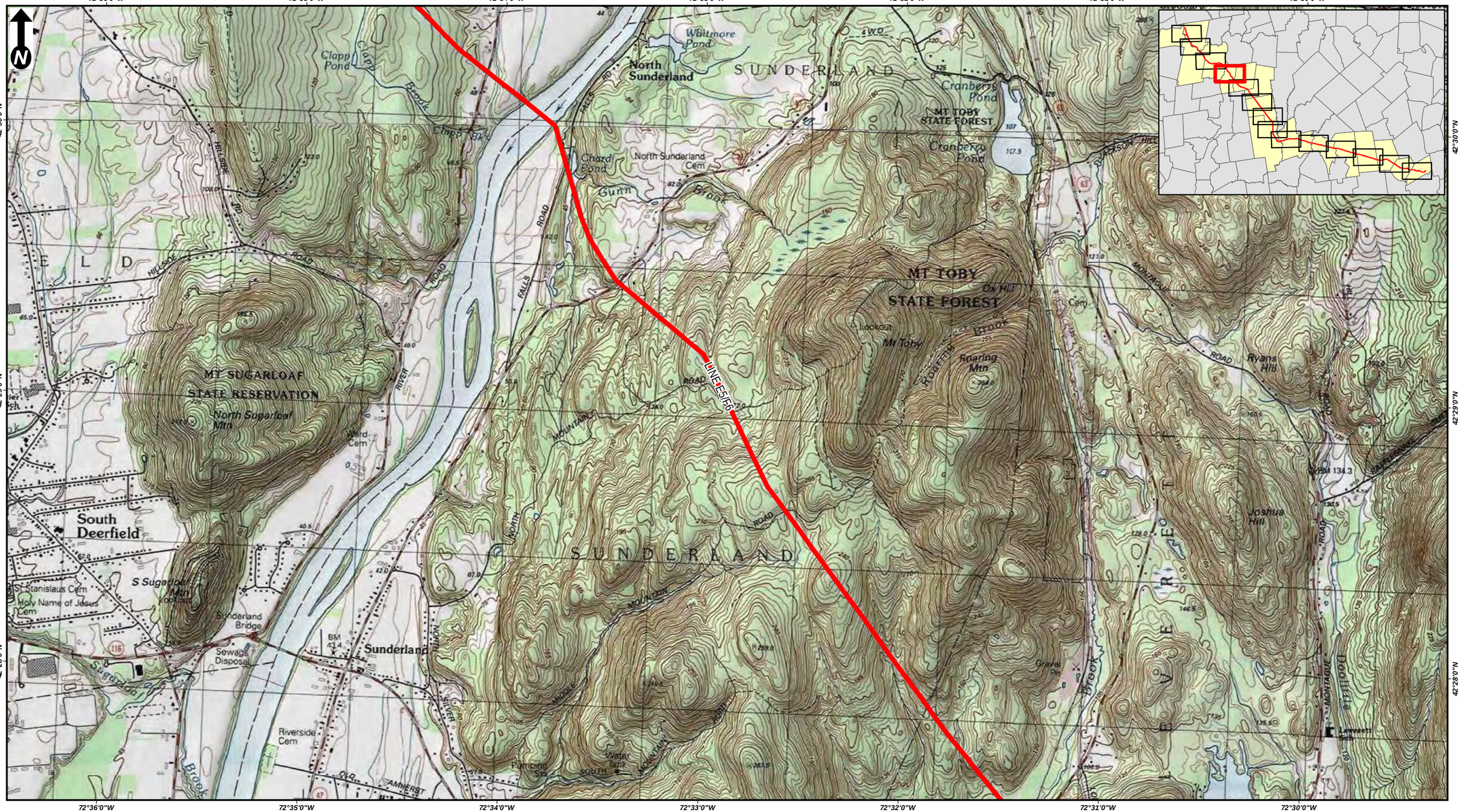

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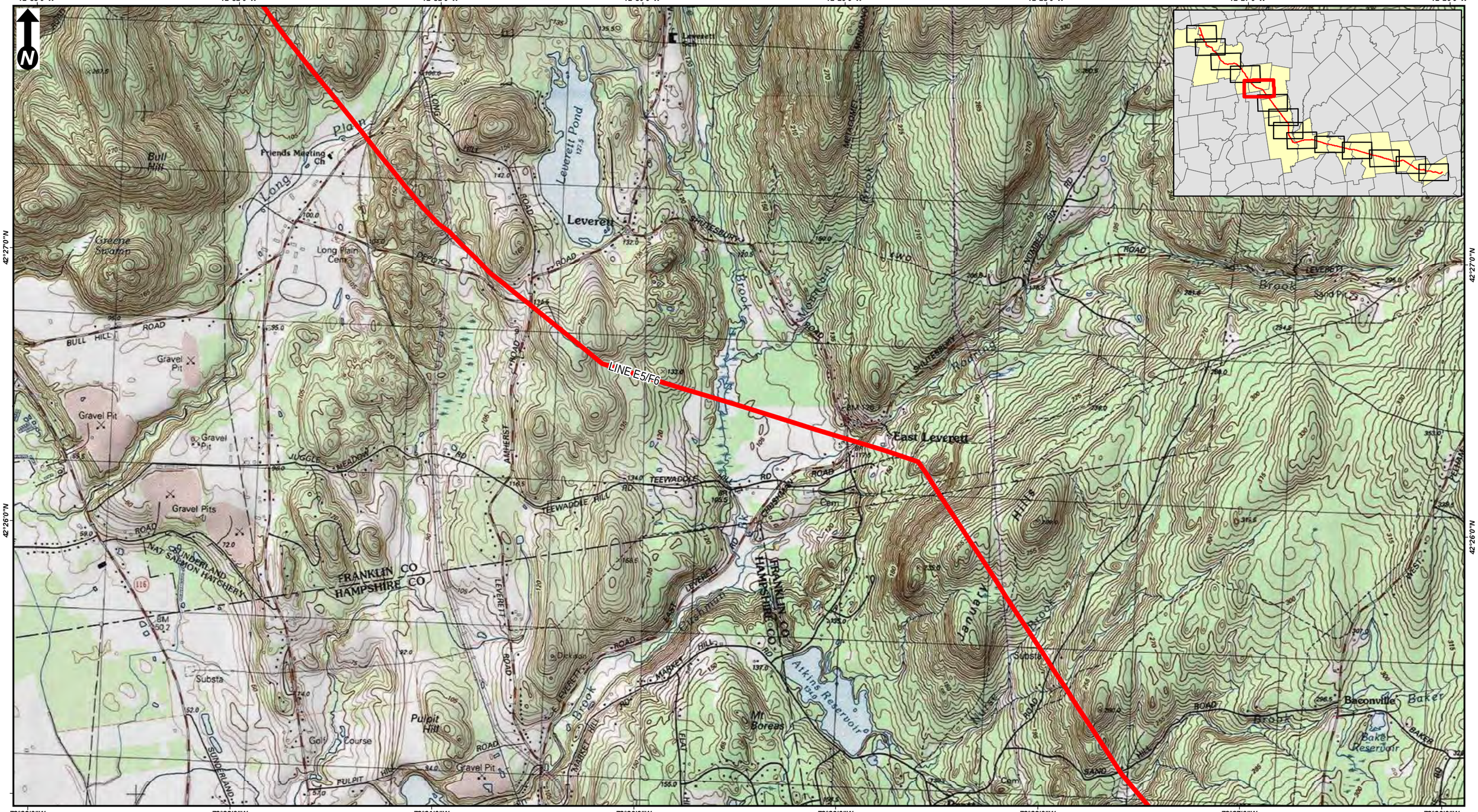

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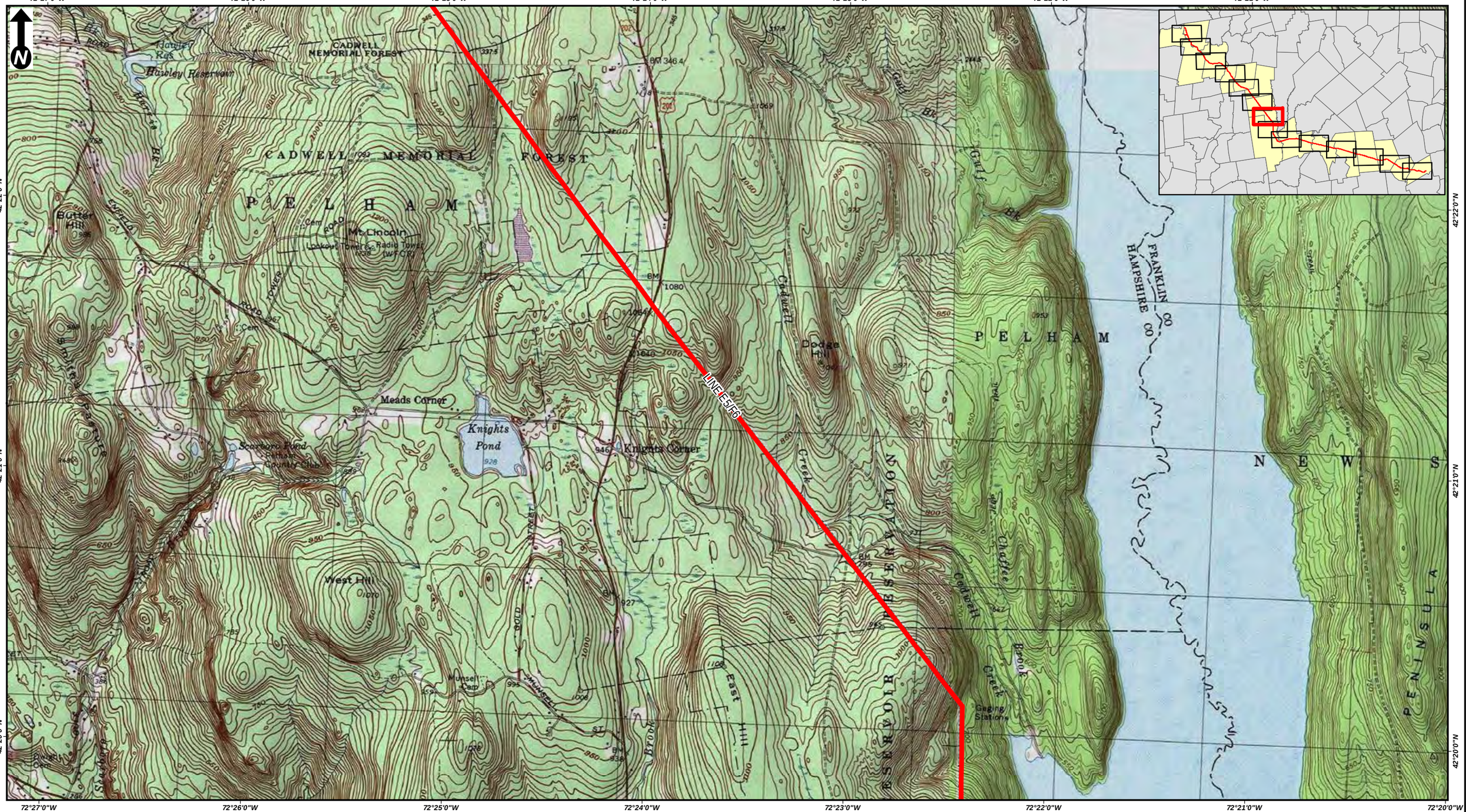

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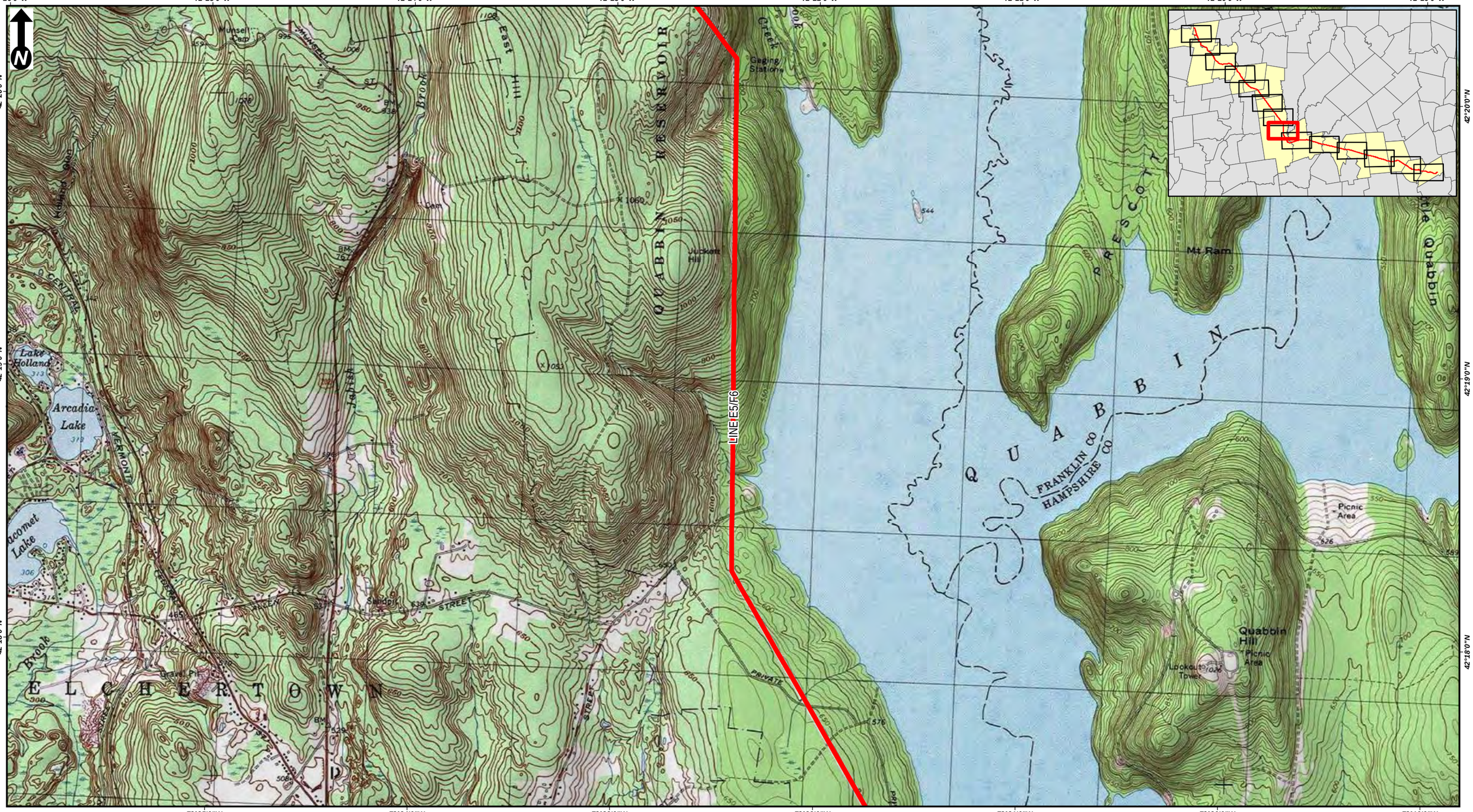

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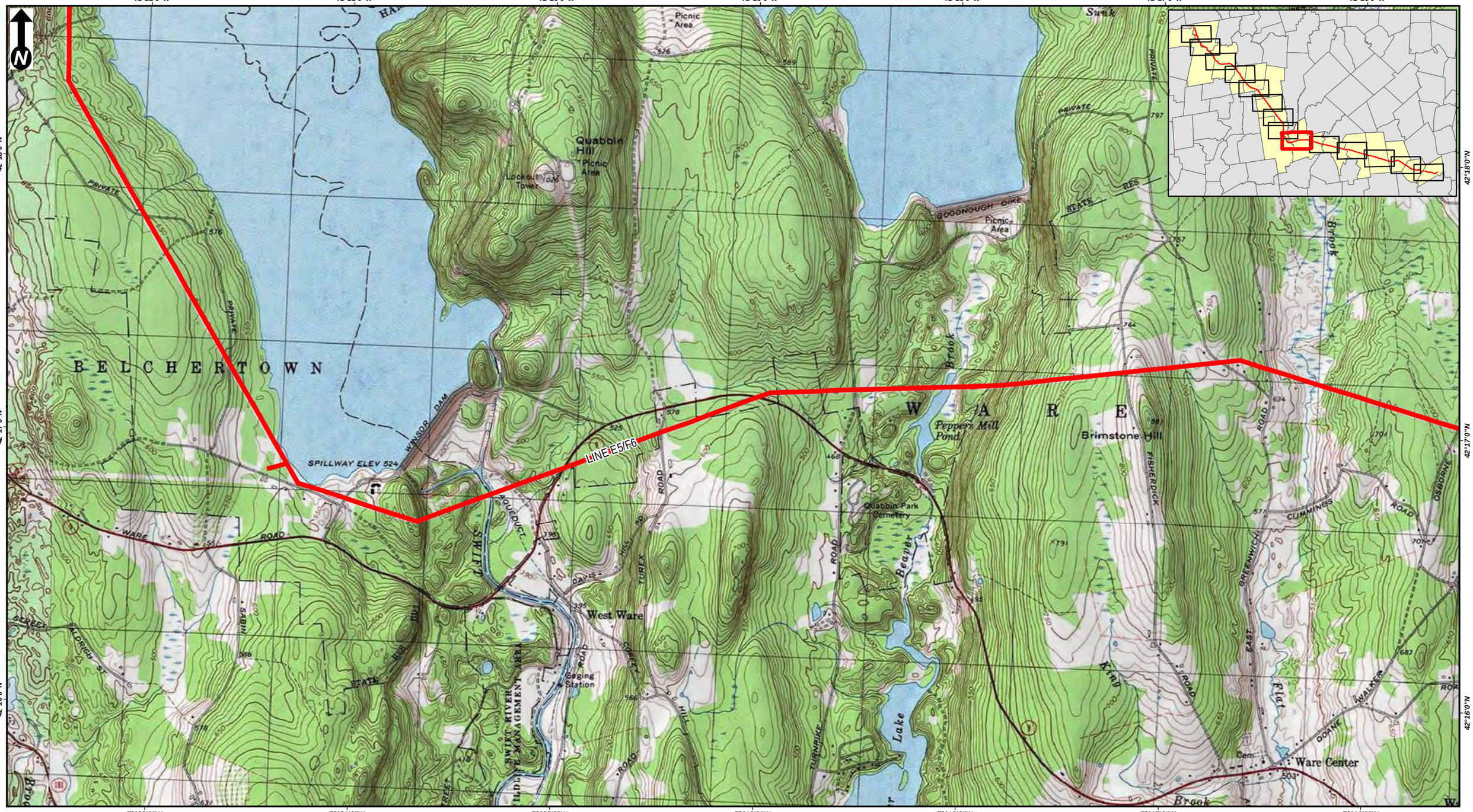

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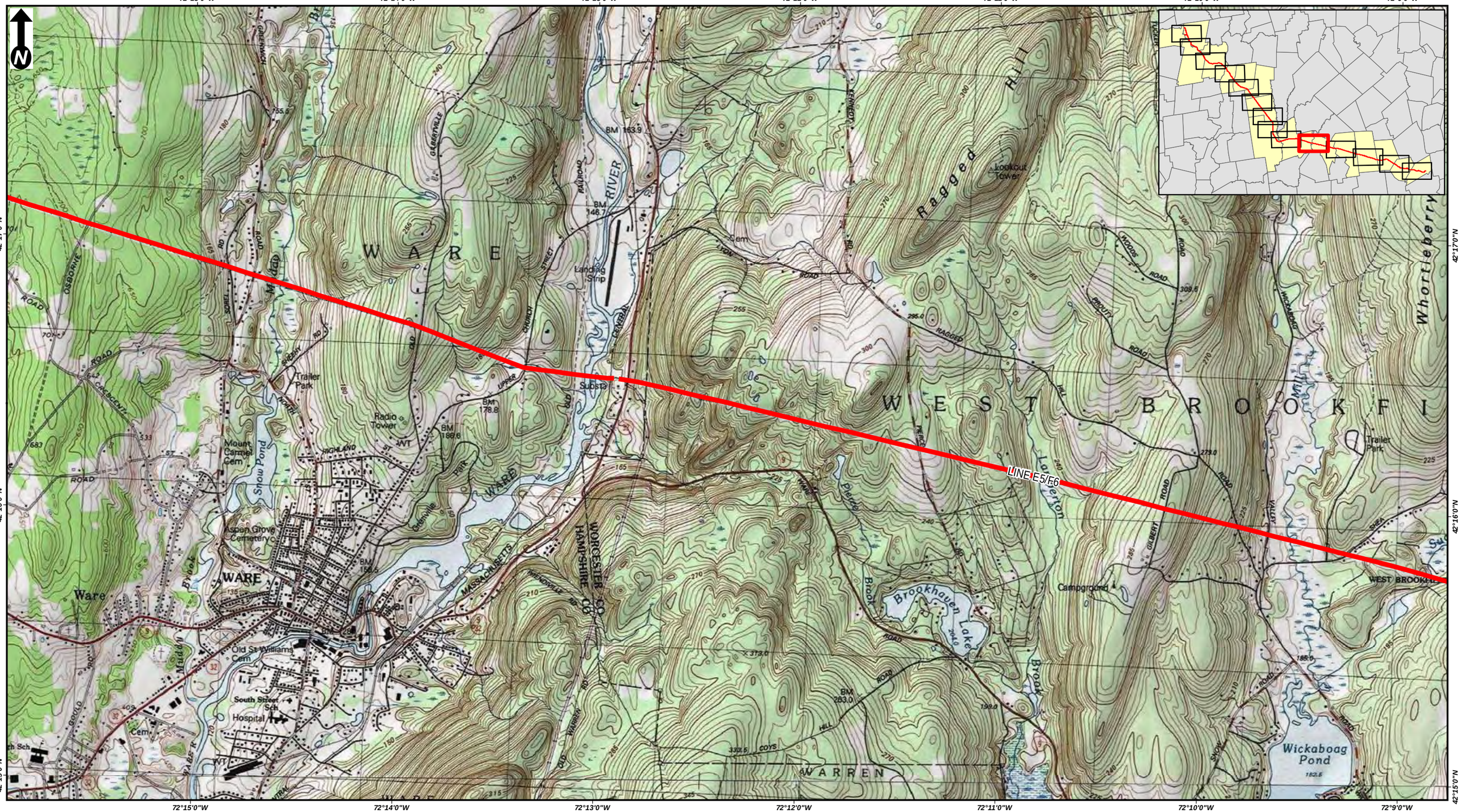

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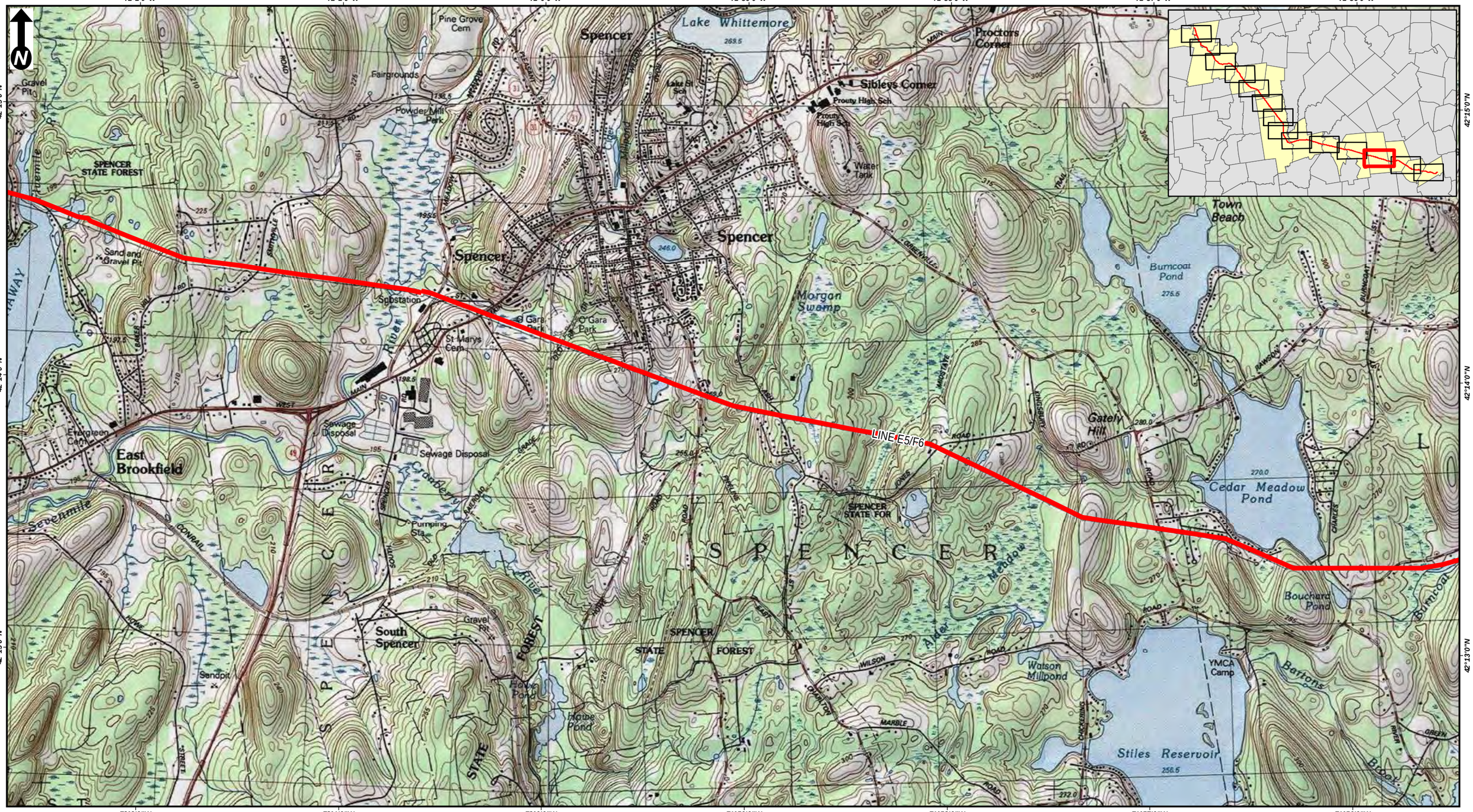

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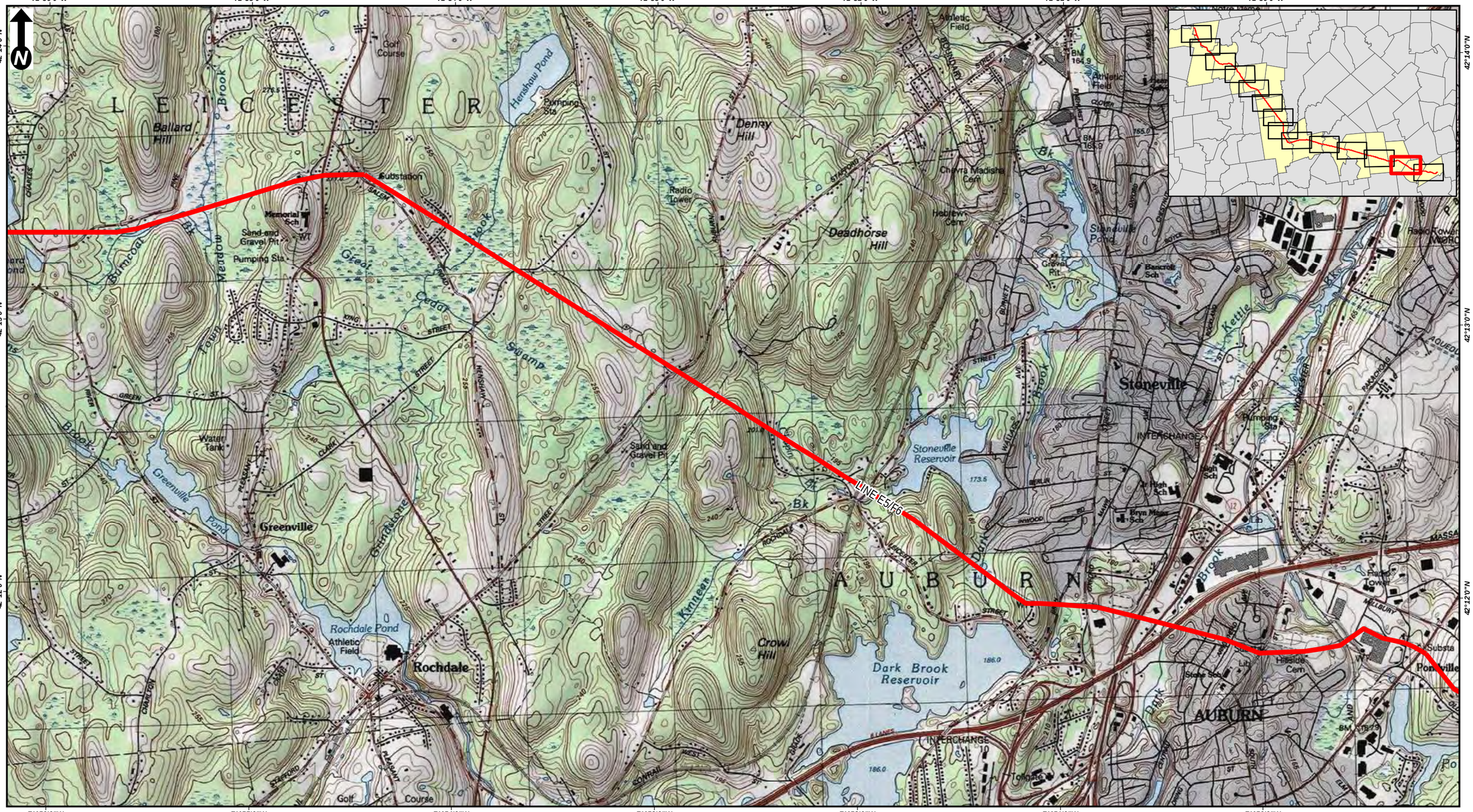

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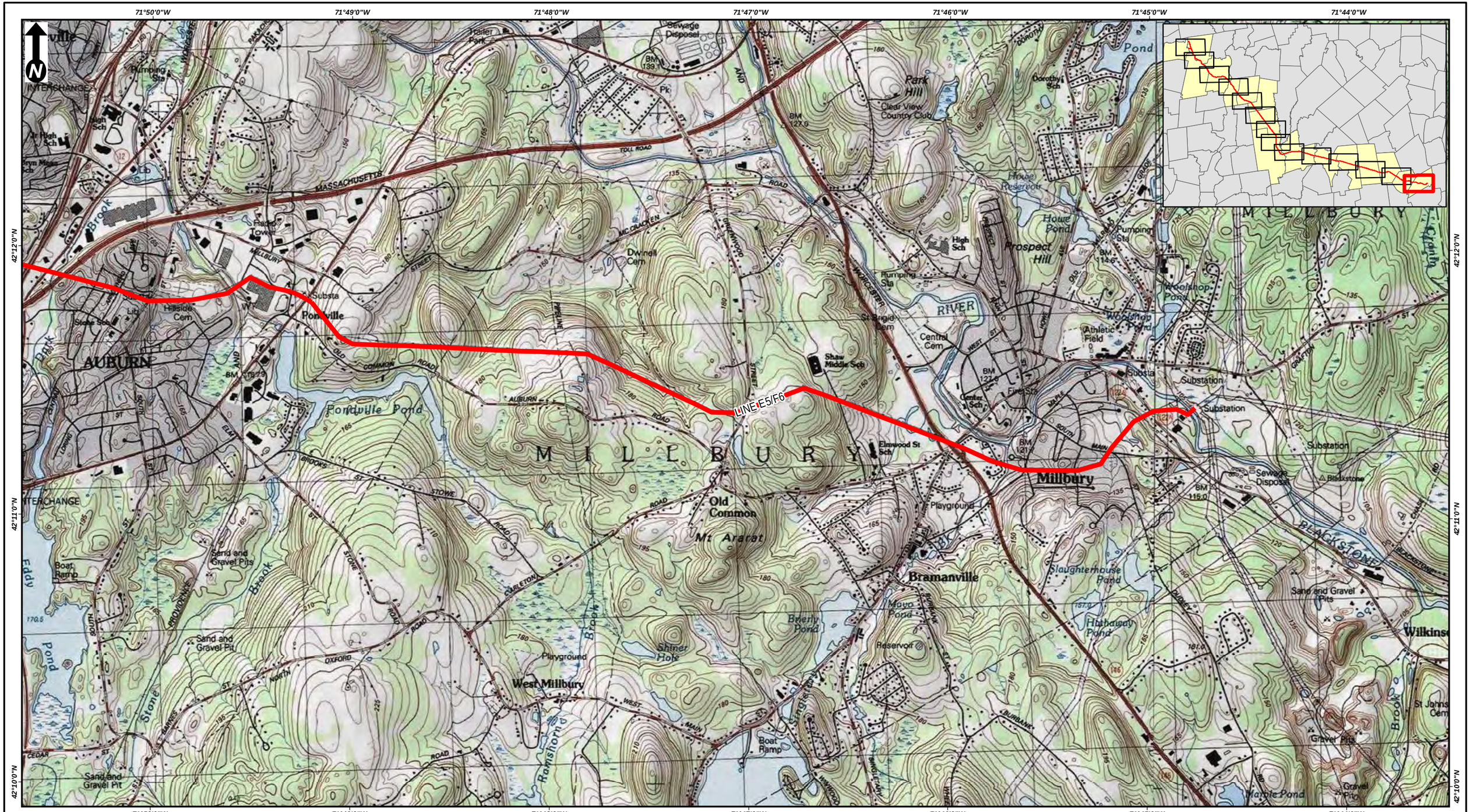

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Central to Western Massachusetts Energy Improvement Project

Shelburne, Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn & Millbury, MA

Environmental Resources Map

December 18, 2024



PREPARED FOR:

nationalgrid

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025.D-0007-0000.1
025.D-0004-0000.0
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Great River Hydro Cr
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025.D-0003-0000.0
SH-W1
Line E5/F6
DEERFIELD S/S
112
INCOME EJ
POPULATION
025.D-0007-0000.2
025.D-0002-0000.0
025.D-0008-0000.0
030.D-0022-0000.0
025.D-0002-0000.1
Line E5/F6

Resource Areas Reviewed:
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Gardner
Springfield

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Article 97 Lands
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Environmental Justice Populations 2020
- Income

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Shelburne, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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030.D-0022-0000.0
025.D-0007-0000.5
Line E5/F6
025.D-0007-0000.4
025.D-0007-0000.1
025.D-0007-0000.3
025.D-0007-0000.2
INCOME EJ POPULATION
025.D-0007-0000.2

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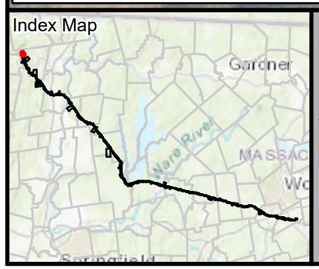

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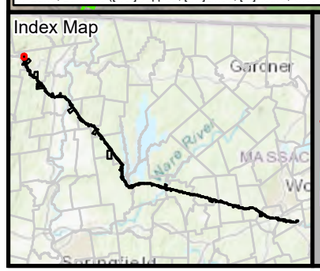

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Environmental Resources Map

Shelburne, MA

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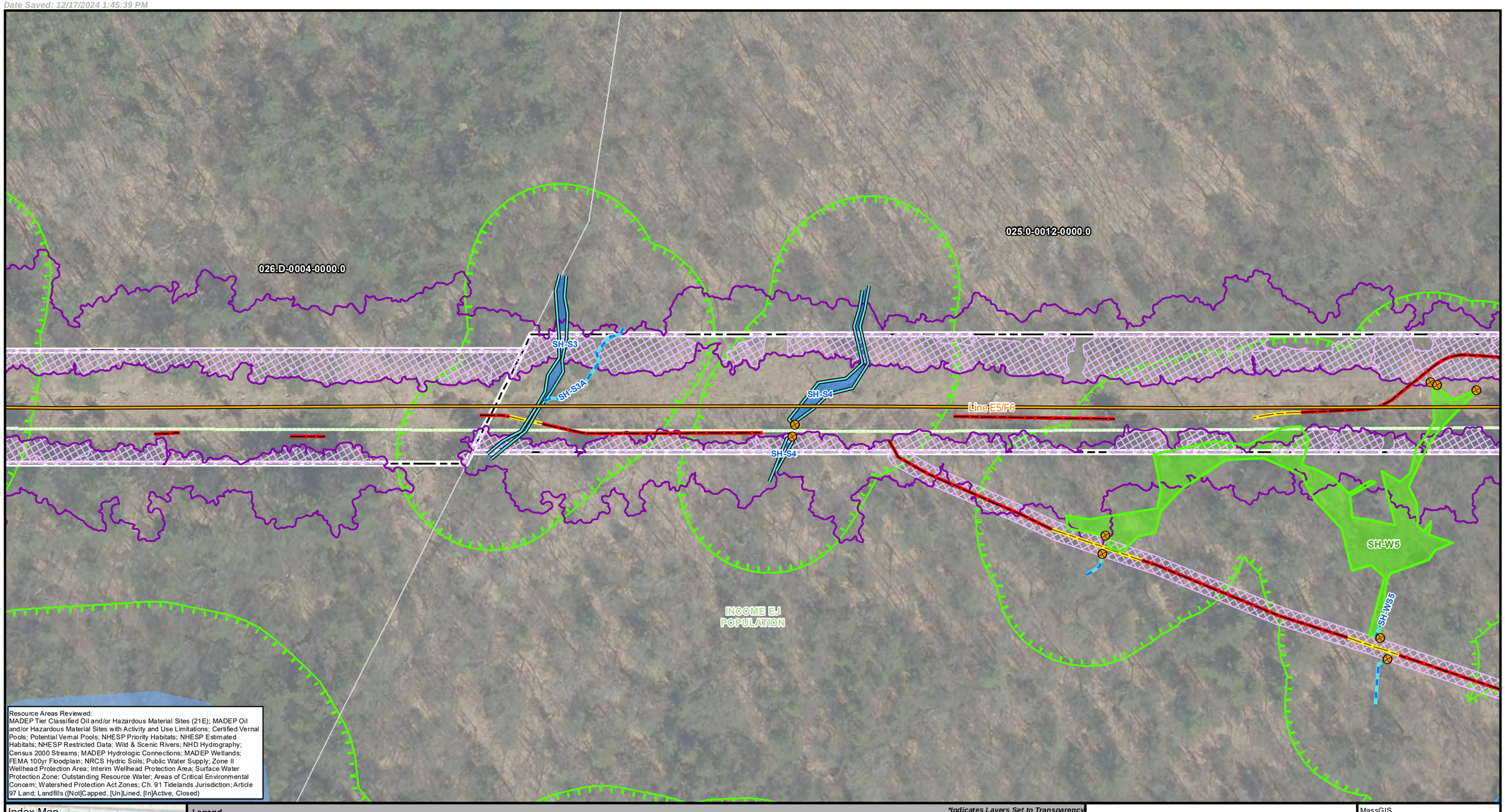

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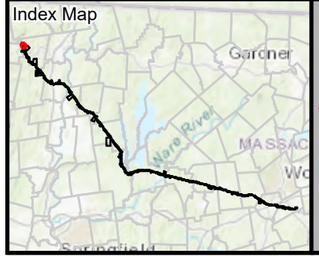

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Environmental Justice Populations 2020

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Environmental Resources Map

Shelburne, MA

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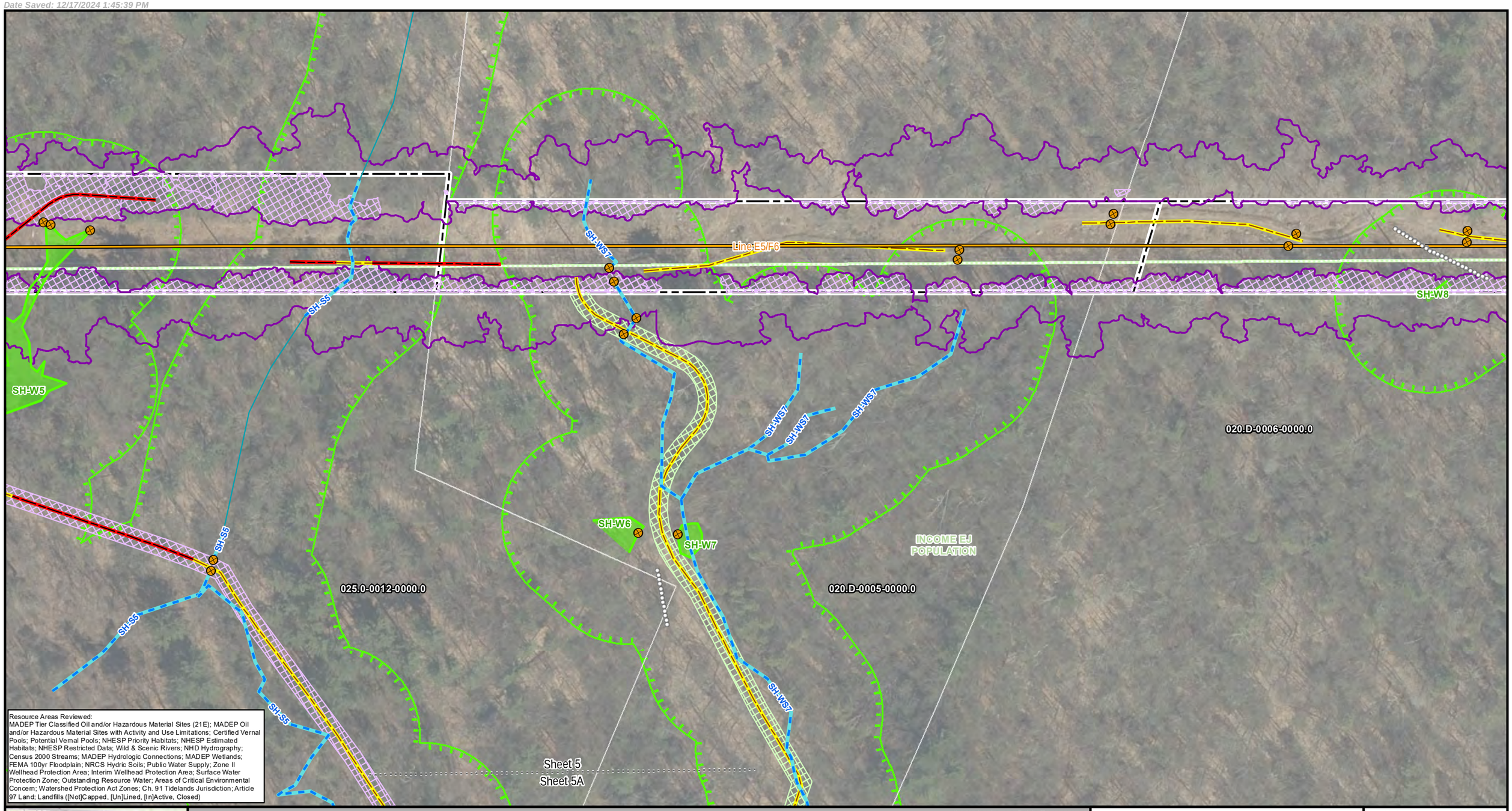

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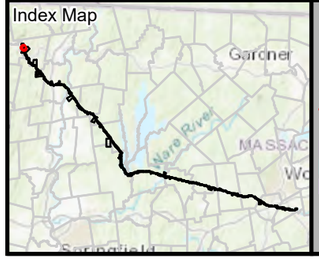

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Environmental Justice Populations 2020

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

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ENTIRE MAP PAGE IS WITHIN INCOME ENVIRONMENTAL JUSTICE POPULATION

043.0-0049-0000.0
043.0-0035-0000.0
043.0-0040-0000.0
025.0-0012-0000.0
020.D-0005-0000.0
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MOHAWK TRL
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Environmental Resources Map

Shelburne, MA
Page 5A of 240

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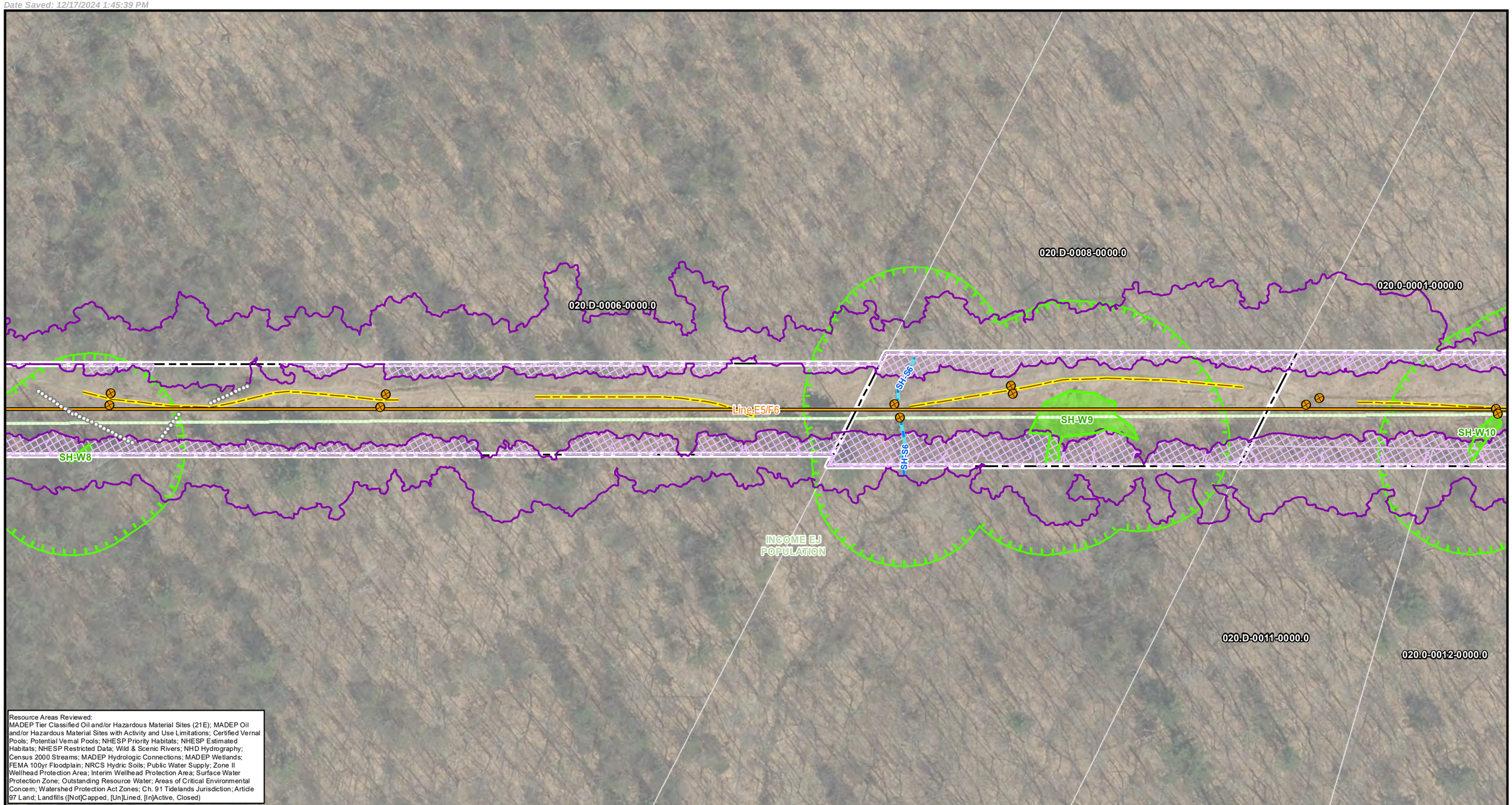

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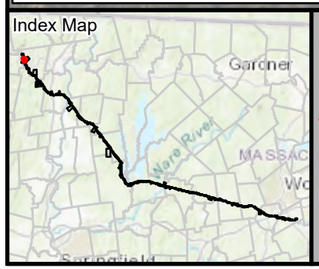

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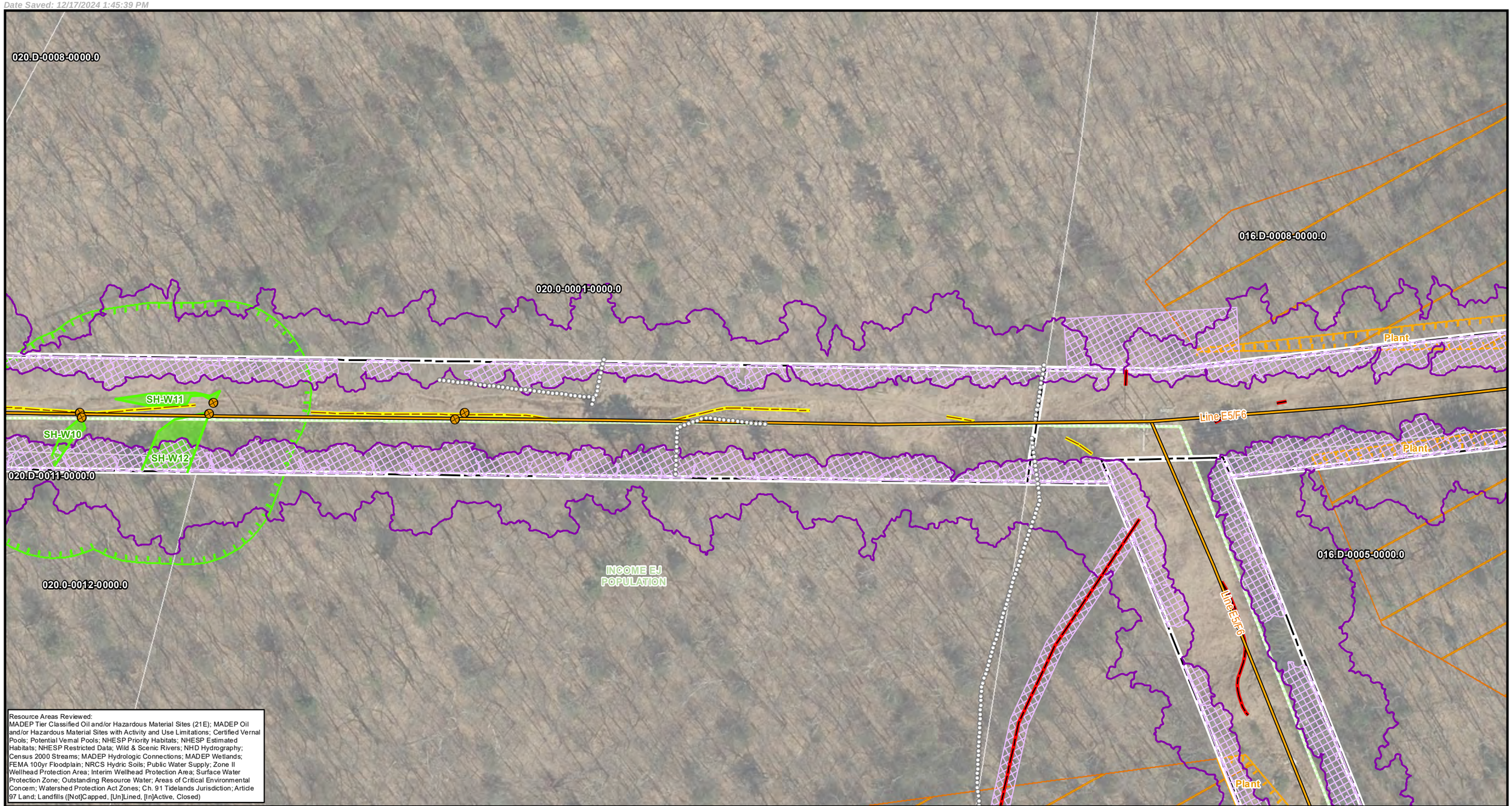

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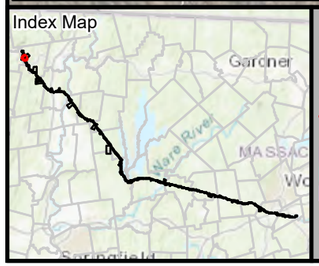

Legend

*Indicates Layers Set to Transparency

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Environmental Justice Populations 2020

- Income

N

1 inch = 100 feet

0 50 100

Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Shelburne, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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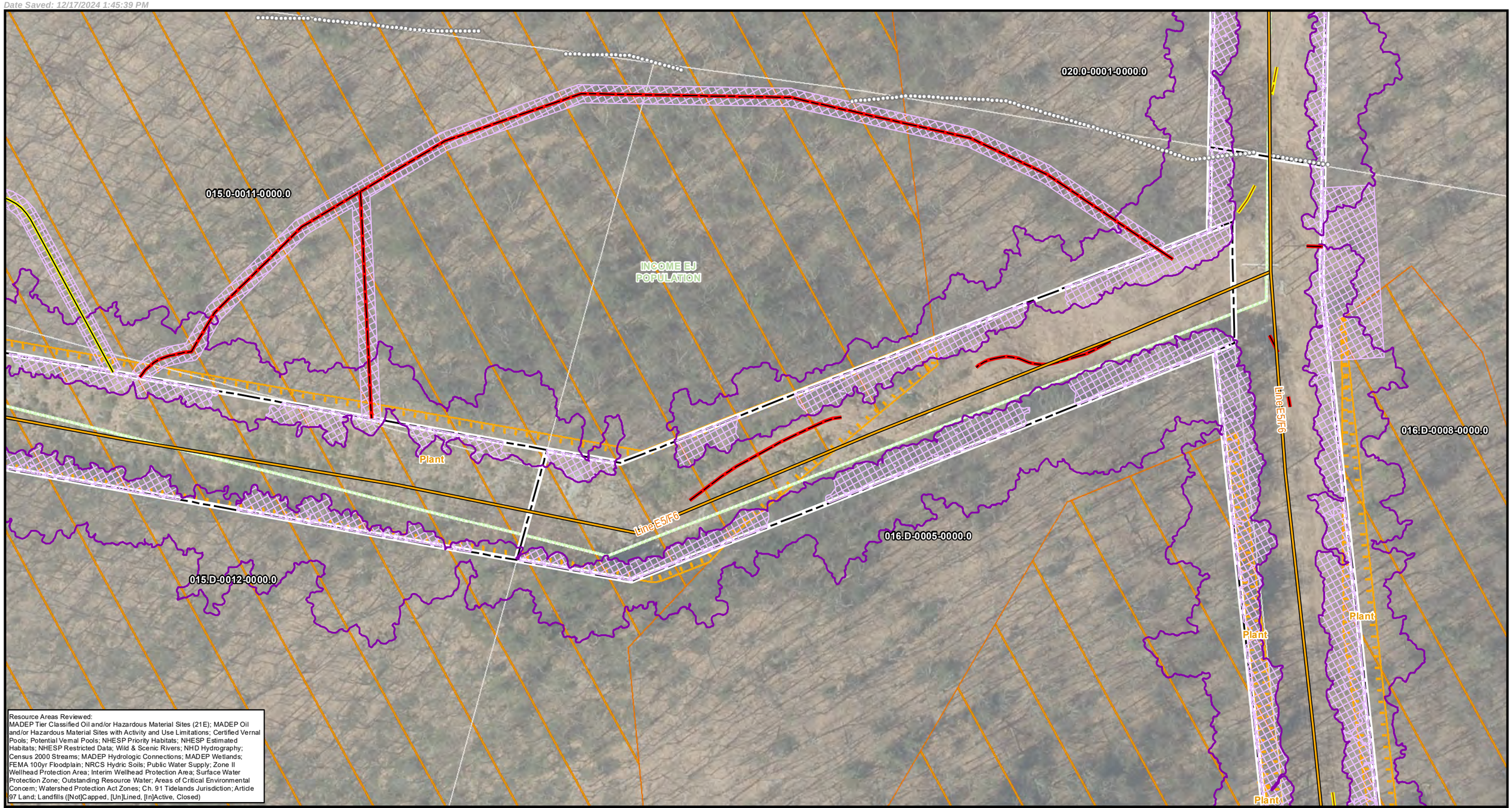

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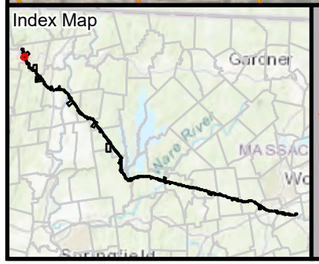

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Environmental Justice Populations 2020

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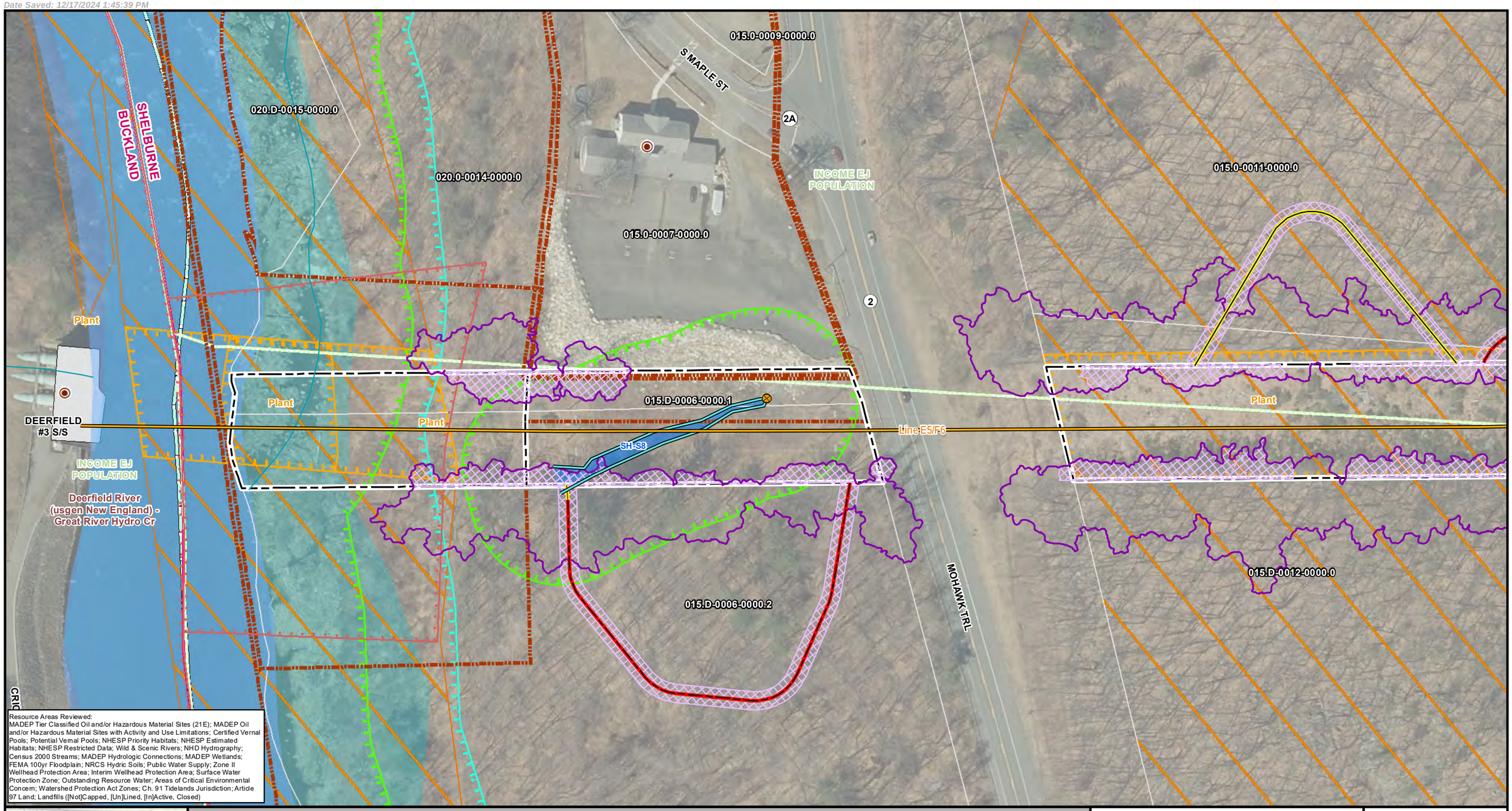

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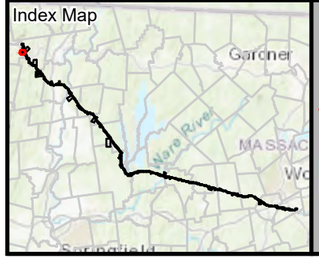

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Article 97 Lands
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Environmental Justice Populations 2020
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Environmental Resources Map

Shelburne, MA

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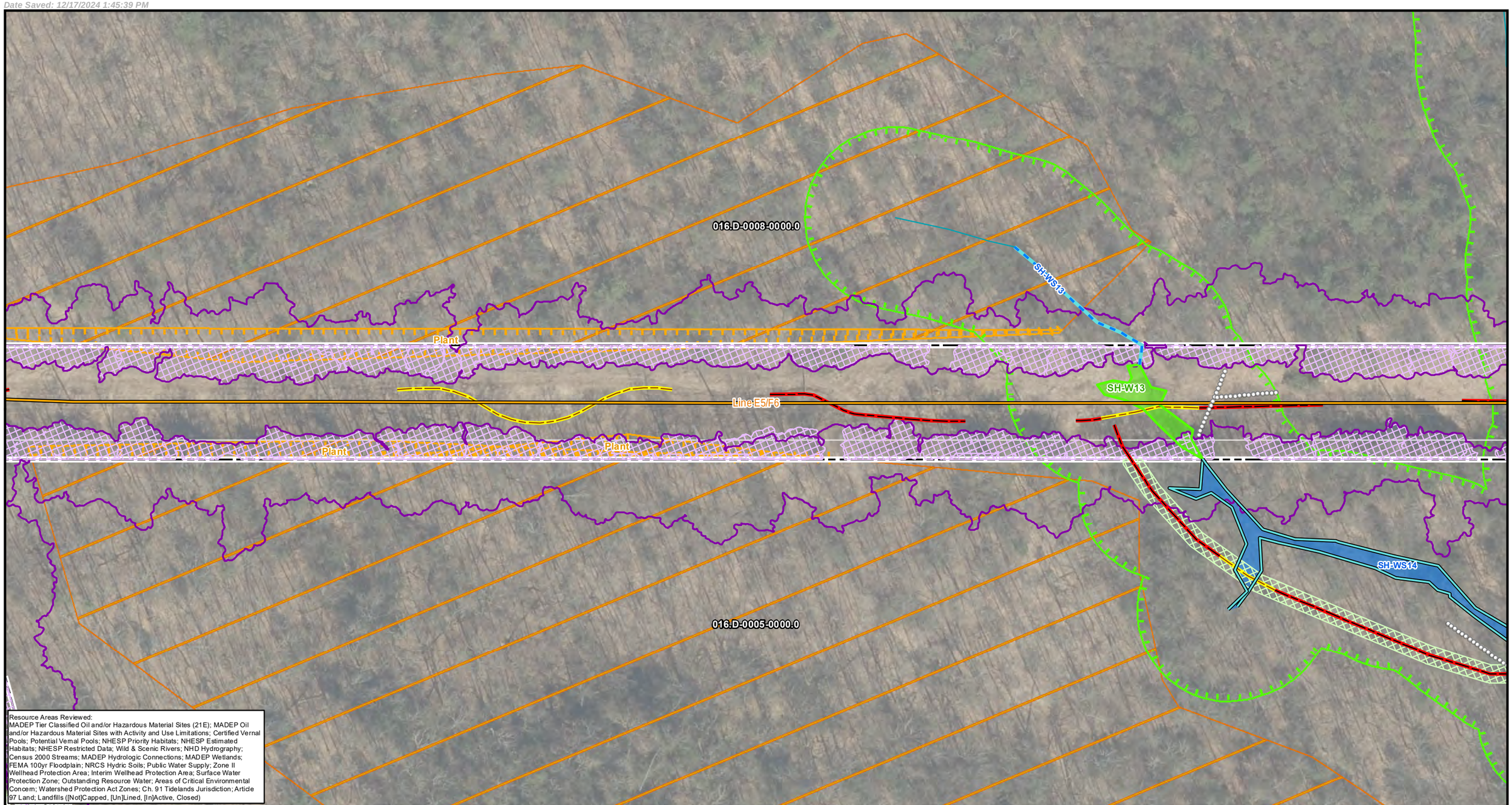

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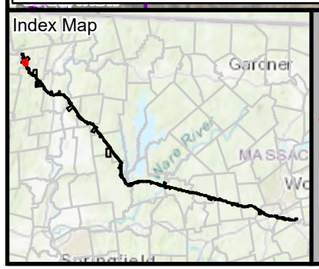

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Environmental Justice Populations 2020

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Shelburne, MA

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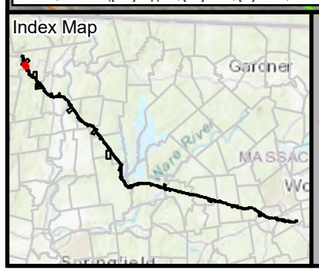

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Shelburne, MA

MassGIS
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Environmental Resources Map

Shelburne, MA
Page 11A of 240

MassGIS
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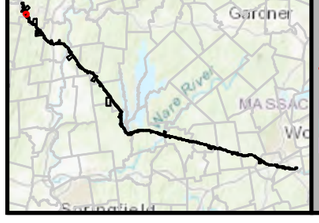

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Line E5/F6

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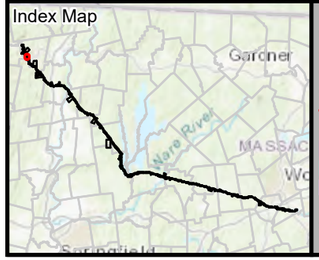

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Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Shelburne, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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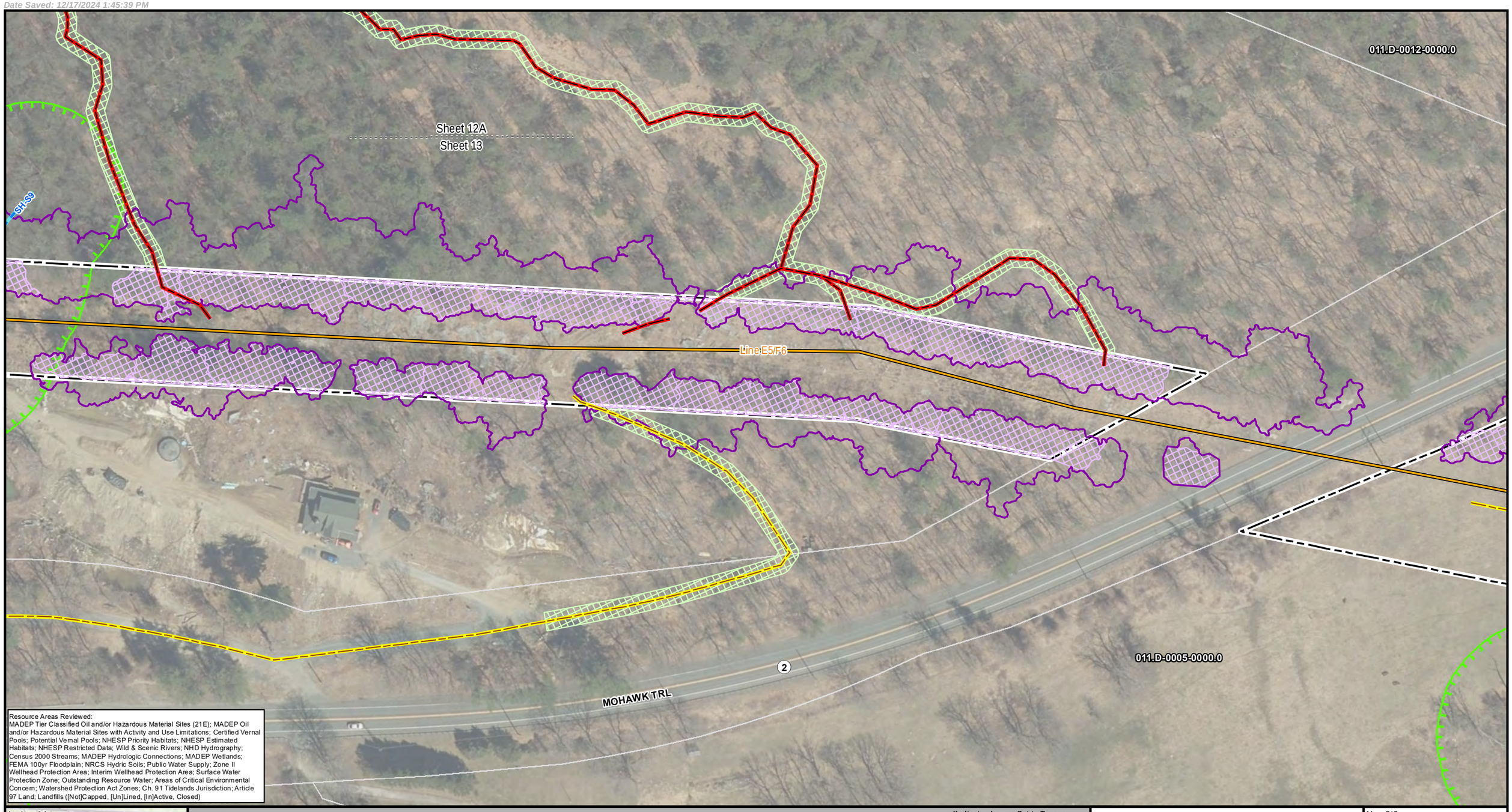

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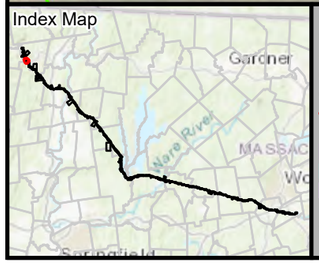

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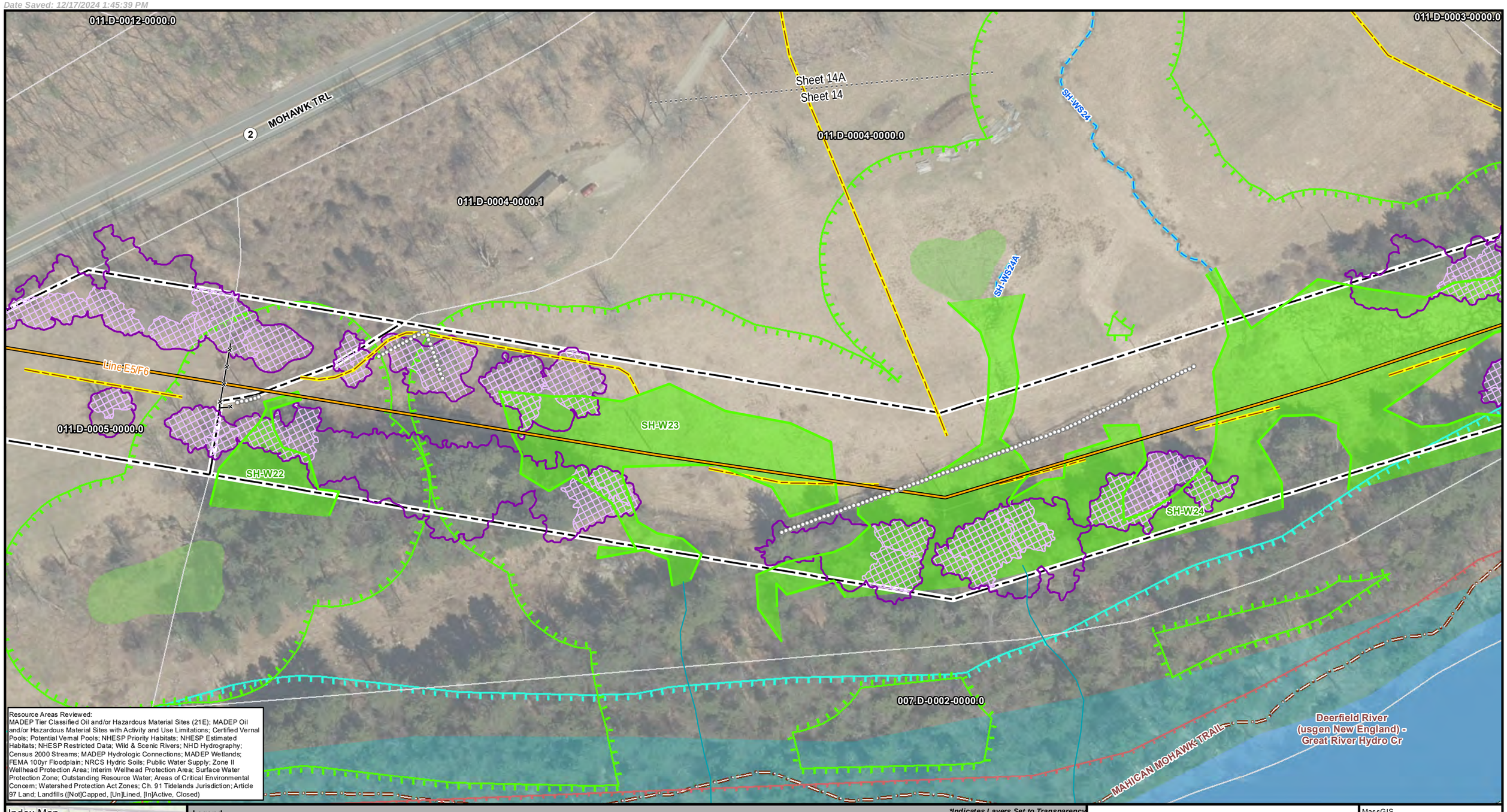

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Environmental Resources Map

Shelburne, MA

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011.D-0004-0000.1
SH-WS24
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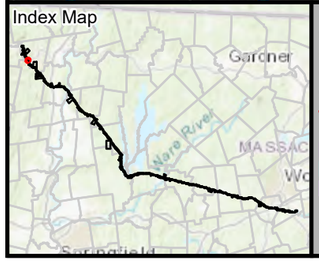

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Environmental Resources Map

Shelburne, MA
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Sheet 15A
Sheet 15
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011.D-0004-0000.0
SH-W24
Line E5/F6
MAHICAN MOHAWK TRAIL
007.D-0002-0000.0
Deerfield River (usgen New England) - Great River Hydro Cr

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Environmental Resources Map

Shelburne, MA
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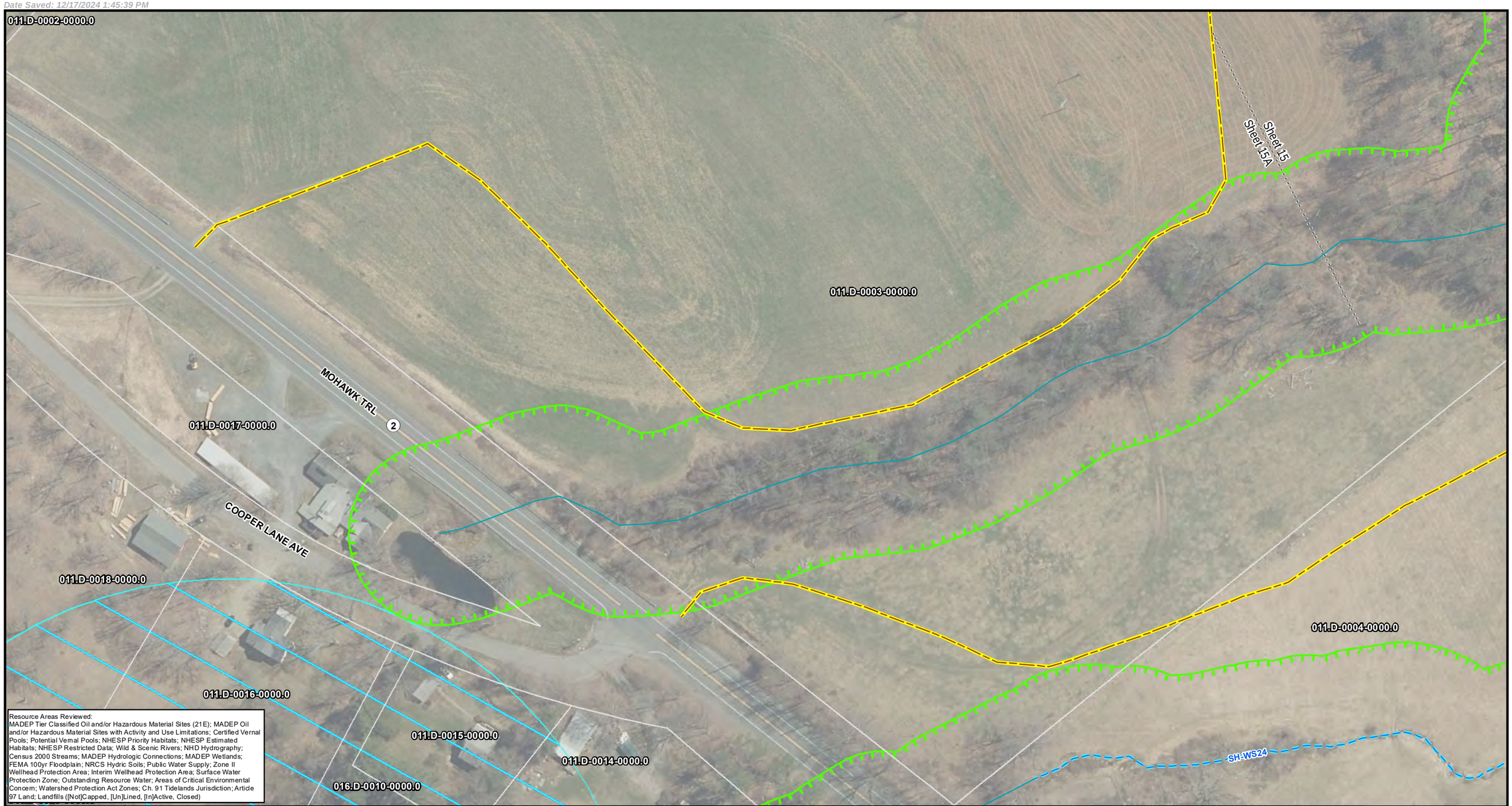

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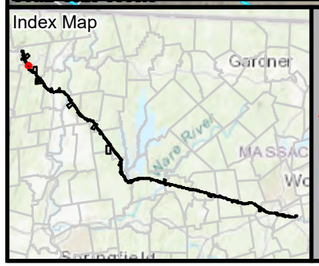

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011.D-0001-0000.0
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MAHICAN MOHAWK TRAIL
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007.D-0002-0000.0
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011.D-0003-0000.0
Plant
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CONWAY
PATRIOT CORRIDOR
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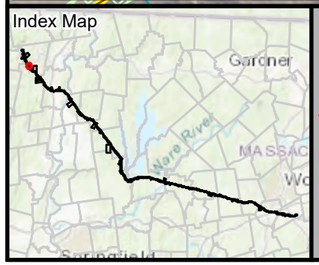

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Shelburne & Conway, MA

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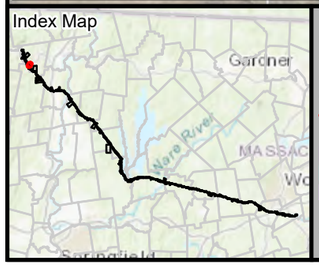

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Shelburne, MA

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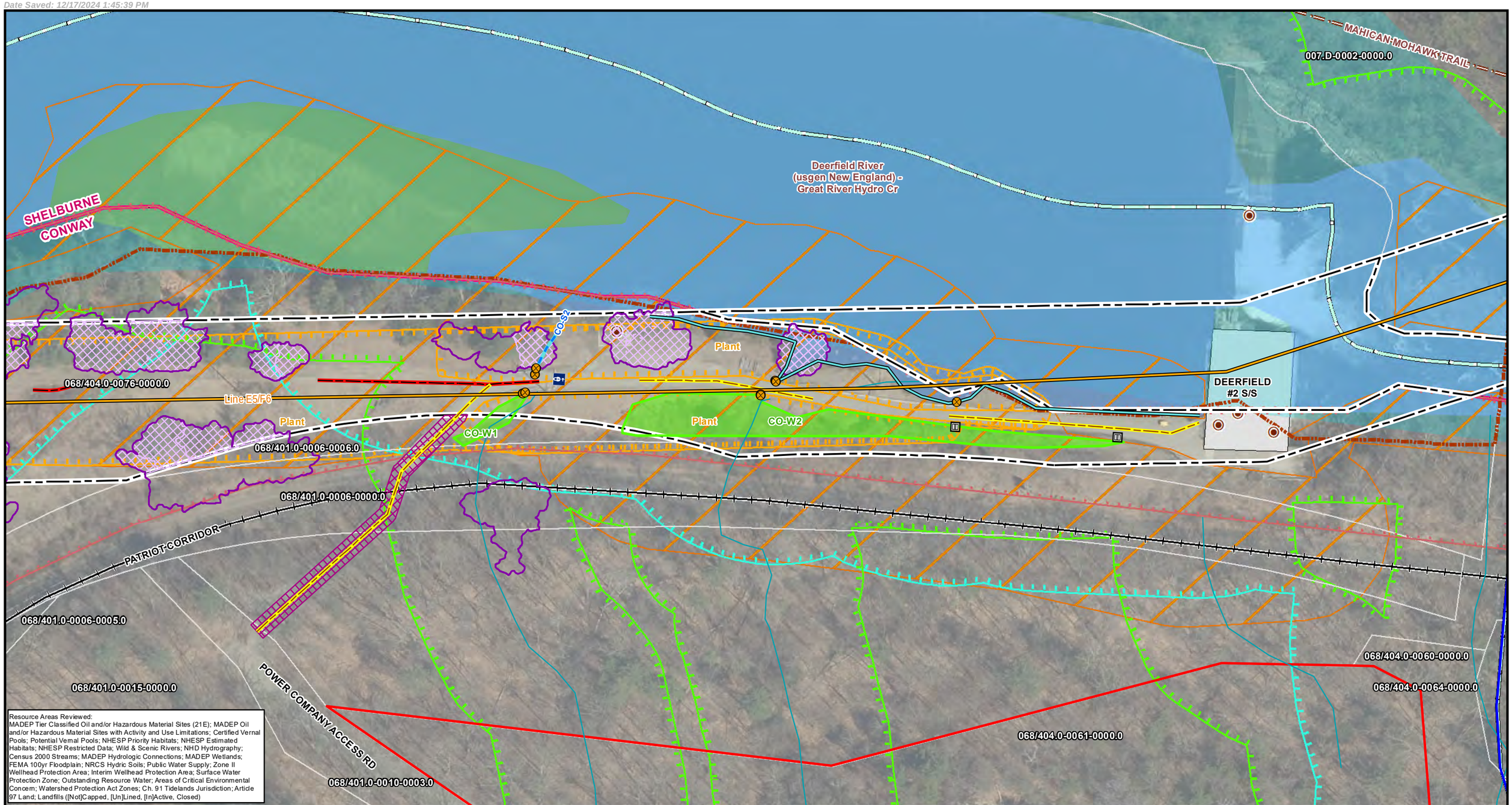

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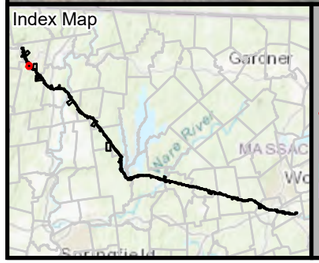

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Shelburne & Conway, MA

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Line E5/F6
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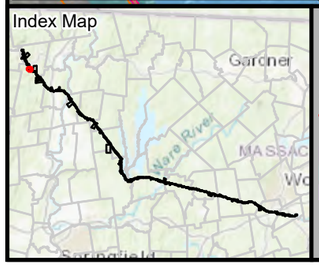

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CO-W1
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Springfield

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MOHAWK TRL
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007.D-0002-0000.0
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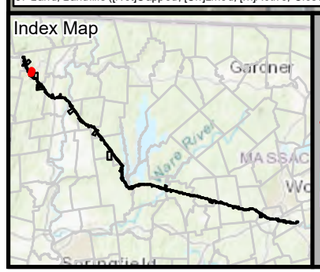

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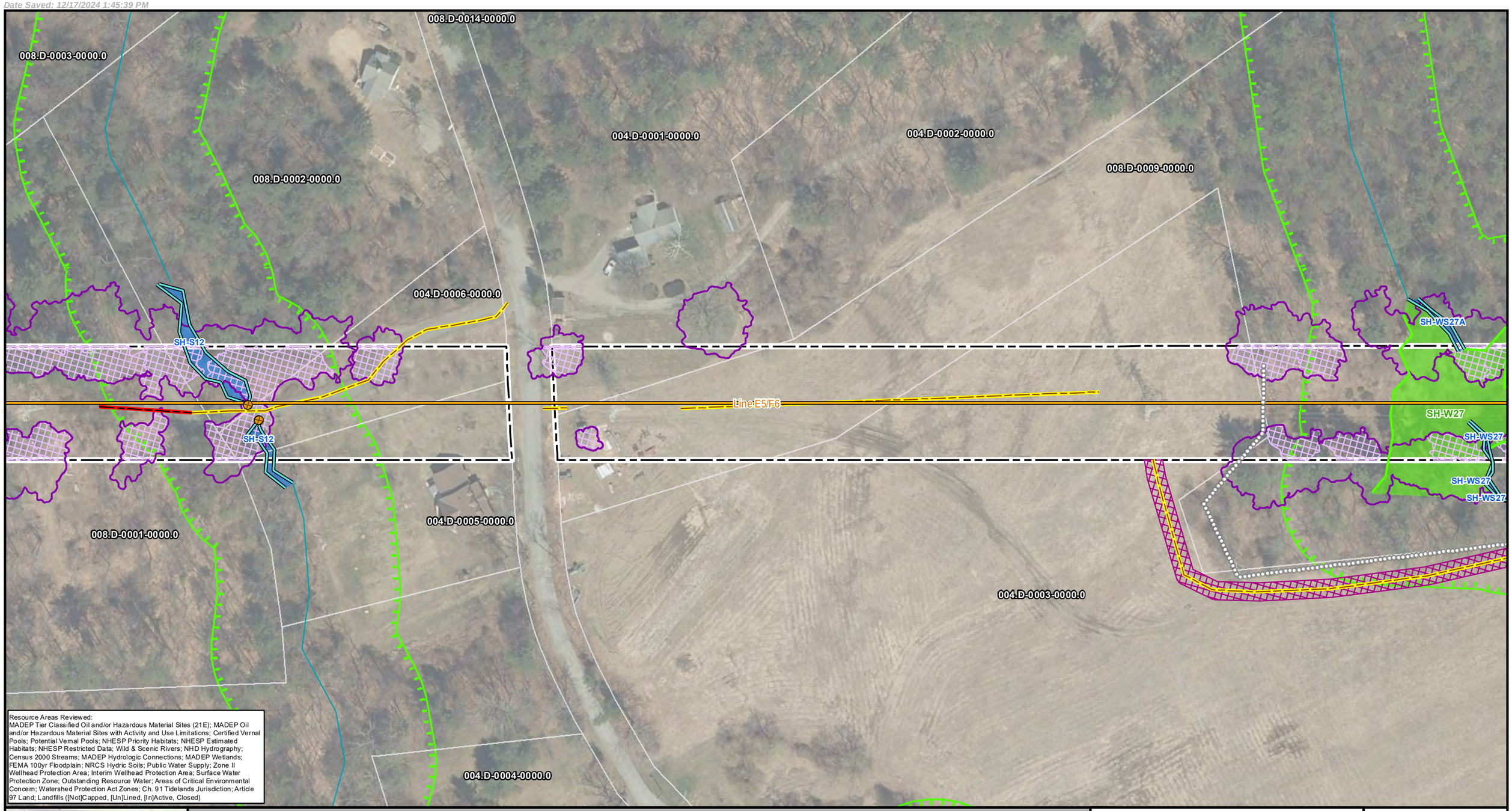

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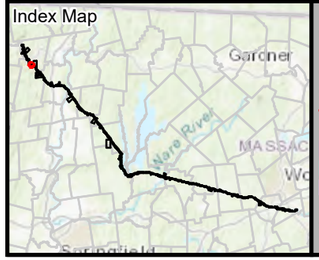

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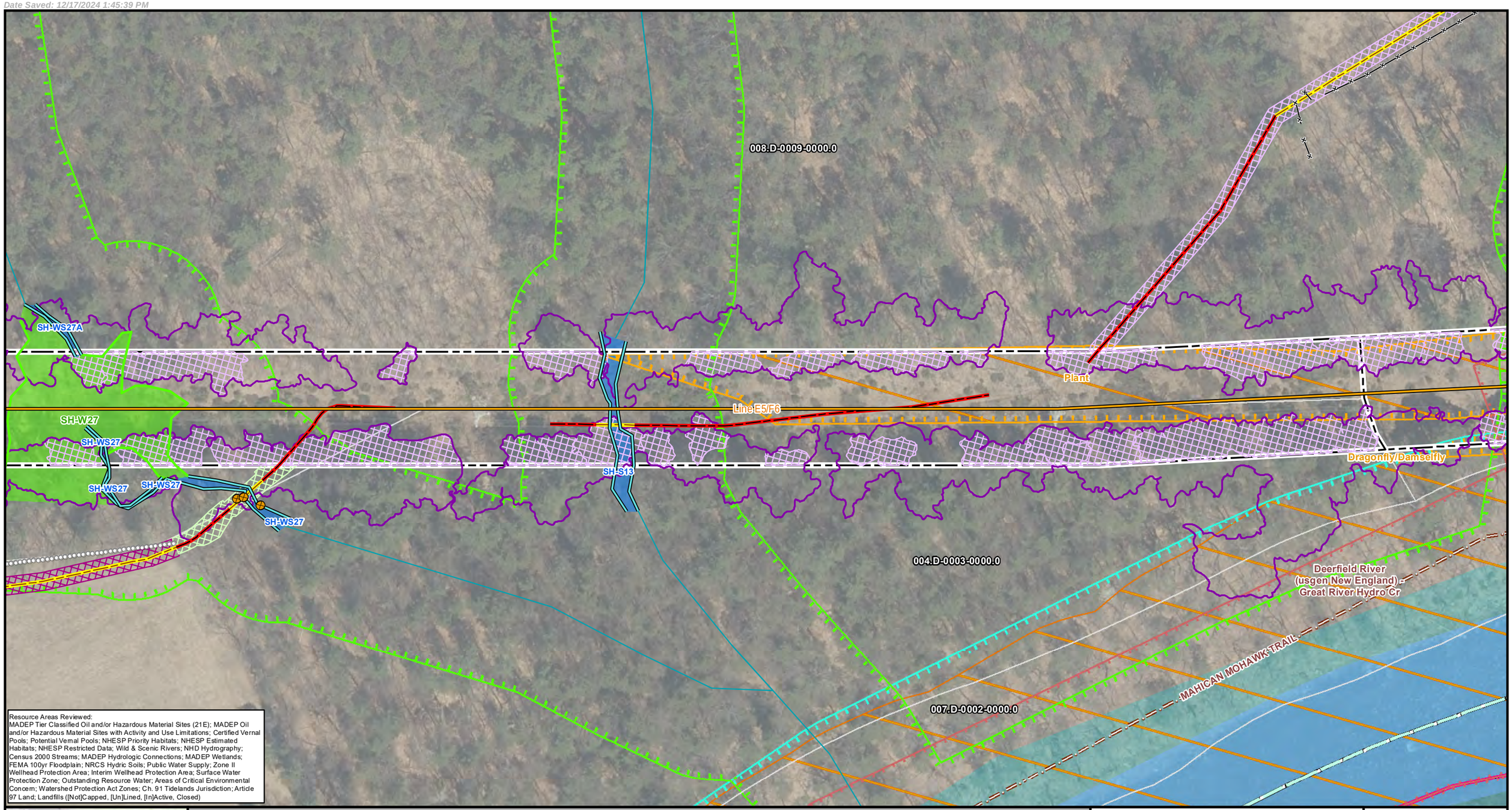

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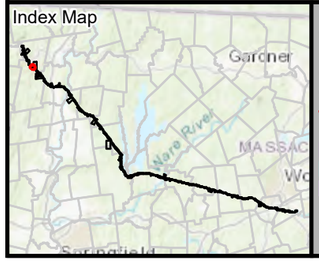

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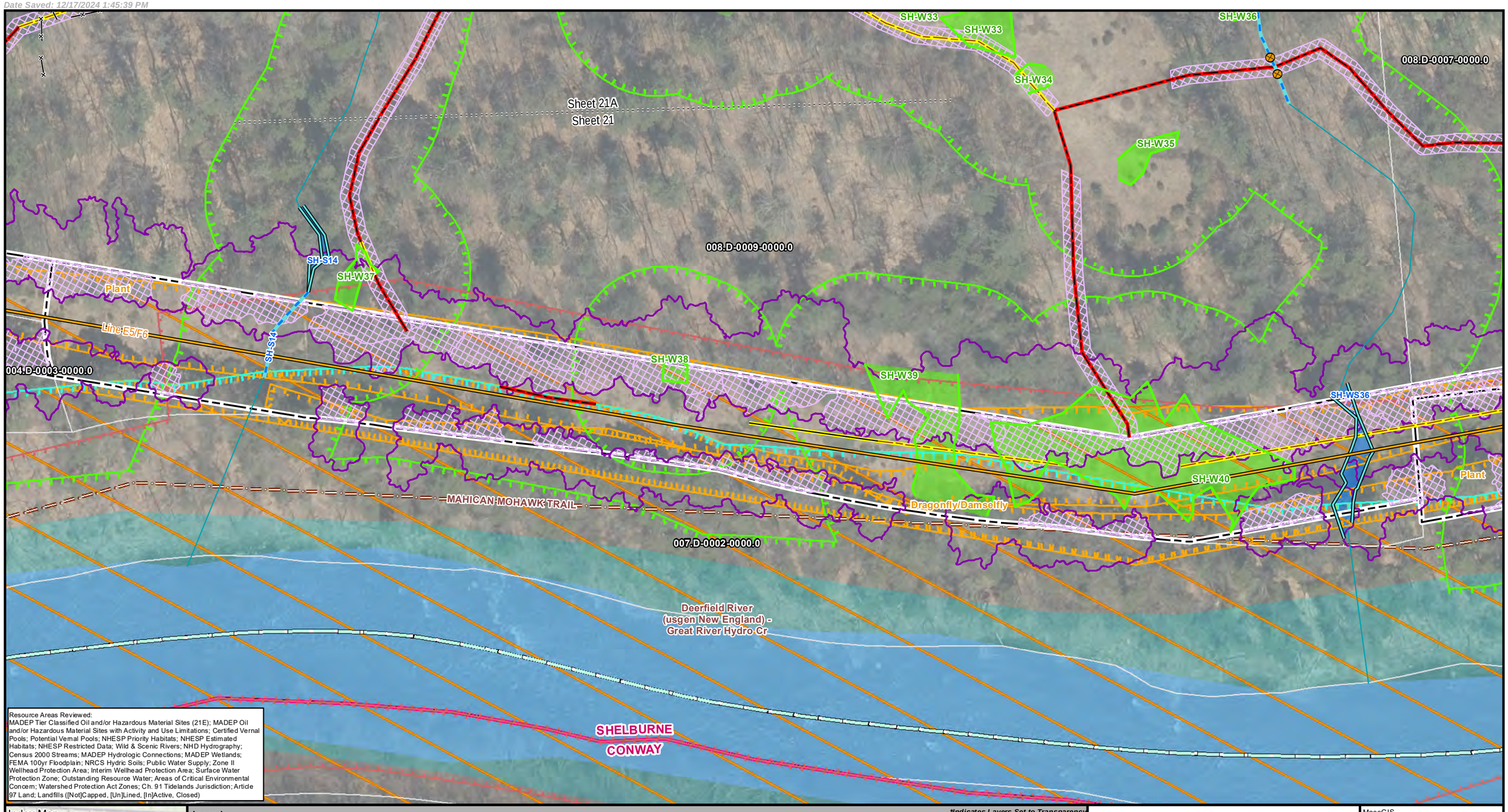

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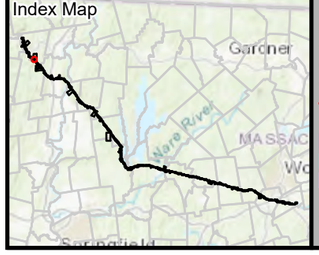

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Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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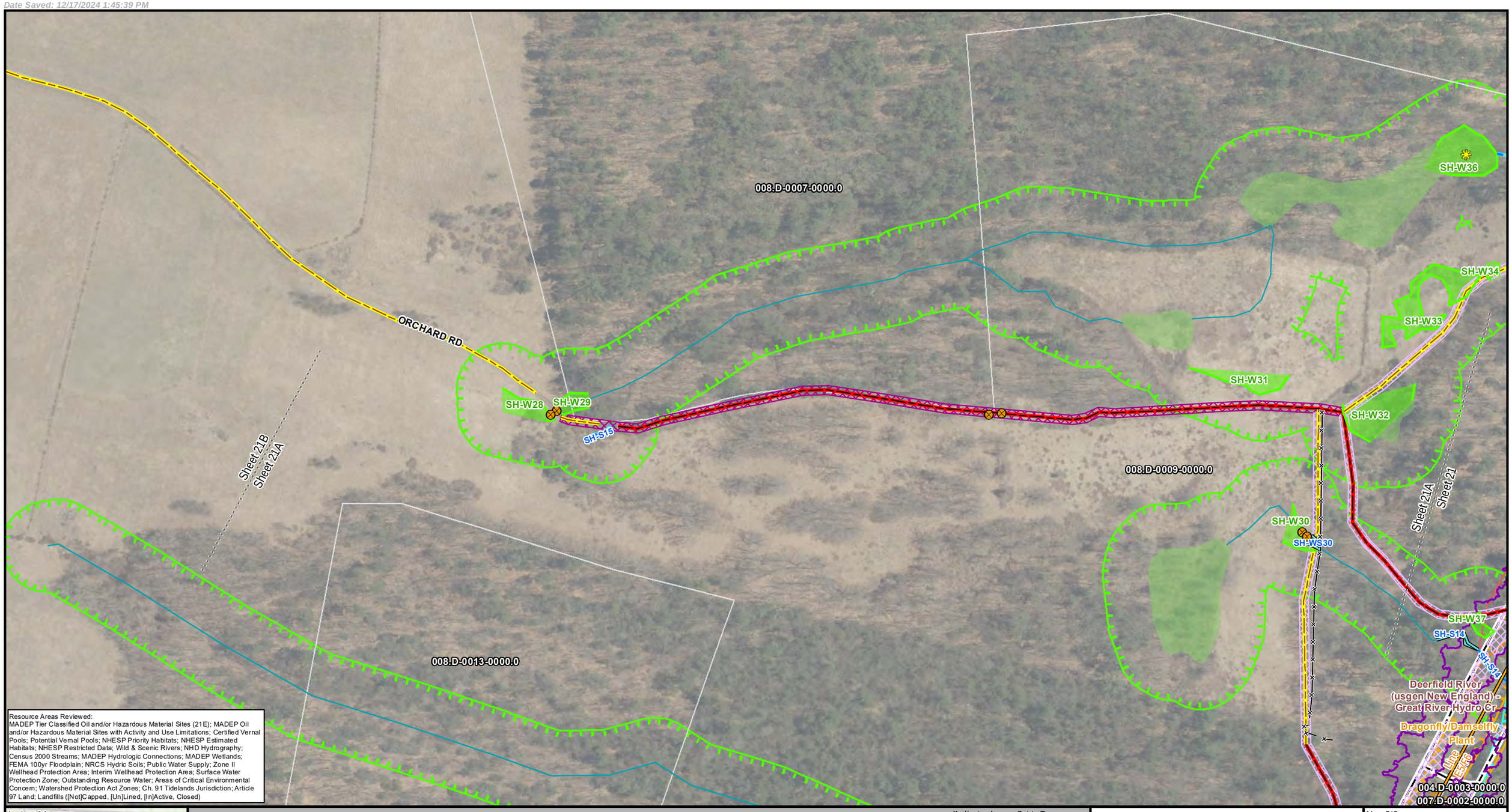

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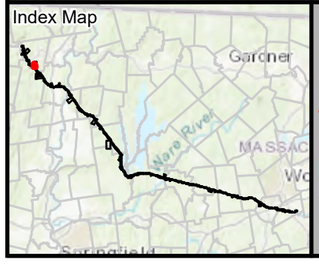
Index Map



Legend

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Article 97 Lands

- Private

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1 inch = 200 feet

0 100 200

Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Shelburne, MA
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MassGIS
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009.D-0004-0000.2
008.D-0008-0000.0
Dragon Brook
008.D-0007-0000.1
008.D-0007-0000.1
009.D-0004-0000.1
BASSETT RD
009.D-0004-0000.3
008.D-0007-0000.0
013.D-0033-0000.0
008.D-0005-0000.0
ORCHARD RD
008.D-0009-0000.0
SH-W28
BARDWELL FERRY RD
008.D-0009-0000.2
Sheet 21B
Sheet 21A
008.D-0005-0000.1
BARDWELL FERRY RD
008.D-0013-0000.0
008.D-0009-0000.1
0.0

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Index Map
Gardner
Springfield

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Shelburne, MA
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007.D-0002-0000.0
Deerfield River (usgen New England) - Great River Hydro Cr
008.D-0007-0000.0
068/405.0-0013-0000.0
PATRIOT CORRIDOR
Plant
Line E5/F6
Dragonfly/Damselfly
MAHICAN-MOHAWK TRAIL
SHELBURNE
CONWAY
South River State Forest
068/405.0-0012-0000.0

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Gardner
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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Shelburne & Conway, MA

MassGIS
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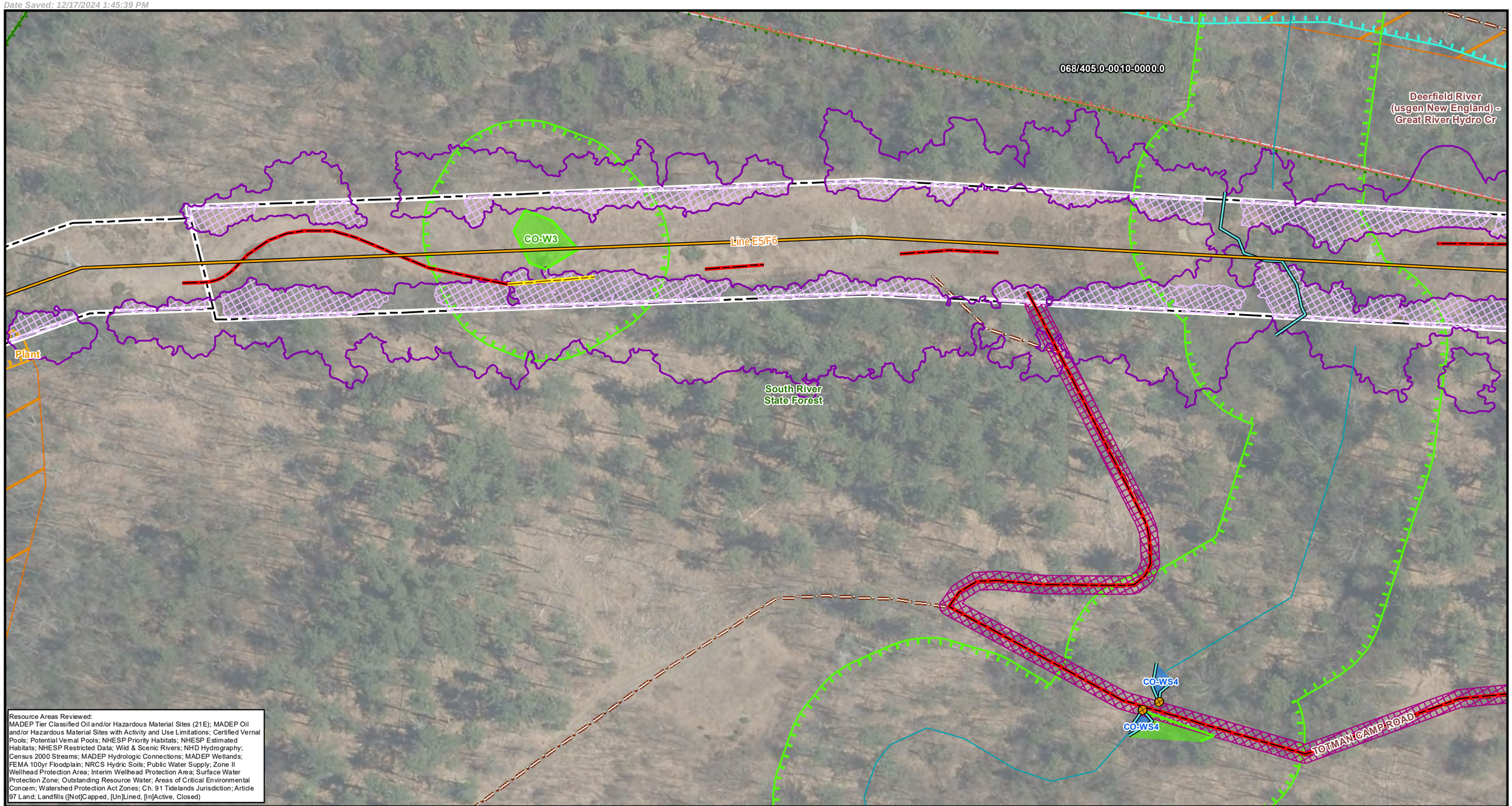

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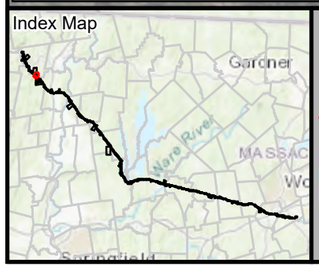

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Conway, MA

MassGIS
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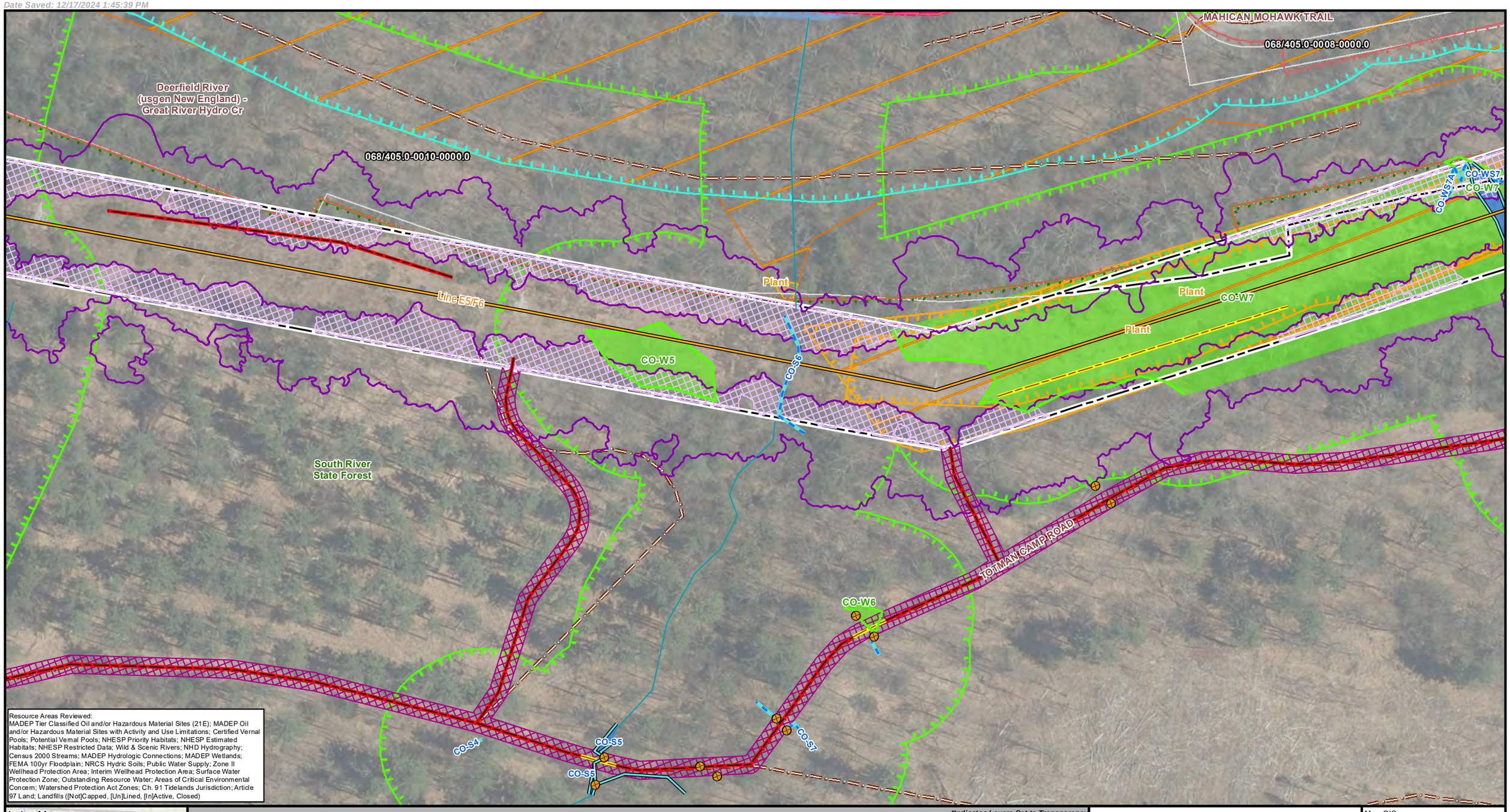

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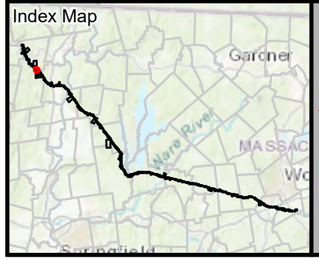

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068/405.0-0009-0001.0
068/405.0-0009-0000.0
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SHELBURNE
CONWAY
Deerfield River
(usgen New England) -
Great River Hydro Cr
BARDWELLS RD
068/405.0-0002-0000.0
MAHICAN
MOHAWK
TRAIL
Plant
Plant
Plant
CO-WS7A
CO-WS7B
CO-WS7
CO-WS7C
CO-W7
CO-W7
068/405.0-0010-0000.0
Line E5/F6
CO-S9
CO-S8
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068/405.0-0004-0000.0
BARDWELLS FERRY ROAD
WHOLEY RD
CO-W8
TOTMAN CAMP ROAD
BARDWELLS FERRY RD
068/406.0-0011-0000.0
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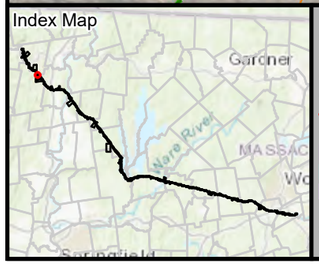

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DEERFIELD
CONWAY
Deerfield River (usgen New England) - Great River Hydro Cr
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CO-S10
CO-S10
CO-S11
Line E5/F6
Plant
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Totman Farm Apr
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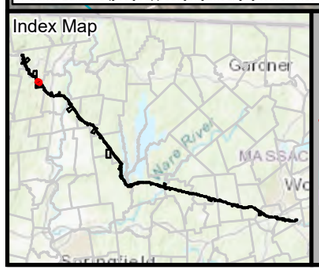

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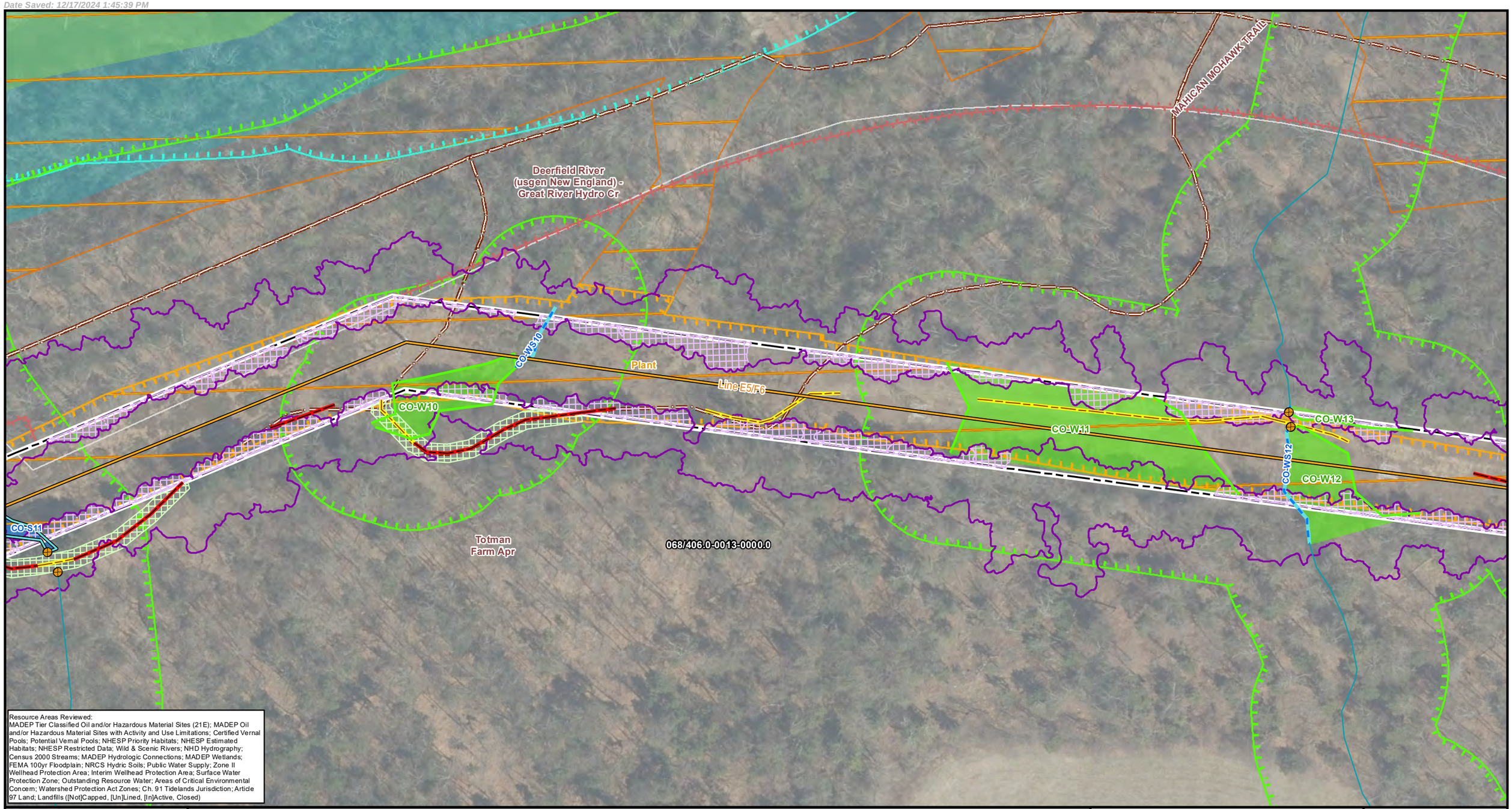

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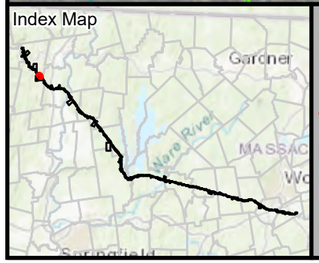
Index Map



Legend

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- Proposed Access
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- Field Delineated Vernal Pool*
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- Private

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Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Conway, MA

MassGIS
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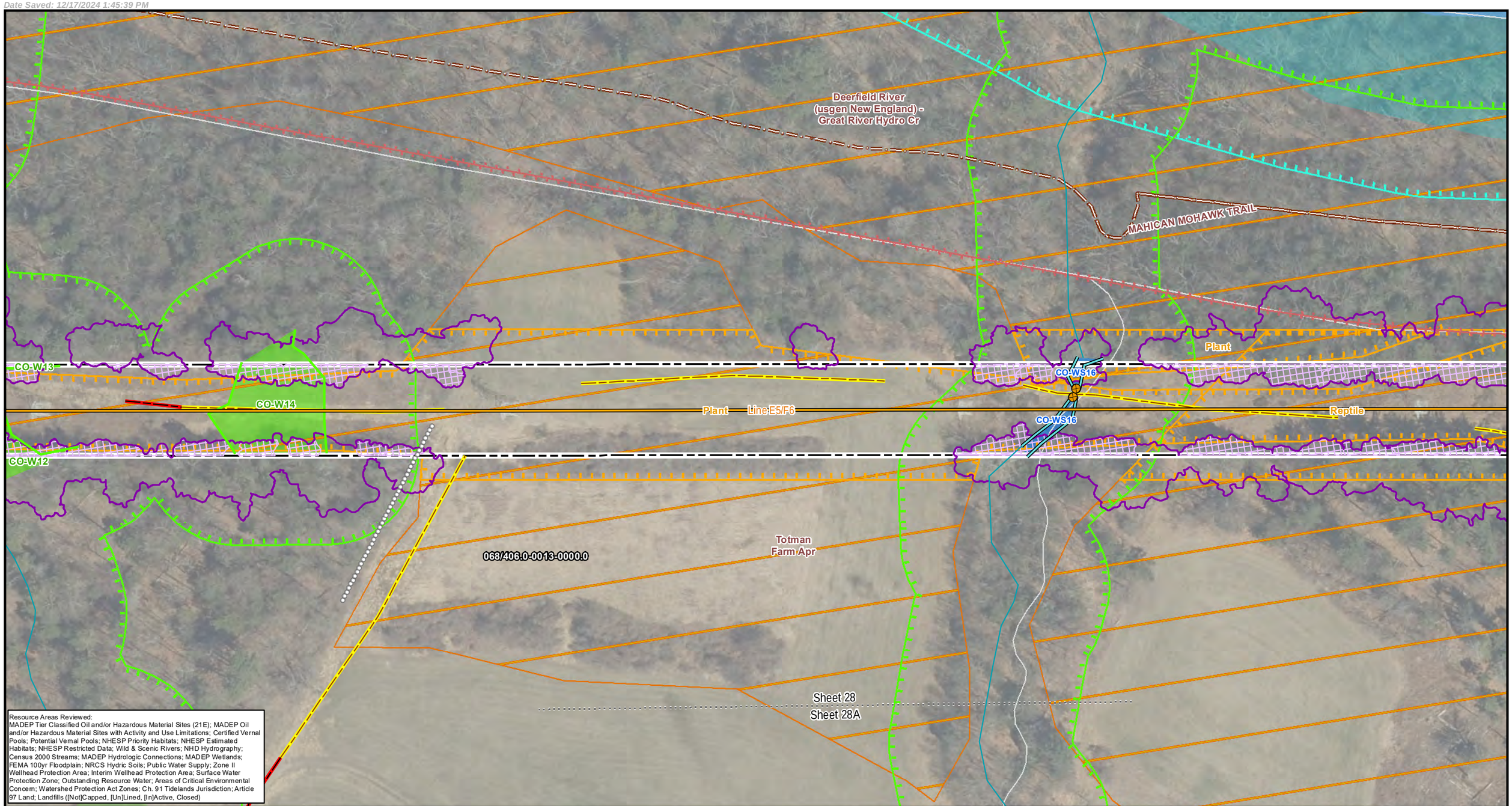

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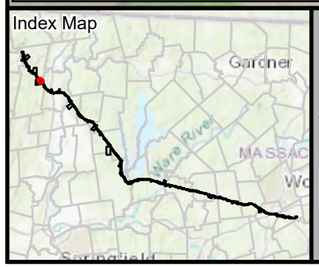

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BARDWELLS FERRY RD
MAHICAN MOHAWK TRAIL
CO-W11
CO-W13
CO-W12
CO-W14
CO-W15
CO-W16
CO-WS16
Totman Farm Apr
Deerfield River (usgen New England) - Great River Hydro Cr
line E5/F6
Plant
Reptile
Sheet 28
Sheet 28A
South River State Forest
CONWAY STATION ROAD
STATION RD

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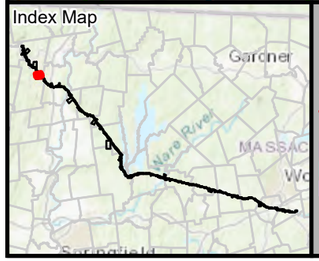

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Environmental Resources Map

Conway, MA
Page 28A of 240

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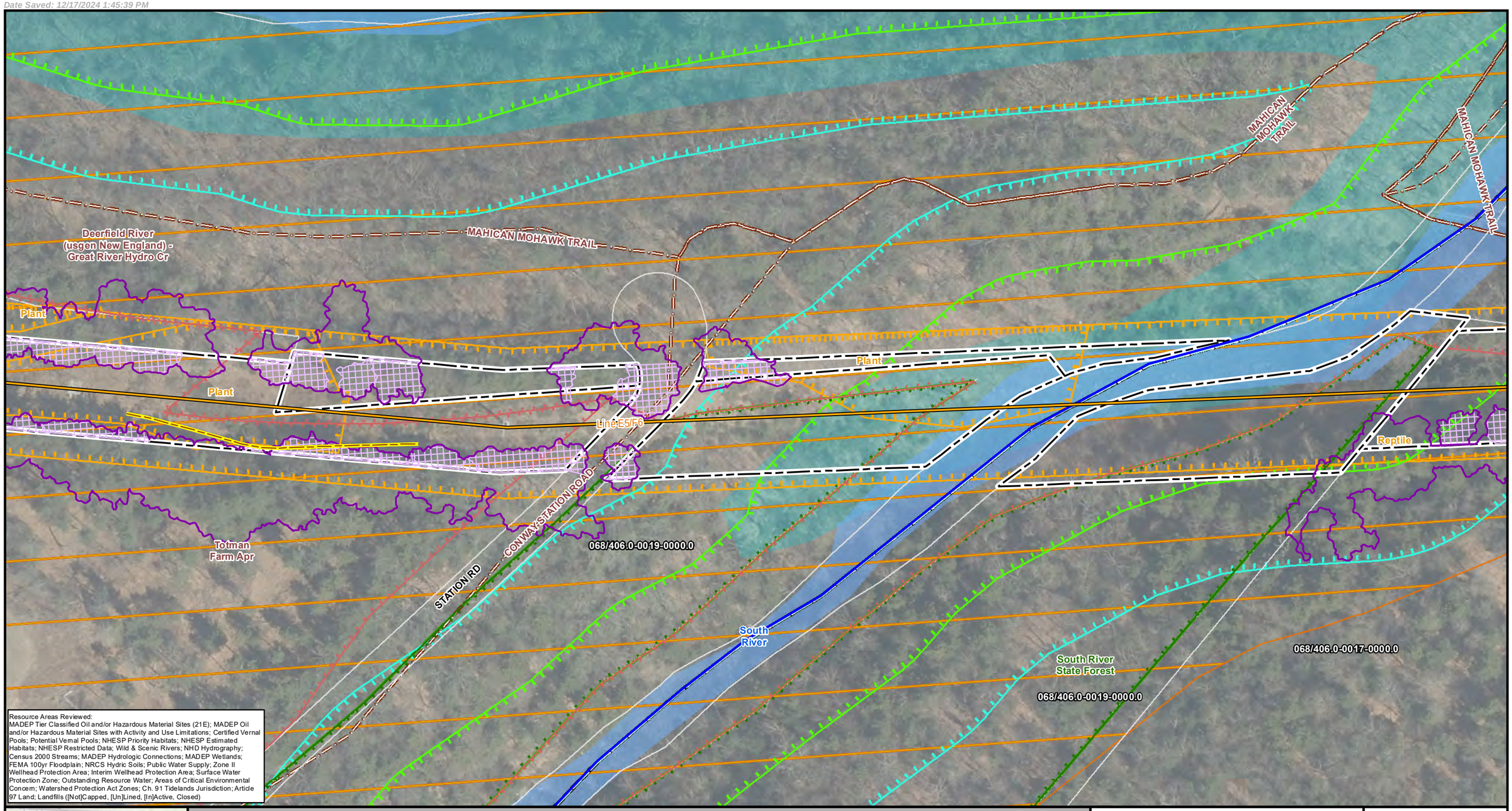

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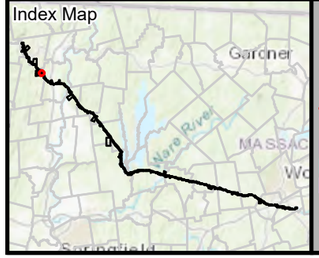

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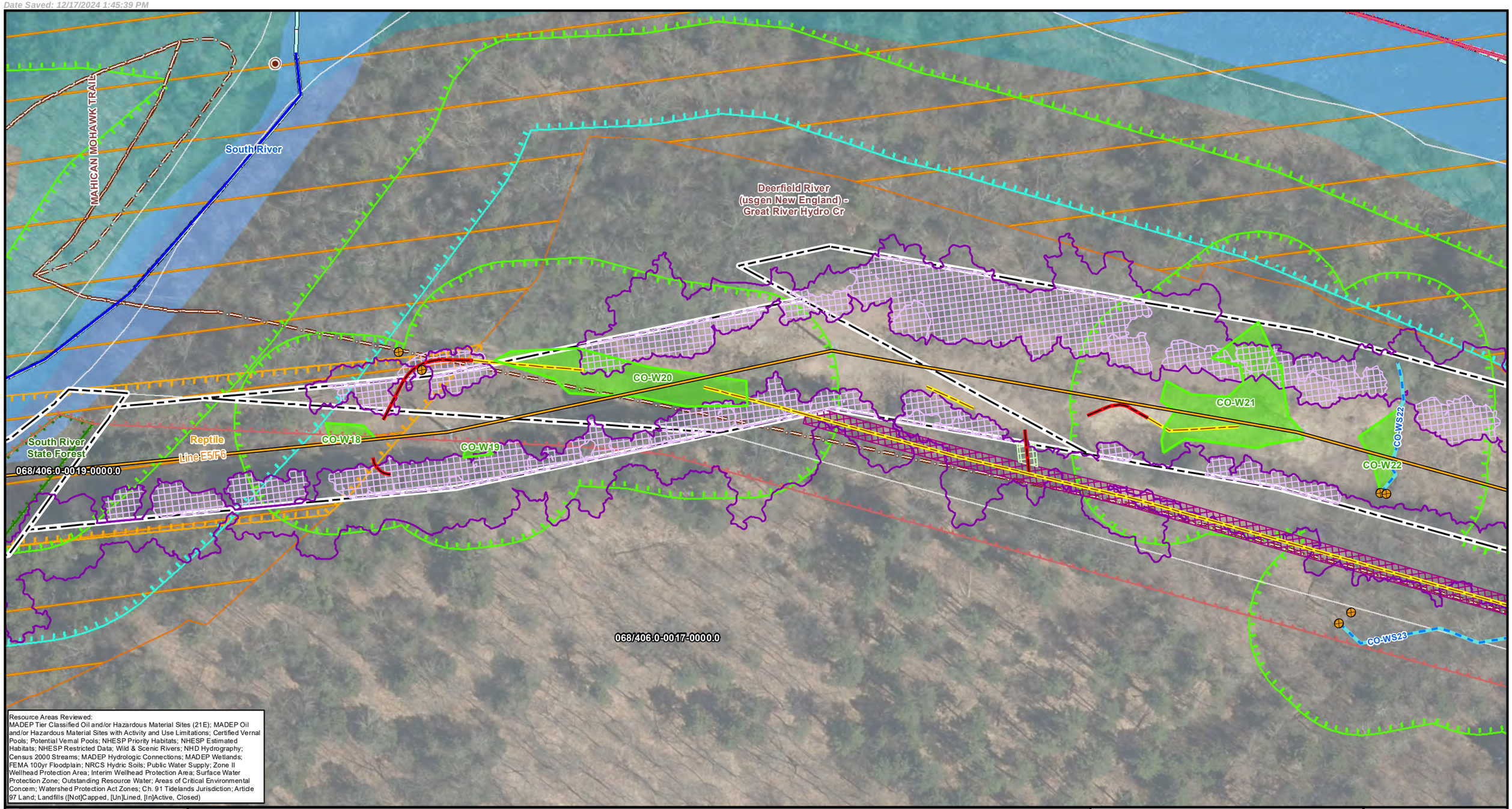

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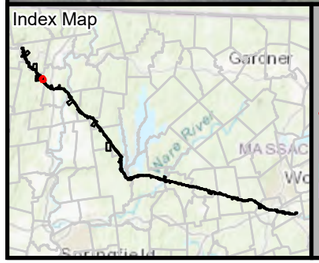

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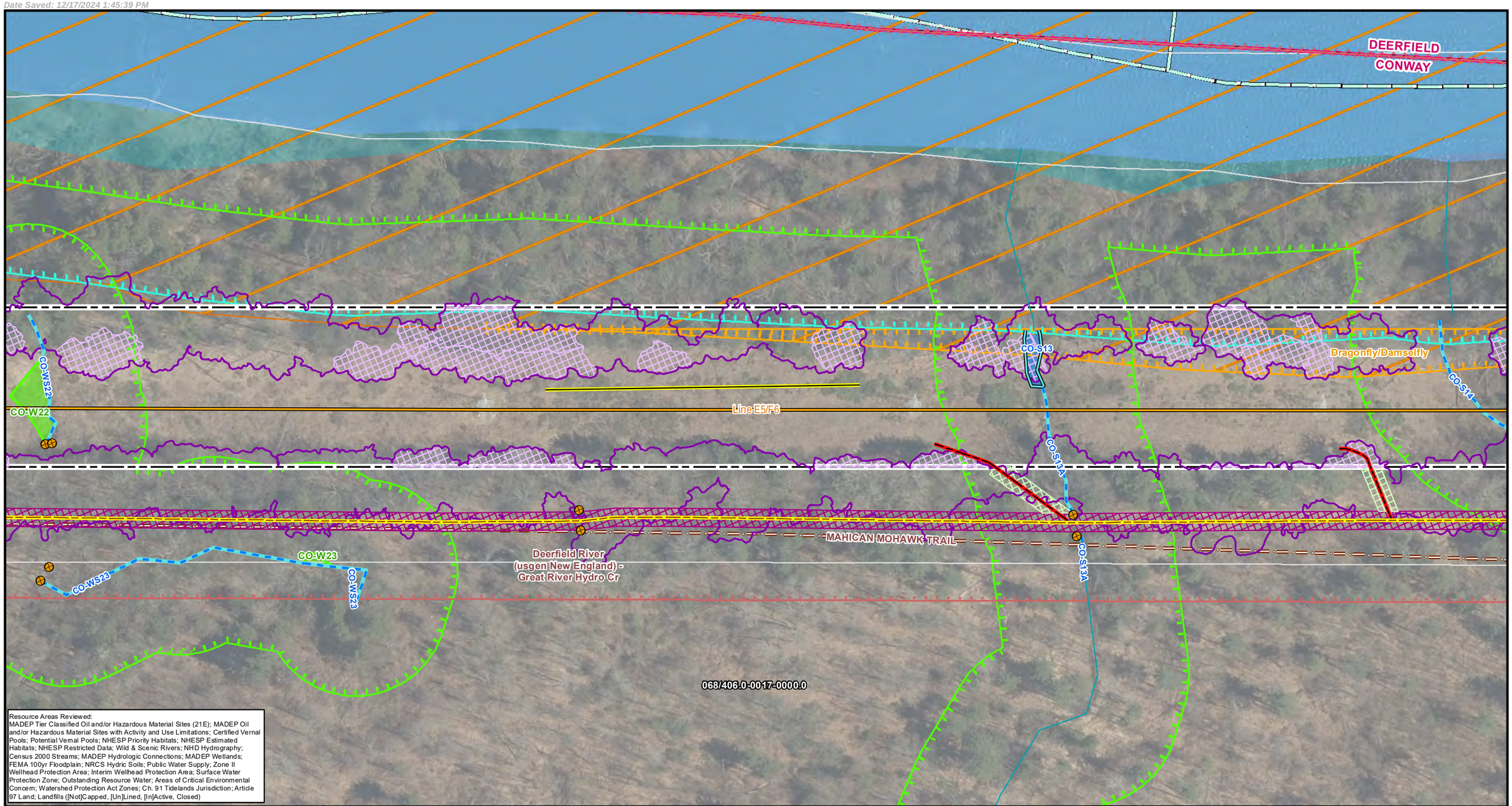

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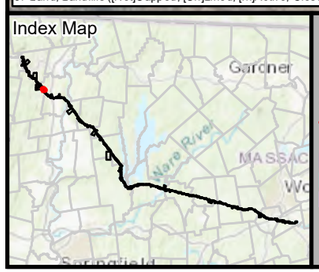

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Dragonfly/Damselfly
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CO-S14
CO-S15A
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068/406.0-0017-0000.0
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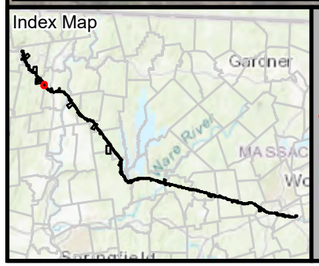

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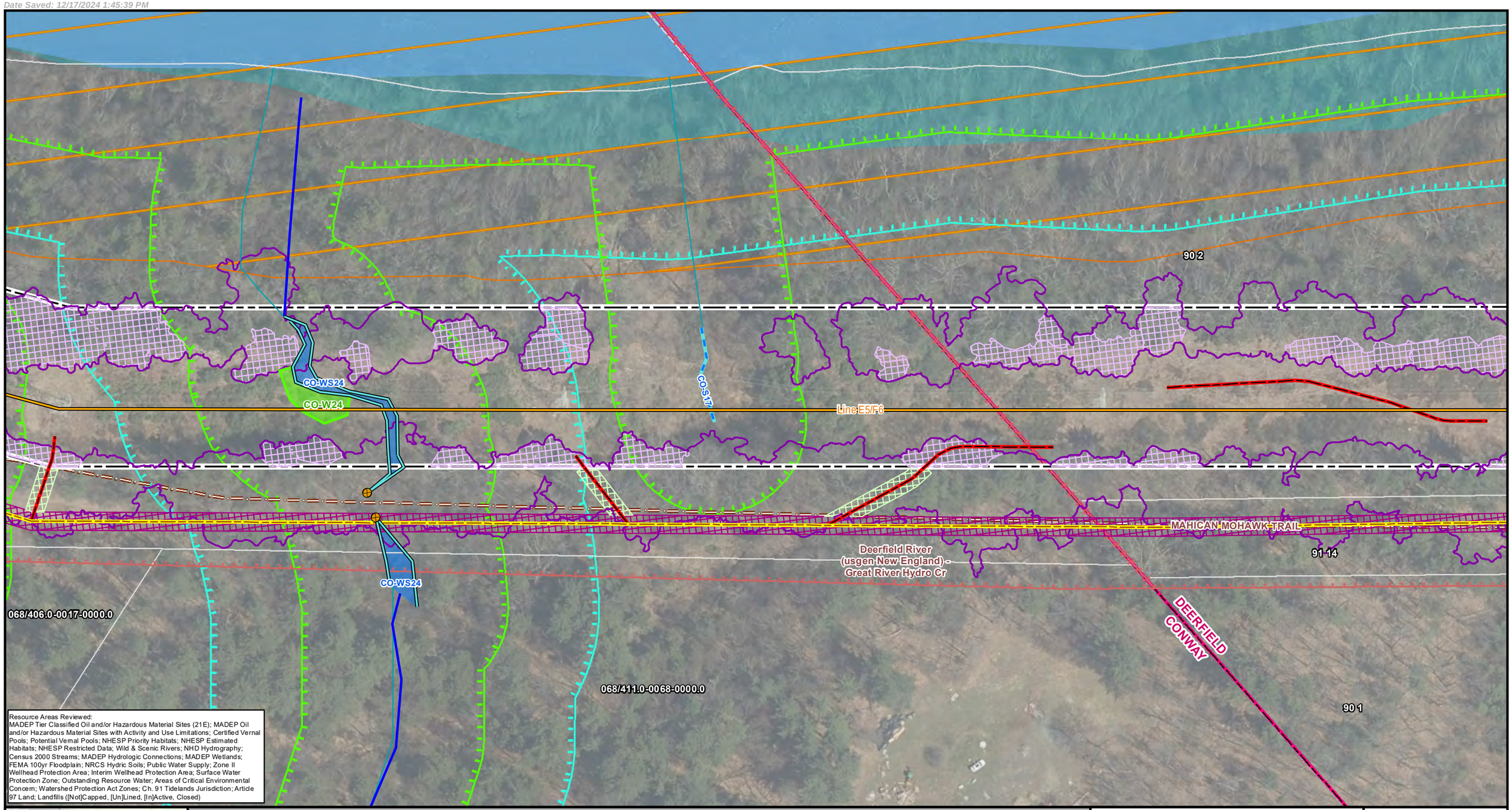

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Article 97 Lands

- Private

*Indicates Layers Set to Transparency

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Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Conway & Deerfield, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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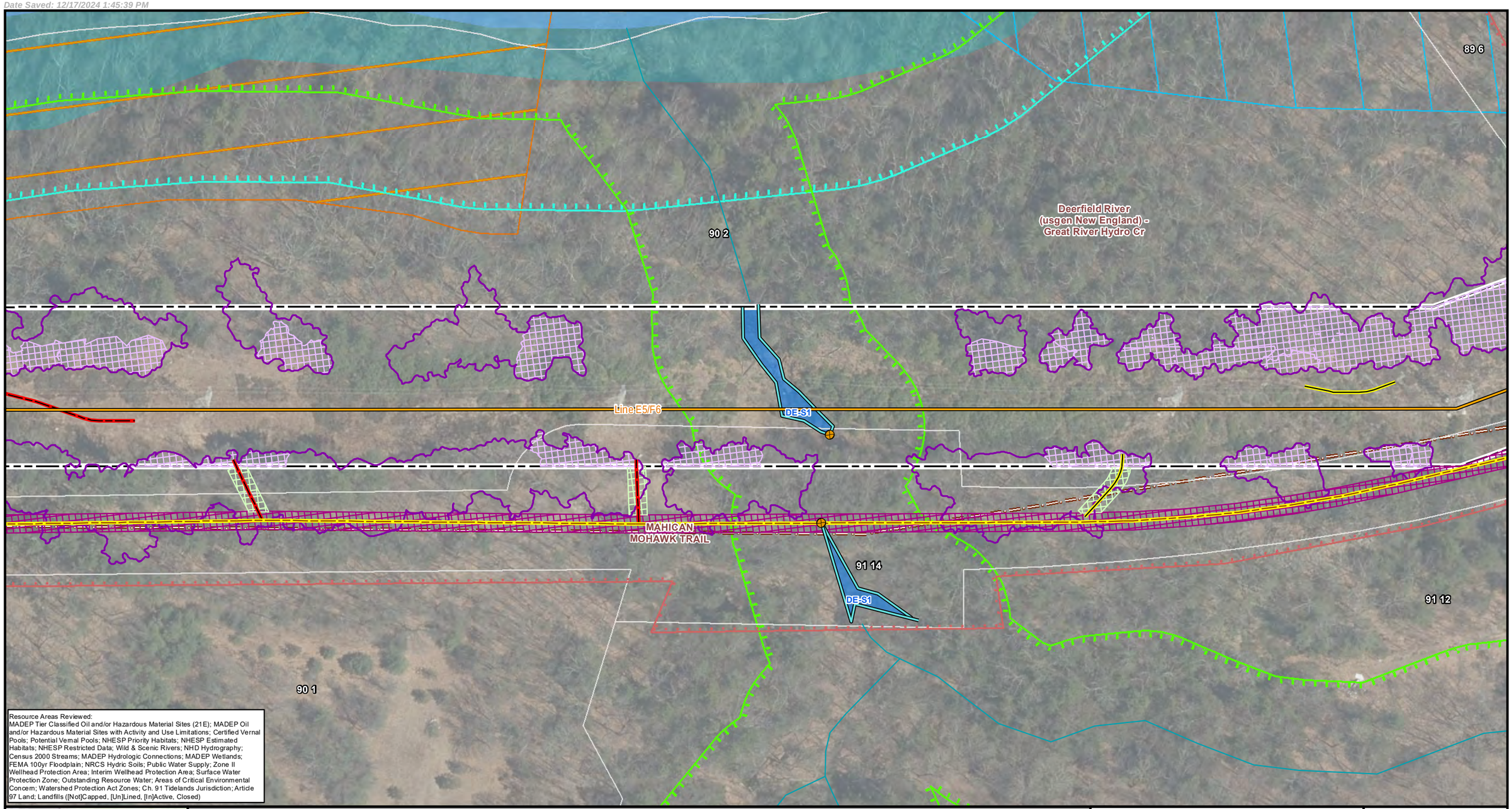

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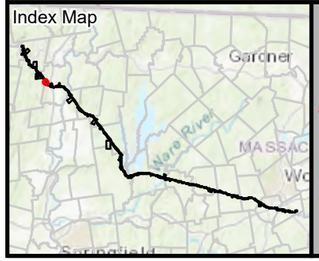

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Deerfield, MA

MassGIS
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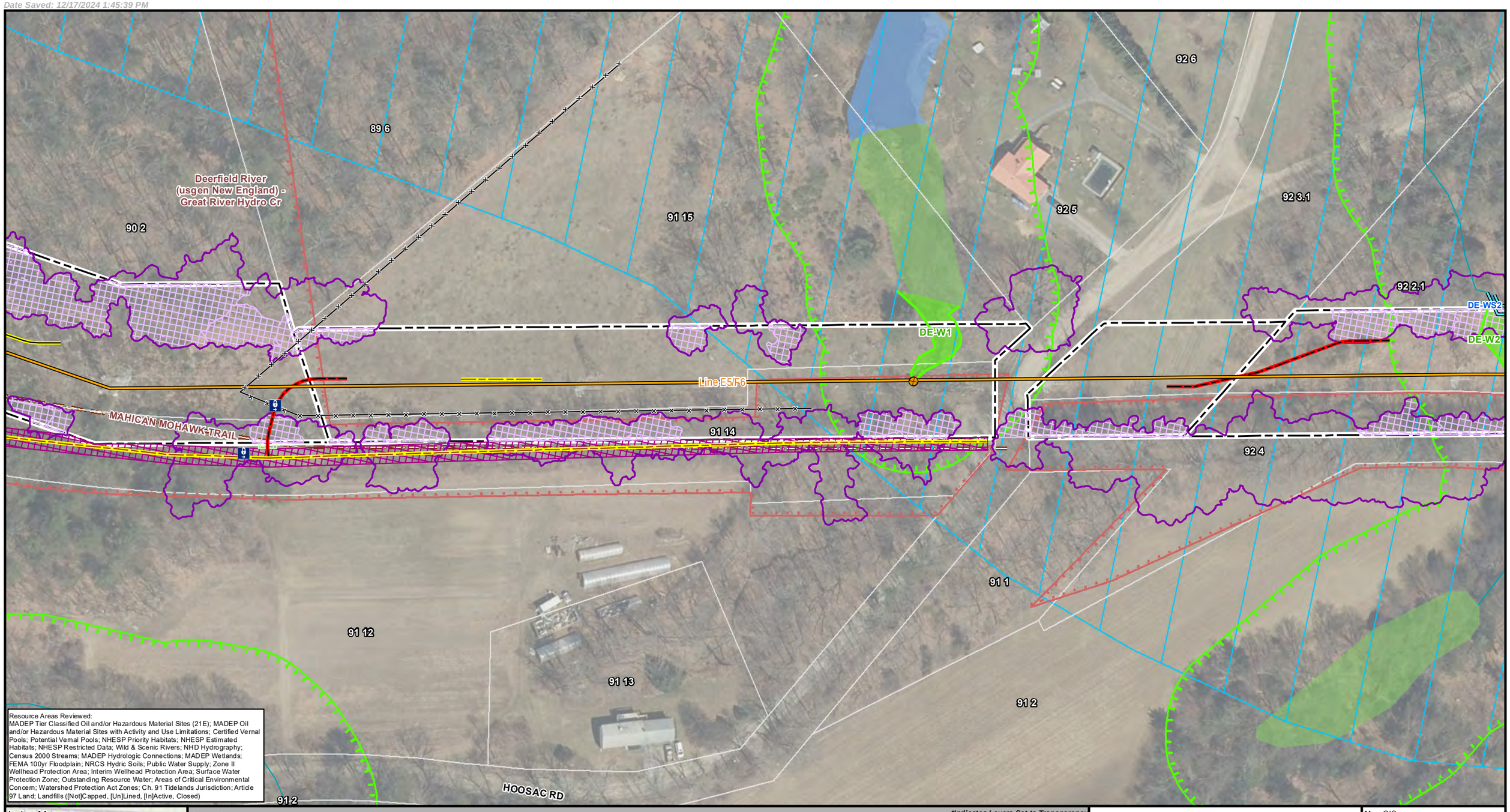

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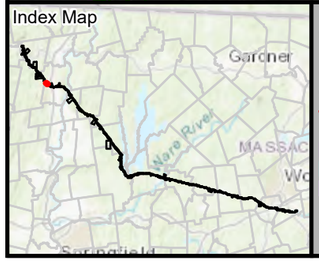

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Deerfield, MA

MassGIS
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92 3
92 13
92 3.1
92 14
92 2.1
106 7
Mill Village
92 2
106 6
Line E5/F6
DE-WS2
DE-W3
DE-W2
DE-W2
SANDGULLY RD
Plant
DE-WS2
92 4
Deerfield River
(usgen New England) -
Great River Hydro Cr
STILLWATER RD
106 16
92 1
92 15
91 2
Bar Way
Farm Inc
106 17
106 5

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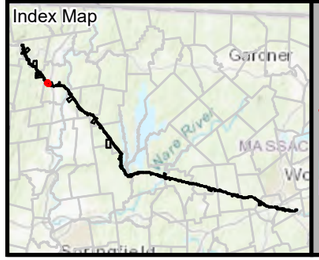

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Article 97 Lands
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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Deerfield, MA

MassGIS
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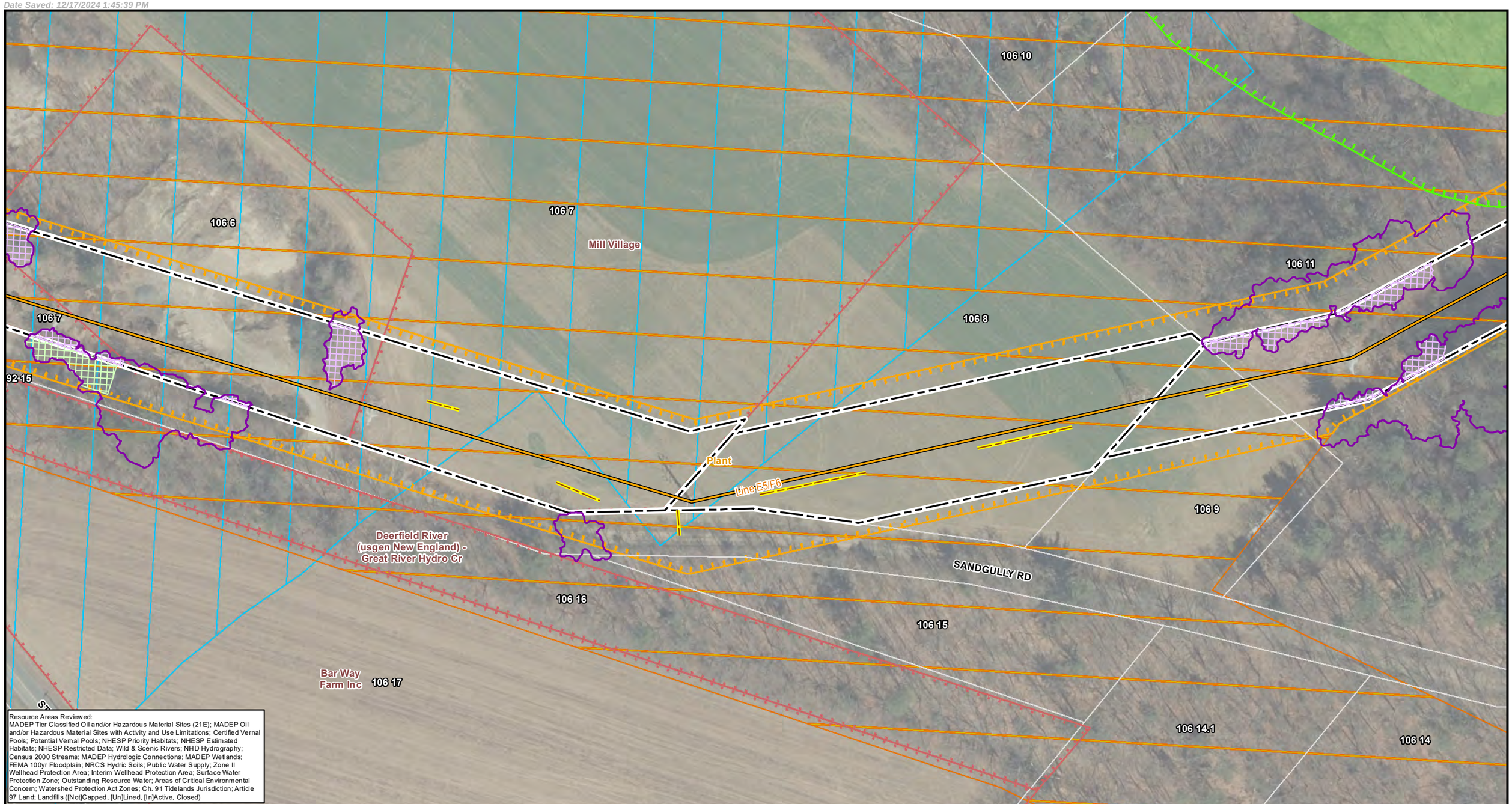

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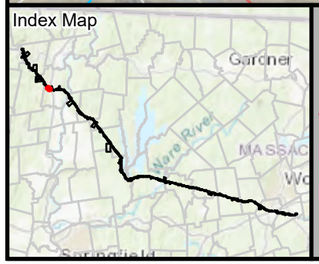

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Article 97 Lands

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Deerfield, MA

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DE-WS4
DE-VP-550
DE-W6
DE-WS6
DE-W6
Plant
Line E5/F6
106 11
105 2
105 4
105 5
105 3

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Gardner
MASSAC
Springfield

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

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DE-WS4
DE-VP-550
DE-W6
Sheet 39A
Sheet 39
DE-WS5
DE-WS7
DE-WS7A
DE-W7
DE-WS7A
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DE-W6
91
91
DE-W10
Plant
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I-91
111 53
111 53
111 55

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Deerfield, MA
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MassGIS
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Deerfield River (usgen New England) - Great River Hydro Cr
Deerfield River Access
I- 91
STILLWATER RD
DE-W5
DE-W4
DE-W6
DE-W7
DE-VP-550
DE-WS5
DE-WS4
DE-WS6
Sheet 39A
Sheet 39
Plant
Line E5F6

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Deerfield, MA

MassGIS
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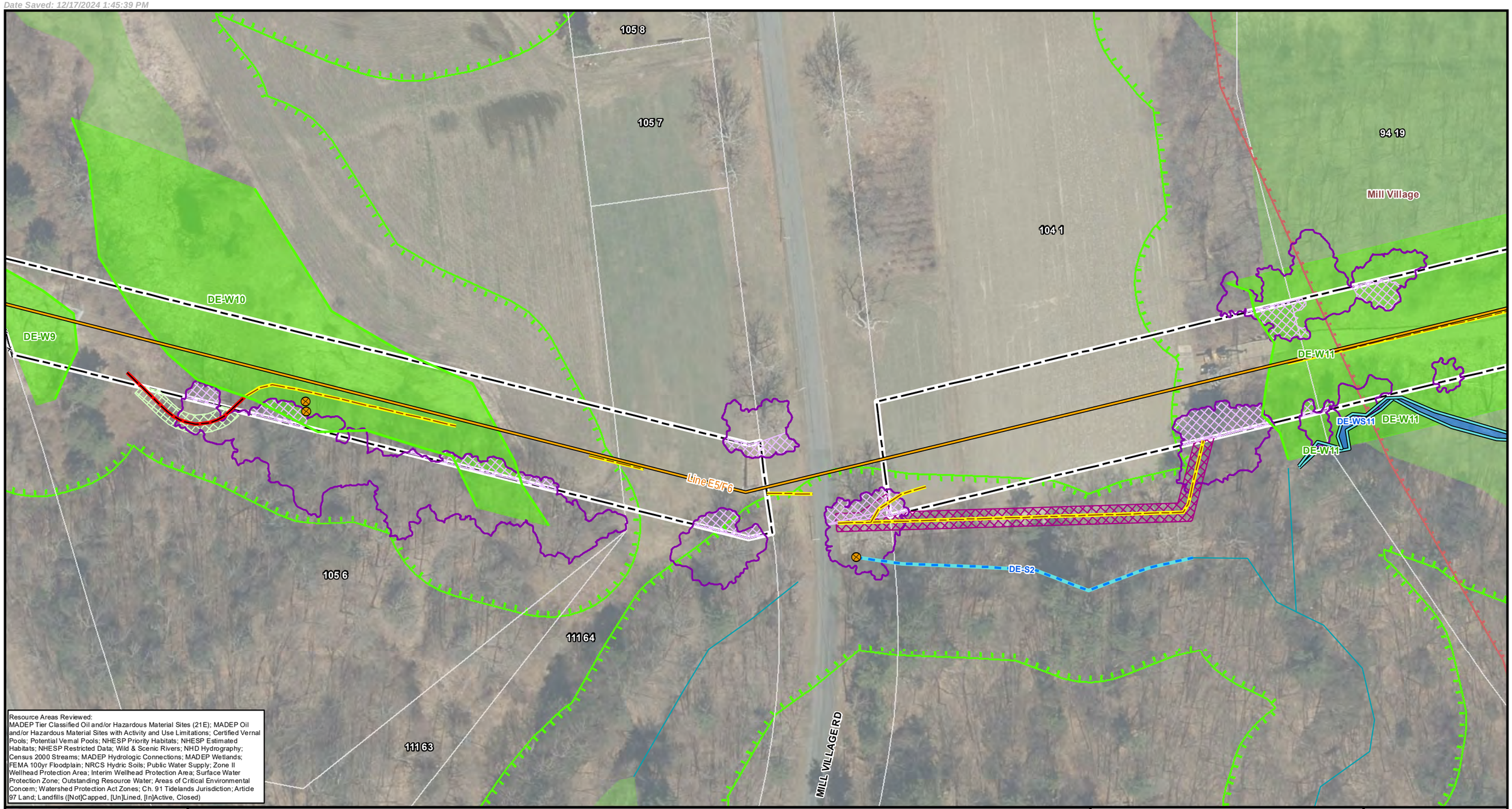

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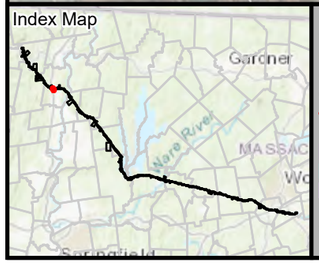

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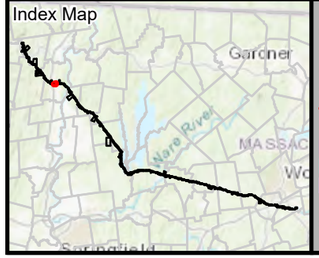

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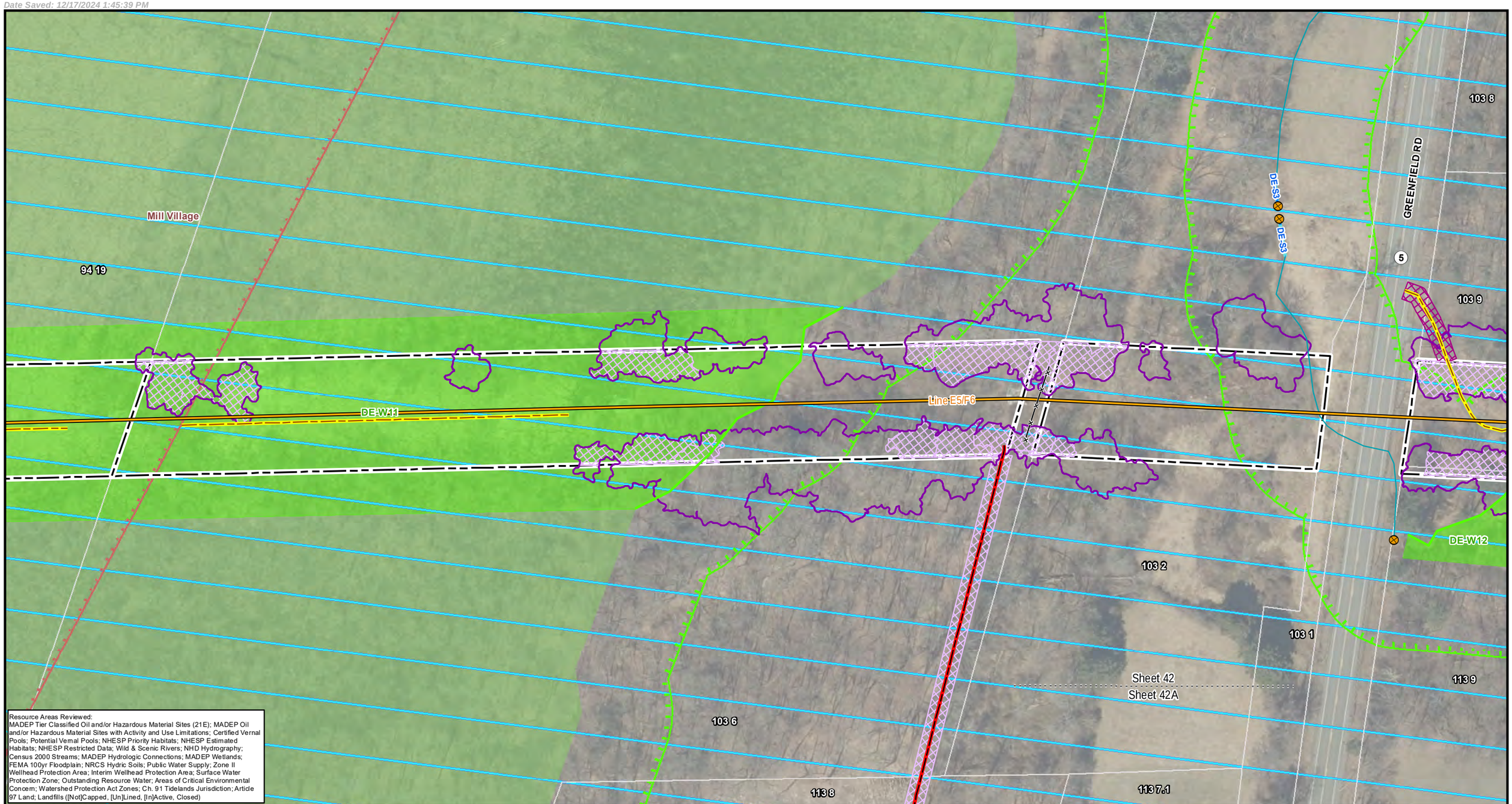

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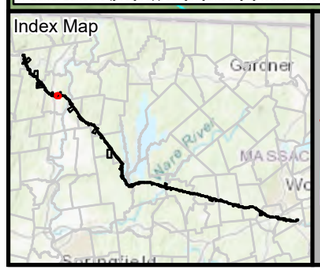

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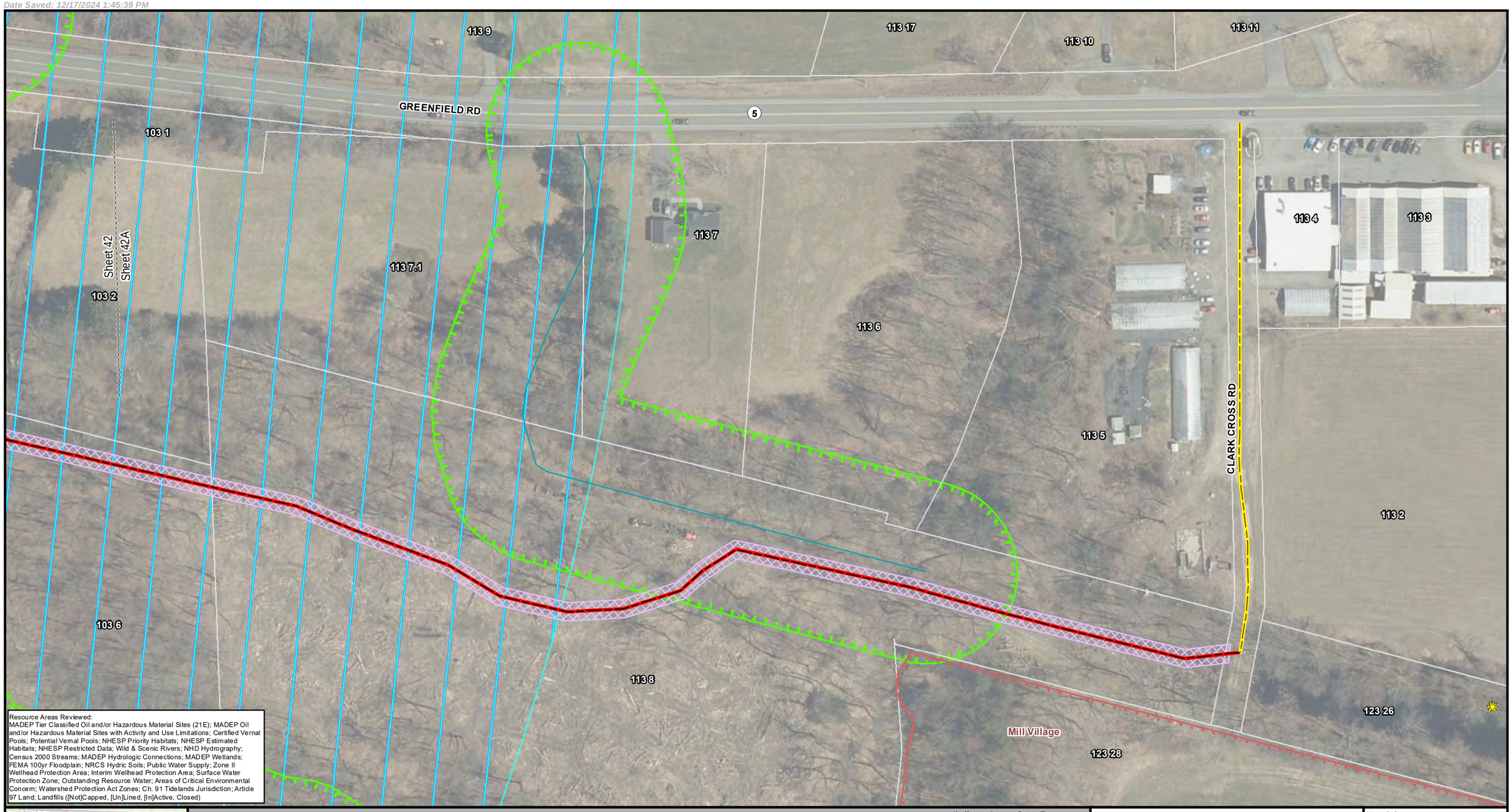

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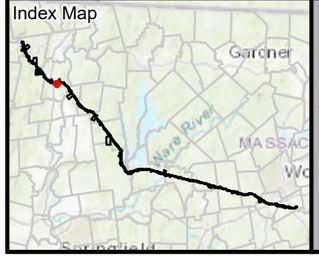

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Deerfield, MA
Page 42A of 240

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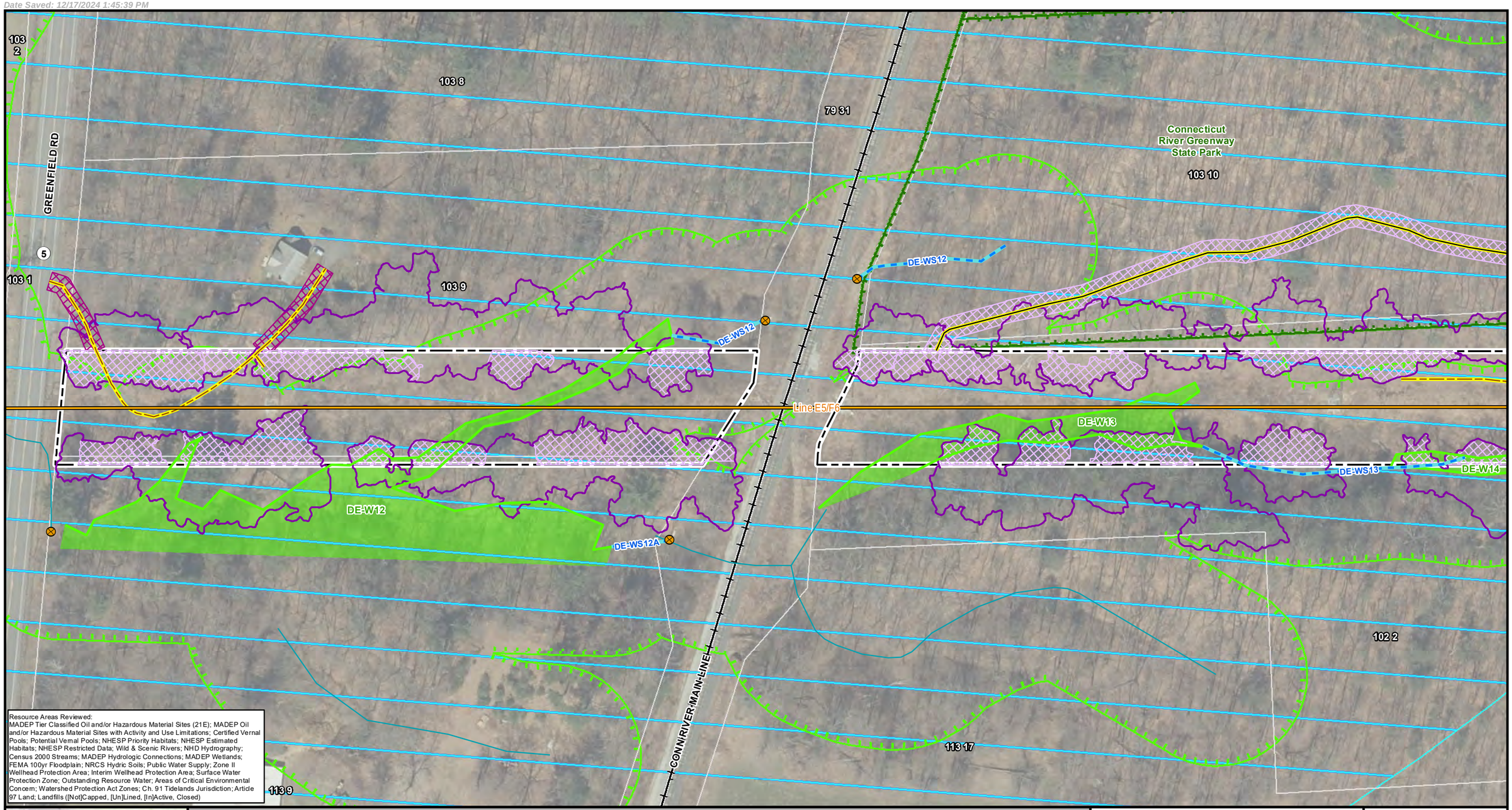

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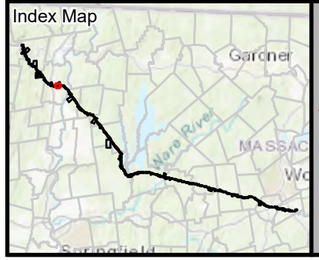

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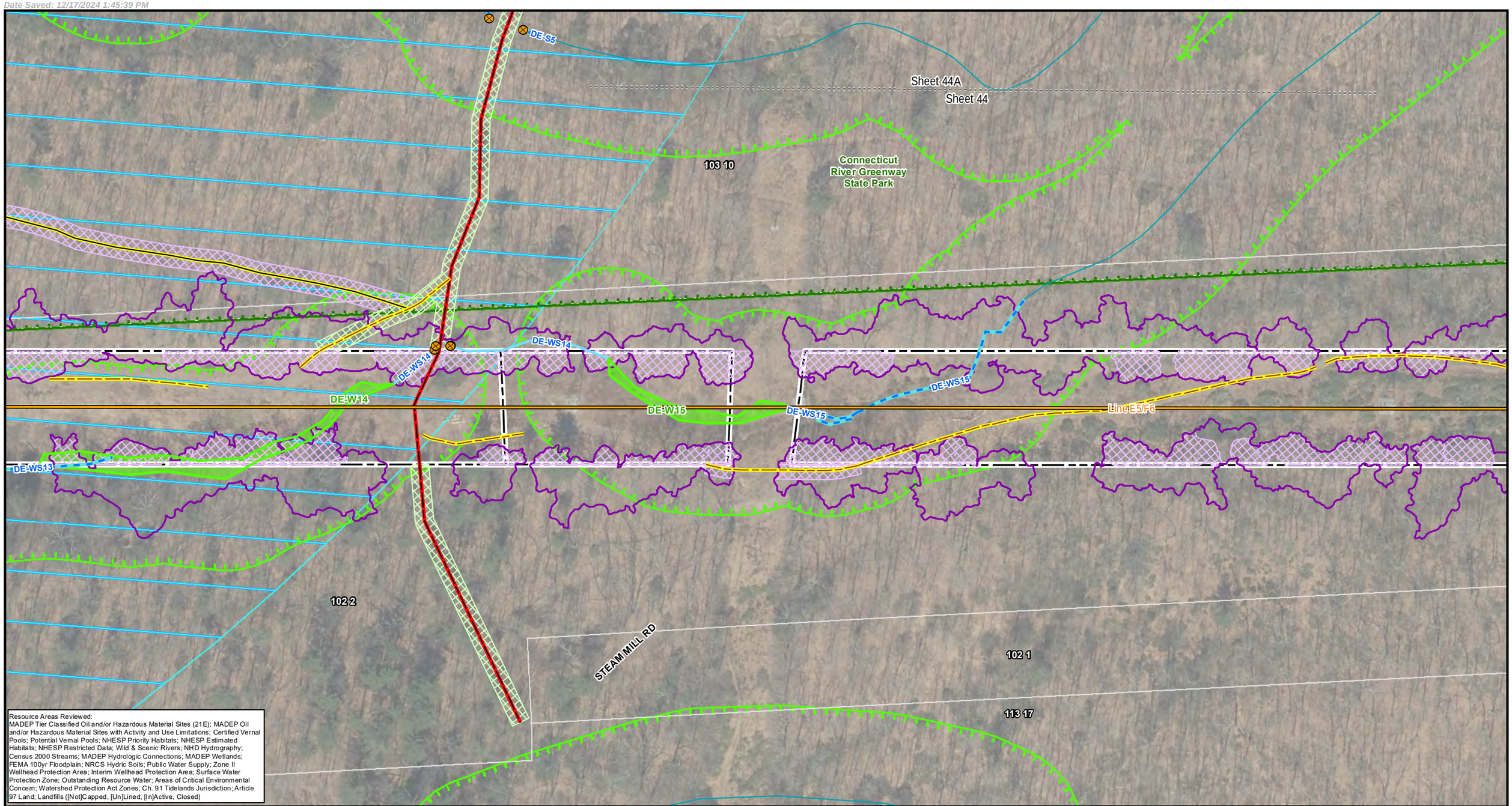

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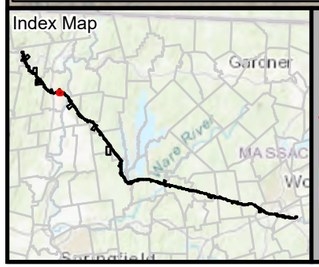

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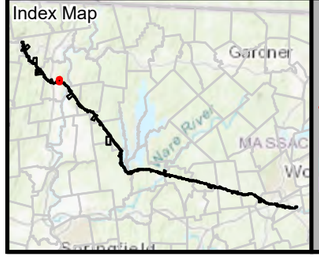

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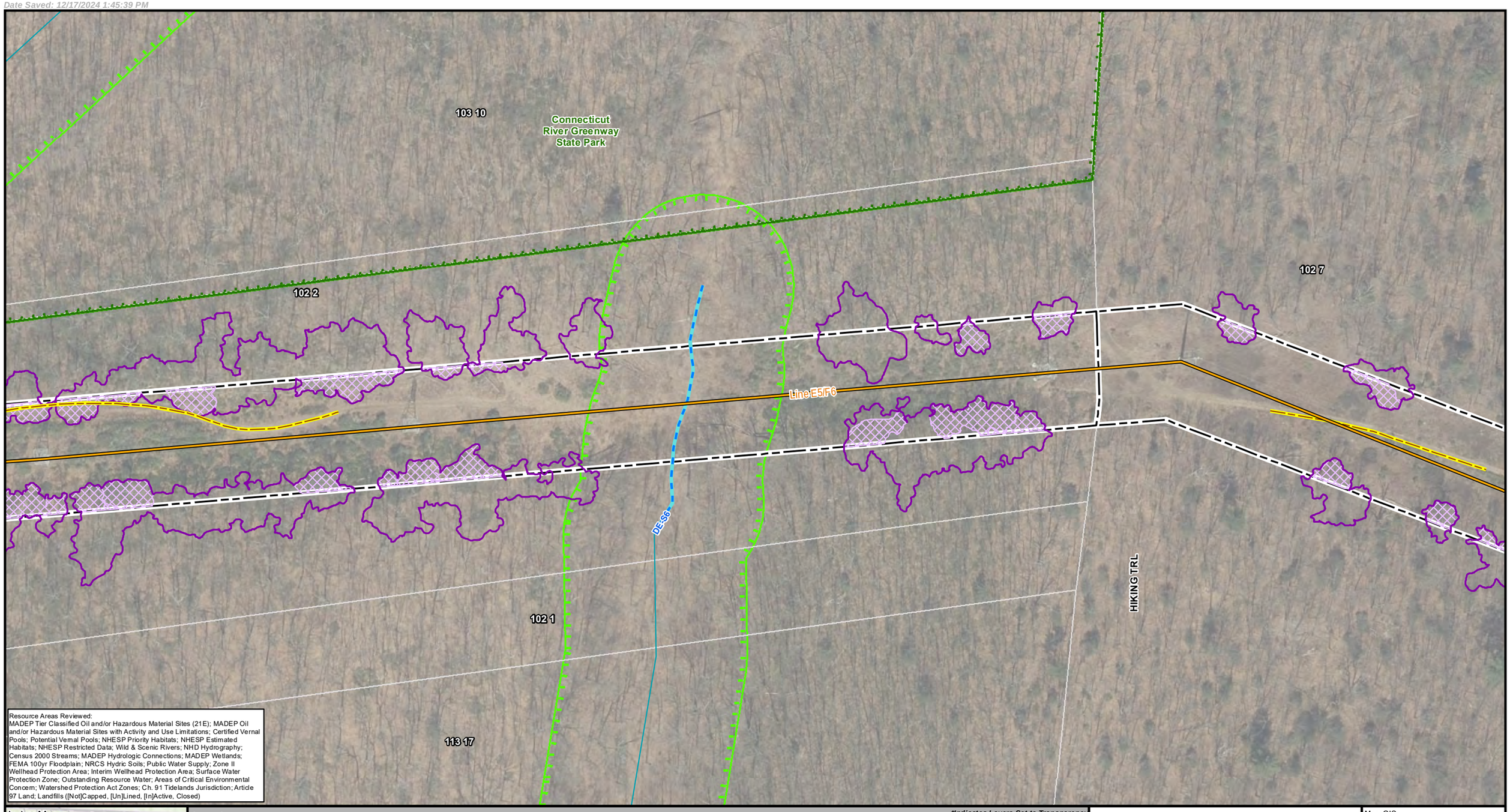

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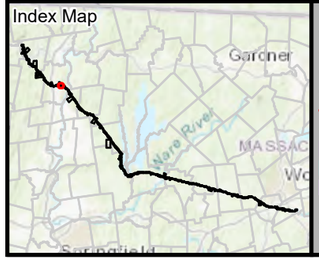
Index Map



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- DCR-State Parks & Recreation

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Deerfield, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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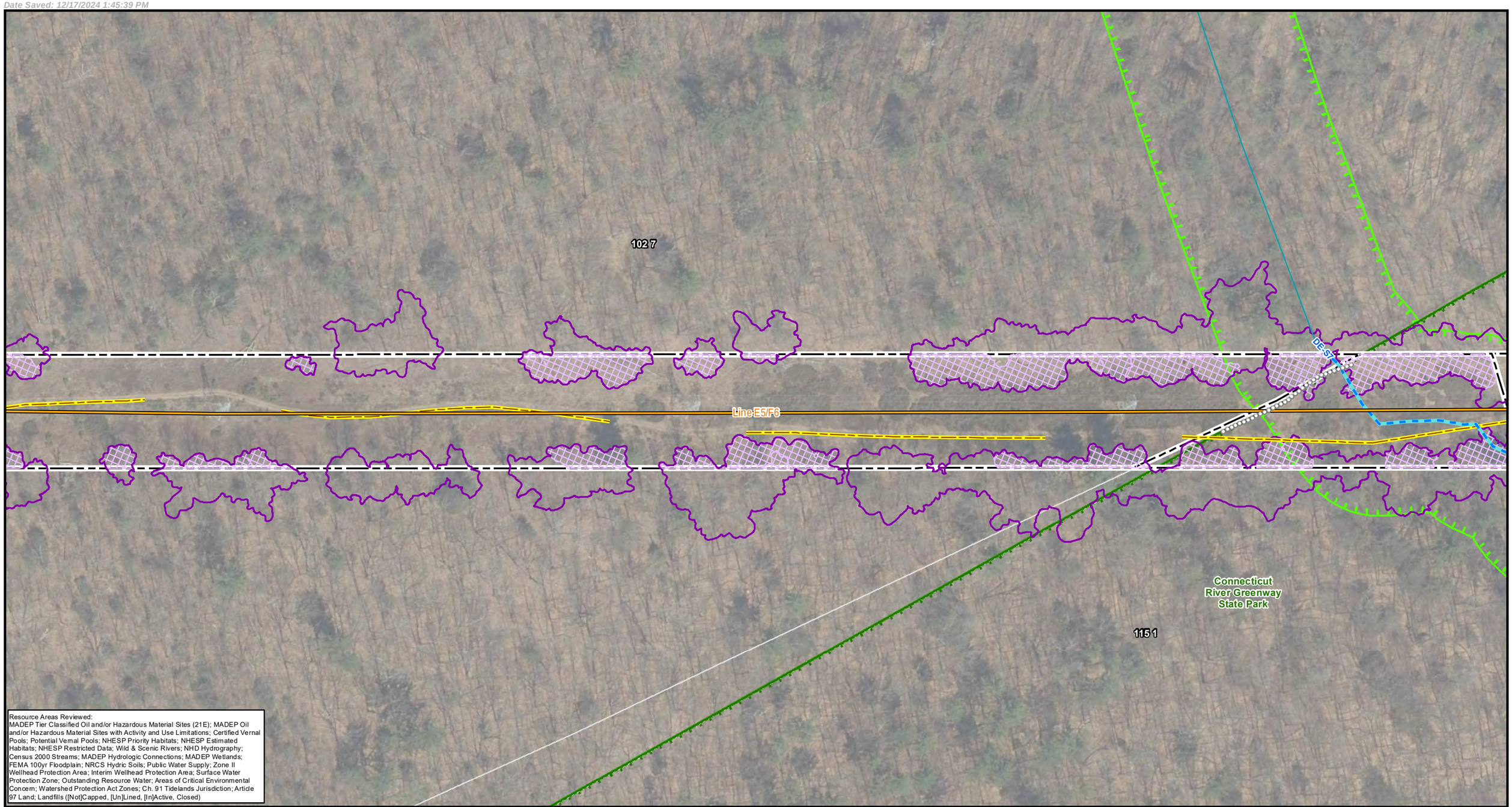

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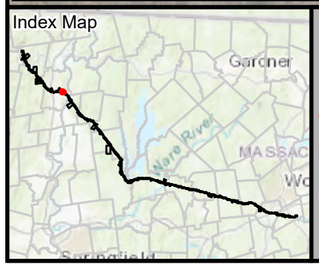

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

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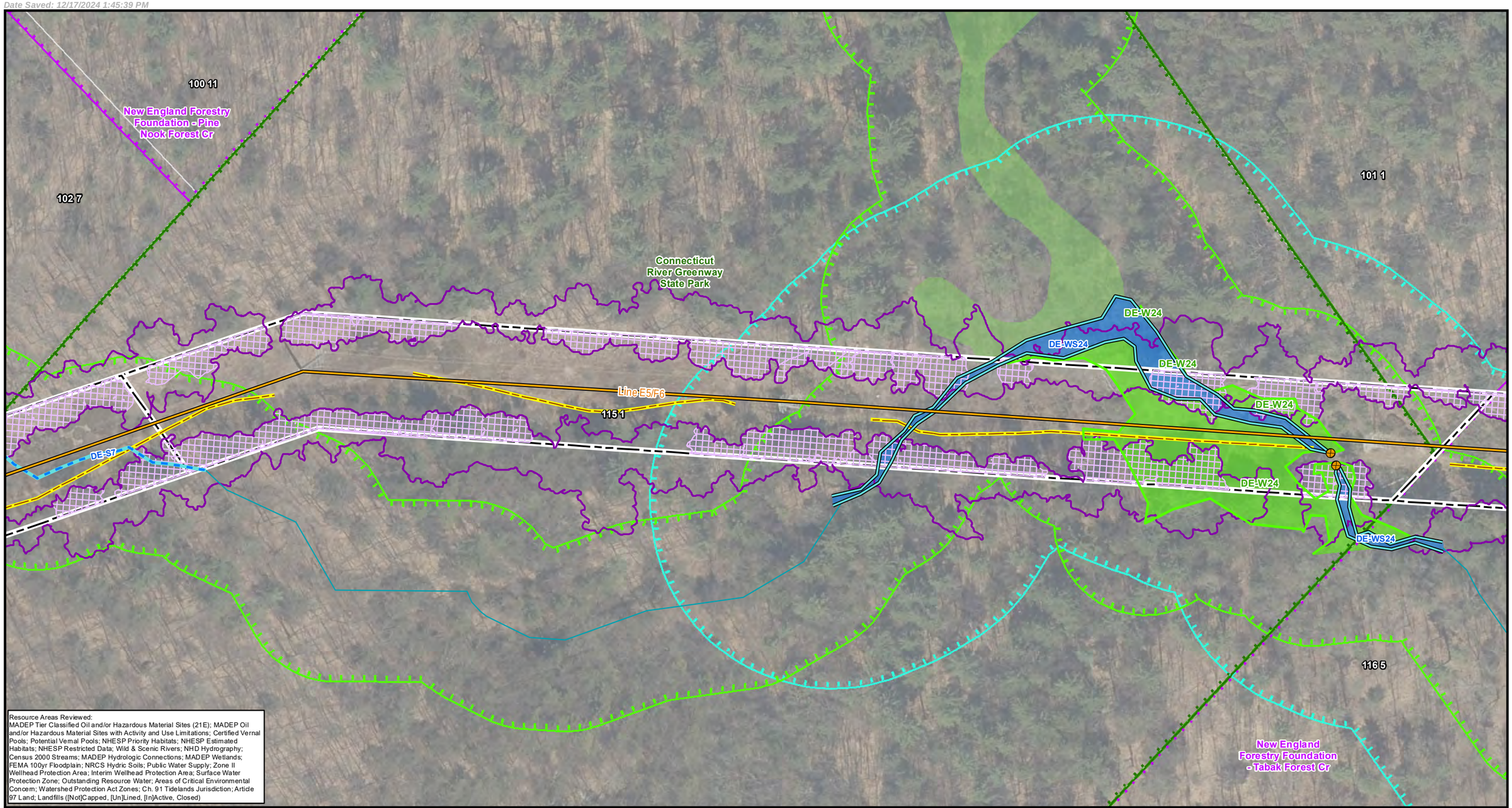

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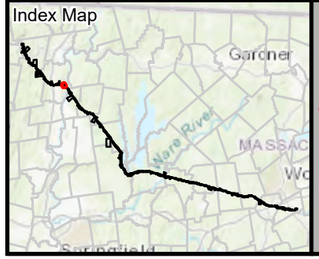

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Deerfield, MA

MassGIS
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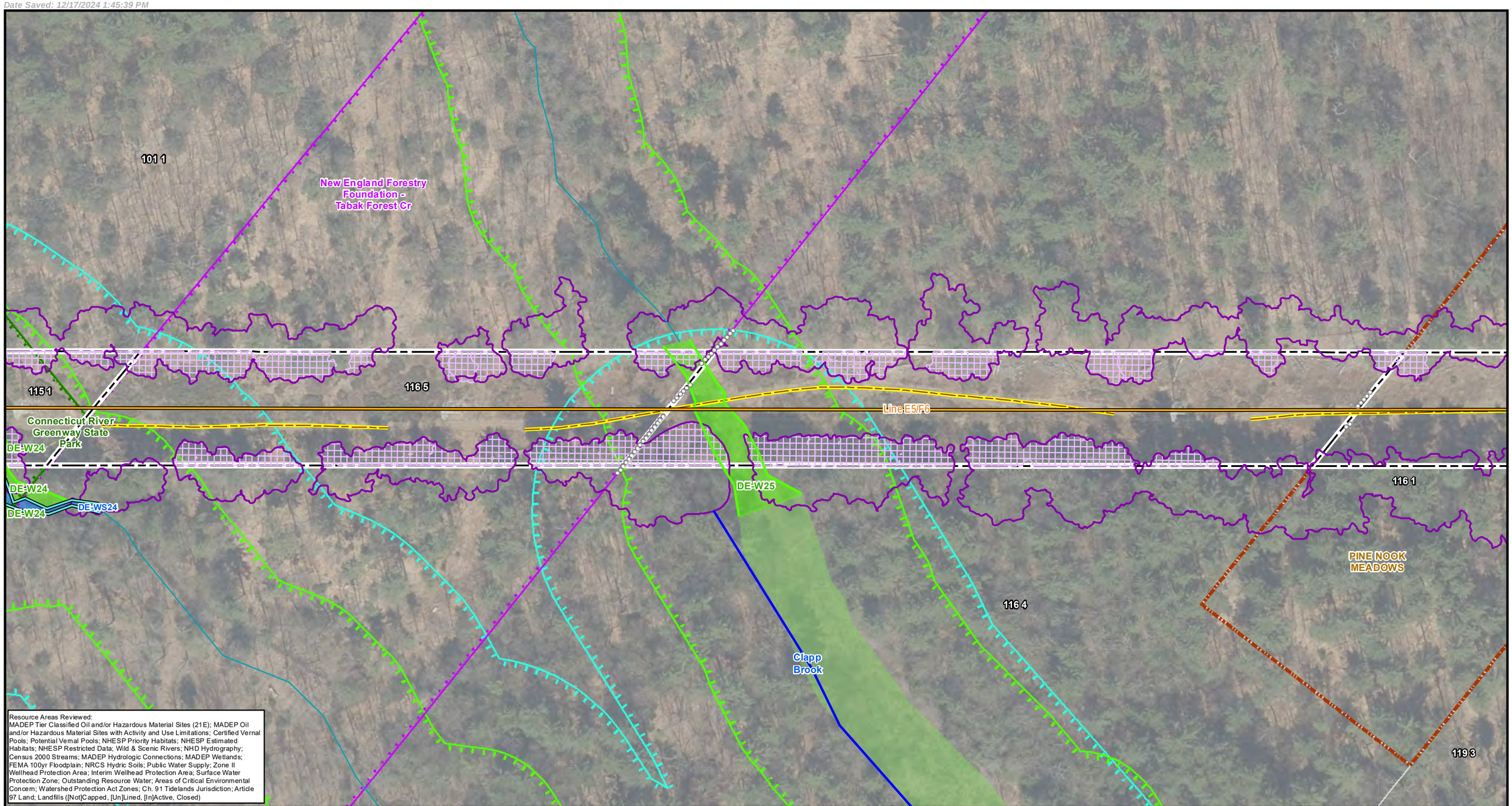

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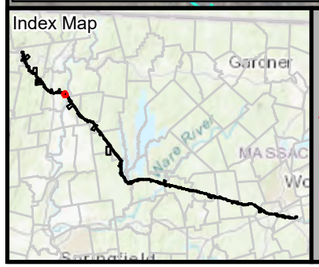

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Deerfield, MA

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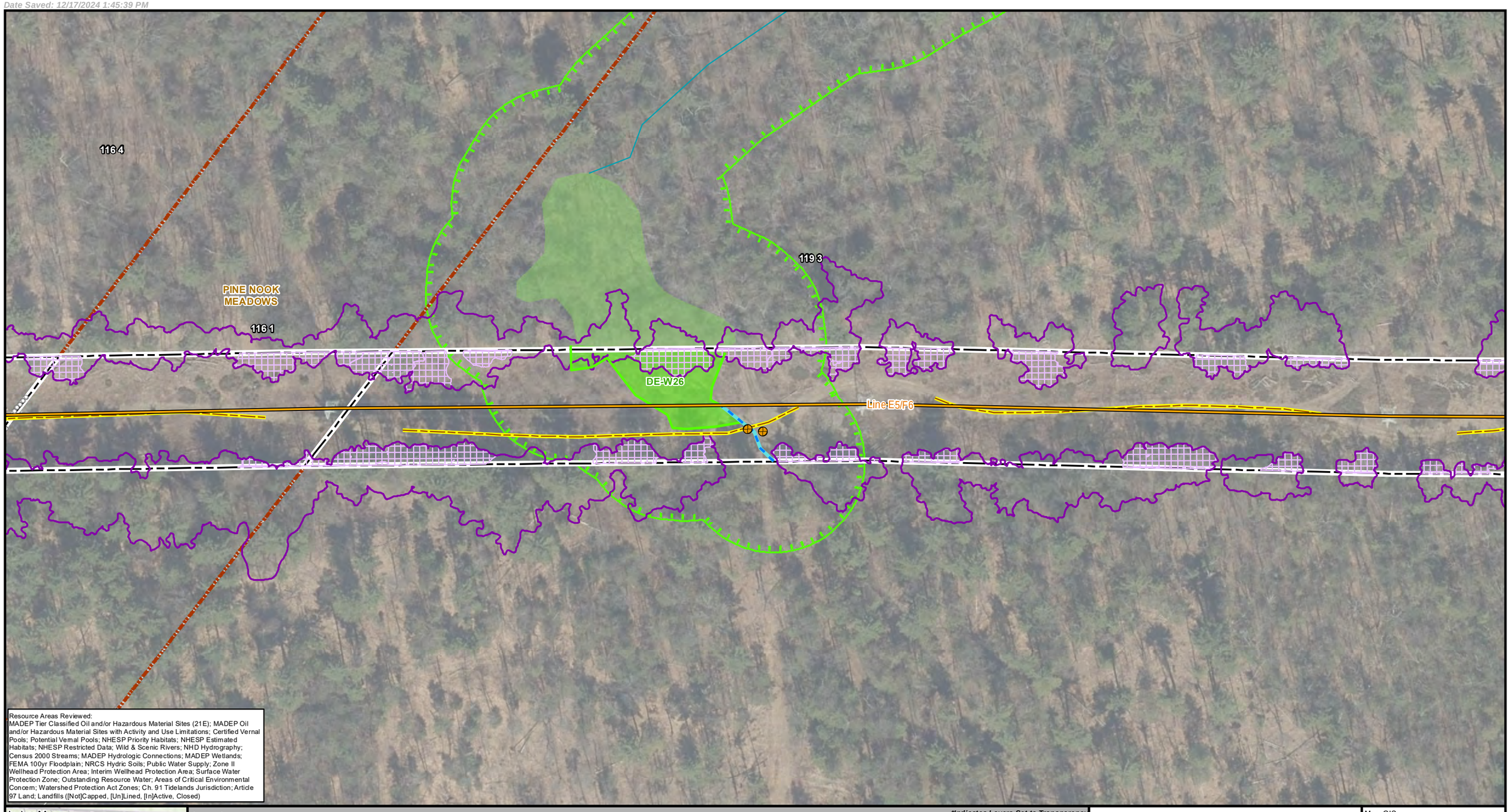

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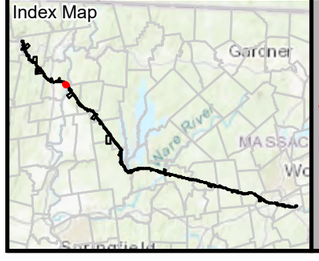

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Deerfield, MA

MassGIS
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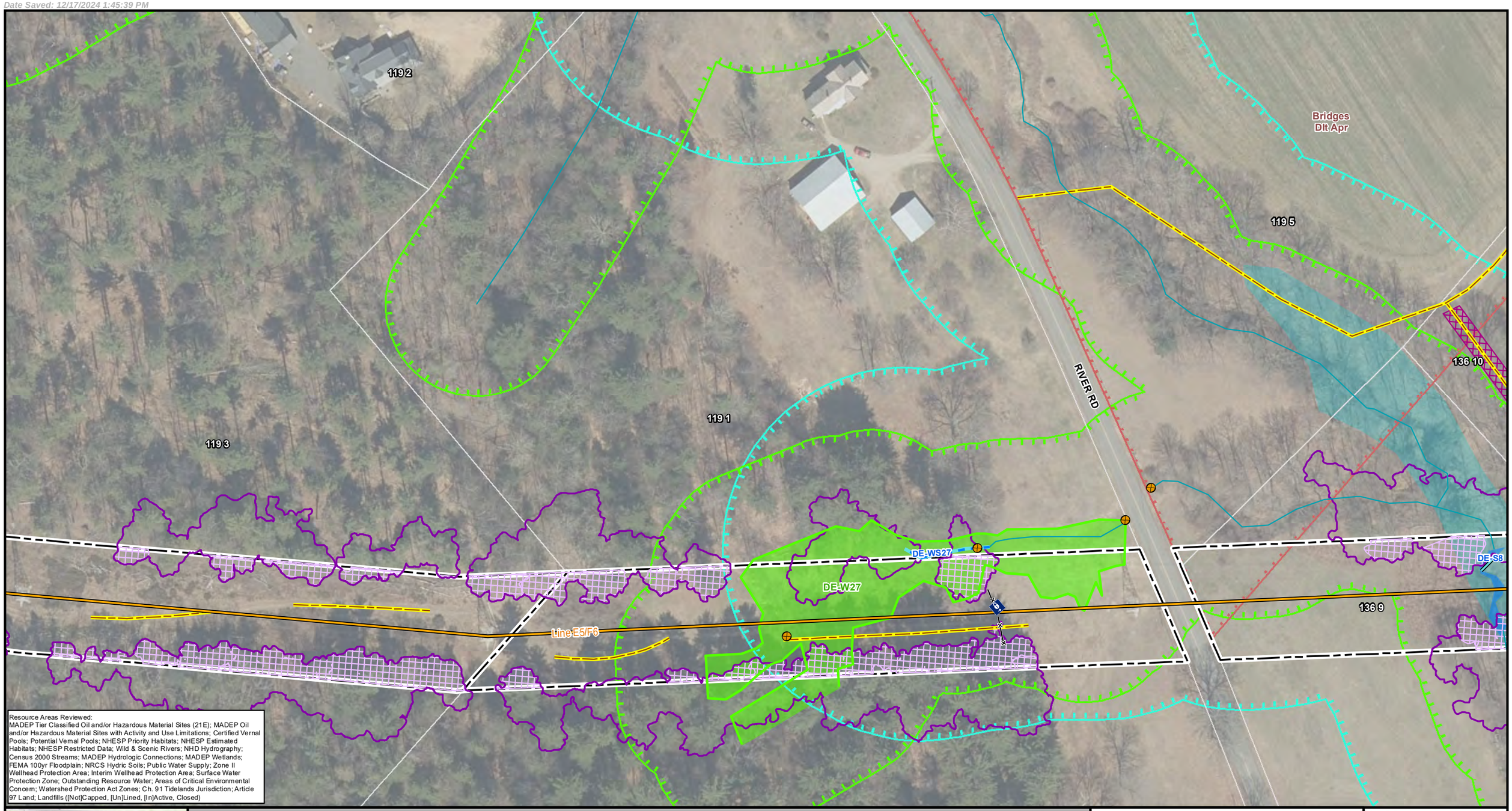

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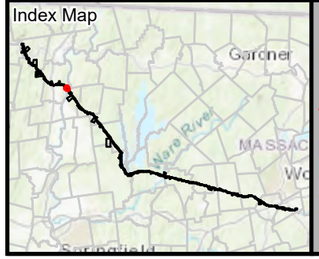

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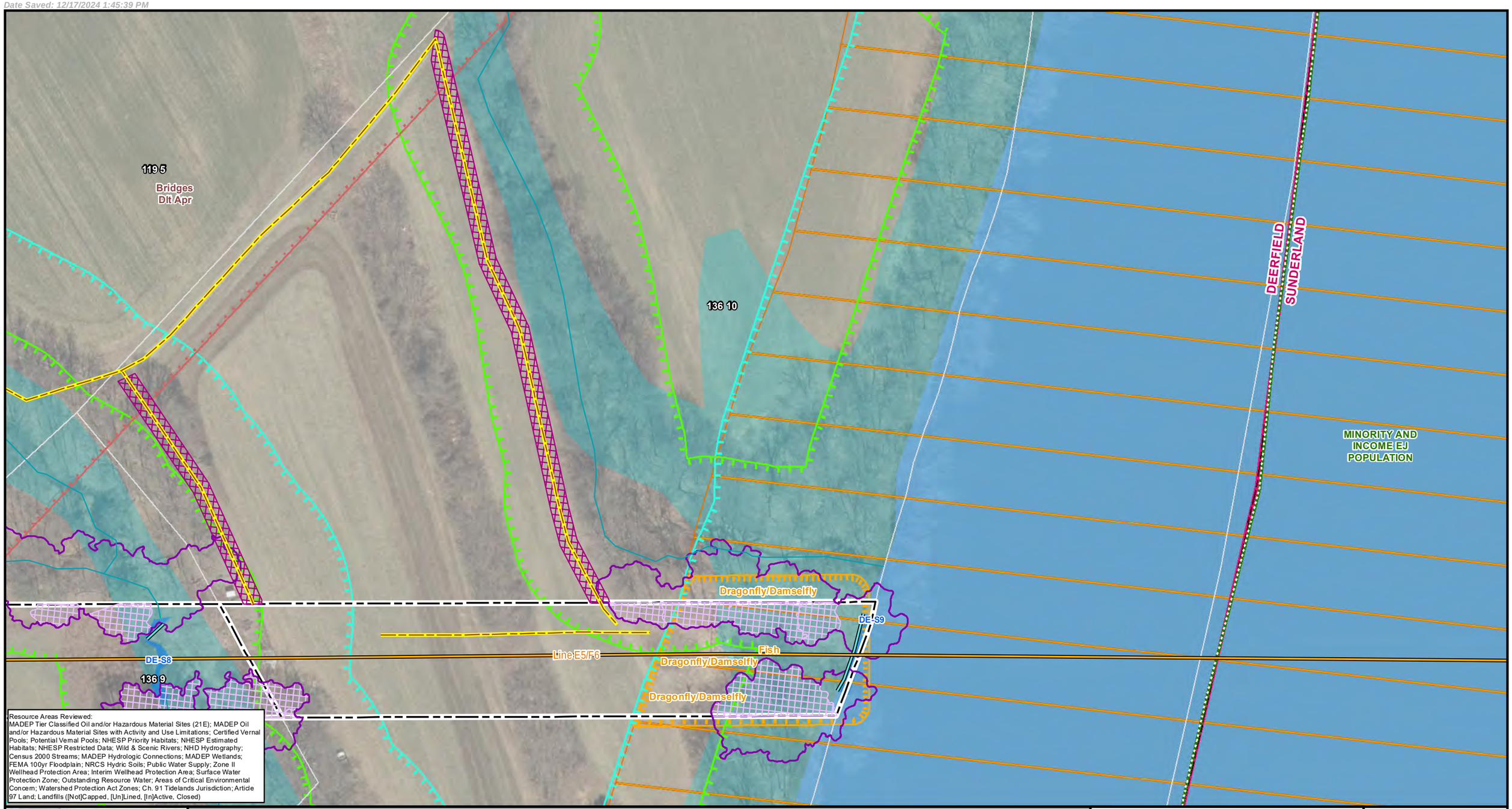

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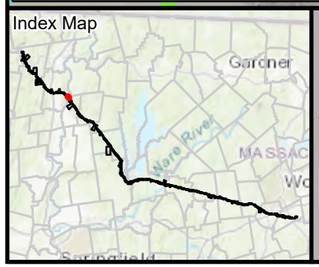

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Deerfield & Sunderland, MA

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1066
GUNN CROSS RD
1076
1068
Gunn Brook
Dragonfly/Damselfly
Dragonfly/Damselfly
Fish
DE-S9
Dragonfly/Damselfly
SU-W1
SU-W1
SU-WS1
1075
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SU-W2
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FALLS RD

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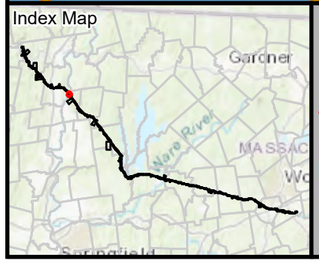

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- Private

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- Minority and Income

*Indicates Layers Set to Transparency

1 inch = 100 feet
0 50 100
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Sunderland, MA
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MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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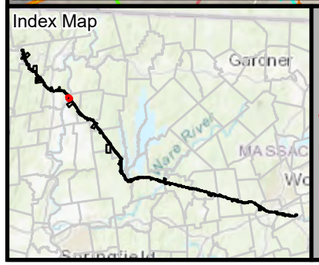

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Sunderland, MA

MassGIS
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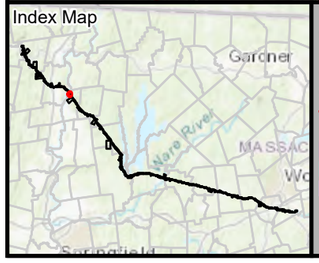

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Sunderland, MA

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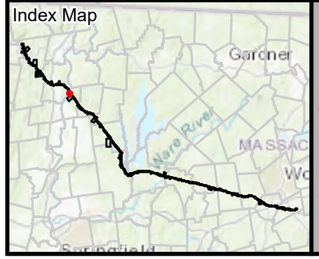

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Sunderland, MA

MassGIS
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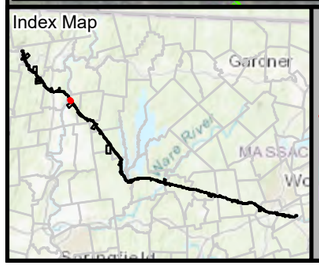

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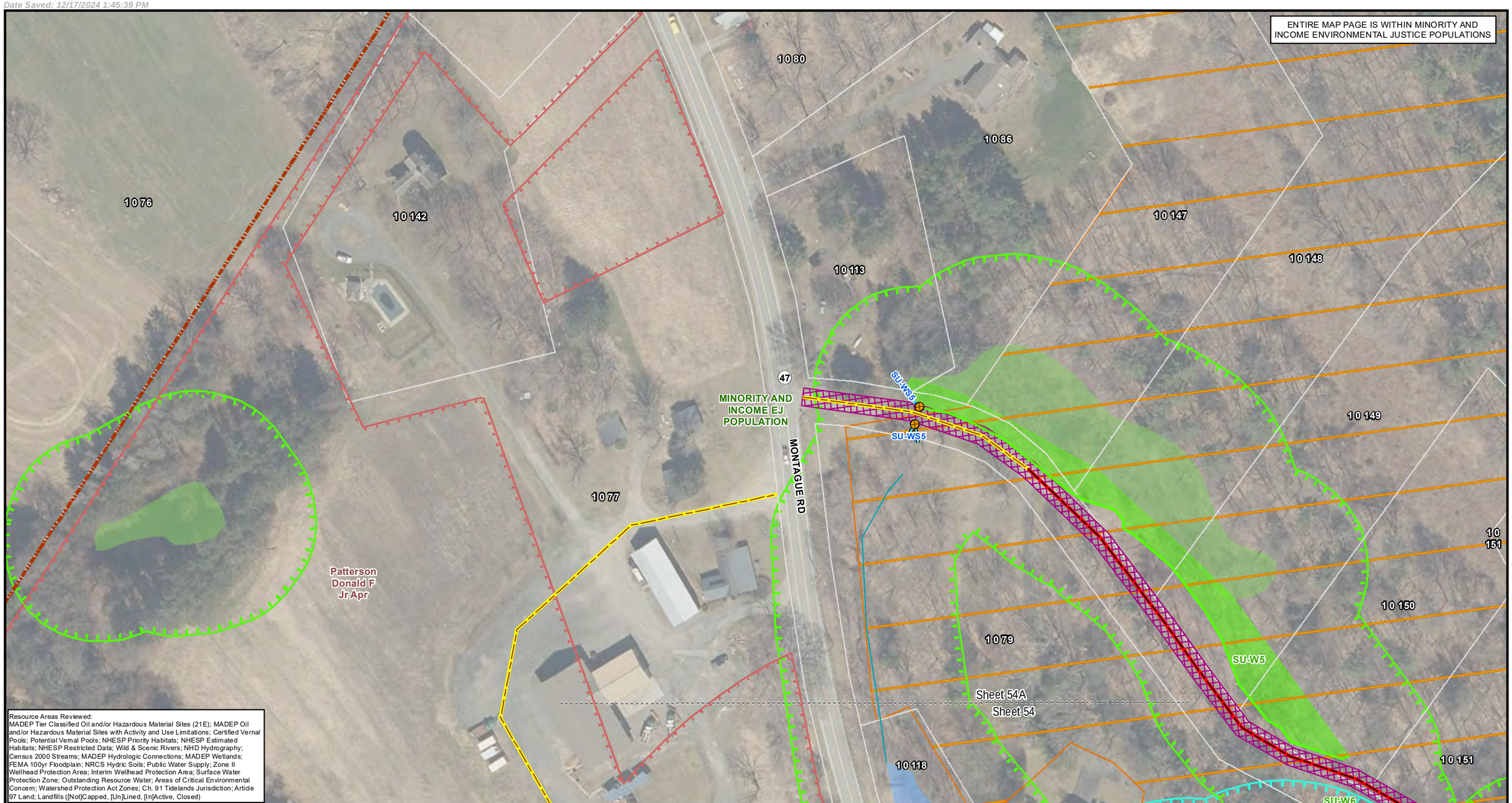
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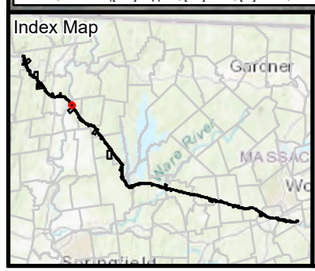

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Environmental Resources Map

Sunderland, MA
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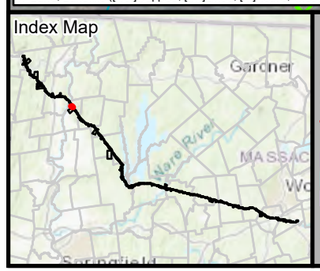

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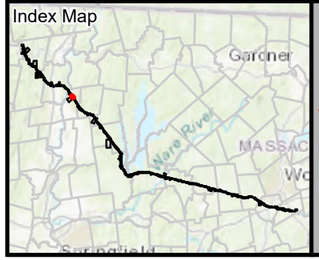
MINORITY AND INCOME EJ POPULATION
Mt. Toby Wma
Sheet 56
Sheet 56A
N MOUNTAIN RD

Resource Areas Reviewed:
MADEP Tier Classified Oil and/or Hazardous Material Sites (21E); MADEP Oil and/or Hazardous Material Sites with Activity and Use Limitations; Certified Vernal Pools; Potential Vernal Pools; NHESP Priority Habitats; NHESP Estimated Habitats; NHESP Restricted Data; Wild & Scenic Rivers; NHD Hydrography; Census 2000 Streams; MADEP Hydrologic Connections; MADEP Wetlands; FEMA 100yr Floodplain; NRCS Hydric Soils; Public Water Supply; Zone II Wellhead Protection Area; Interim Wellhead Protection Area; Surface Water Protection Zone; Outstanding Resource Water; Areas of Critical Environmental Concern; Watershed Protection Act Zones; Ch. 91 Tidelands Jurisdiction; Article 97 Land; Landfills ([Not]Capped, [Un]Lined, [In]Active, Closed)

Index Map


Legend

- Project Route
- Existing Access
- Proposed Access
- Edge of ROW
- National Grid Owned Property
- Field Delineated Wetland Lines
- Field Delineated Wetlands*
- Field Delineated Vernal Pool*
- Estimated Wetland
- Field Delineated Stream Centerline
- Field Delineated Inland Bank
- Field Delineated Ditch / Swale
- Estimated Inland Bank
- Estimated Stream Centerline
- Field Delineated Stream Area*
- Approximate Water Line
- Perennial Stream
- Coldwater Fisheries Resources
- MADEP Hydrologic Connections
- MADEP Wetlands*
- MADEP Open Water*
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- 200ft Riverfront Area
- FEMA 100yr Floodplain*
- Outstanding Resource Water
- NHESP Priority & Estimated Habitats
- NHESP Restricted Data
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- Surface Water Protection Zone
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- MADEP AUL Site
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- MHC Historic Area
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- Culvert
- Catch Basin
- Access Gate
- Railroad
- Hiking Trails
- Approximate Pipeline
- Fenceline
- Guardrail
- Stonewall
- Existing Treeline
- Tree Removal
- Selective Tree Removal
- Pruning
- Town Boundary
- Parcel Boundaries

Article 97 Lands
- Dept. of Fish & Game

Environmental Justice Populations 2020
- Minority and Income

*Indicates Layers Set to Transparency

1 inch = 100 feet
0 50 100
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Sunderland, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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SU-W13
Reptile
SU-S2
SU-S27
SU-VP-502-3
MINORITY AND INCOME EJ POPULATION
Mt. Toby Wma
N MOUNTAIN RD
UNKNOWN
UNKNOWN
209
2026
2027
2011
2025
2024
2012
2012
2010
2067
2031
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2013
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Sheet 56A

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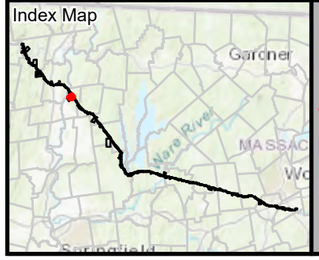

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Environmental Resources Map

Sunderland, MA
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Sheet 56A
Sheet 56B

MINORITY AND INCOME EJ POPULATION

UNKNOWN

SU-S27
SU-WS26
SU-W26
SU-WS26
SU-VP-502-3
SU-W24
SU-W24
SU-WS24
SU-WS24
SU-W24
SU-W23
SU-W23
SU-WS23
SU-WS23
SU-VP-502-2
SU-W21
SU-W22
SU-W20
SU-W20

N BEARS DEN DR
BEARS DEN DR
PARK RD
N MOUNTAIN RD
CLAYBROOK RD
GUNN MTN RD
Mt. Toby Wma

2027
2024
2012
2012
2067
2018
4041
4042
4045
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403
402
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401

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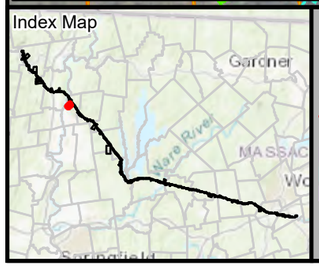

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- Dept. of Fish & Game

Environmental Justice Populations 2020
- Minority and Income

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Sunderland, MA
Page 56B of 240

MassGIS
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301
MINORITY AND INCOME EJ POPULATION
208
3032
Reptile
SU-W13
SU-W14
SU-WS13
SU-WS13A
Line E5/E6
SU-S2
N MOUNTAIN RD
209
Mt. Toby Wma
3031

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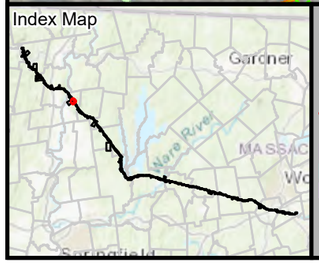

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3010
3011
3032
Mt. Toby Wma
Plant
Reptile
Line E5/F6
209
3031
MINORITY AND INCOME EJ POPULATION
3013

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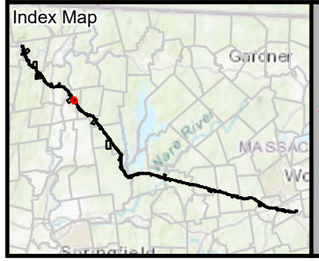

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- Selective Tree Removal
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- Parcel Boundaries

Article 97 Lands

- Dept. of Fish & Game

Environmental Justice Populations 2020

- Minority and Income

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0 50 100
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Sunderland, MA

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309
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MIDDLE MOUNTAIN ROAD
MIDDLE MTN RD
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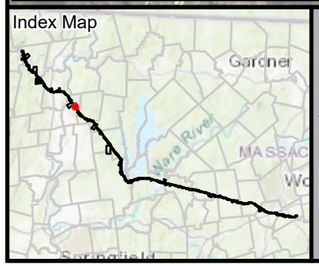

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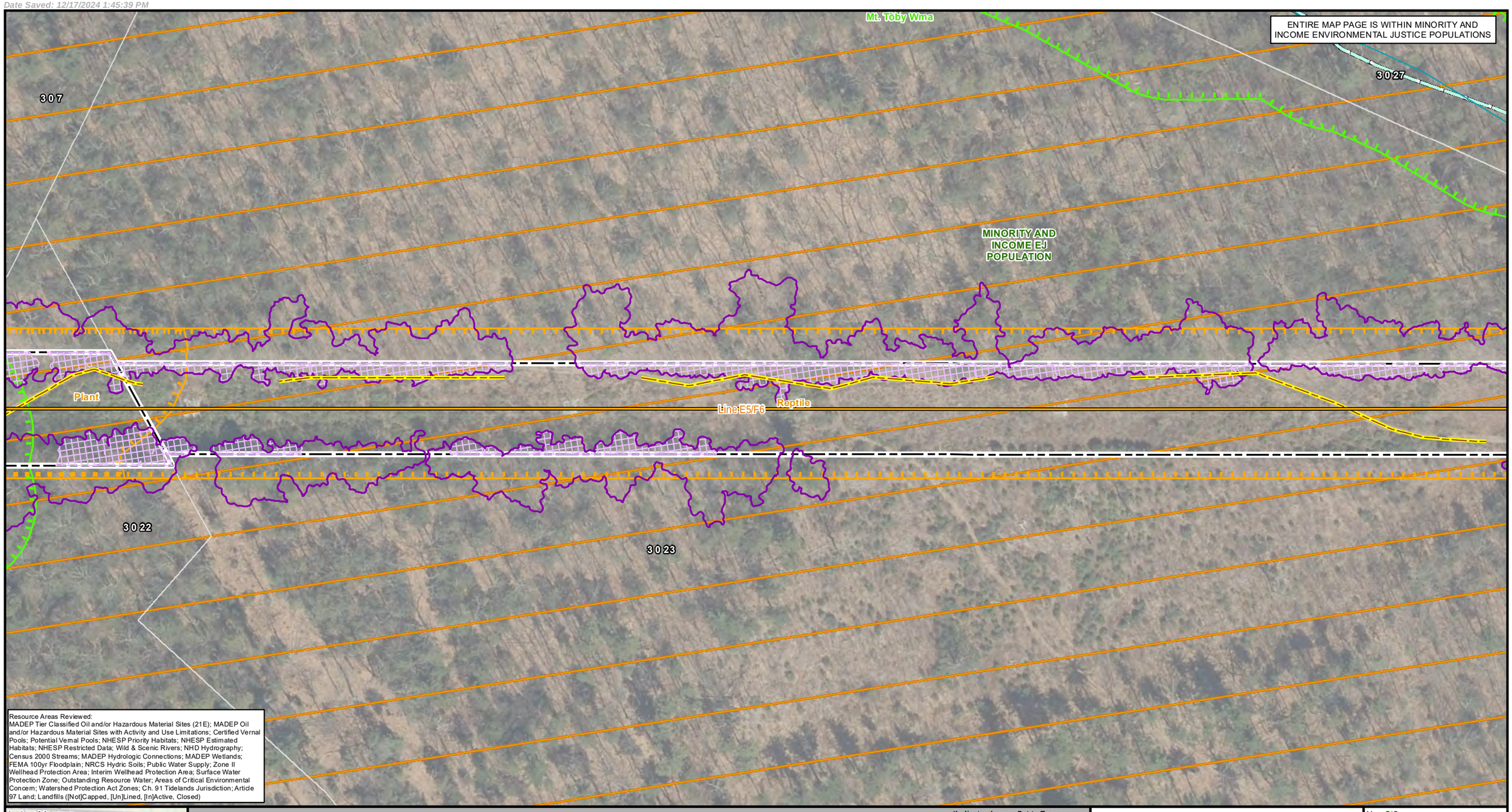

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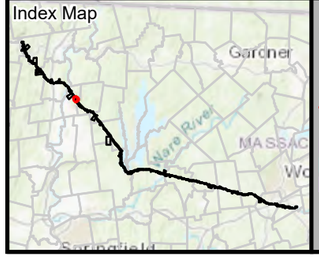

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ENTIRE MAP PAGE IS WITHIN MINORITY AND INCOME ENVIRONMENTAL JUSTICE POPULATIONS

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MINORITY AND INCOME EJ POPULATION

SU-S4

SU-S4

SU-S5

SU-WS-9

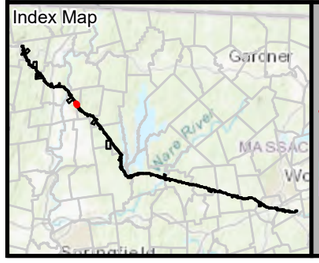
SU-W19

Reptile

Line E5/F6

Resource Areas Reviewed:
MADEP Tier Classified Oil and/or Hazardous Material Sites (21E); MADEP Oil and/or Hazardous Material Sites with Activity and Use Limitations; Certified Vernal Pools; Potential Vernal Pools; NHESP Priority Habitats; NHESP Estimated Habitats; NHESP Restricted Data; Wild & Scenic Rivers; NHD Hydrography; Census 2000 Streams; MADEP Hydrologic Connections; MADEP Wetlands; FEMA 100yr Floodplain; NRCS Hydric Soils; Public Water Supply; Zone II Wellhead Protection Area; Interim Wellhead Protection Area; Surface Water Protection Zone; Outstanding Resource Water; Areas of Critical Environmental Concern; Watershed Protection Act Zones; Ch. 91 Tidelands Jurisdiction; Article 97 Land; Landfills ([Not]Capped, [Un]Lined, [In]Active, Closed)

Index Map



Legend

- Project Route
- Existing Access
- Proposed Access
- Edge of ROW
- National Grid Owned Property
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- Field Delineated Wetlands*
- Field Delineated Vernal Pool*
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- Selective Tree Removal
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Environmental Justice Populations 2020

- Minority and Income

*Indicates Layers Set to Transparency

1 inch = 100 feet

0 50 100

Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Sunderland, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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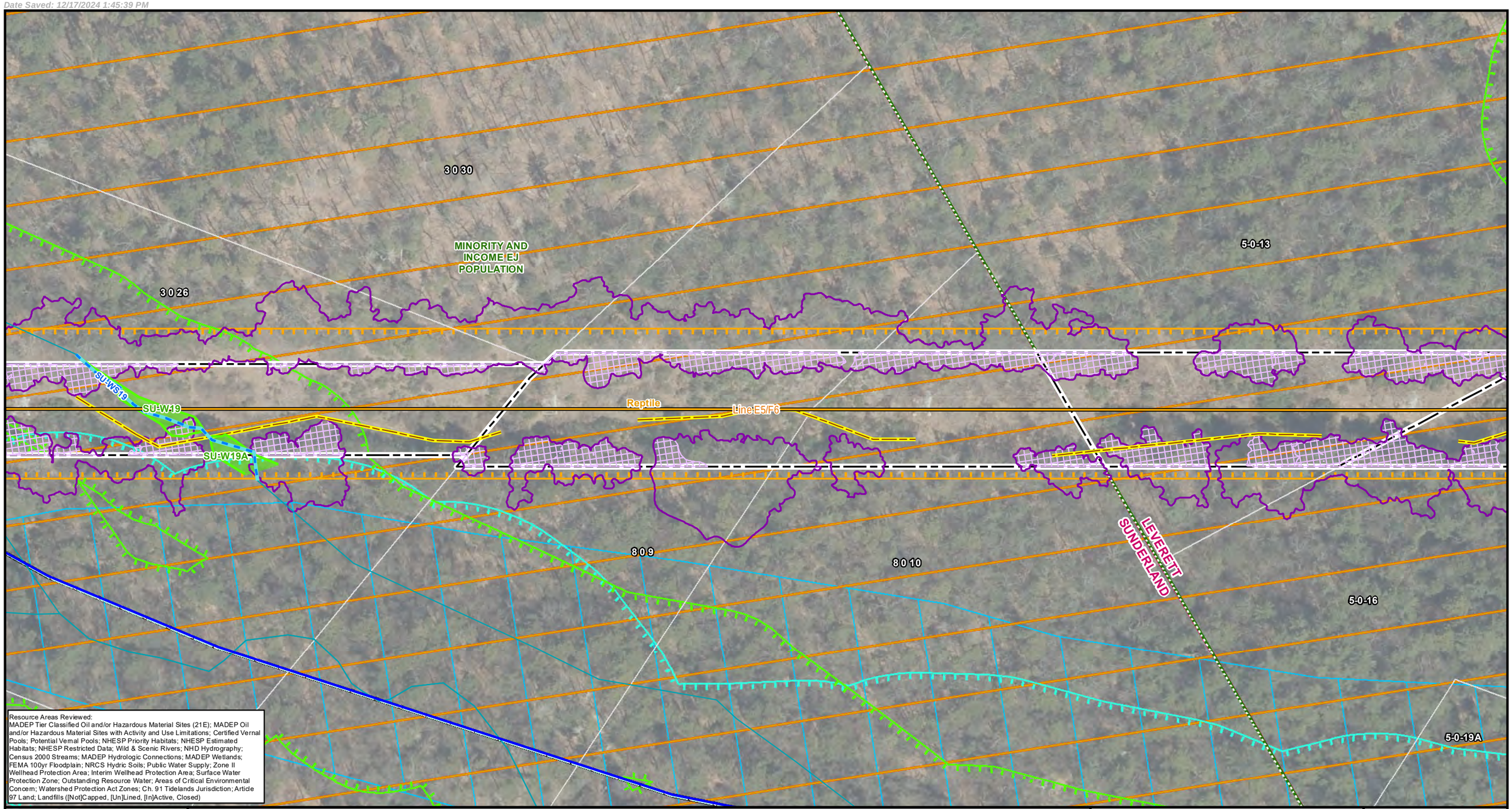

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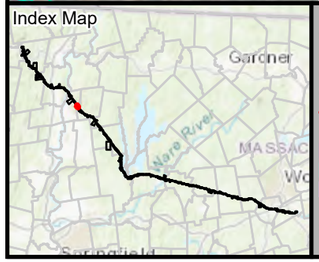

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Environmental Justice Populations 2020

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Sunderland & Leverett, MA

MassGIS
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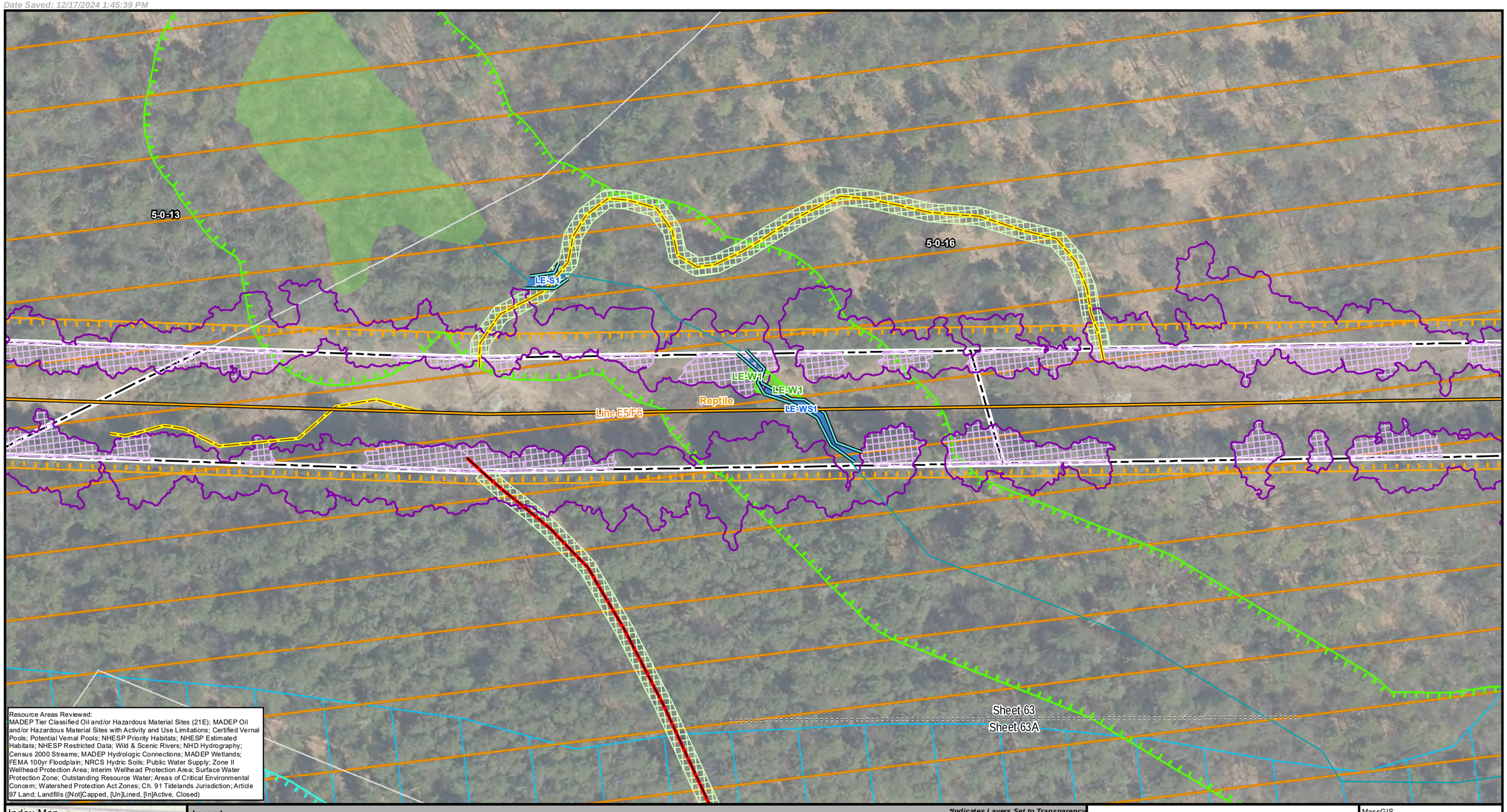

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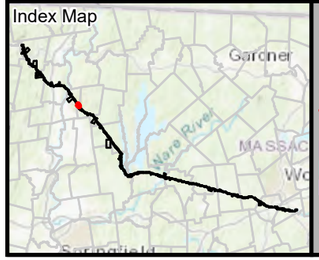

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Leverett, MA

MassGIS
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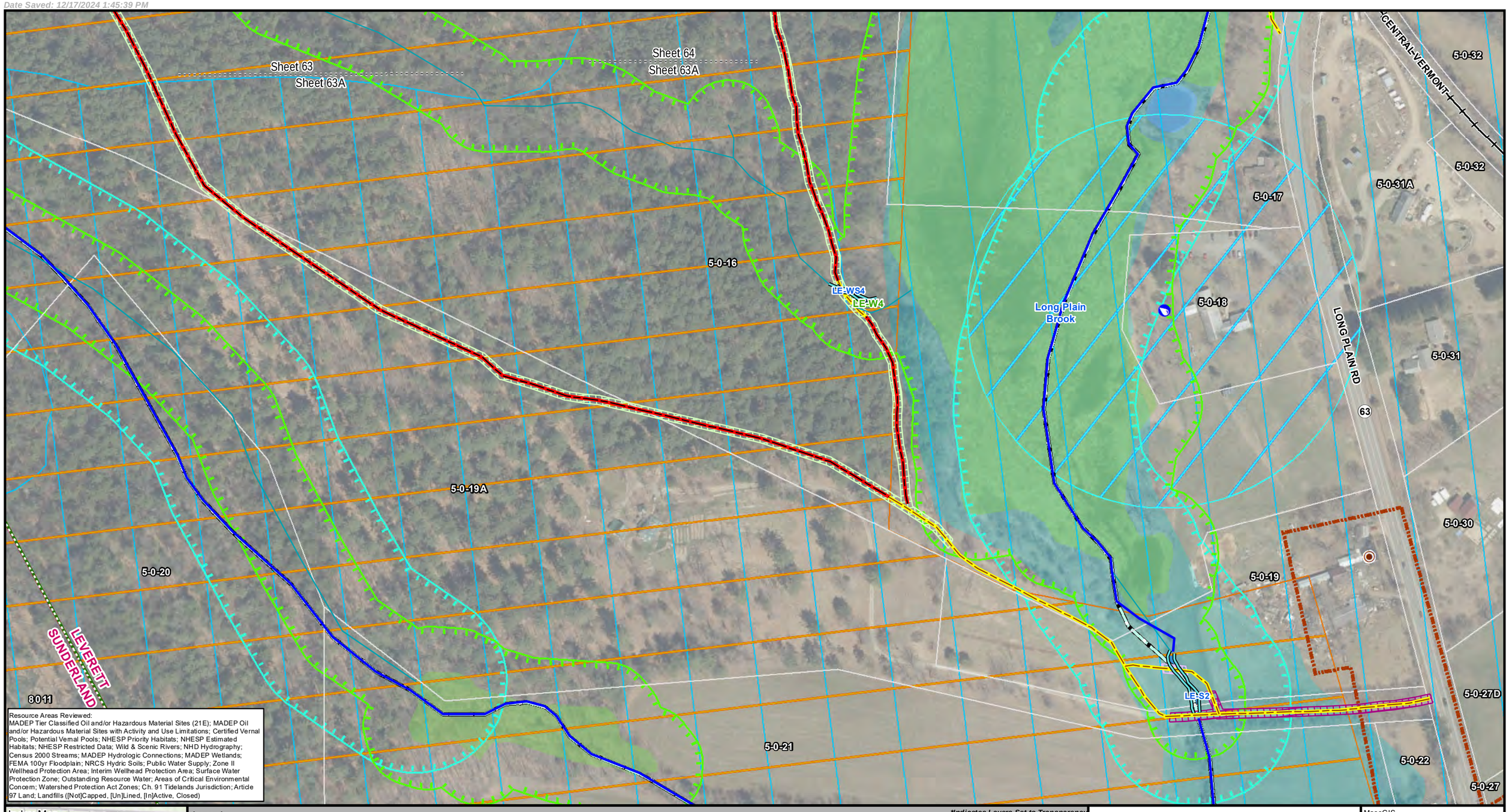

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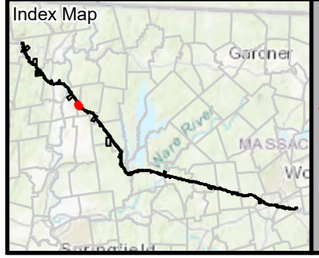

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Environmental Justice Populations 2020

- Minority and Income

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0 100 200

Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Deerfield, MA
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MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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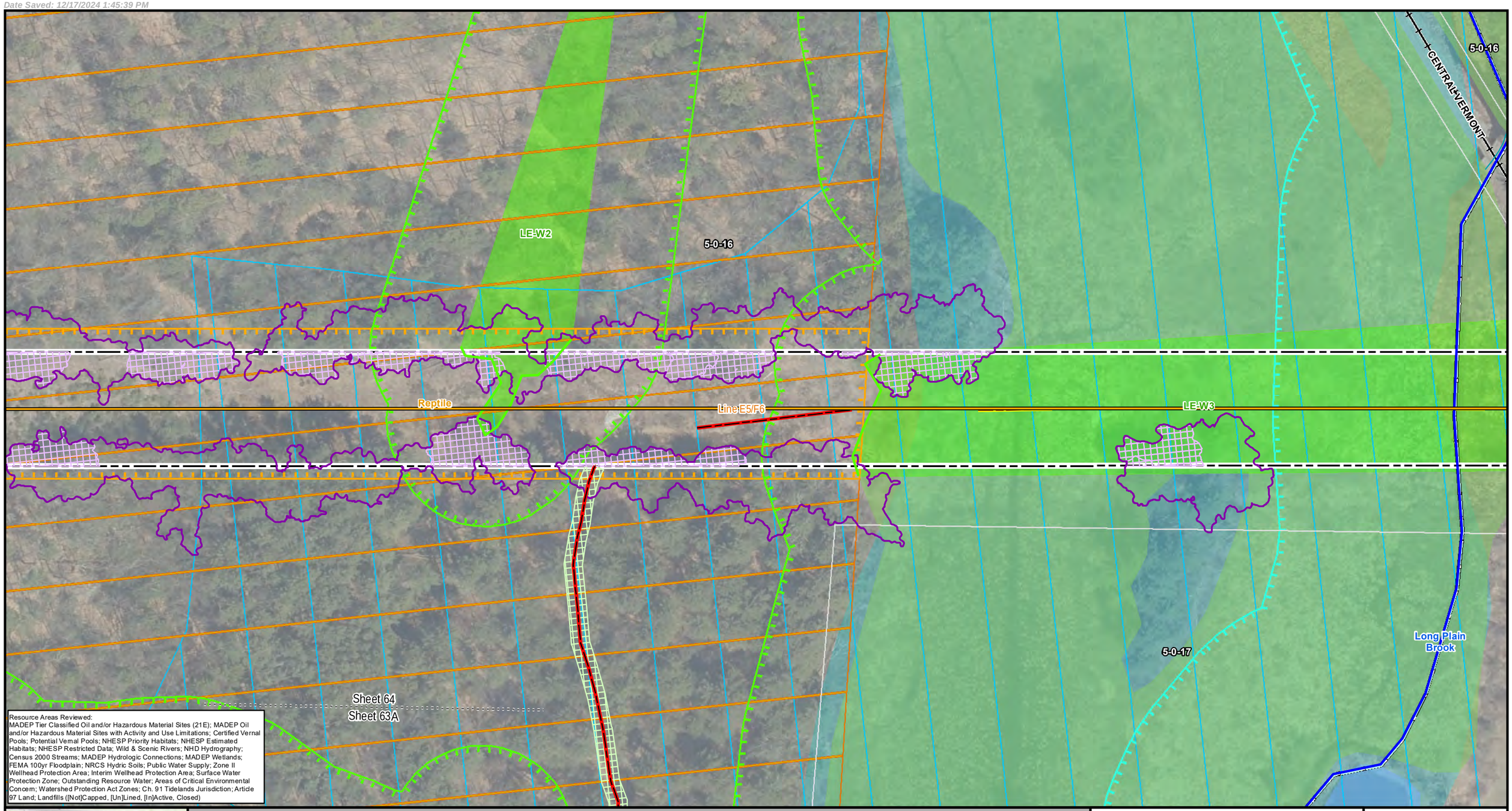

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Leverett, MA

MassGIS
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5-0-35
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Sheet 65
5-0-34
5-0-16
LONG PLAIN RD
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Heronemus Forest
5-0-33
LE-VP-478
5-0-16
LE-W3
LE-W5
Line E5/F6
Amphibian
CENTRAL VERMONT
Long Plain Brook
5-0-17
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5-0-31A

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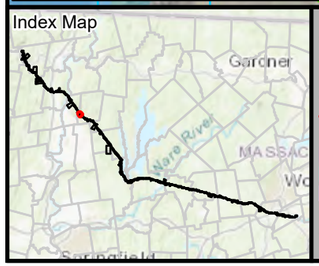

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Article 97 Lands
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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Leverett, MA

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5-0-52A
5-0-52A
5-0-52
5-0-38C
5-0-53
LONG HILL RD
5-0-56
LE-VP-477-1
LE-W11
LE-VP-477-2
Heronemus Forest
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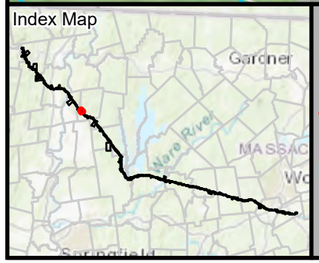

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LE-VP-475
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Gardner
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- Parcel Boundaries

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- Land Trust

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1 inch = 100 feet
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Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Leverett, MA
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MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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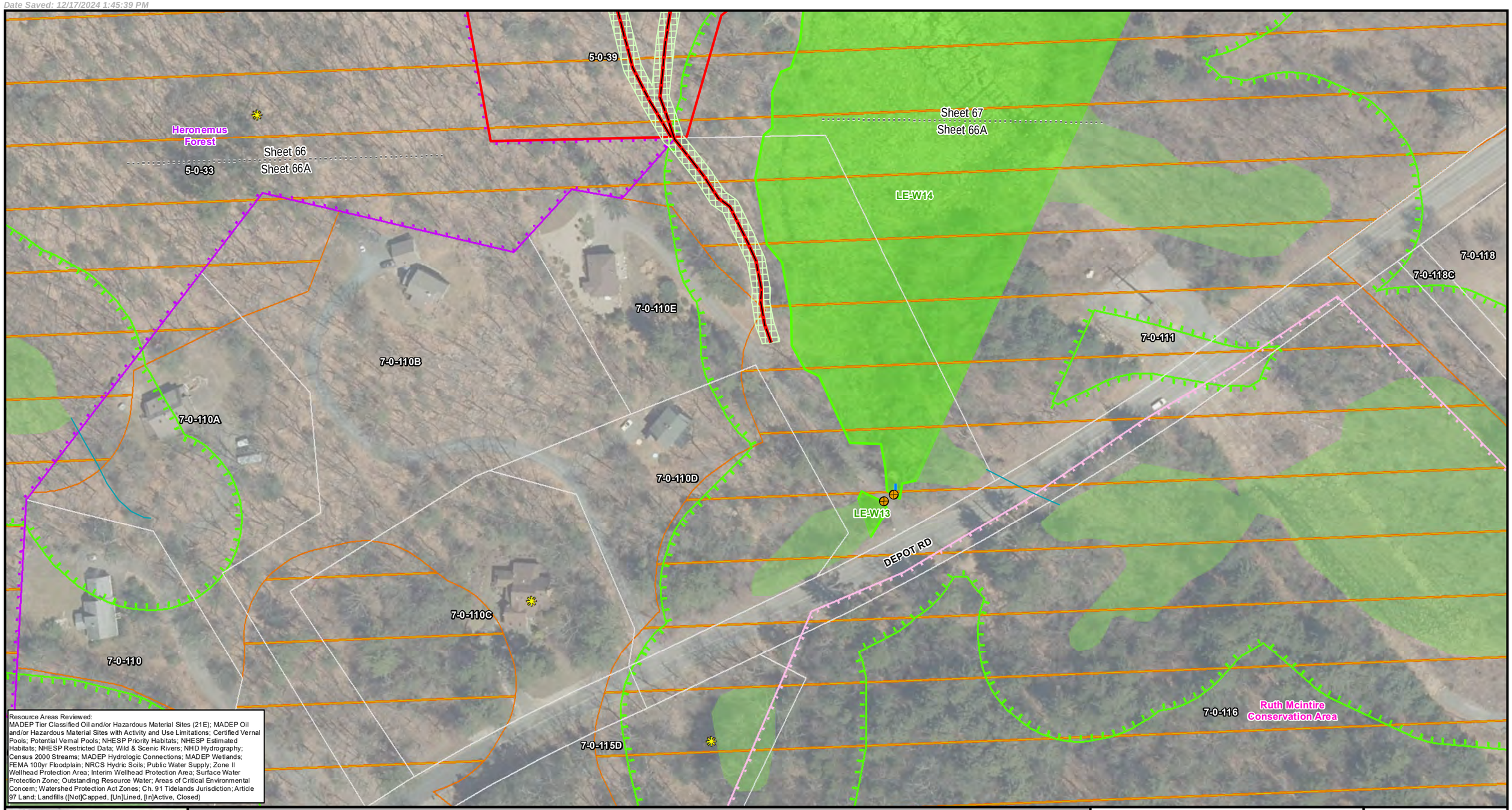

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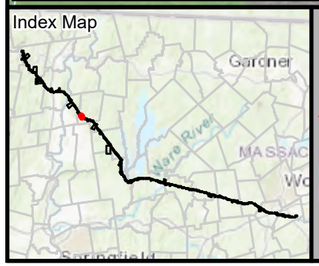

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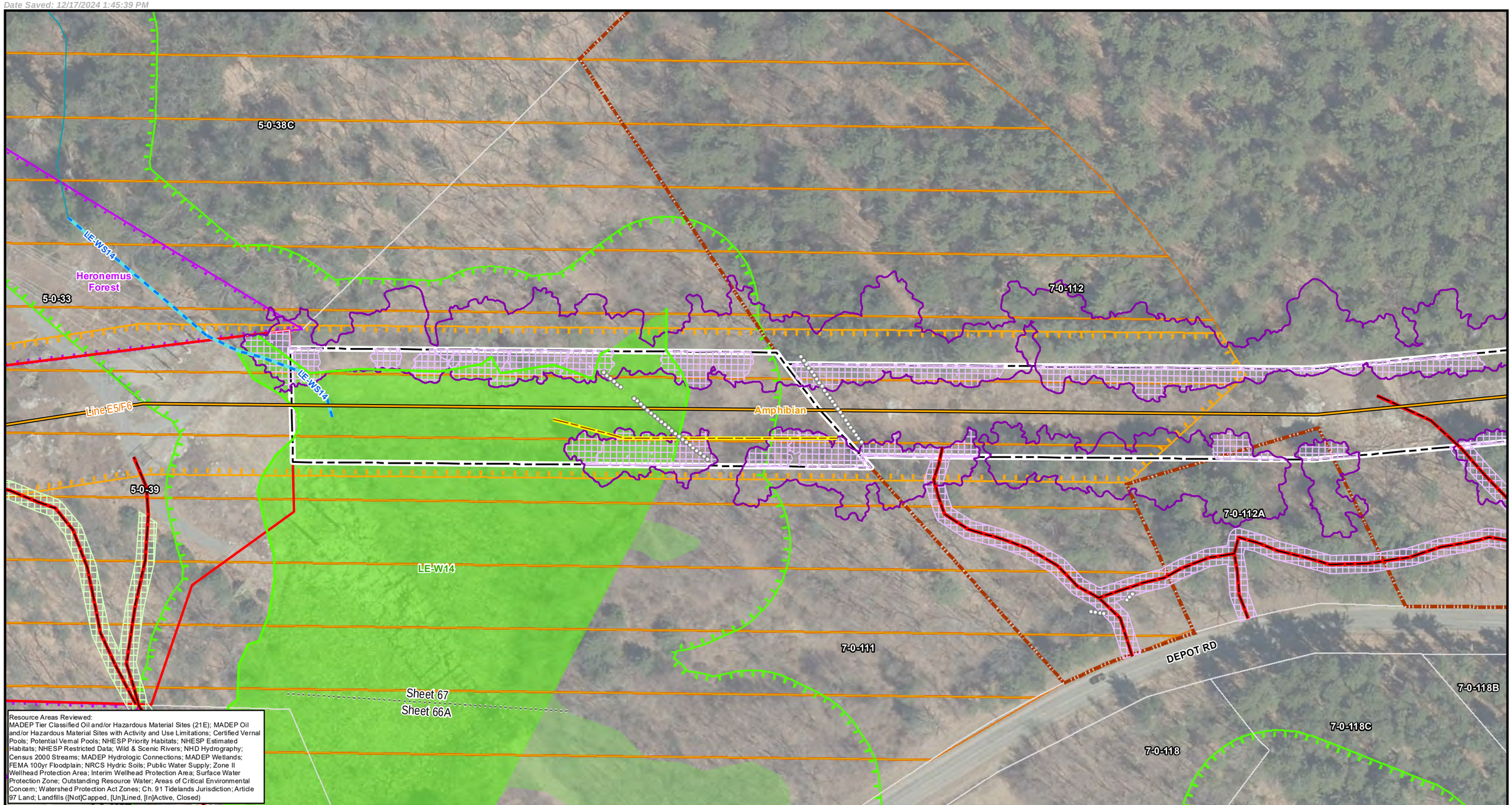

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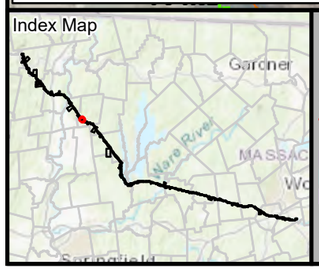

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7-0-113
7-0-204
7-0-205
7-0-114
7-0-201
7-0-203
7-0-112
LE:W15
Reptile
Line:E5/F6
WE:WS15
AMHERST RD
7-0-112A
7-0-119A
DEPOT RD
7-0-119
7-0-118A
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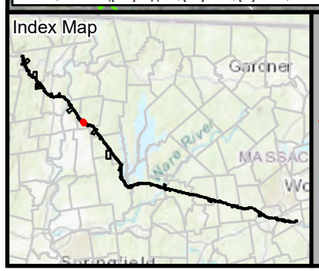

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Leverett, MA

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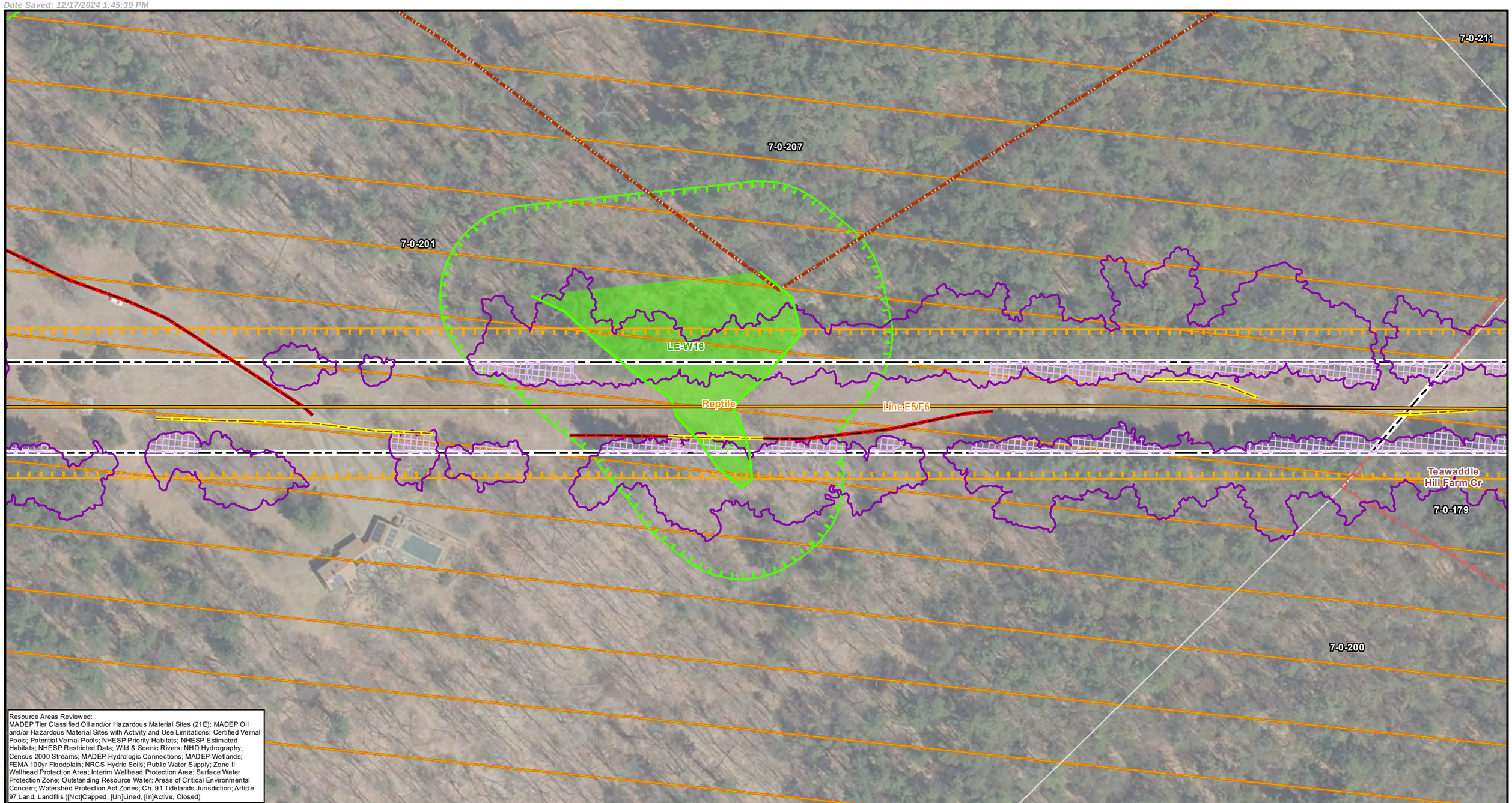

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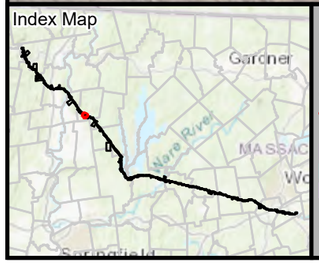

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7-0-211

7-0-201

7-0-179

Reptile

Line E5/E6

LE-W17

LE-W18

Teawaddle Hill Farm Cr

7-0-200

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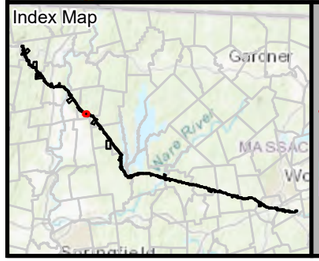

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Adams Family Conservation Area
8-0-124A
LE-W22
Reptile
LE-WS22
Reptile
Line E5/F6
LE-W18
LE-W22
Teawaddle Hill Farm Cr
7-0-179
LE-W19
Doolittle Brook
Sheet 71
Sheet 71A
Williams Family Conservation Area
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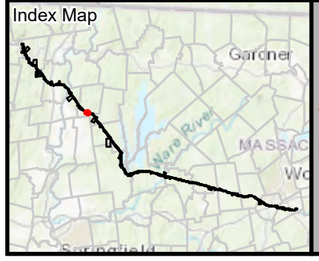

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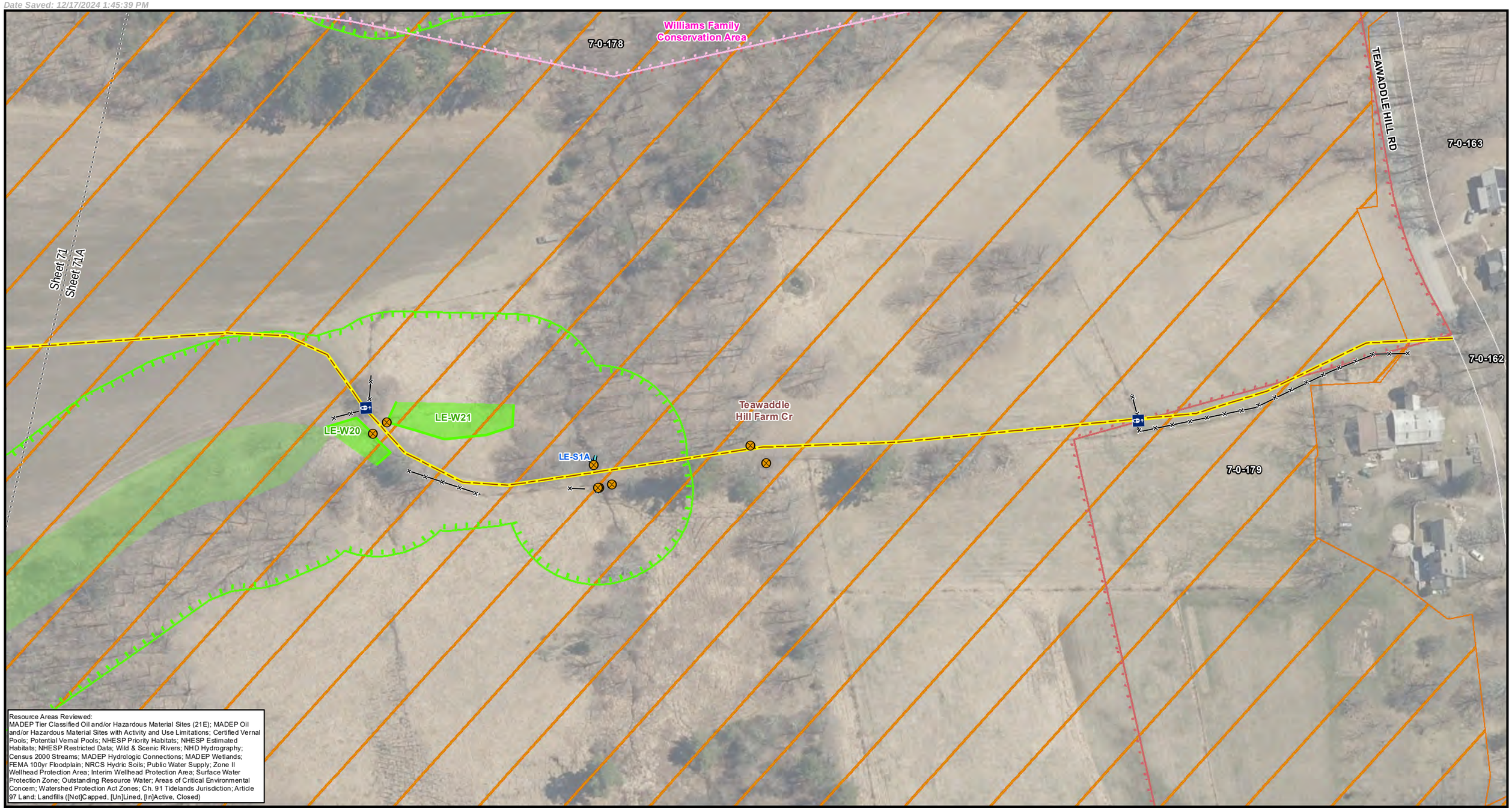

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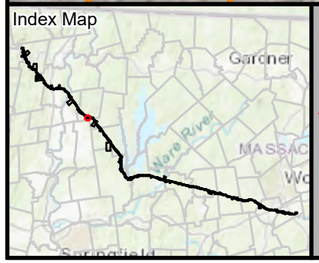

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Article 97 Lands

- Municipal
- Private

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N

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0 50 100

Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Leverett, MA
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MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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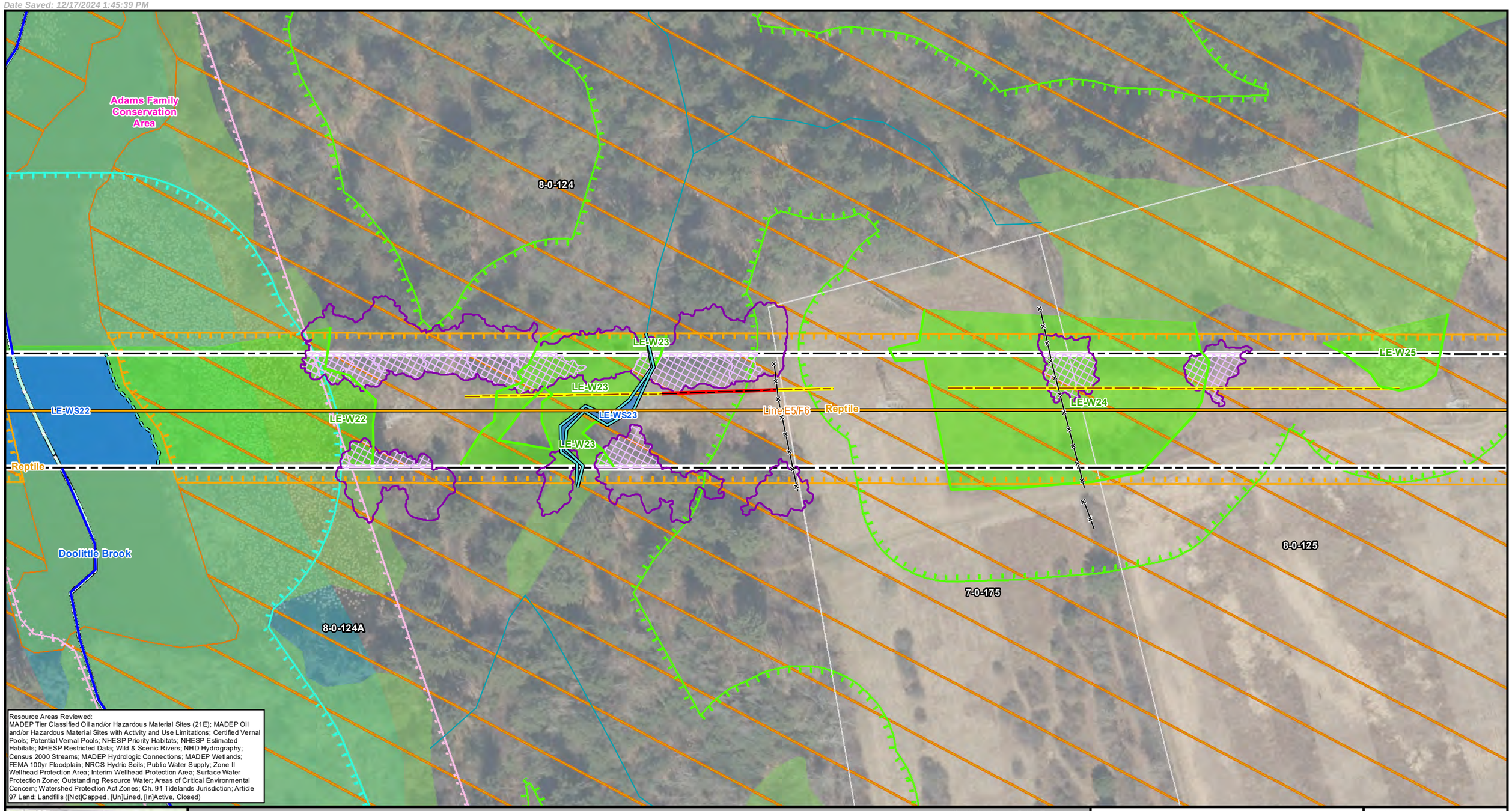

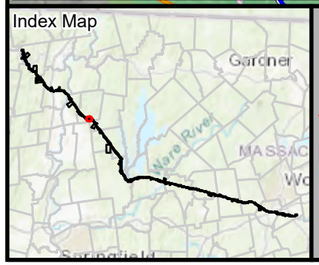

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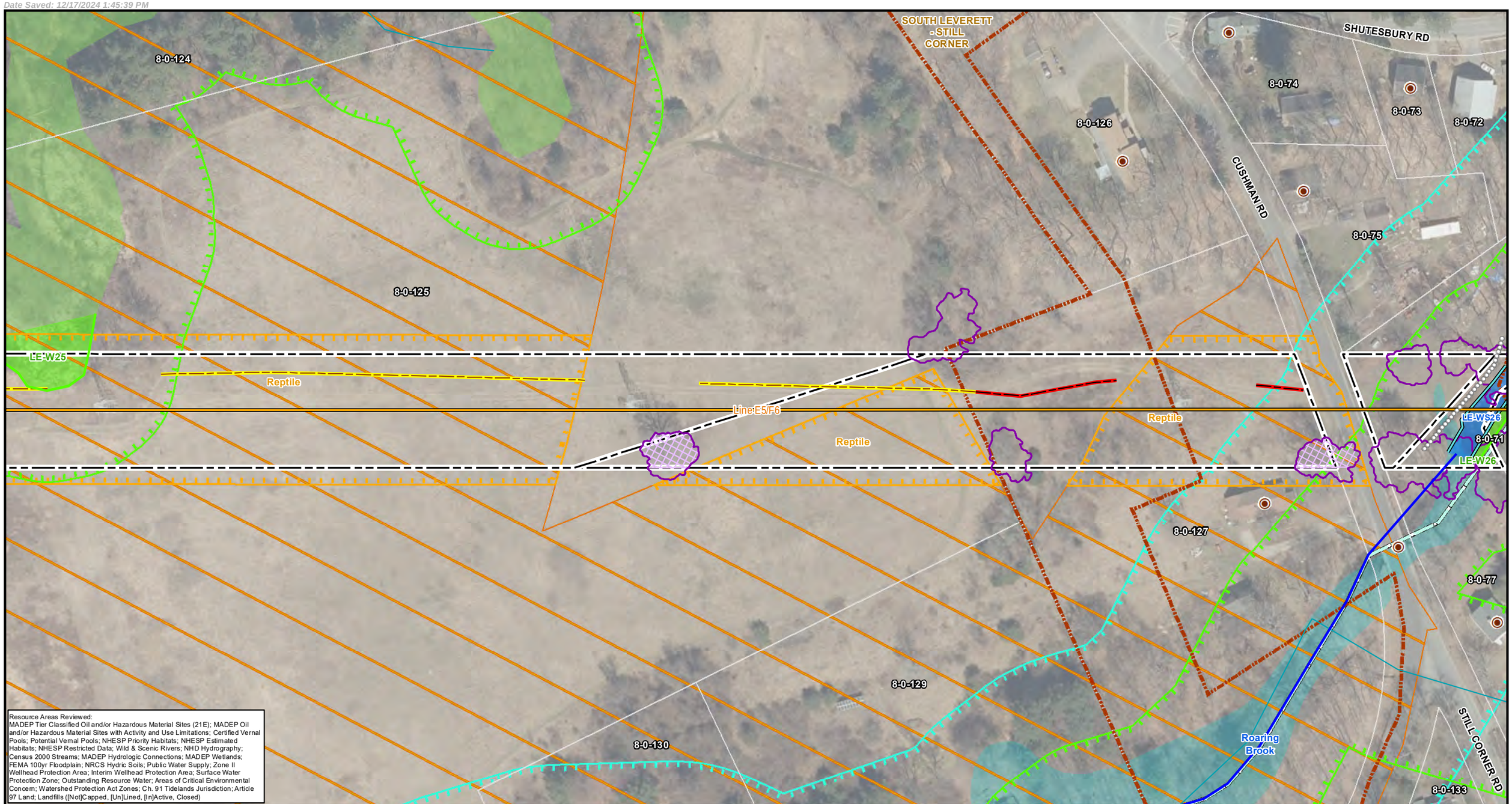

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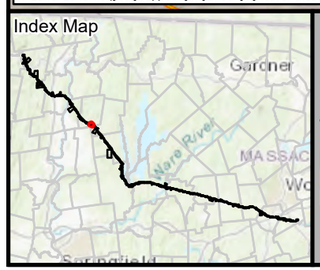

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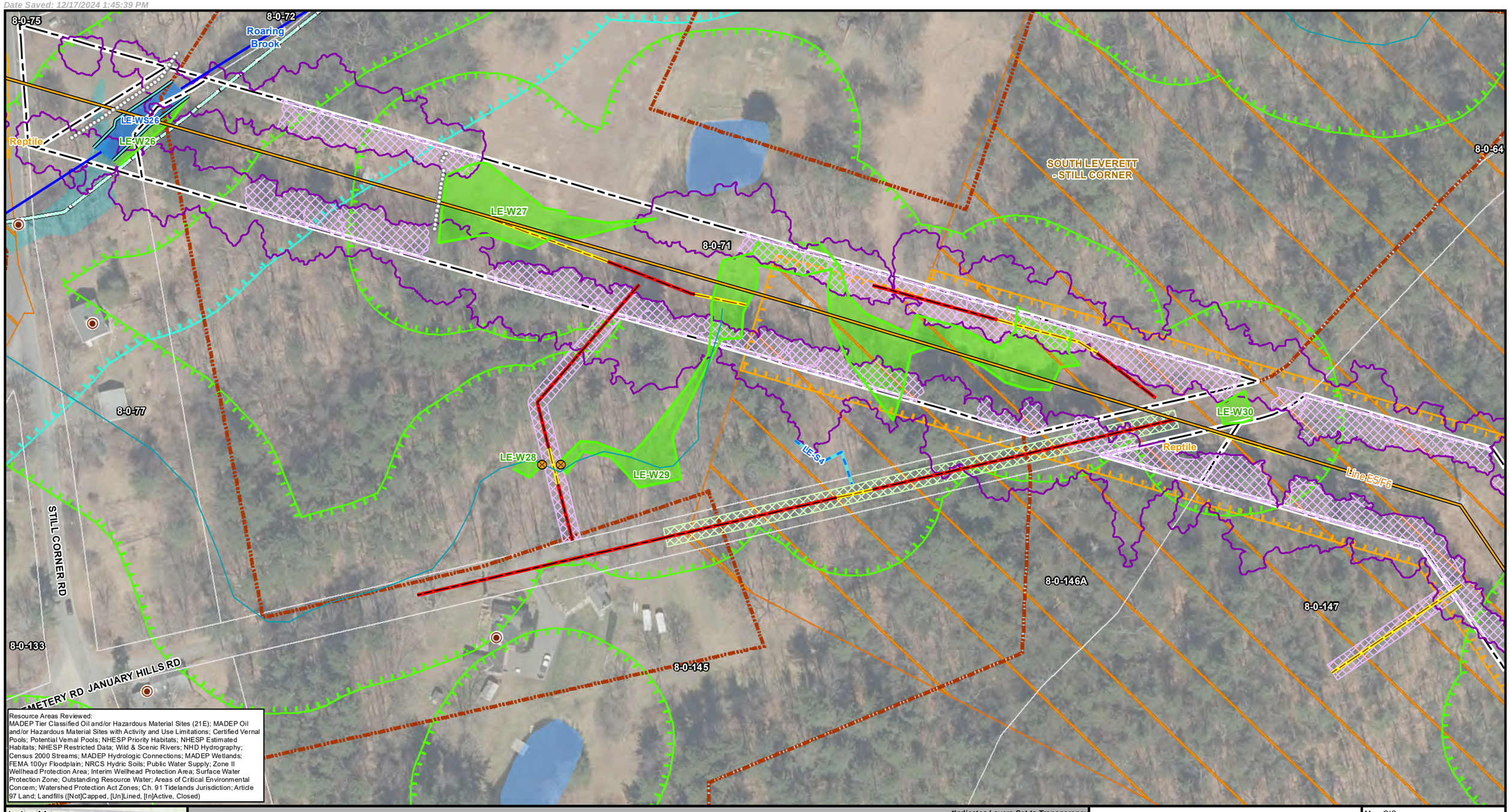

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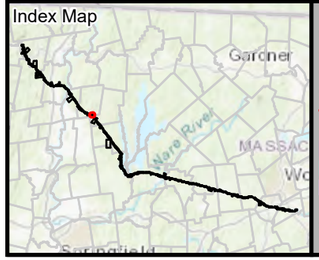

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Environmental Resources Map

Leverett, MA

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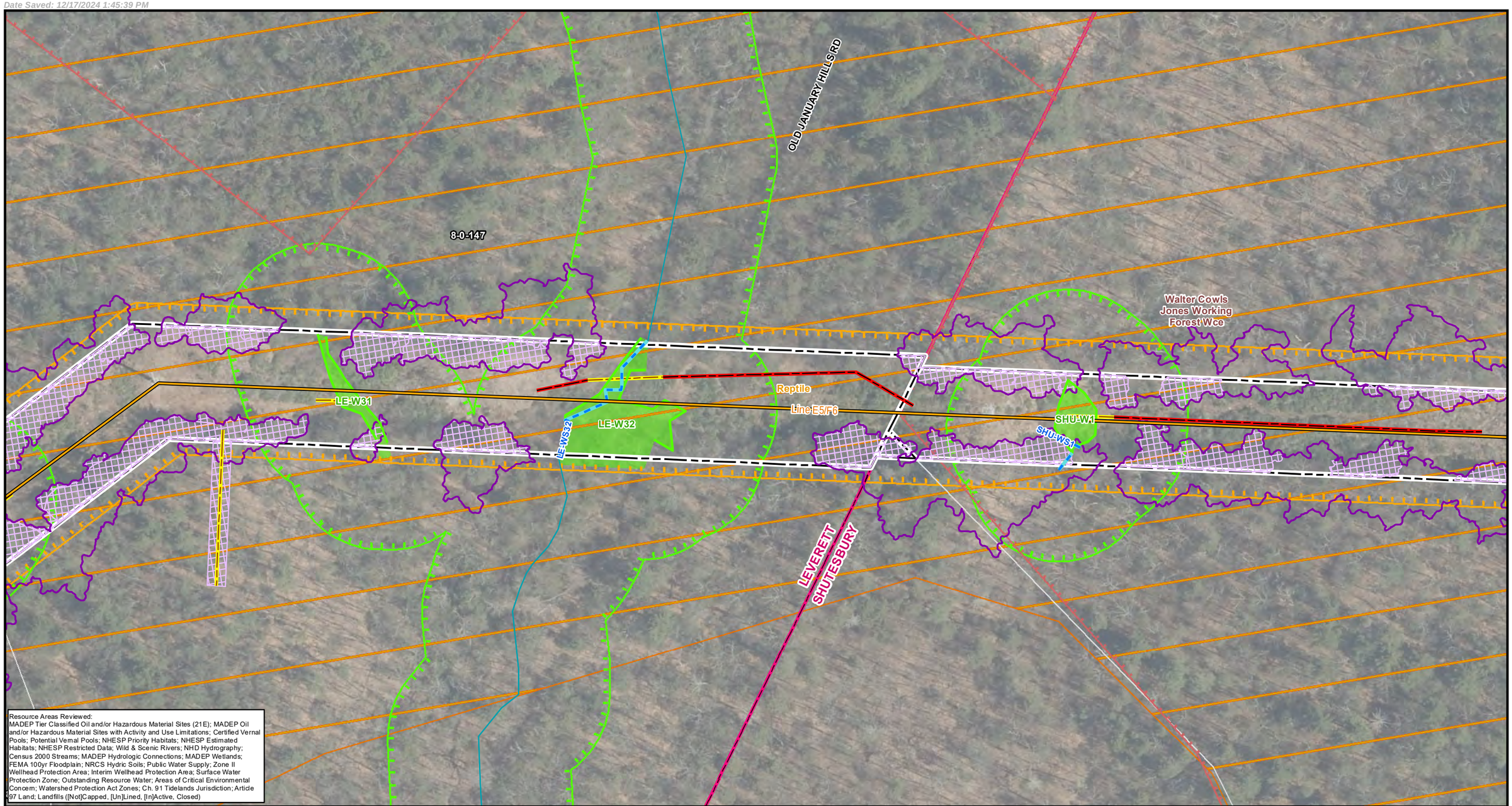

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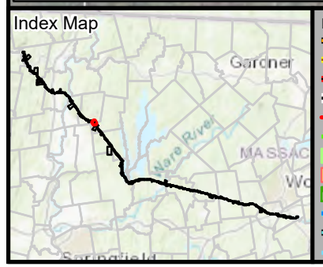

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Article 97 Lands

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Leverett & Shutesbury, MA

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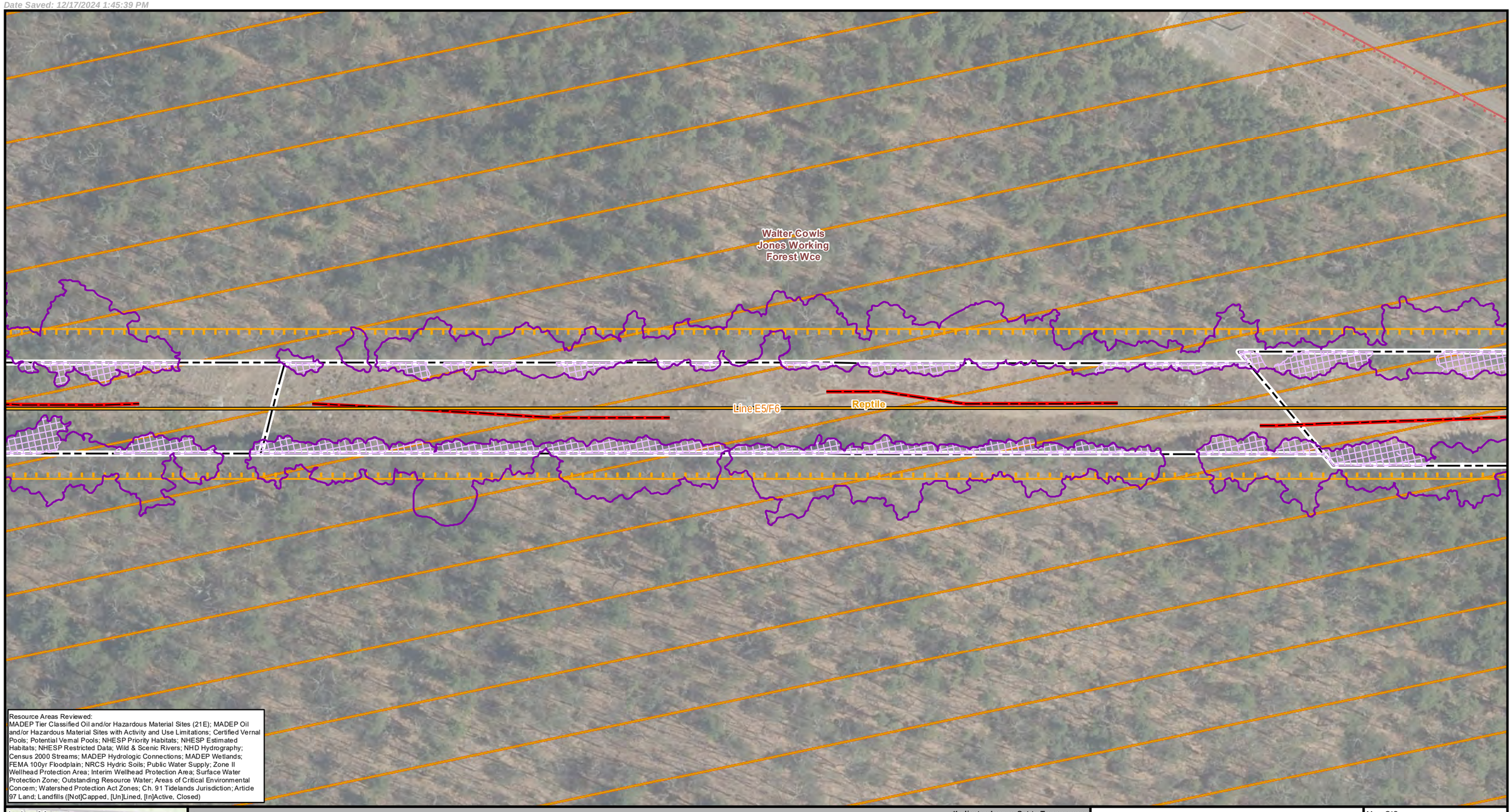

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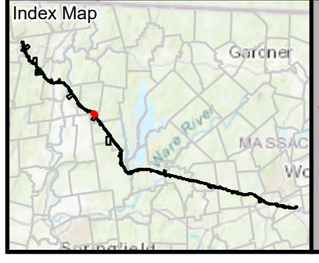

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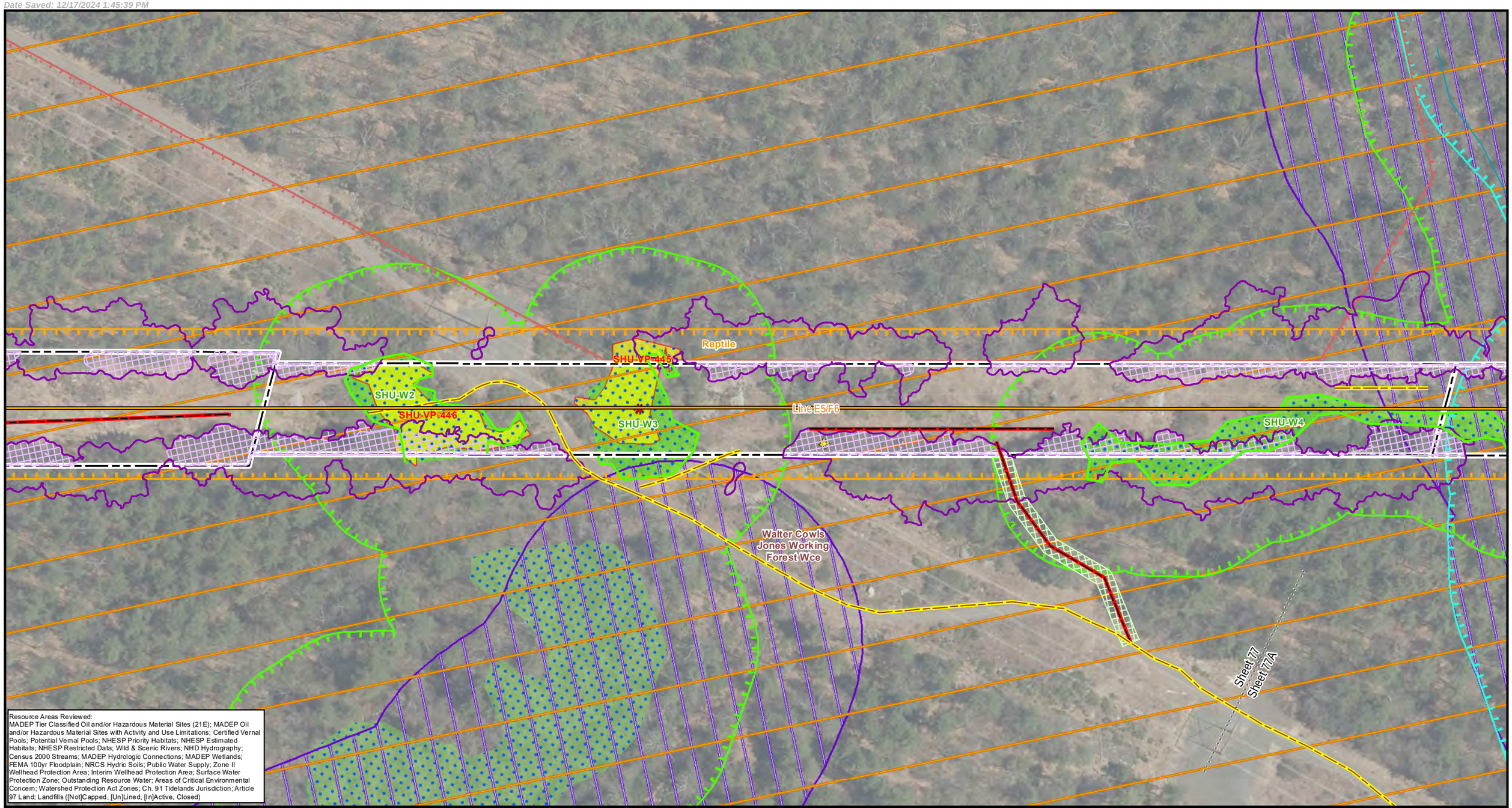

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Environmental Resources Map

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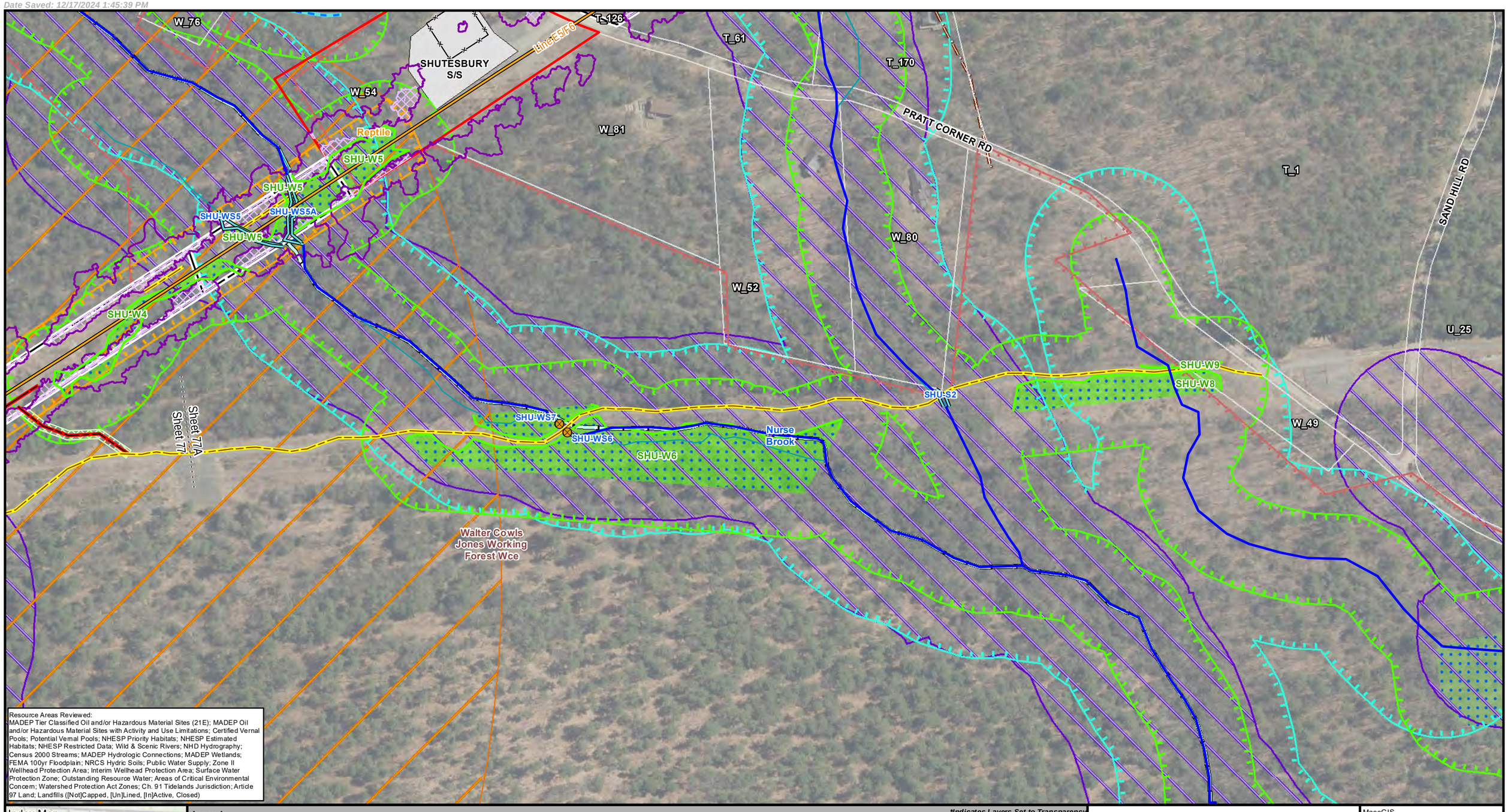

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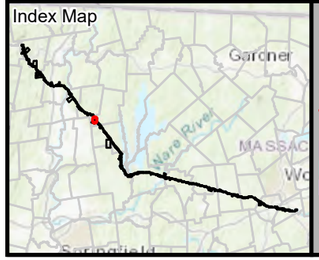

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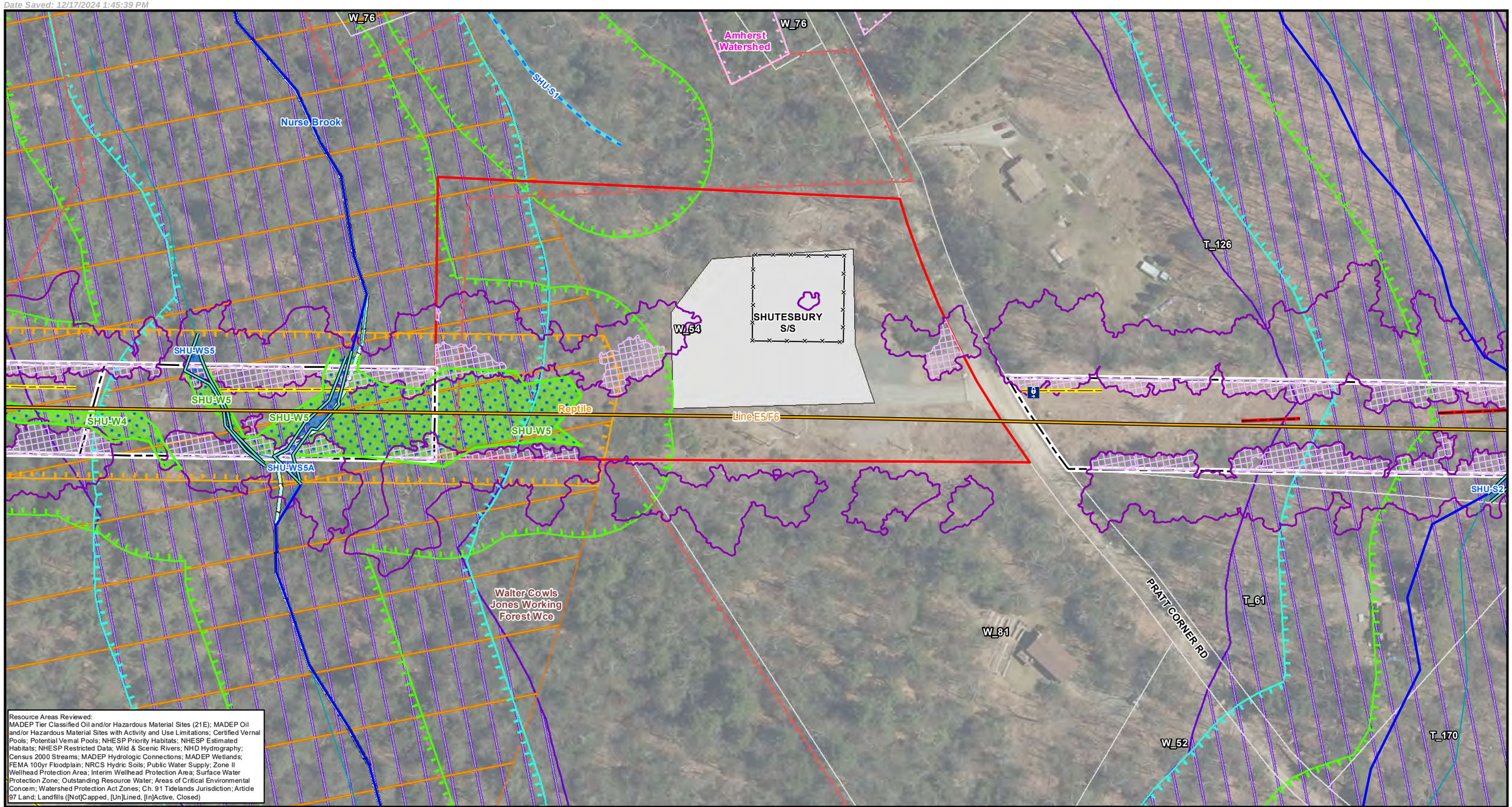

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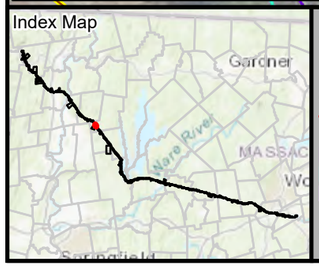

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Environmental Resources Map

Shutesbury, MA

MassGIS
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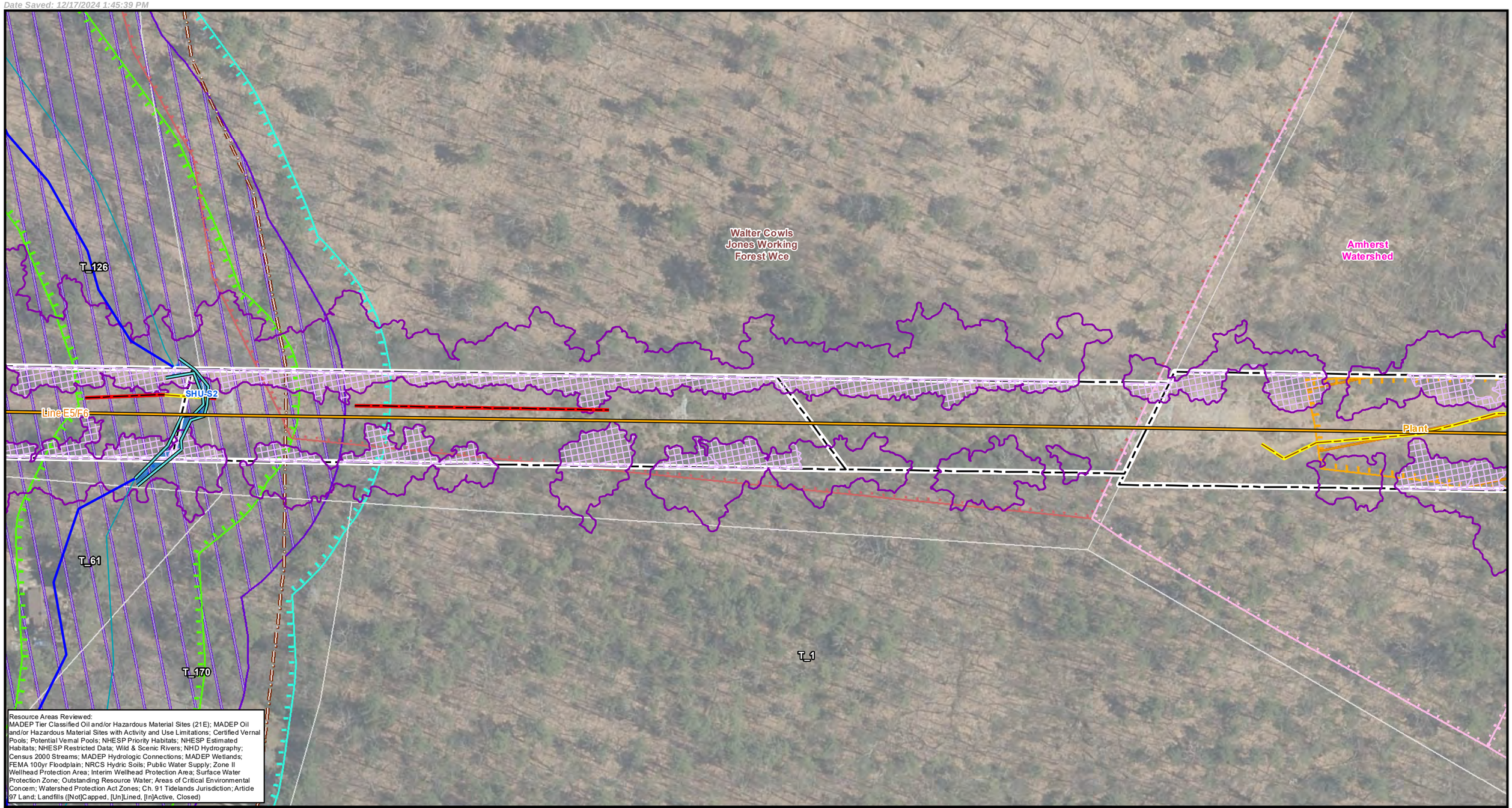

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Walter Cowls Jones Working Forest Wce
Dean Brook
SAND HILL RD
T_6
SHU-WS10
SHU-S3
SHU-W11
Plant
Line
E5/F6
SHU-W10
SHU-WS10
SHU-W10
T_6
U_8
Amherst Watershed

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Gardner
Springfield

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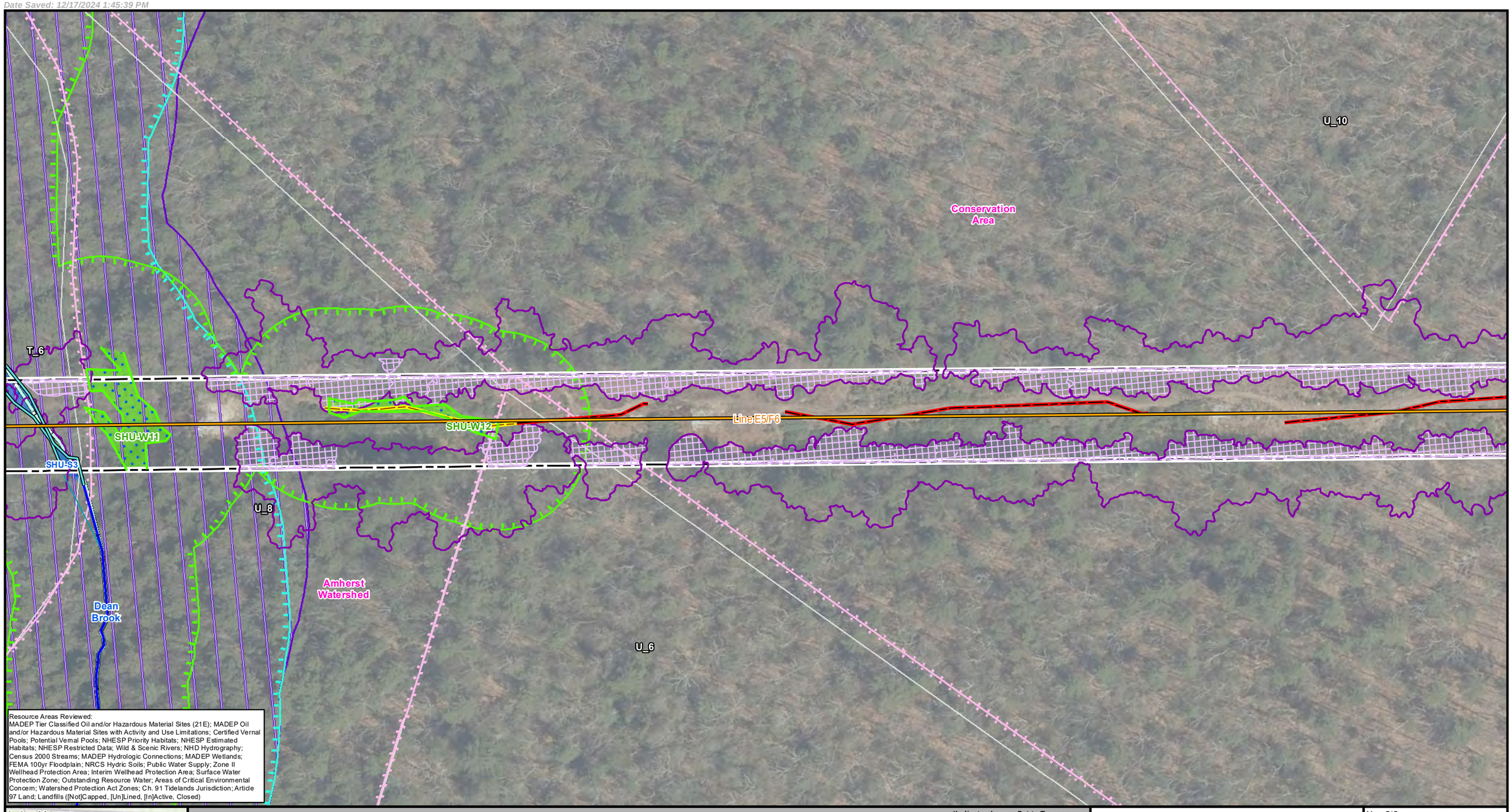

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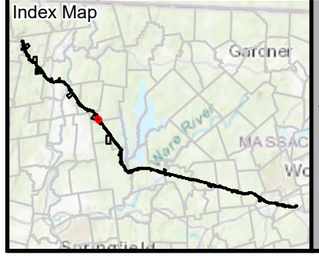

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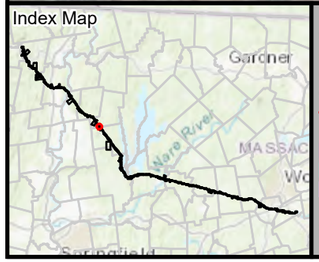

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Environmental Resources Map

Shutesbury & Pelham, MA

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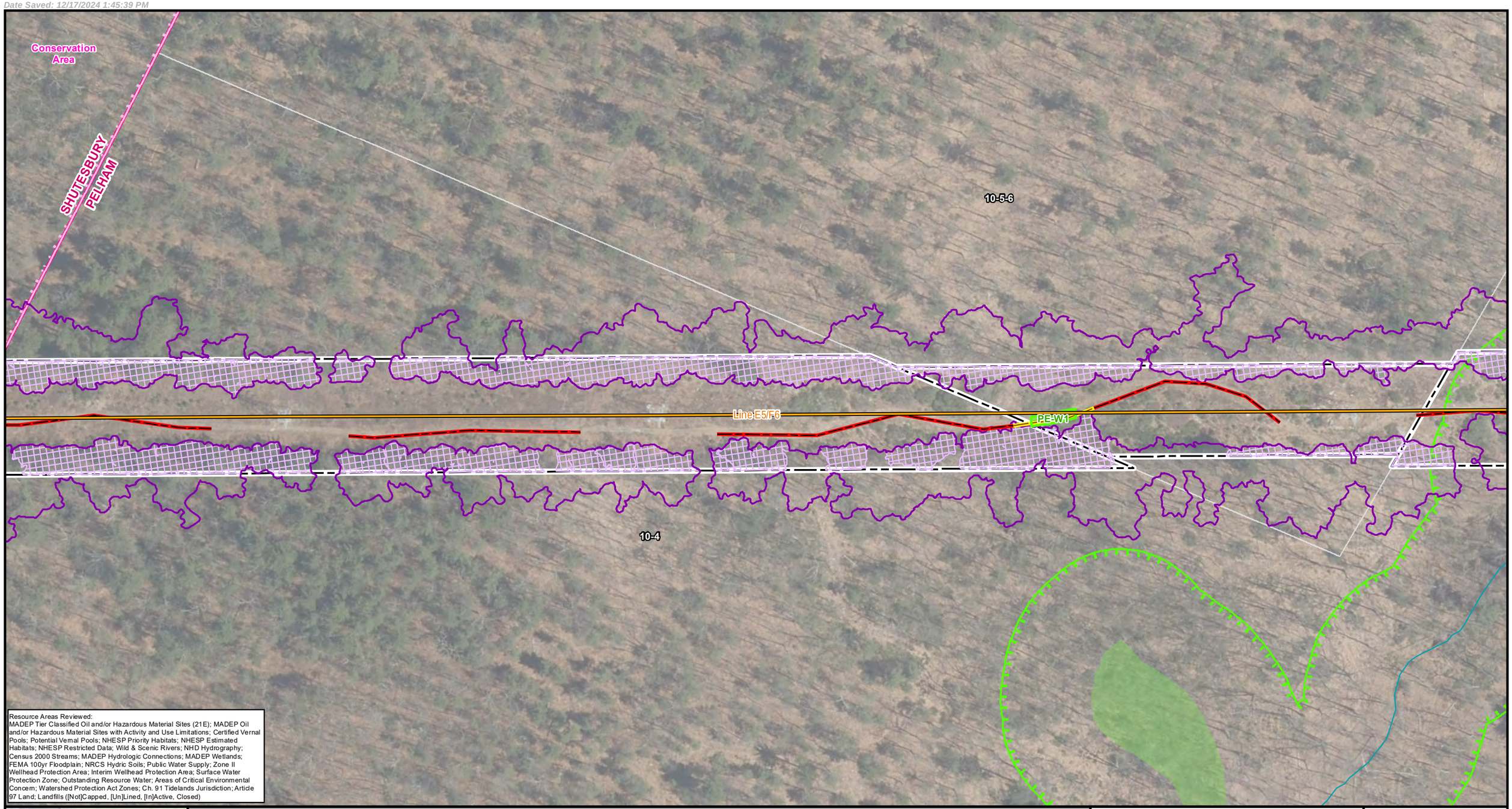

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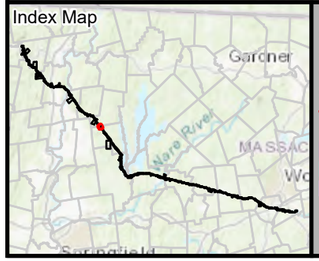

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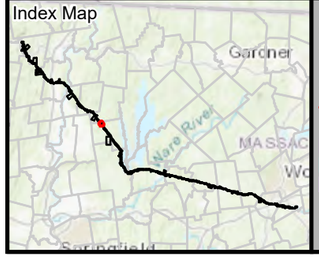

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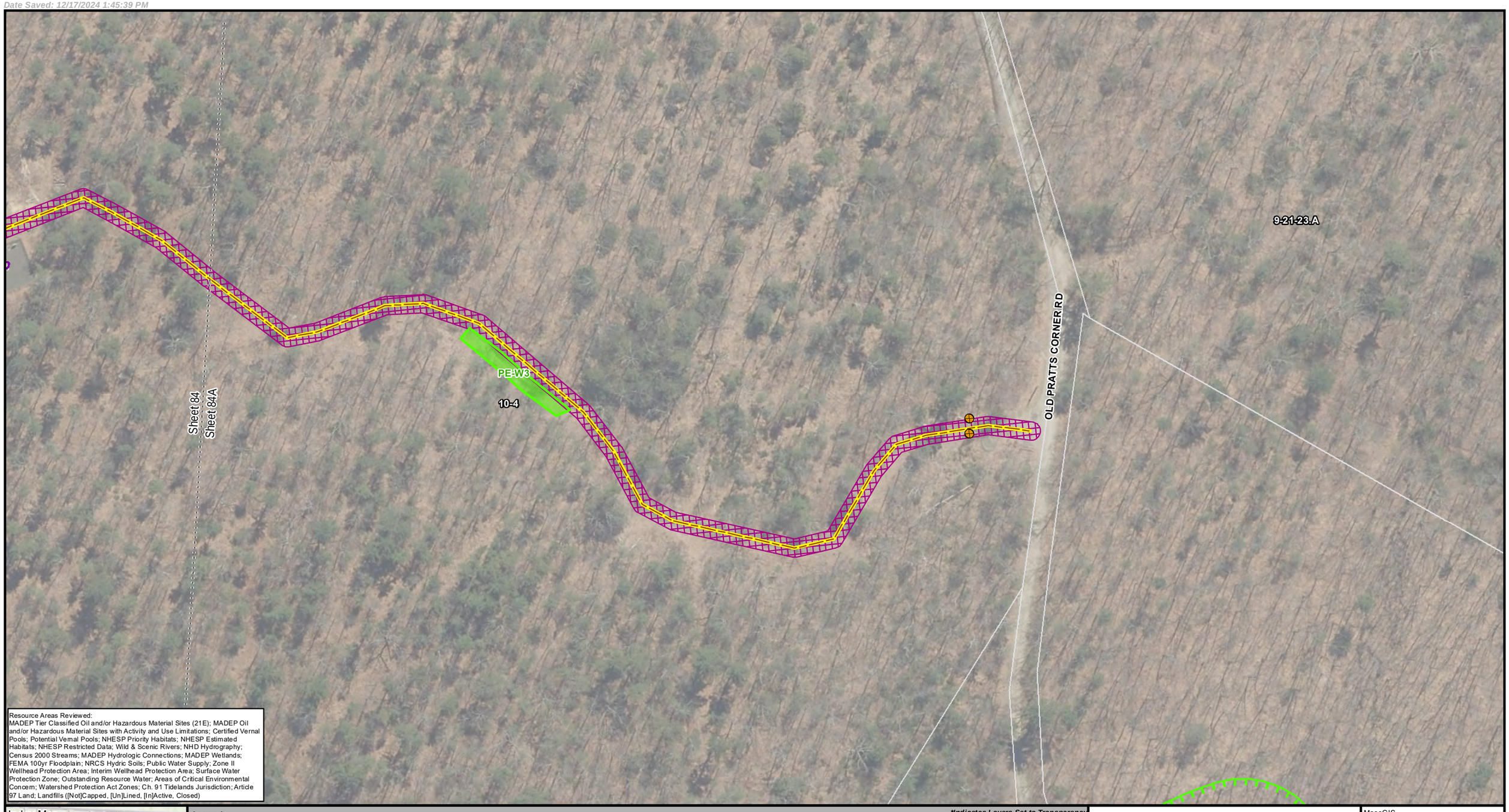

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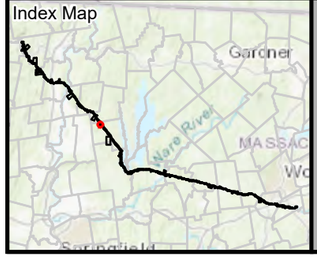

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1 inch = 100 feet
0 50 100
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Pelham, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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10-13.B
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PE-WS4
PE-W4
PE-W6
PE-W5
PE-WS5
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PE-WS8
Line E5/F6
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Buffam Brook
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BUFFAM RD
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Resource Areas Reviewed:
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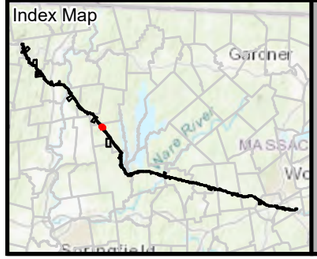

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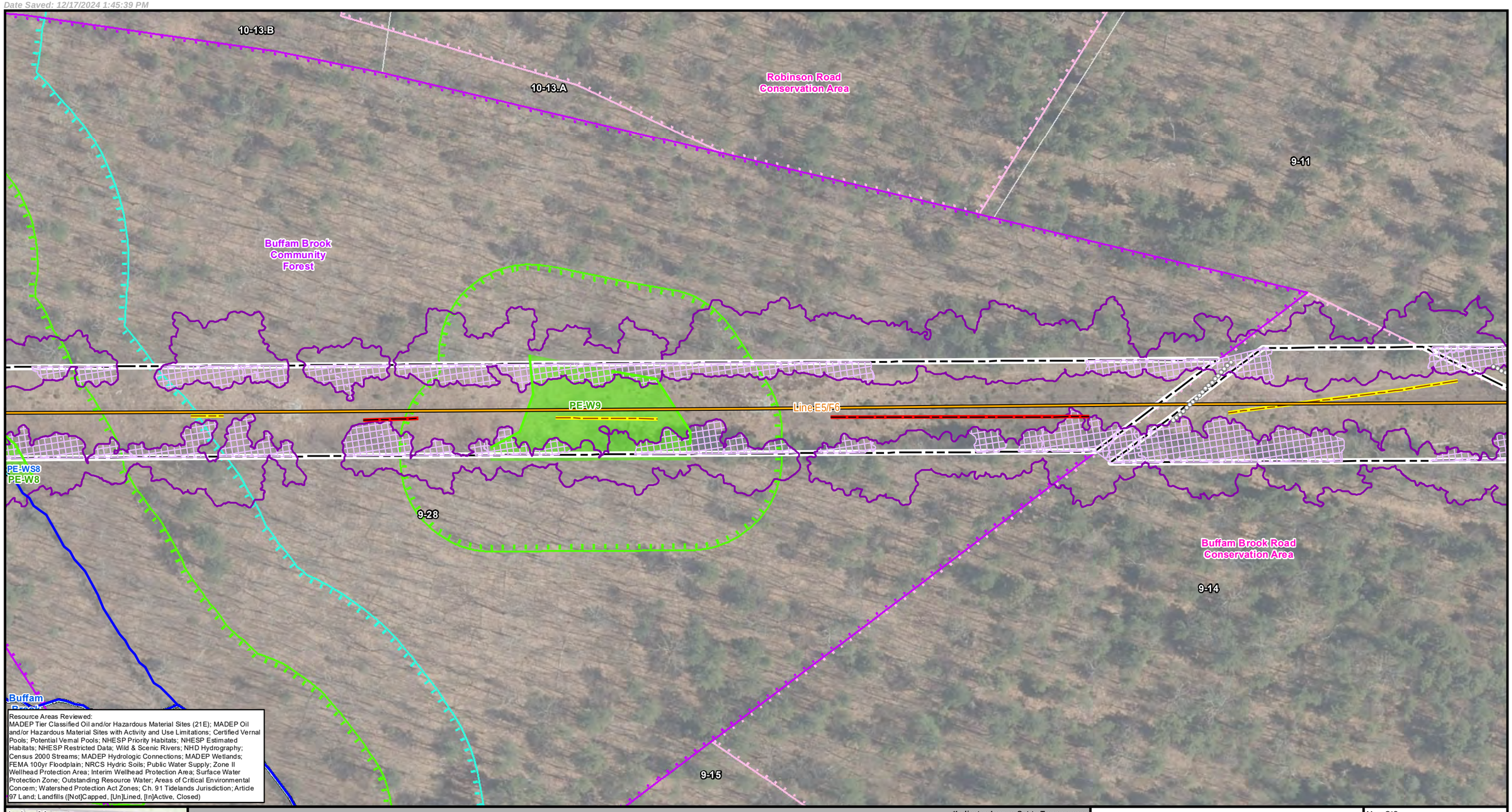

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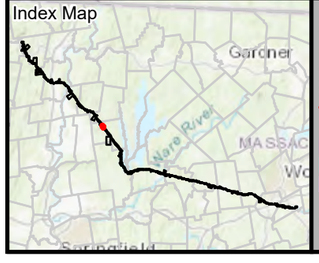

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Amherst Water Supply Land

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PE-W11

Line E5/F6

PE-W10

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Buffam Brook Road Conservation Area

Buffam Brook Community Forest

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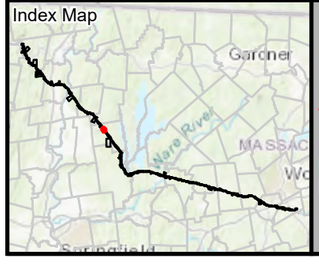

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Article 97 Lands

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0 50 100

Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Pelham, MA

MassGIS
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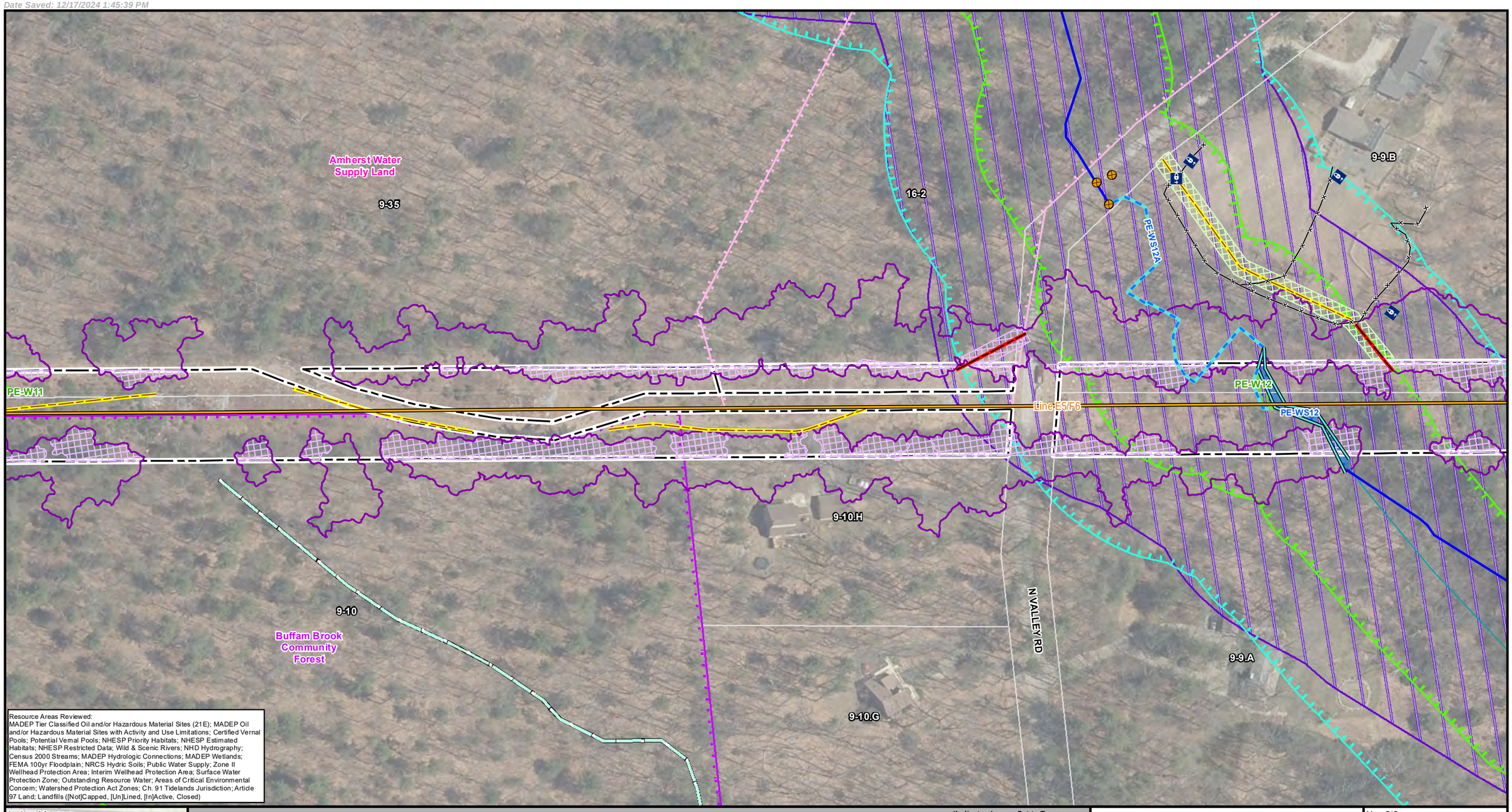

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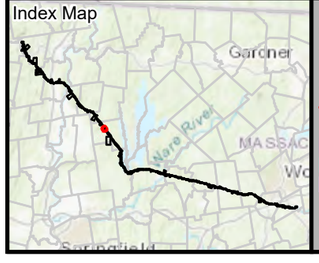

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Article 97 Lands

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Pelham, MA

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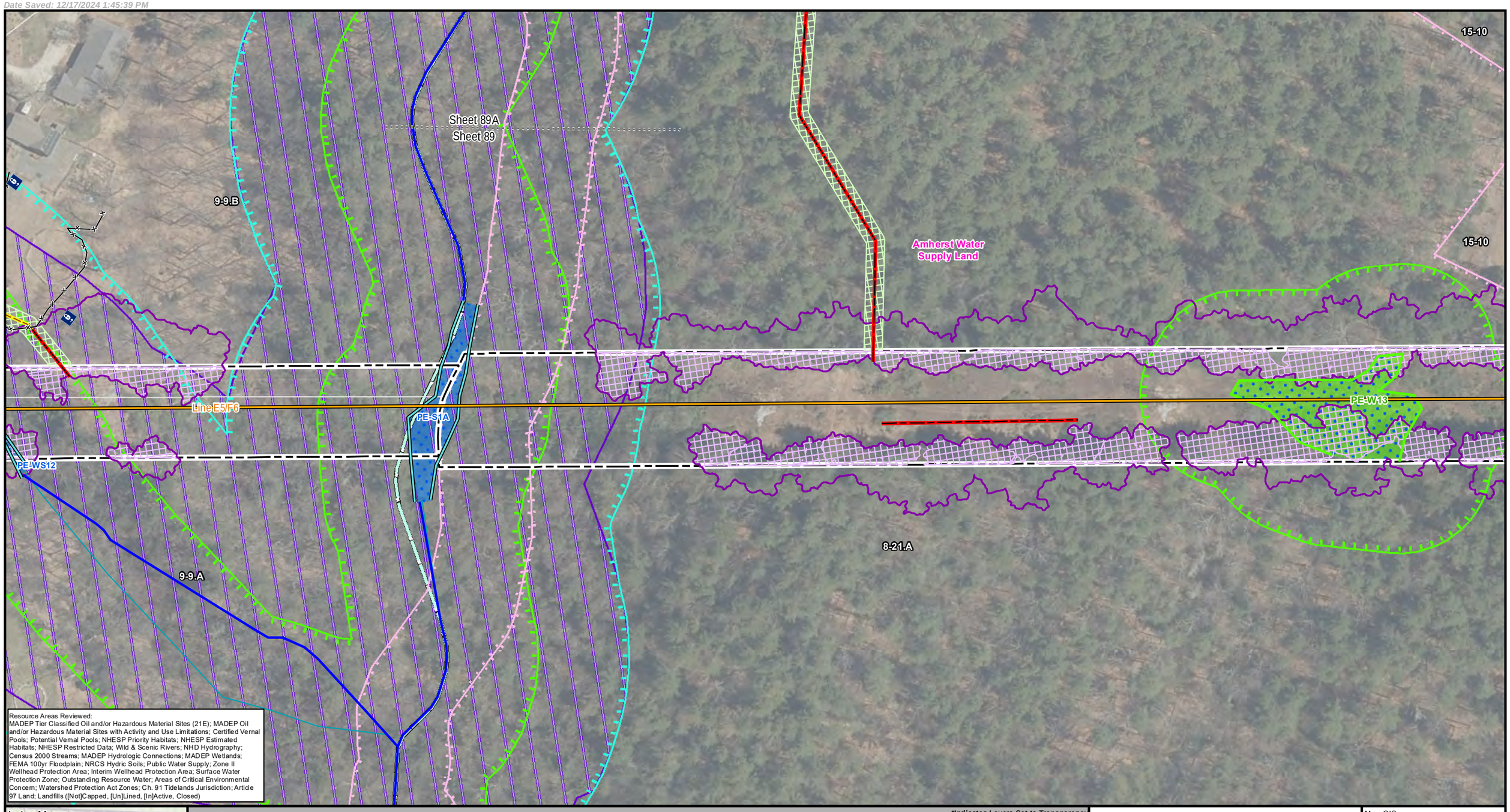

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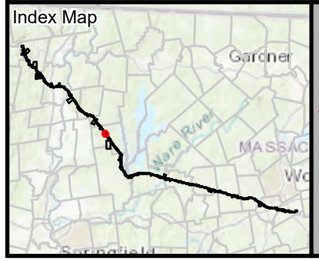

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NEW ENGLAND TRAIL
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15-14-10
AMHERST RD
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Amherst Watershed
Dunlop Brook
PE-S3
PE-WS16
PE-W16
PE-WS18A
PE-W17
PE-WS17
PE-W18
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PE-WS18

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Article 97 Lands

- Municipal

*Indicates Layers Set to Transparency

1 inch = 100 feet
0 50 100
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Pelham, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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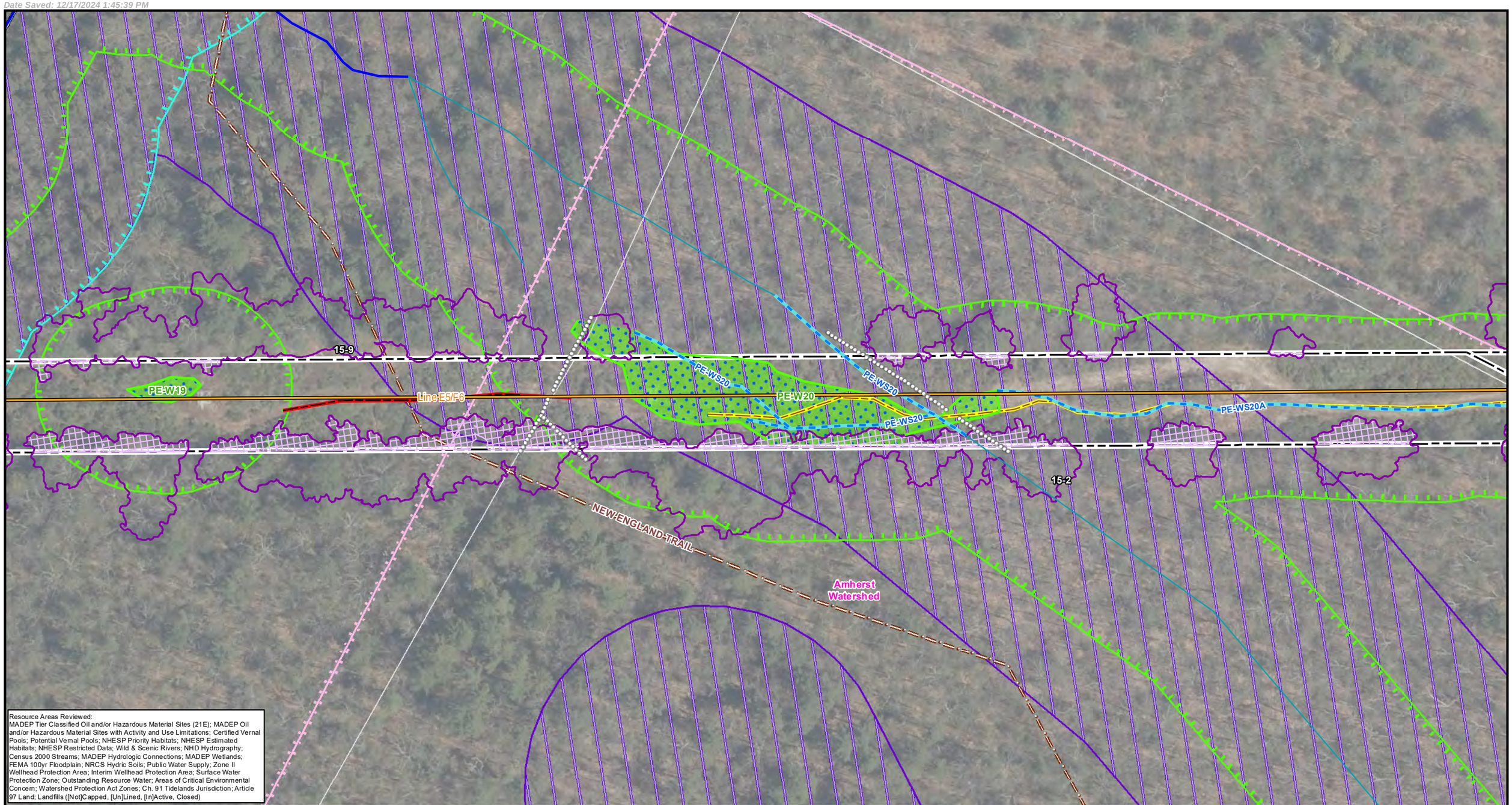

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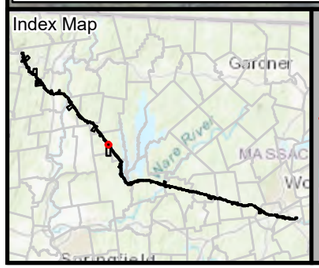

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Article 97 Lands

- Municipal

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Pelham, MA

MassGIS
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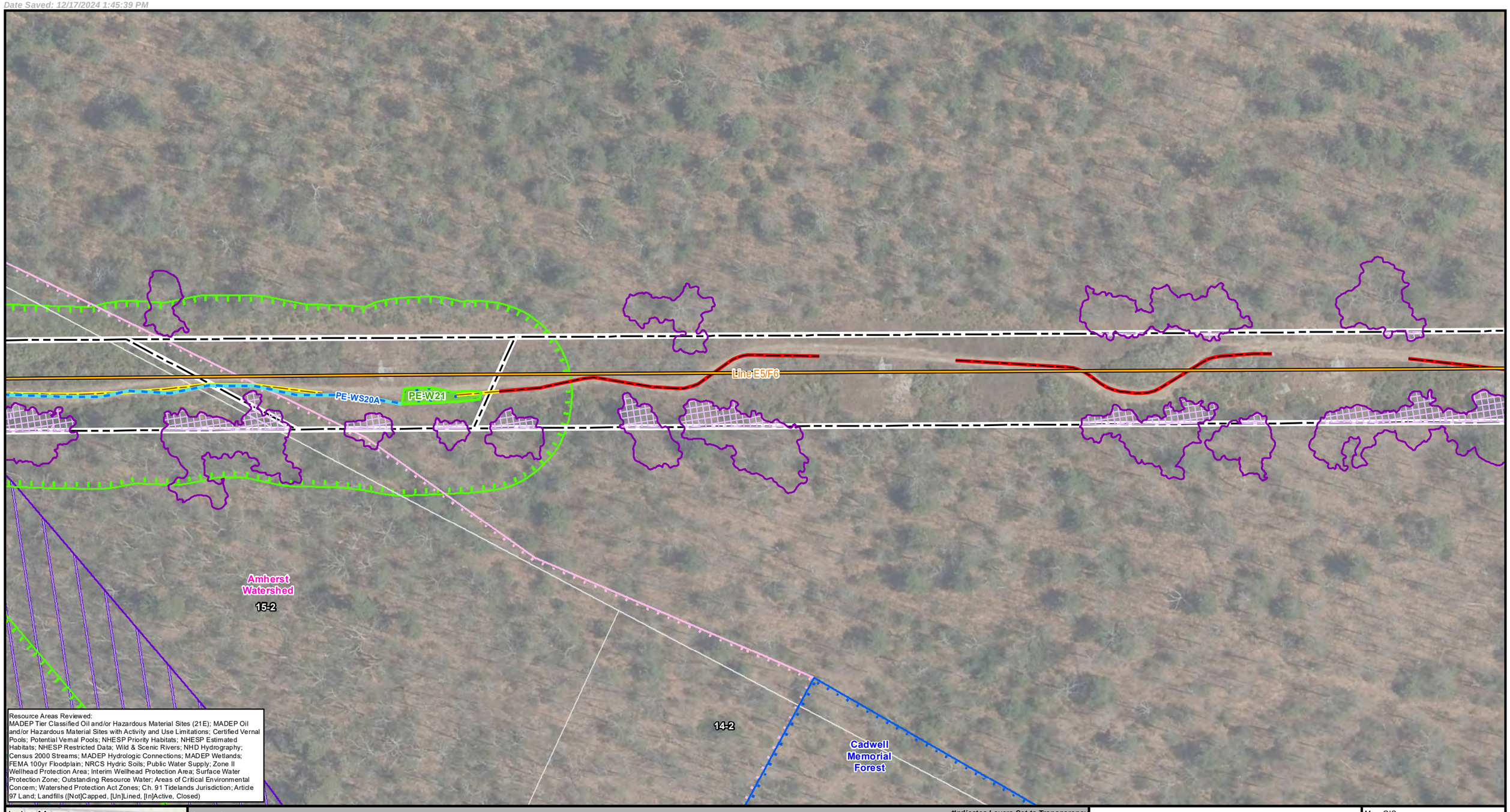

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Article 97 Lands

- Commonwealth of Massachusetts
- Municipal

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1 inch = 100 feet
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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Pelham, MA

MassGIS
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Resource Areas Reviewed:
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Article 97 Lands

- Commonwealth of Massachusetts

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Pelham, MA

MassGIS
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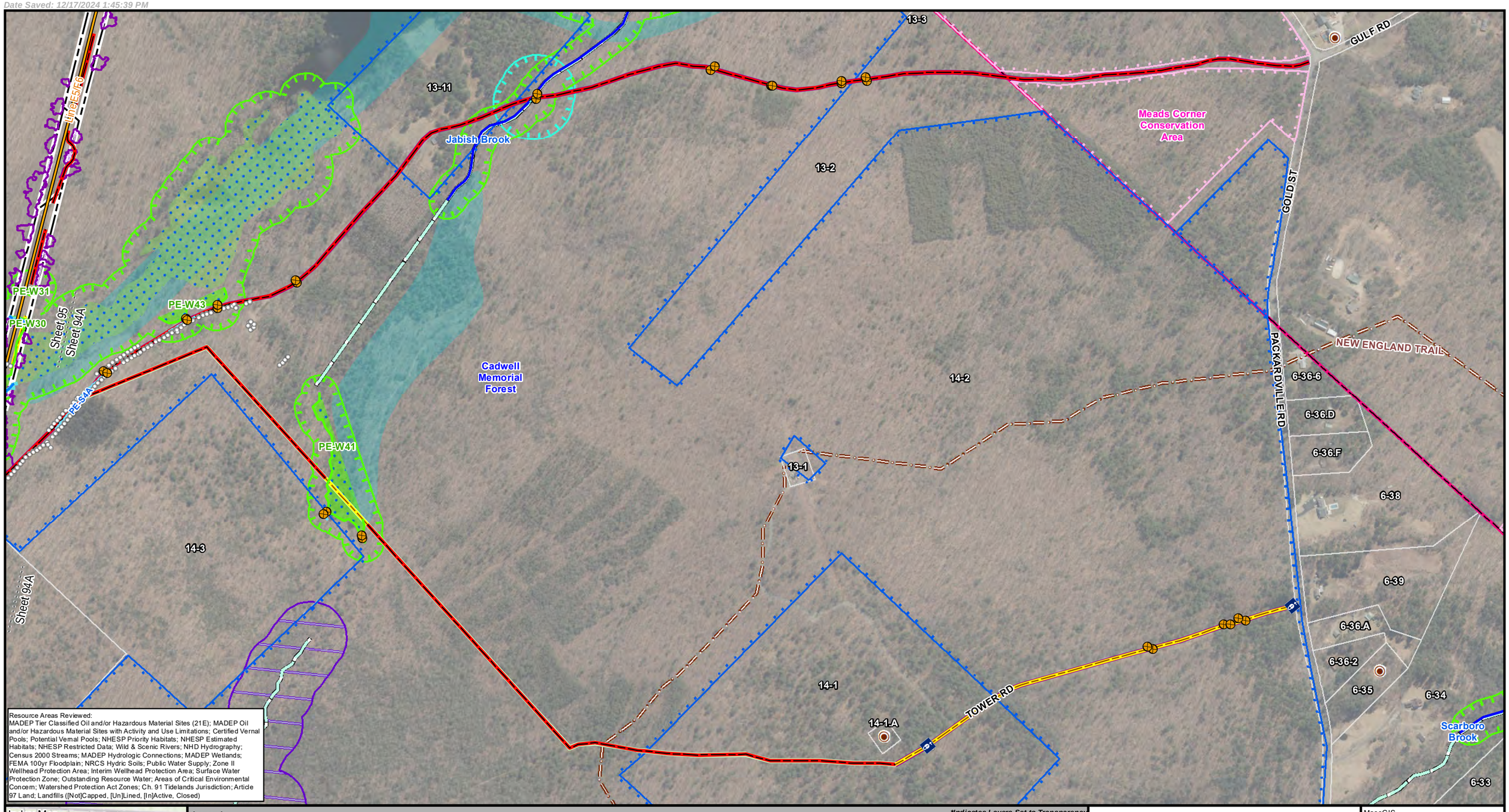

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Article 97 Lands

- Commonwealth of Massachusetts
- Municipal

*Indicates Layers Set to Transparency

1 inch = 500 feet
0 260 520
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Belchertown & Pelham, MA
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MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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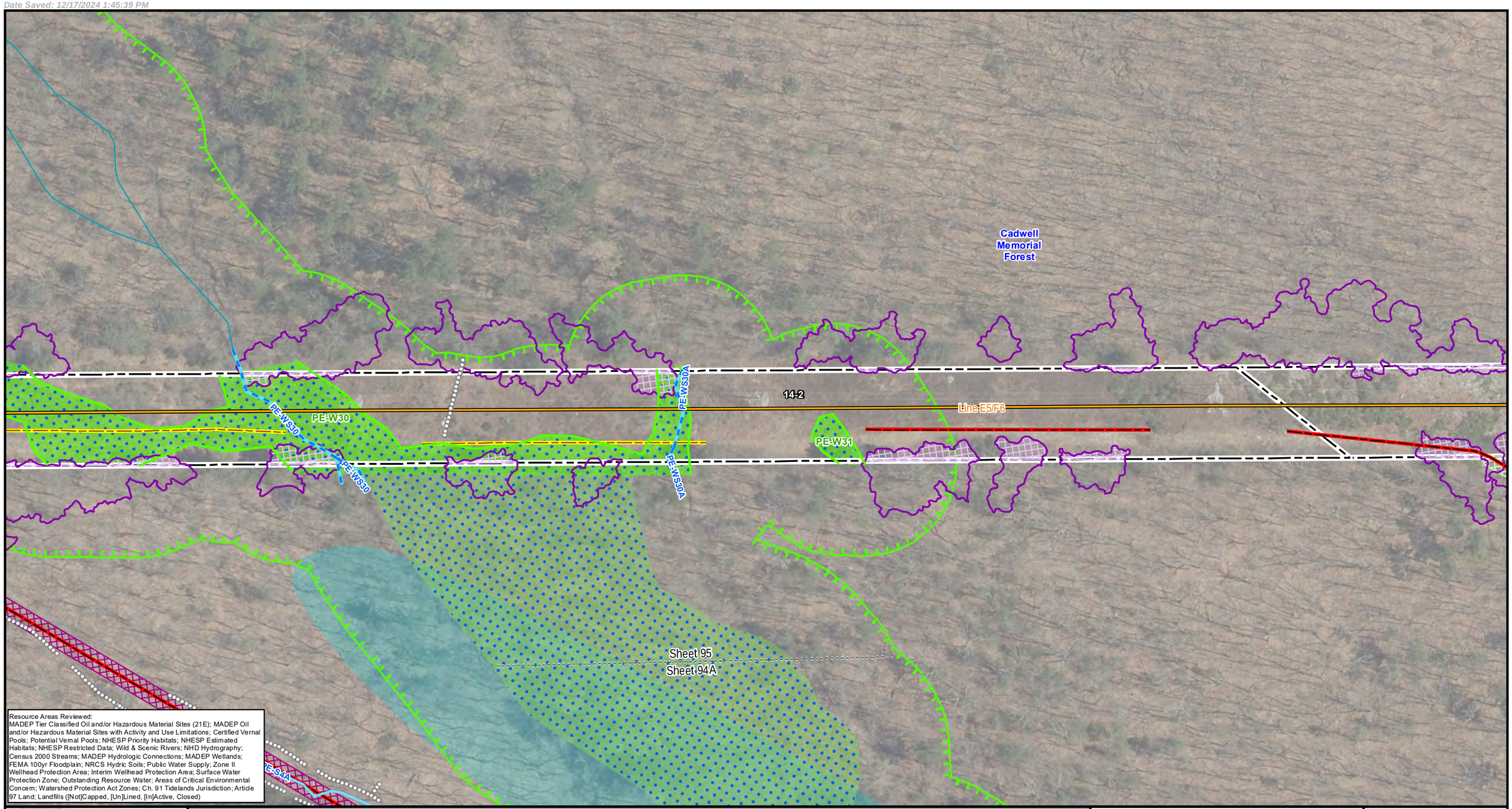

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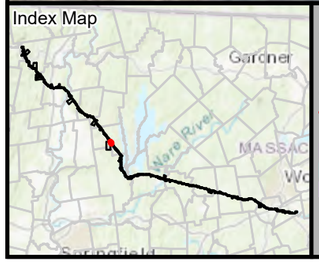

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- Commonwealth of Massachusetts

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Environmental Resources Map

Pelham, MA

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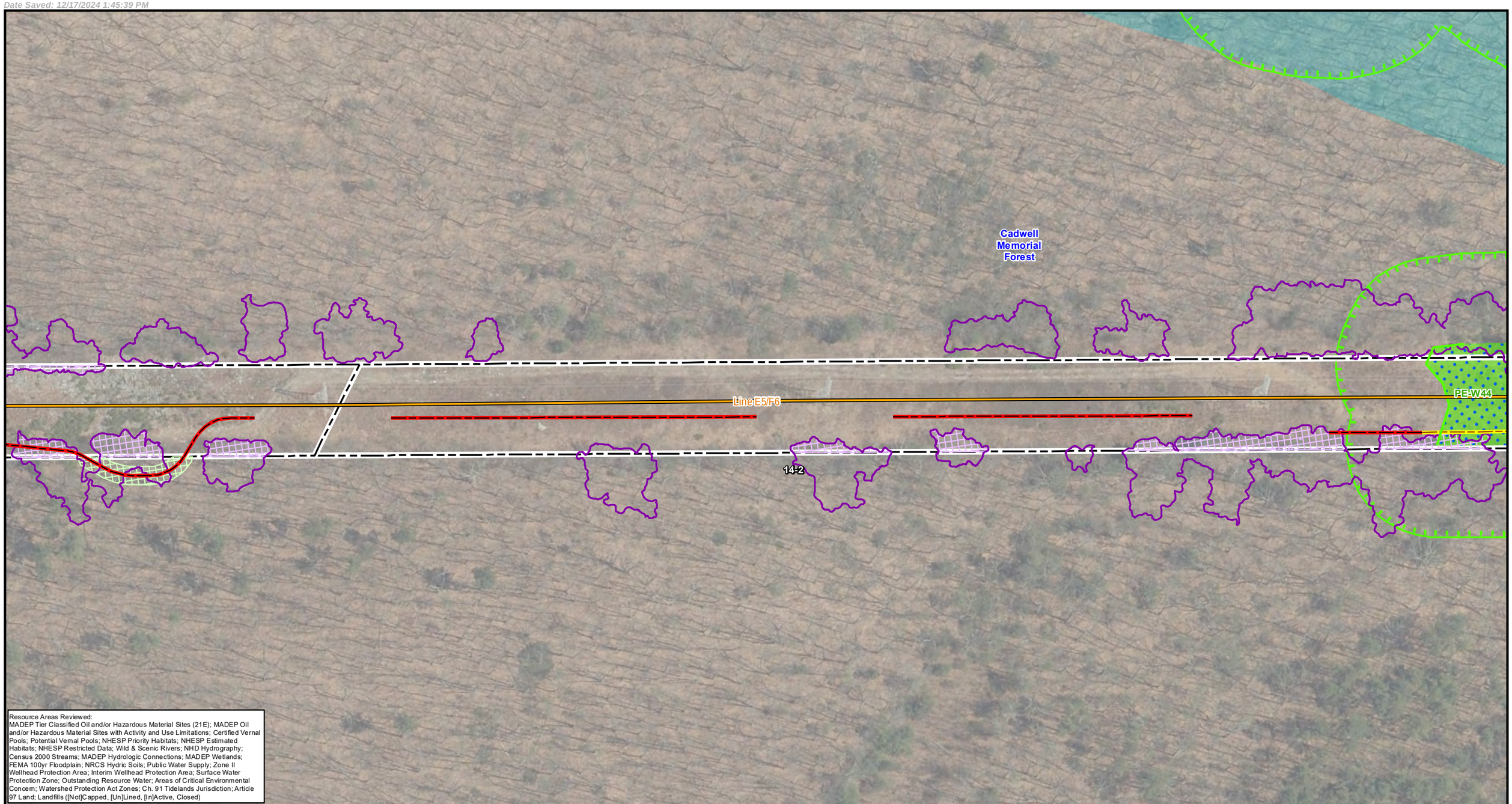

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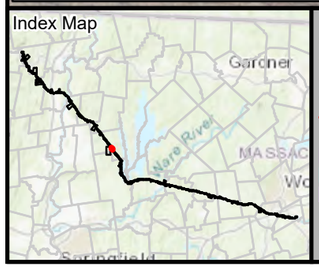

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Pelham, MA

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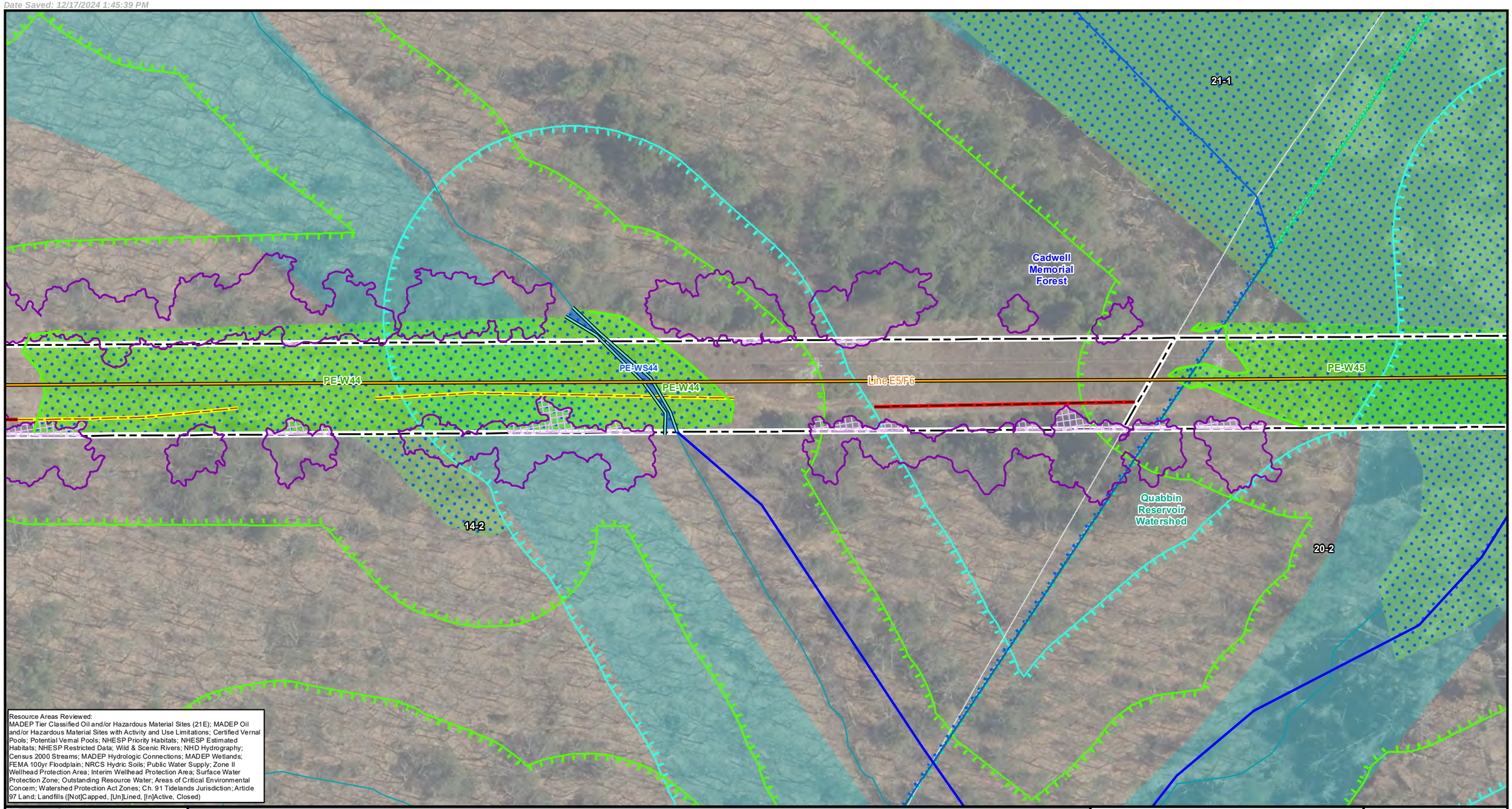

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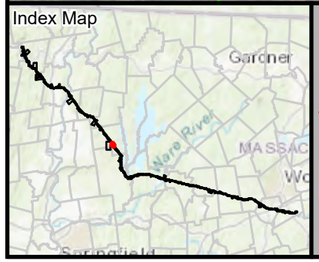

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Article 97 Lands

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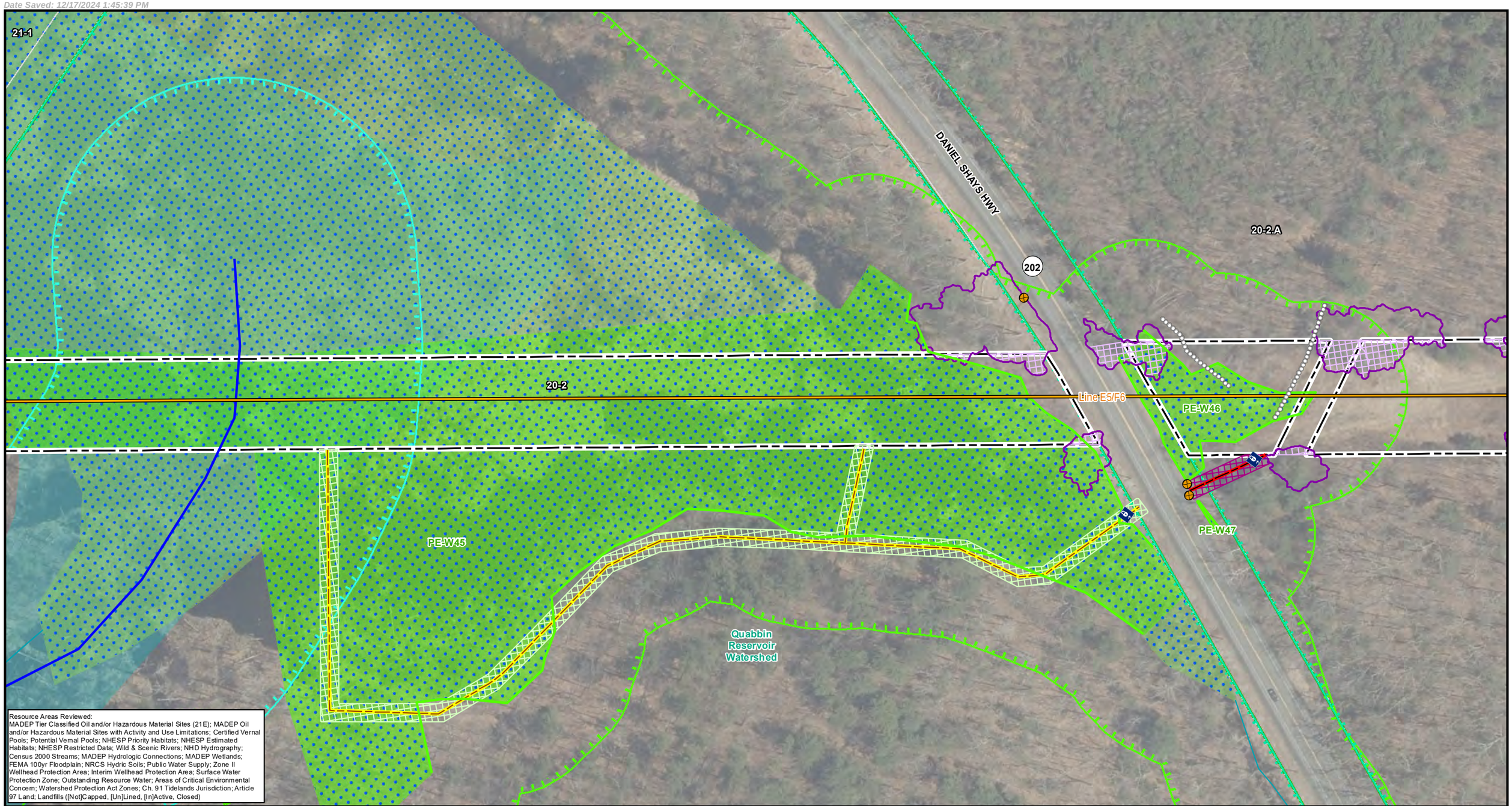

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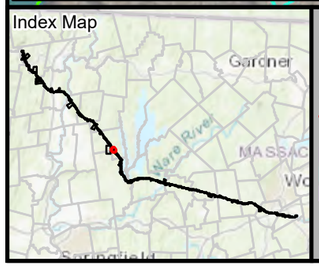

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Article 97 Lands

- DCR-Water Supply Protection

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1 inch = 100 feet
0 50 100
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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Pelham, MA

MassGIS
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20-2.A

Quabbin Reservoir Watershed

PE-W48

Line E5/F6

Resource Areas Reviewed:
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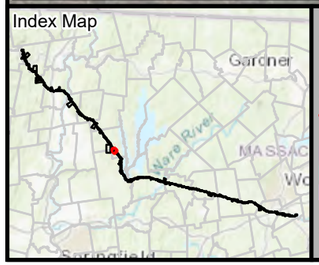

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Article 97 Lands

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Pelham, MA

MassGIS
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20-2.A

Quabbin Reservoir Watershed

PE-S7

PE-S7

Line E5/F6

PE-W49

PE-WS49

PE-WS49

PE-WS49

Resource Areas Reviewed:
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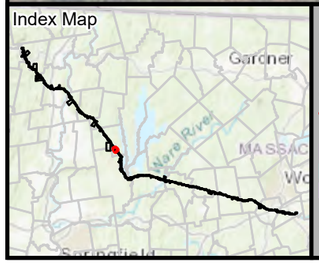

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Article 97 Lands

- DCR-Water Supply Protection

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Pelham, MA

MassGIS
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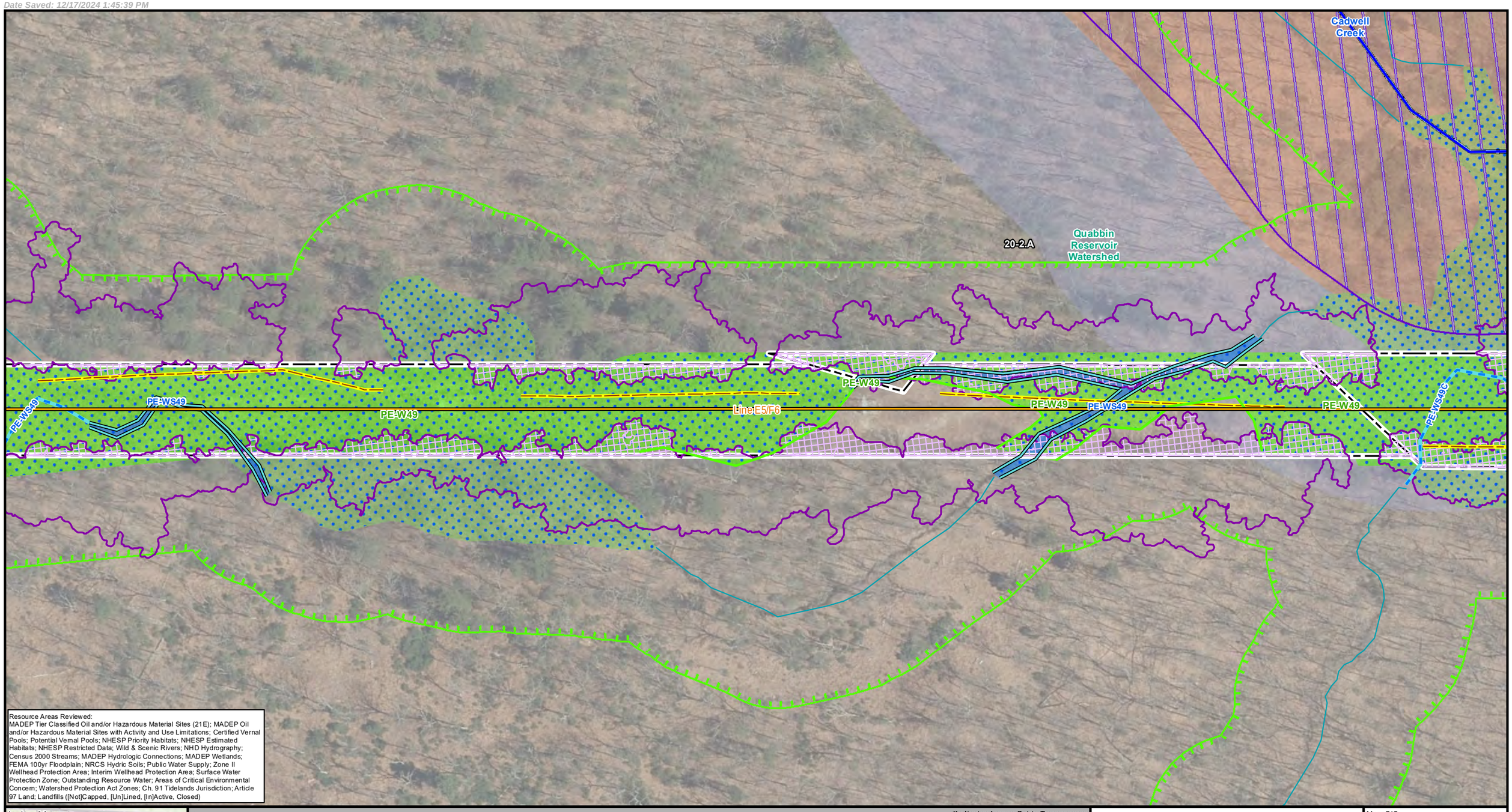

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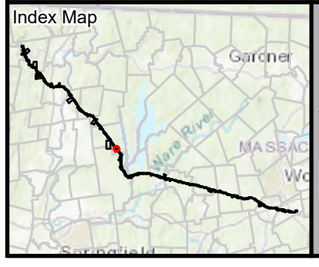

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Article 97 Lands

- DCR-Water Supply Protection

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0 50 100

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Pelham, MA

MassGIS
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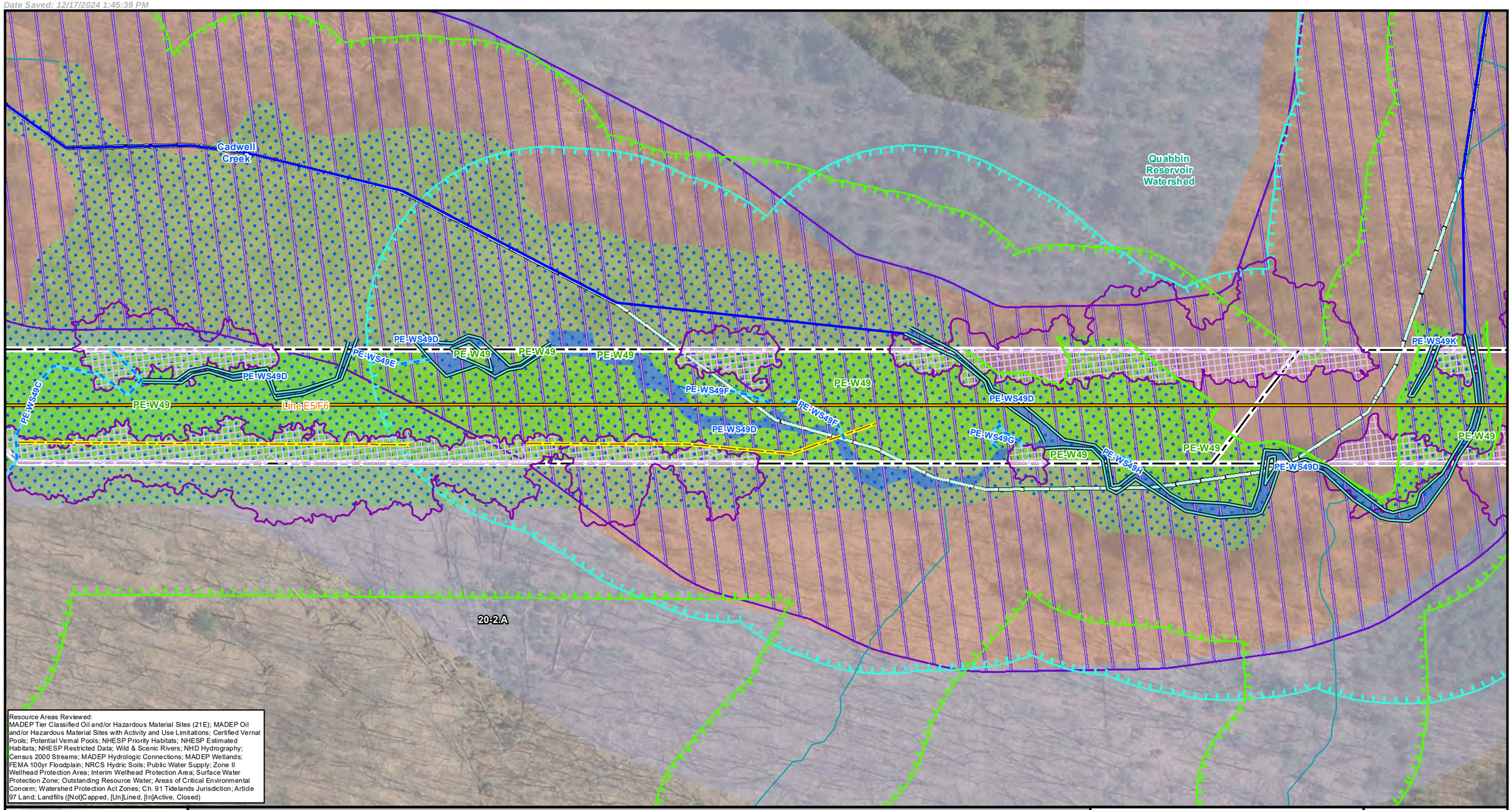

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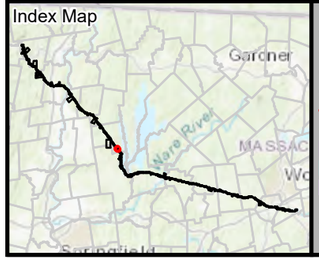

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Article 97 Lands

- DCR-Water Supply Protection

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Pelham, MA

MassGIS
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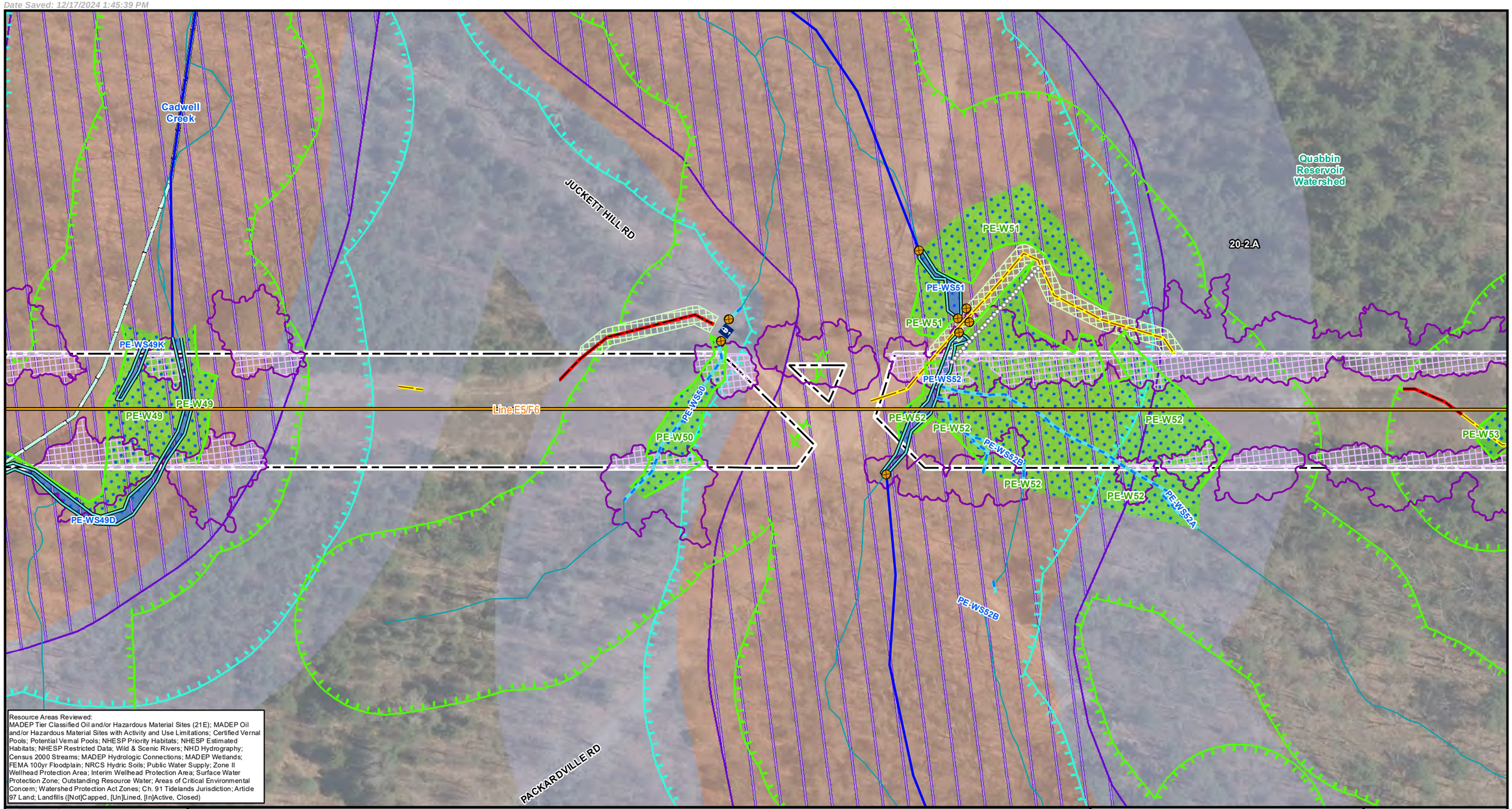

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Article 97 Lands

- DCR-Water Supply Protection

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Environmental Resources Map

Pelham, MA

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Quabbin Reservoir Watershed

20-2.A

PE-W53

PE-W55

PE-WS55

Line E5/F6

PELHAM

BELCHERTOWN

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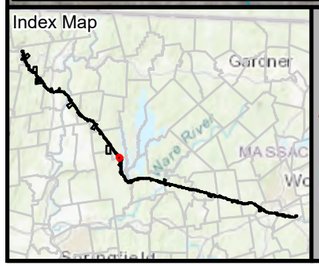

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Article 97 Lands

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Environmental Resources Map

Pelham & Belchertown, MA

MassGIS
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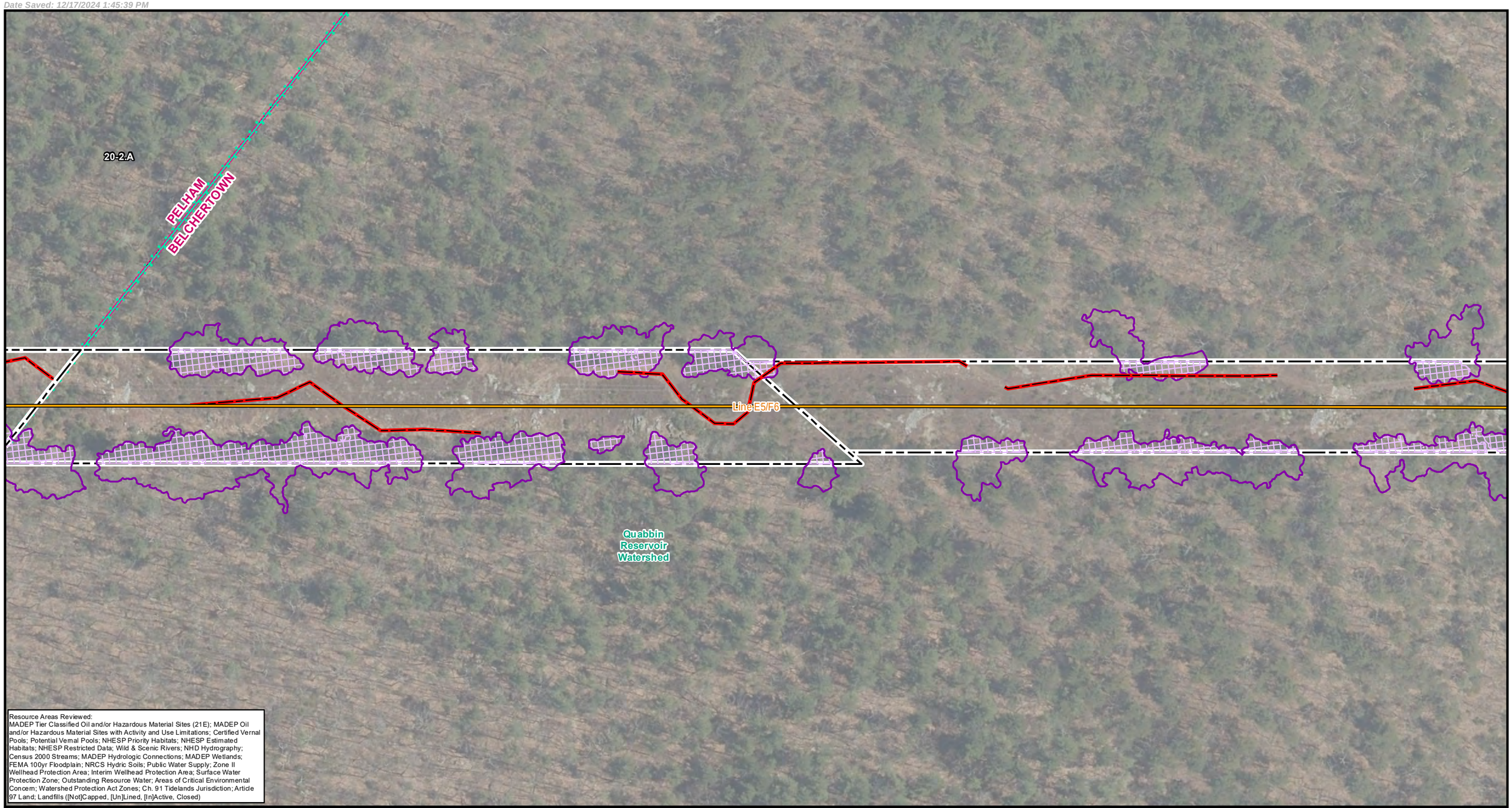

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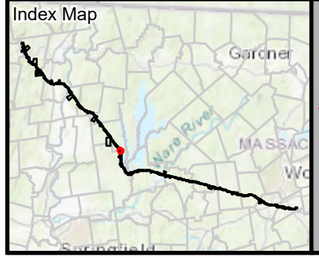

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*Indicates Layers Set to Transparency

1 inch = 100 feet

0 50 100

Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Pelham & Belchertown, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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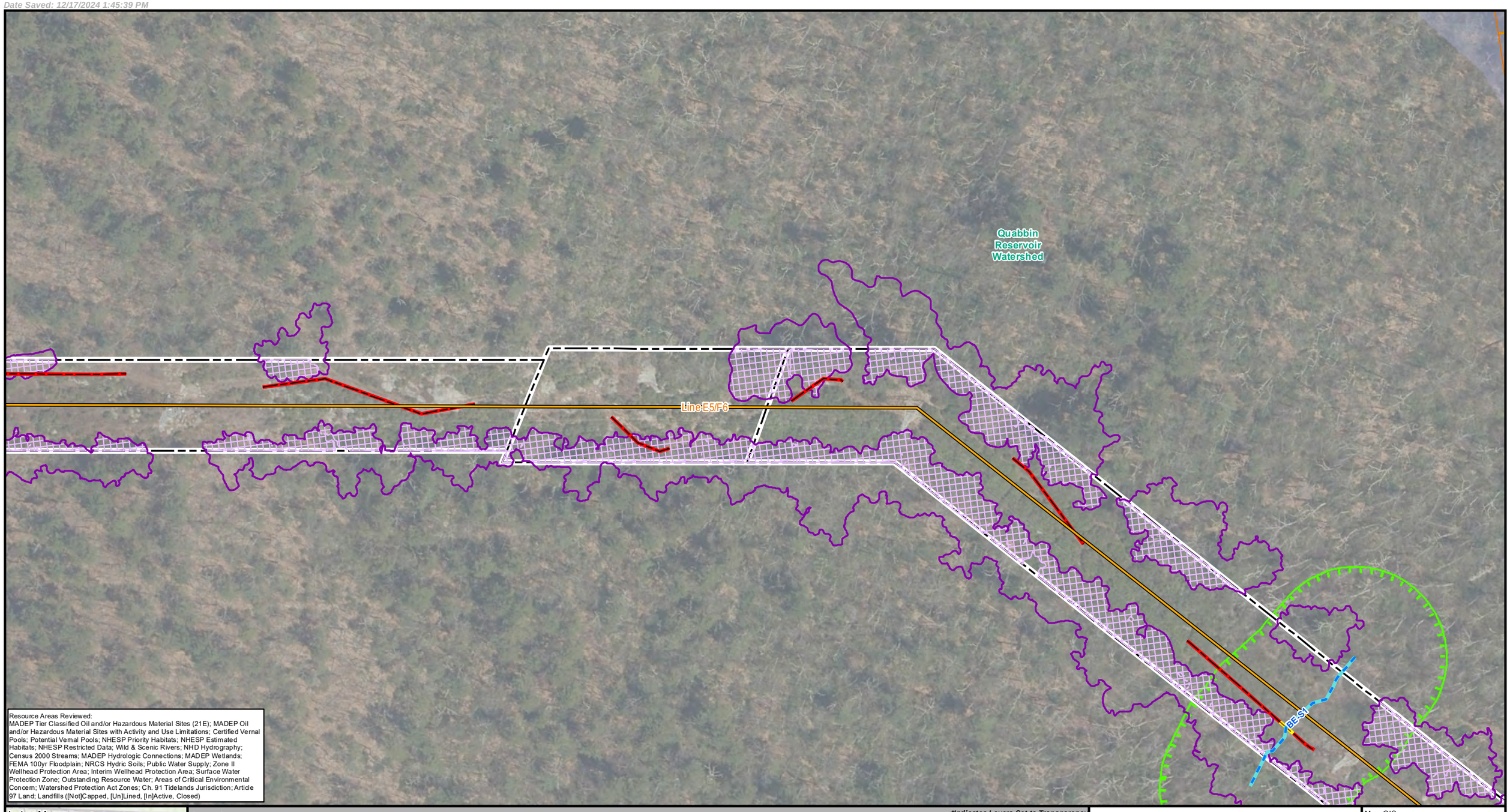

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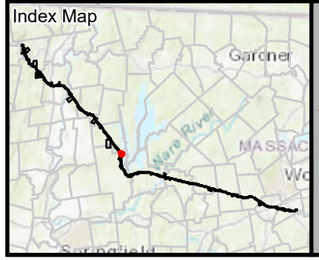

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Belchertown, MA

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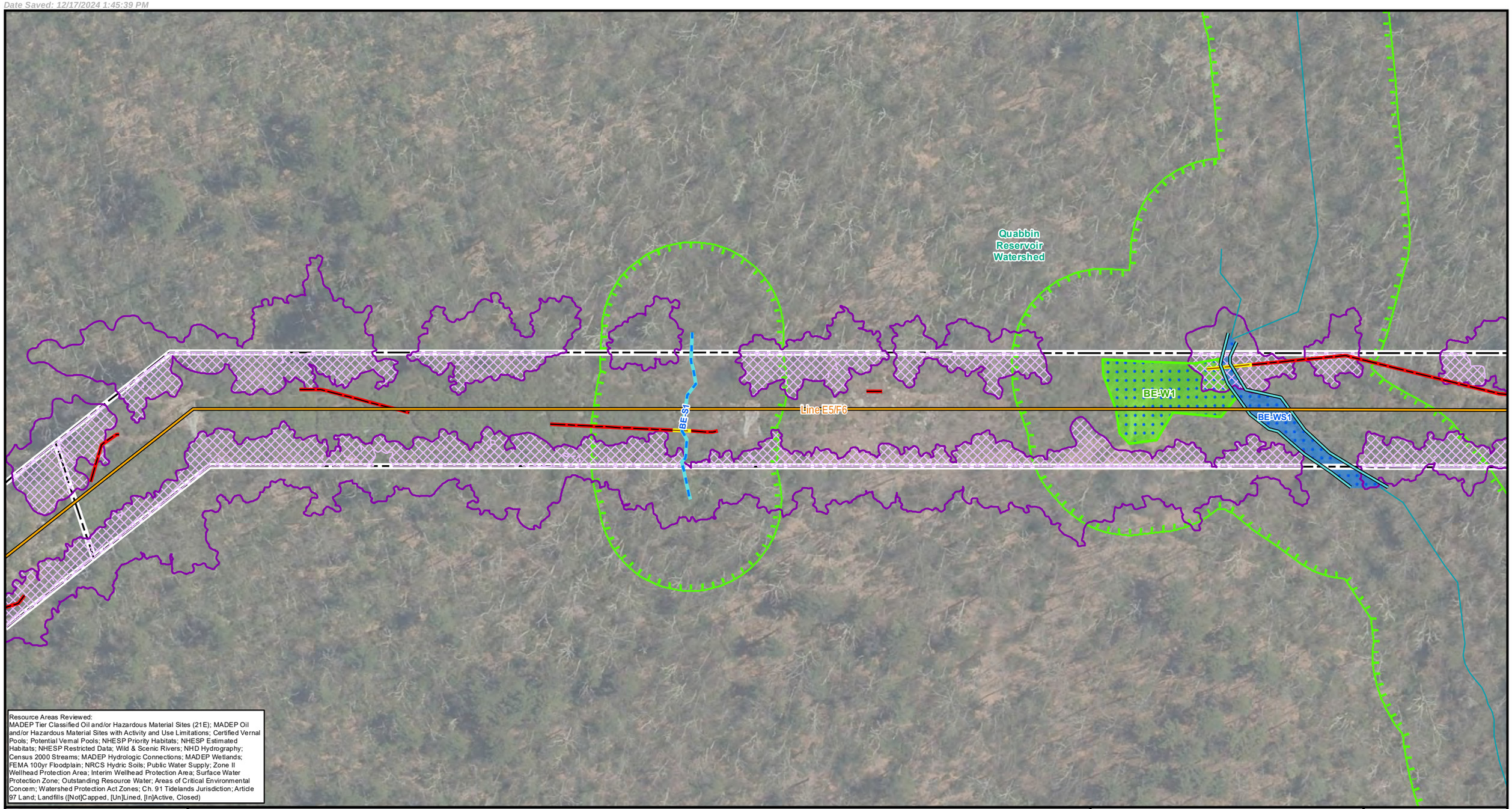

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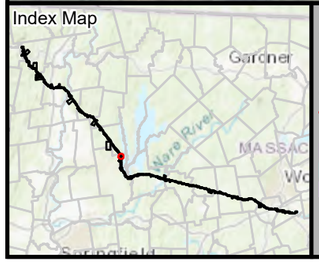

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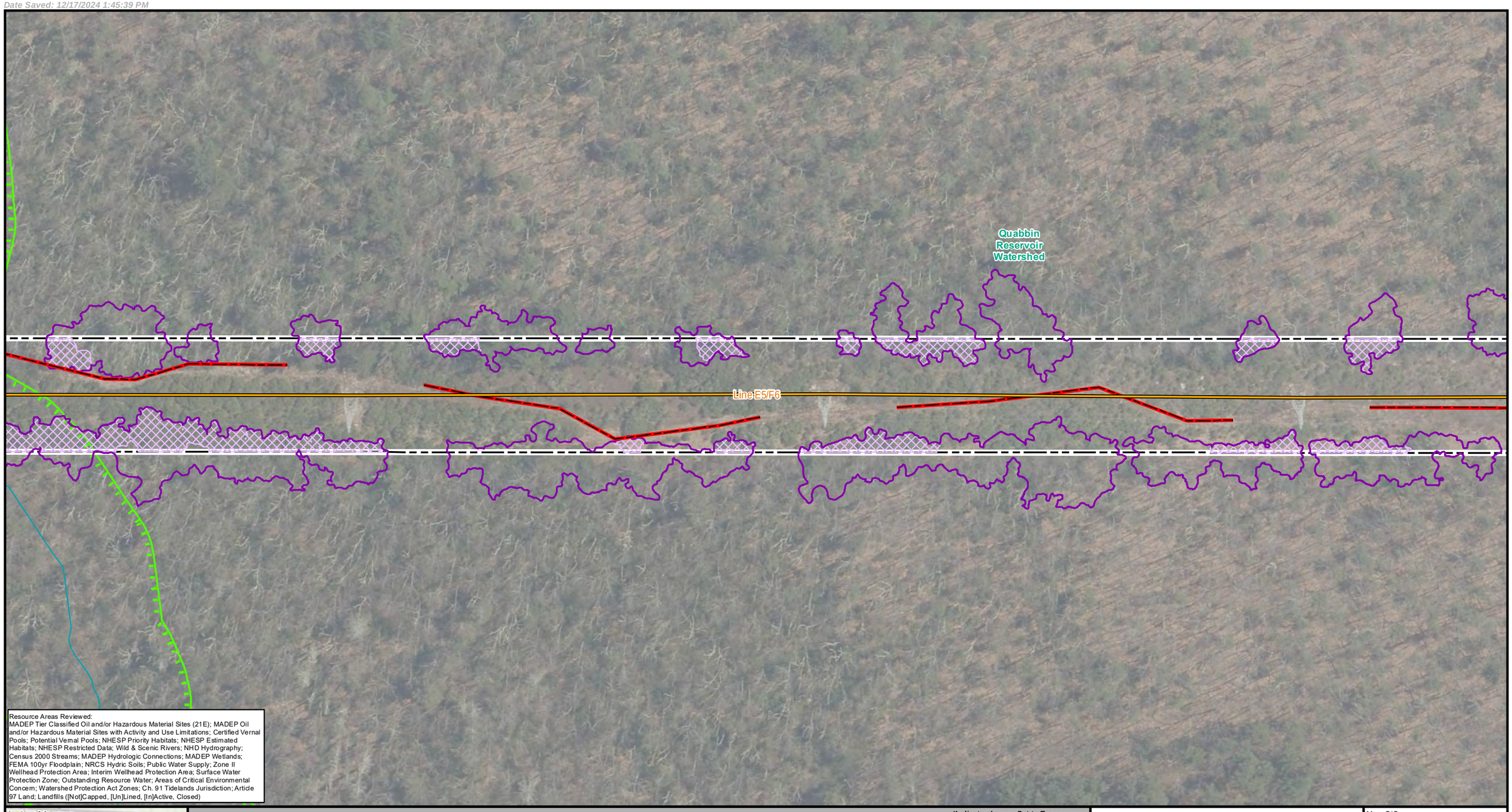

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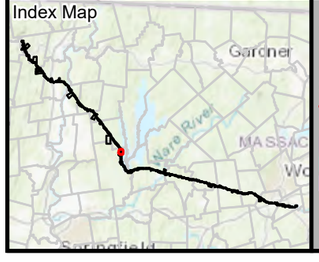

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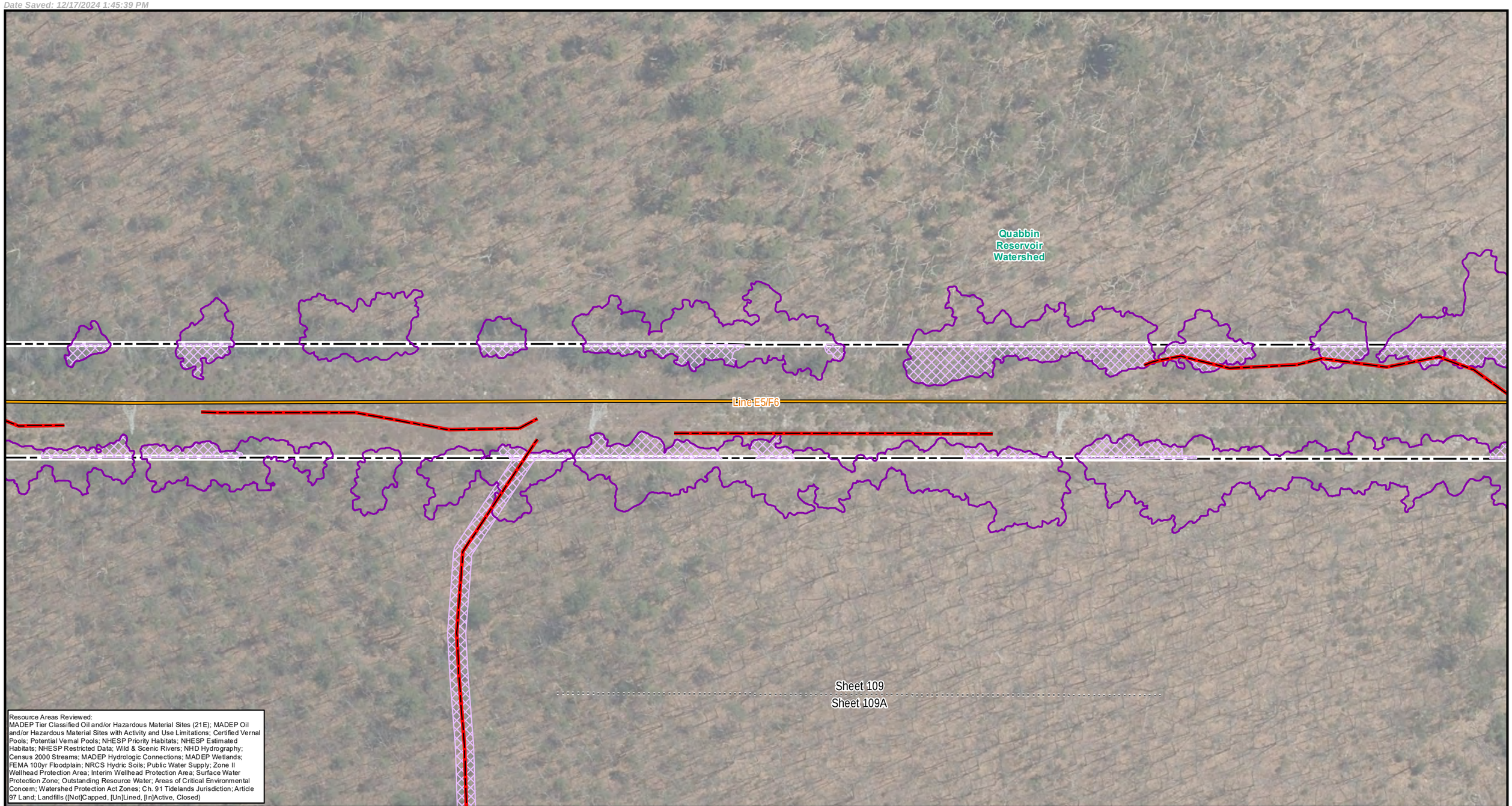

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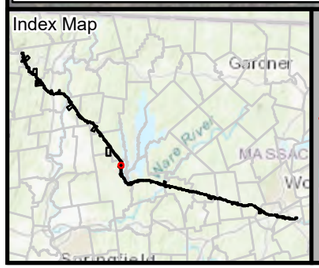

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Belchertown, MA

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Line E-5/F-6

Sheet 109
Sheet 109A

Quabbin Reservoir Watershed

BE-W3

BE-W4

JUCKETT RD

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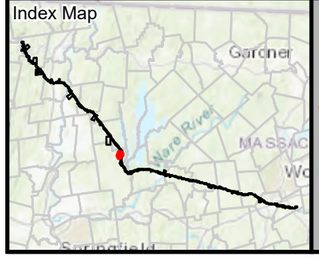

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Belchertown, MA
Page 109A of 240

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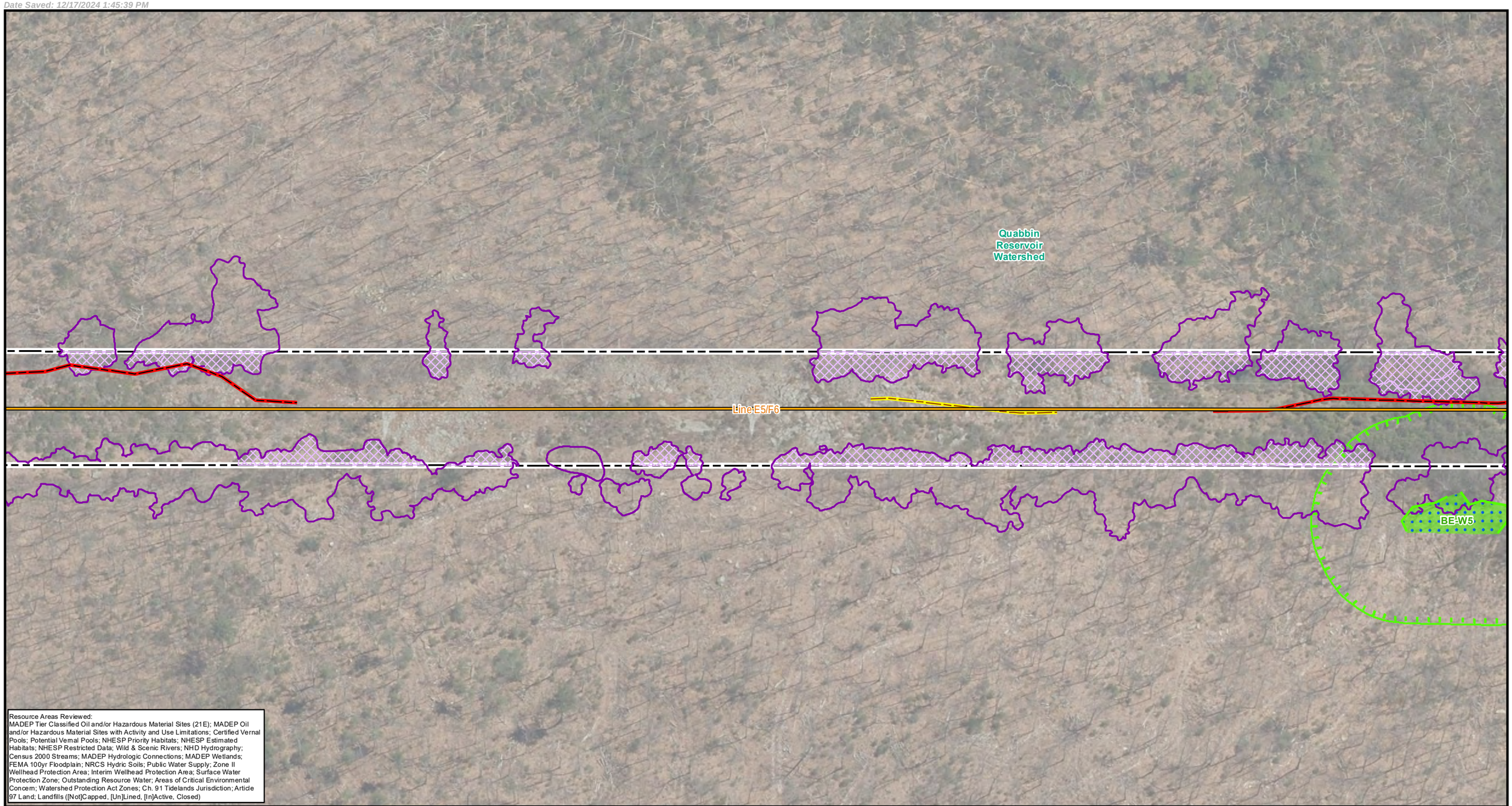

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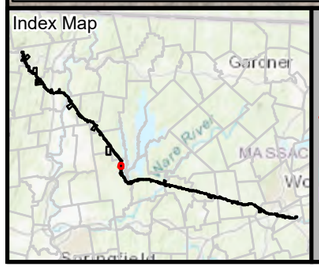

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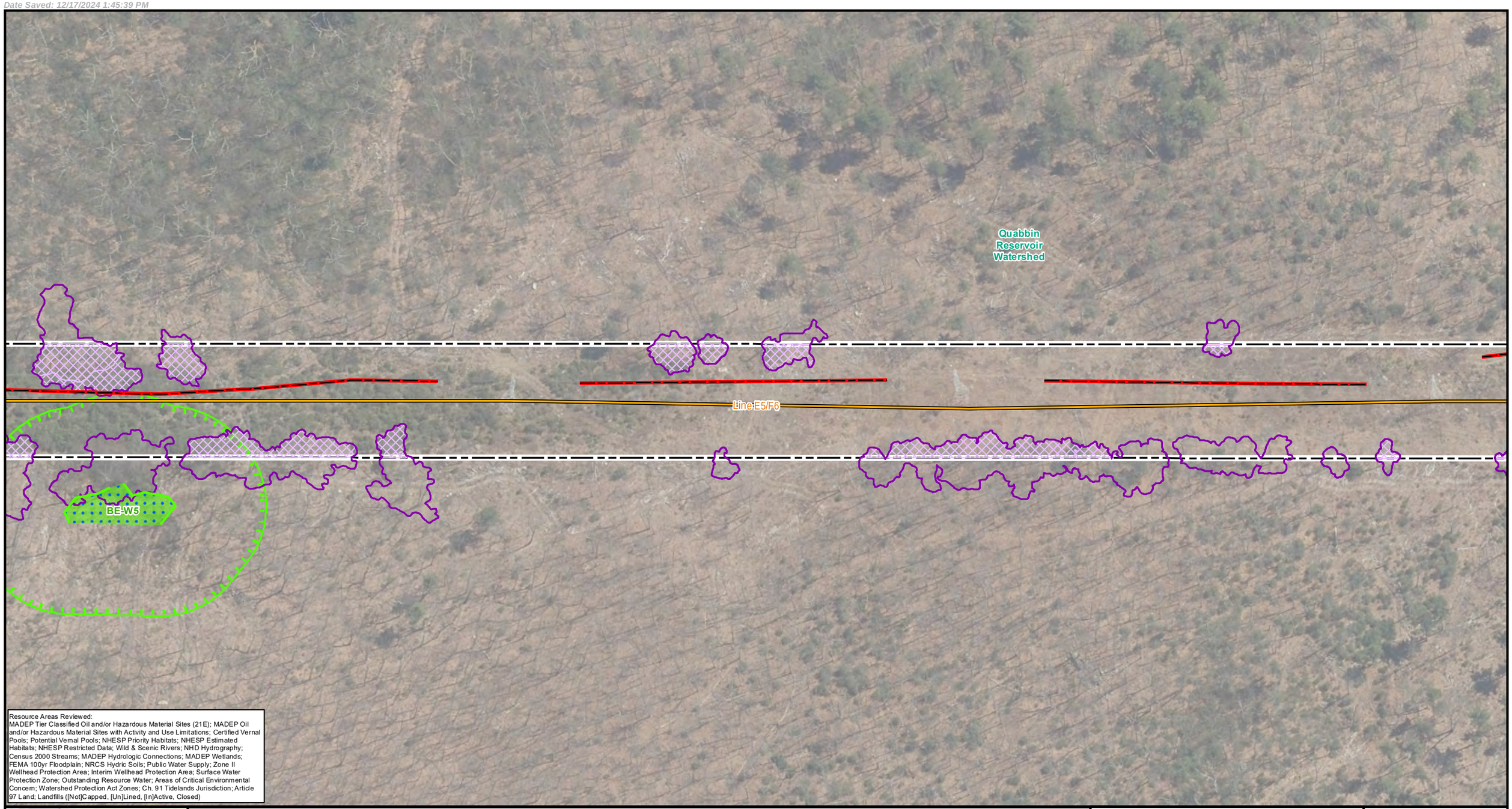

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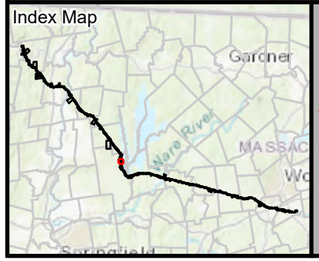

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Article 97 Lands

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Belchertown, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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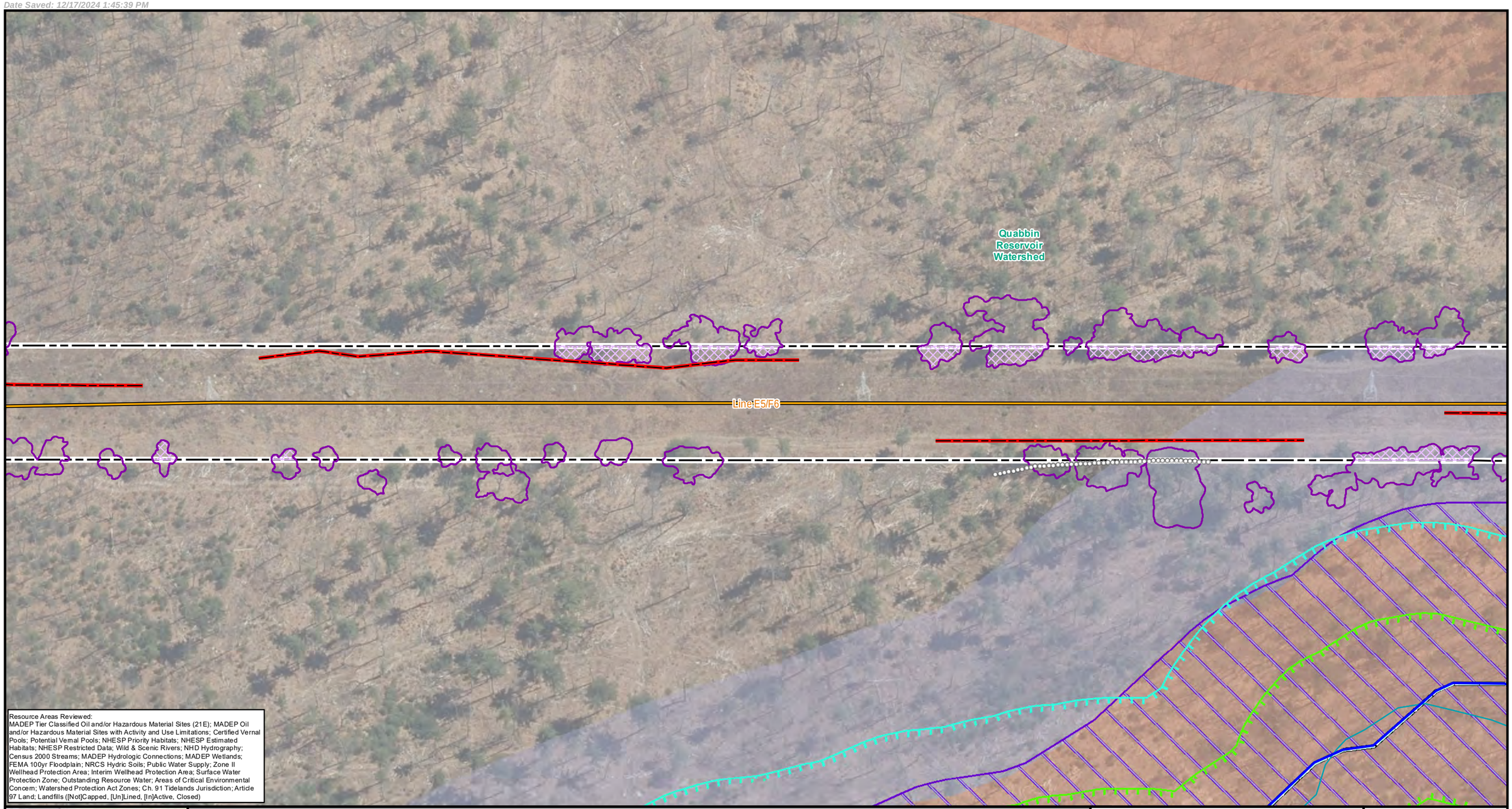

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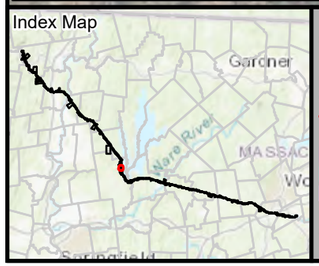

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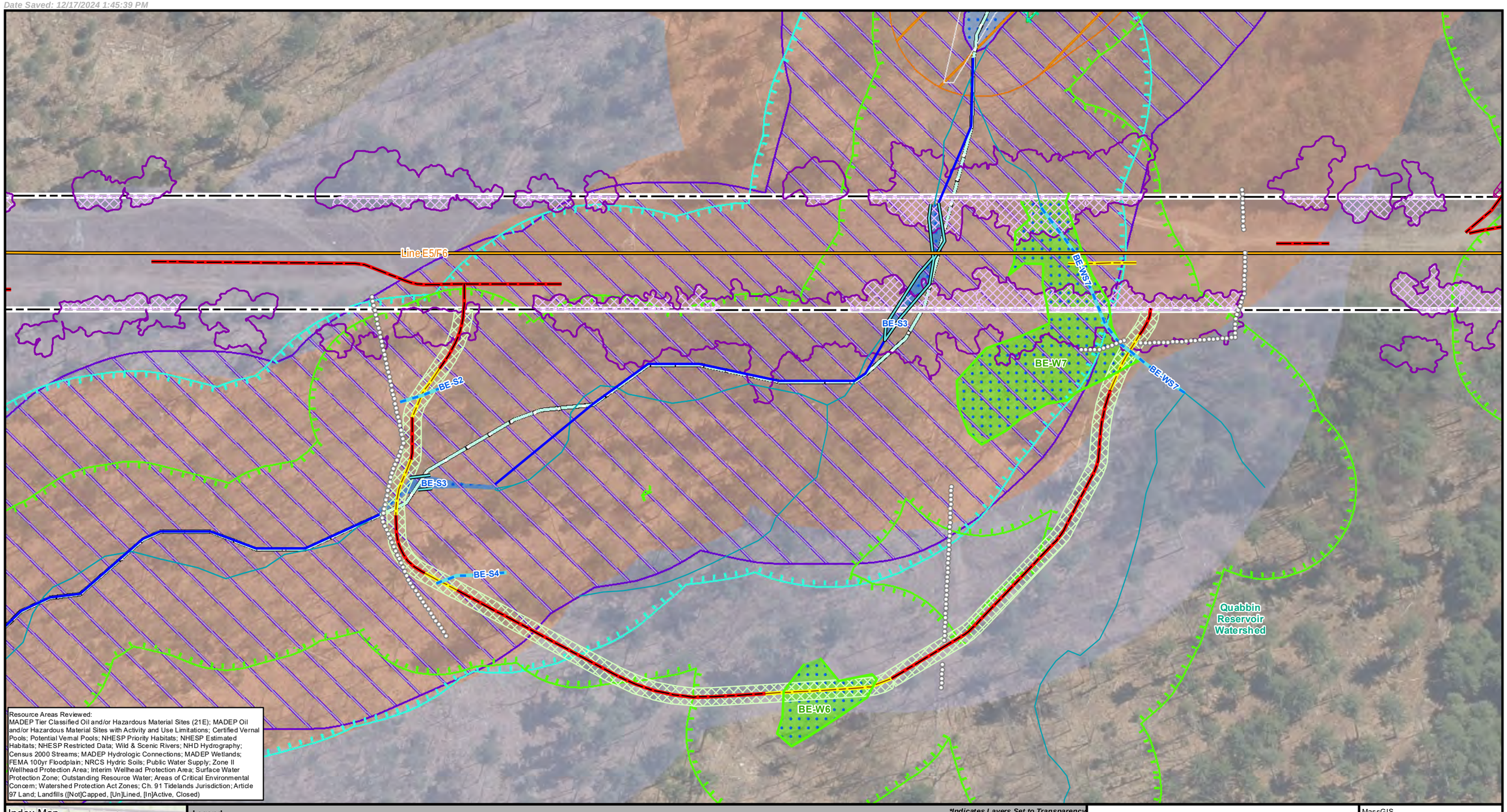

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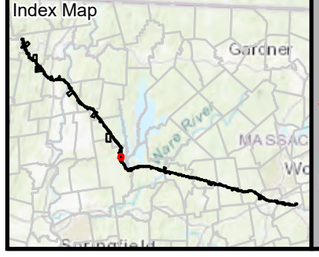

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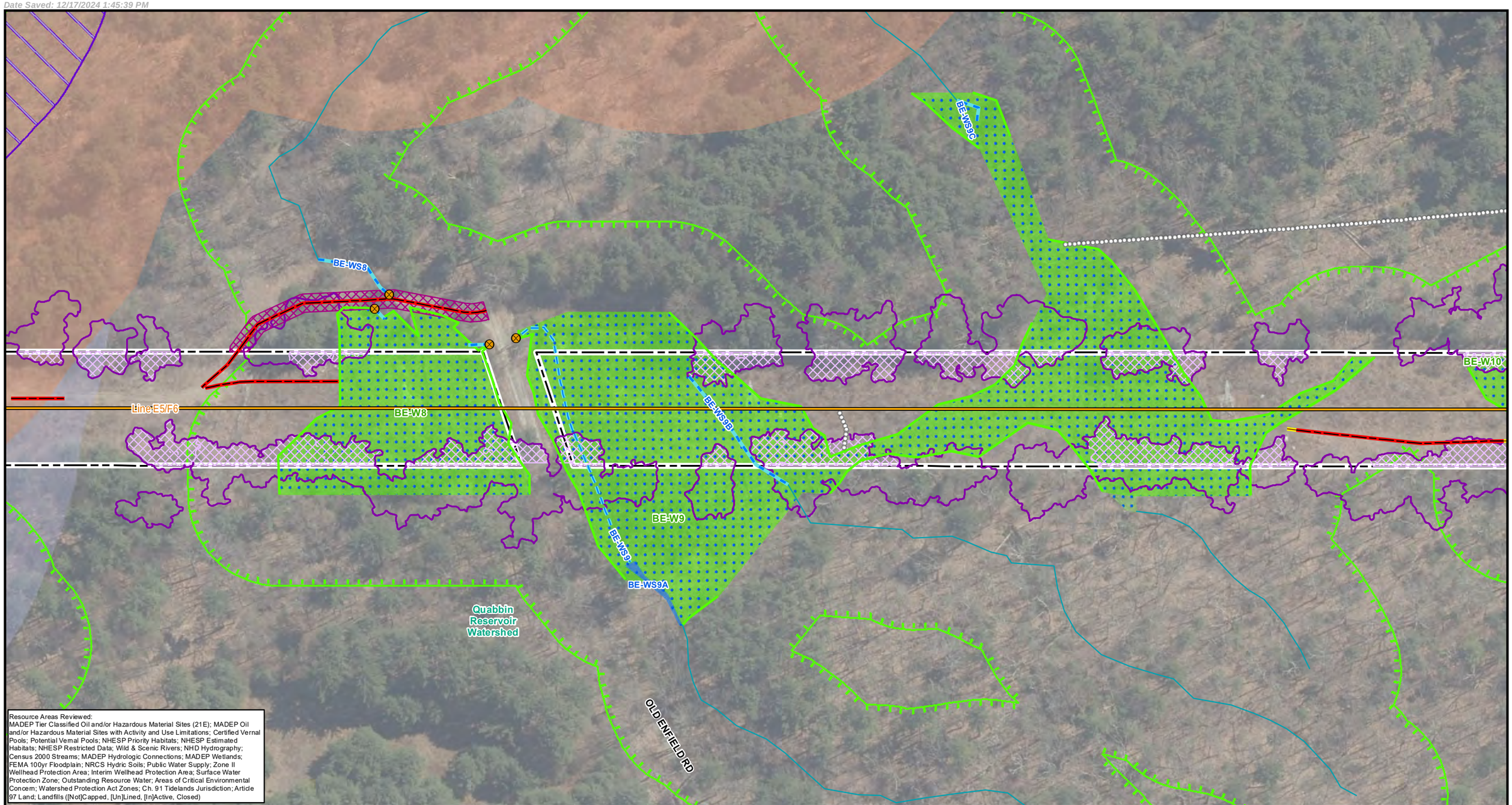

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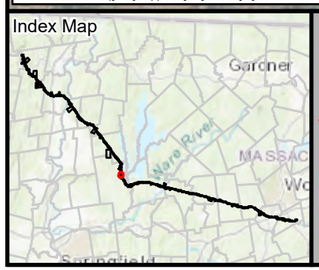

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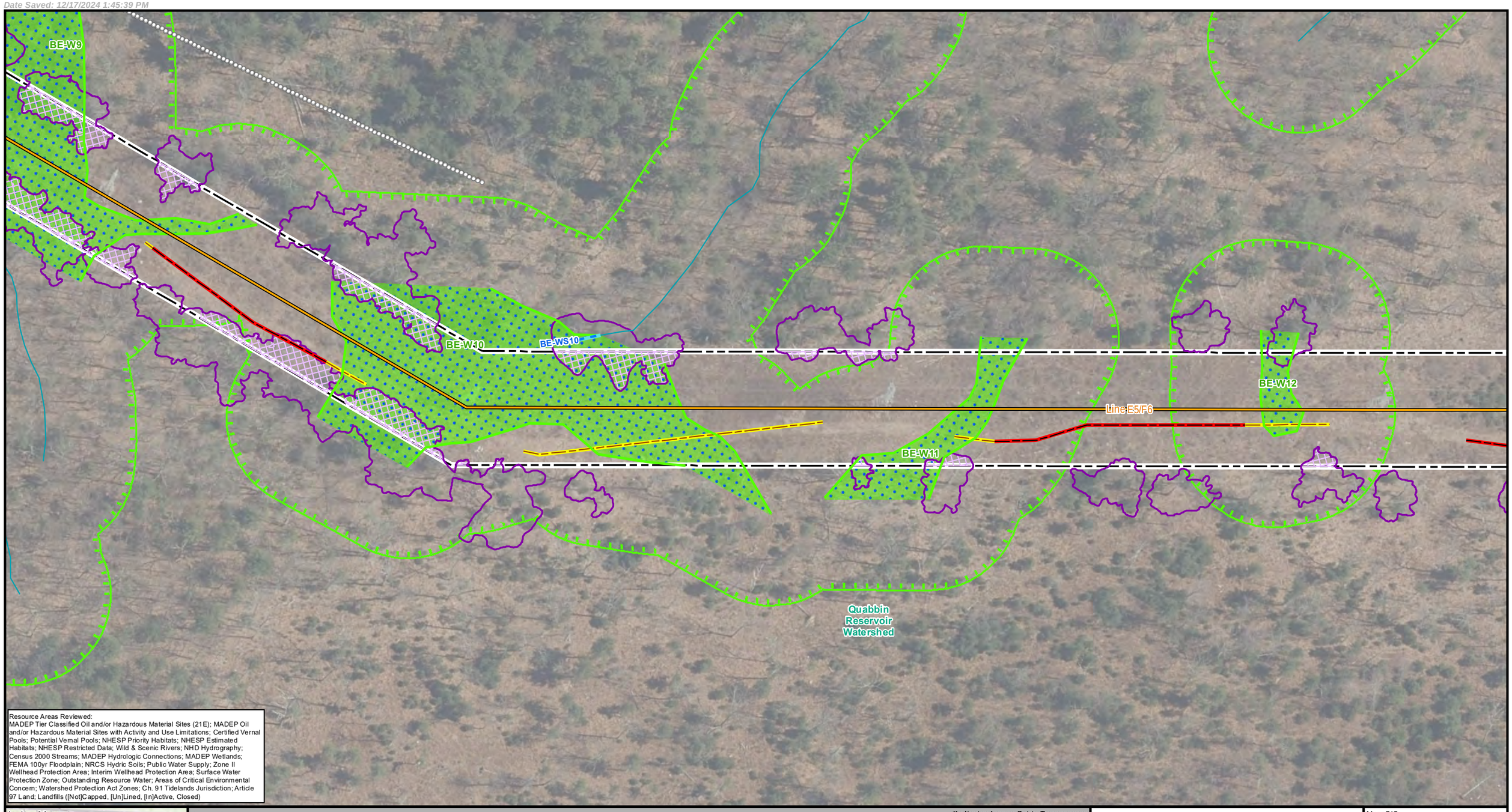

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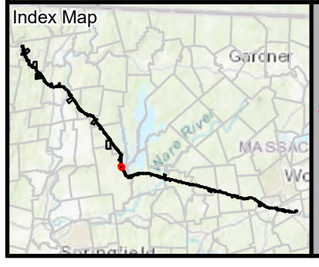

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Belchertown, MA
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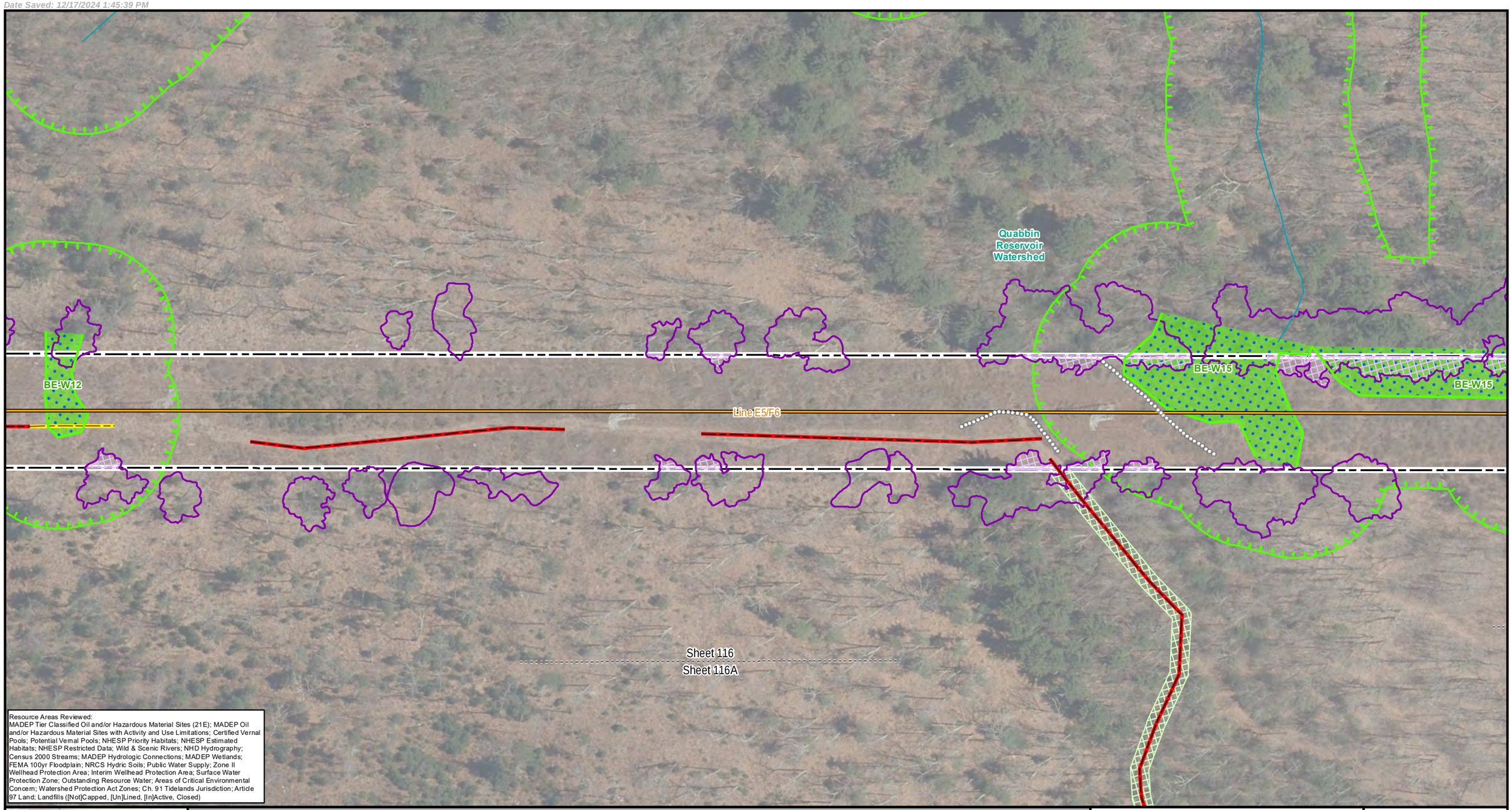

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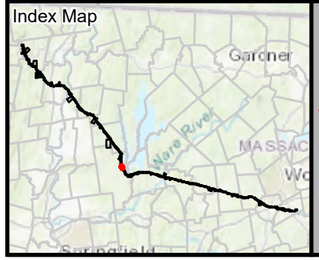

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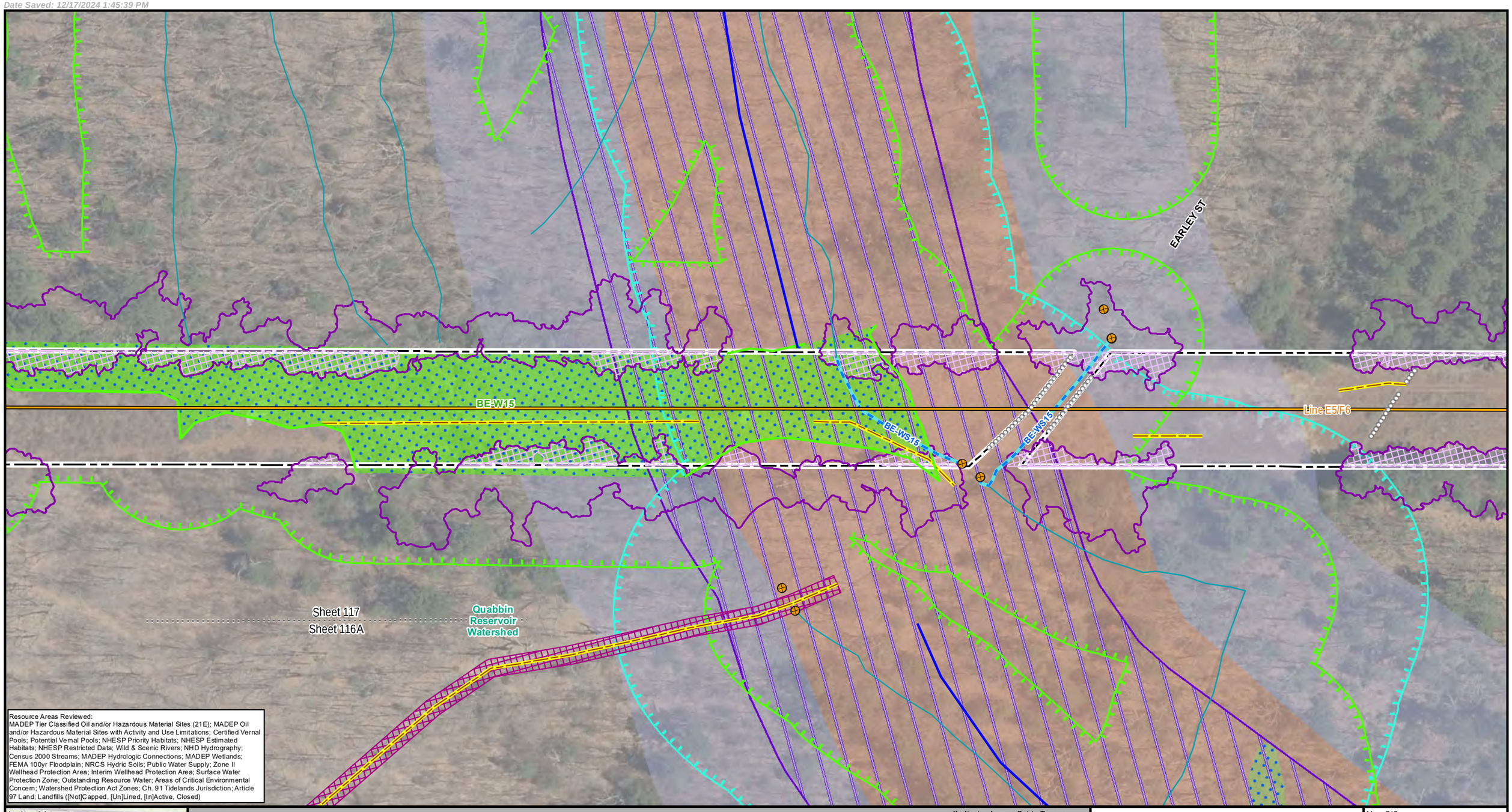

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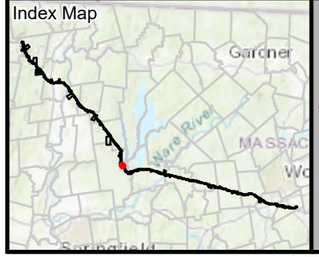

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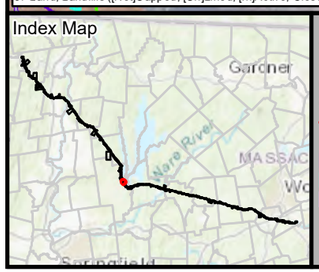

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Belchertown, MA

MassGIS
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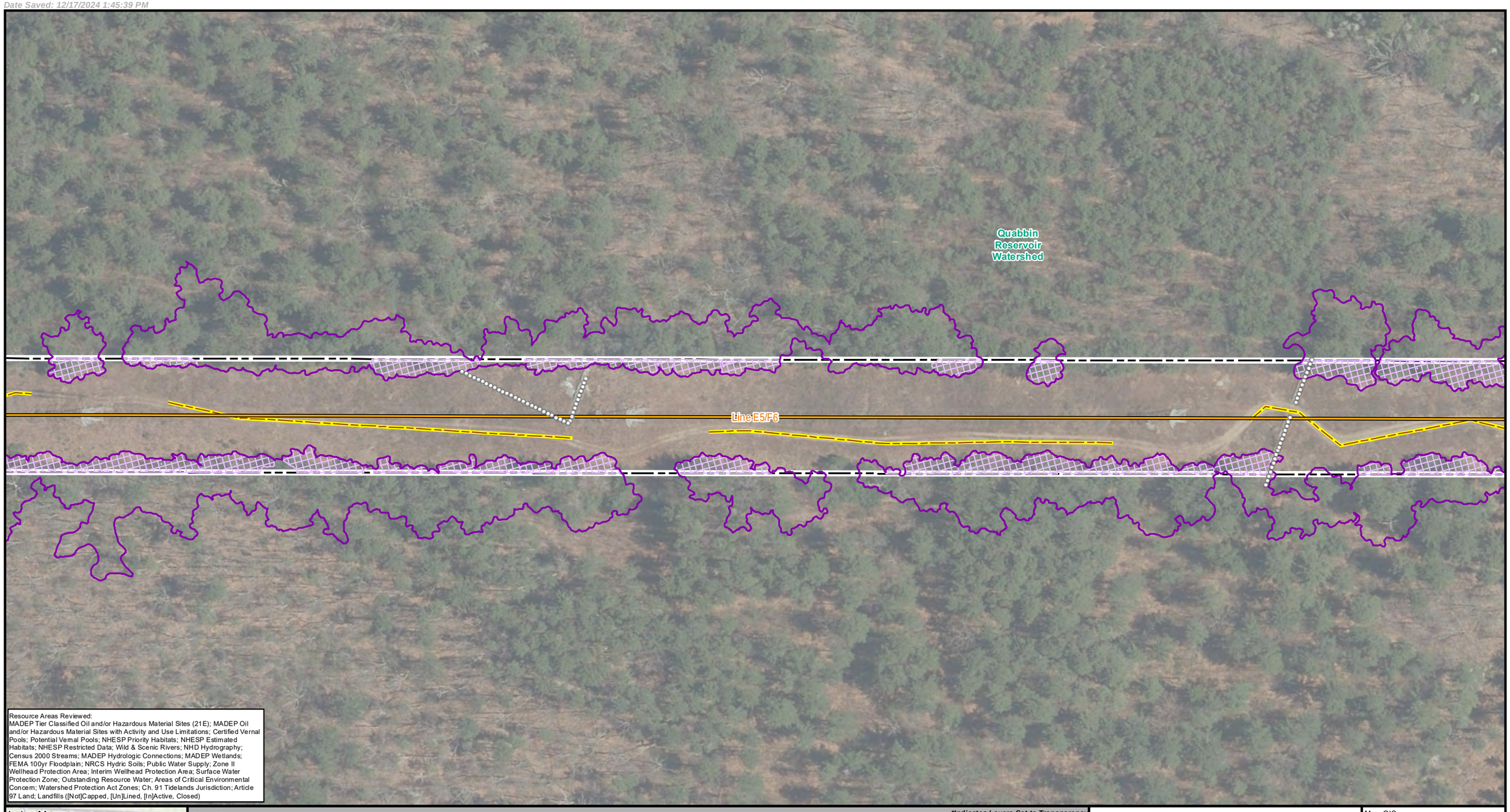

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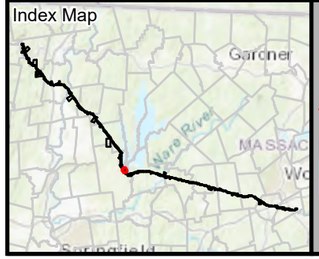

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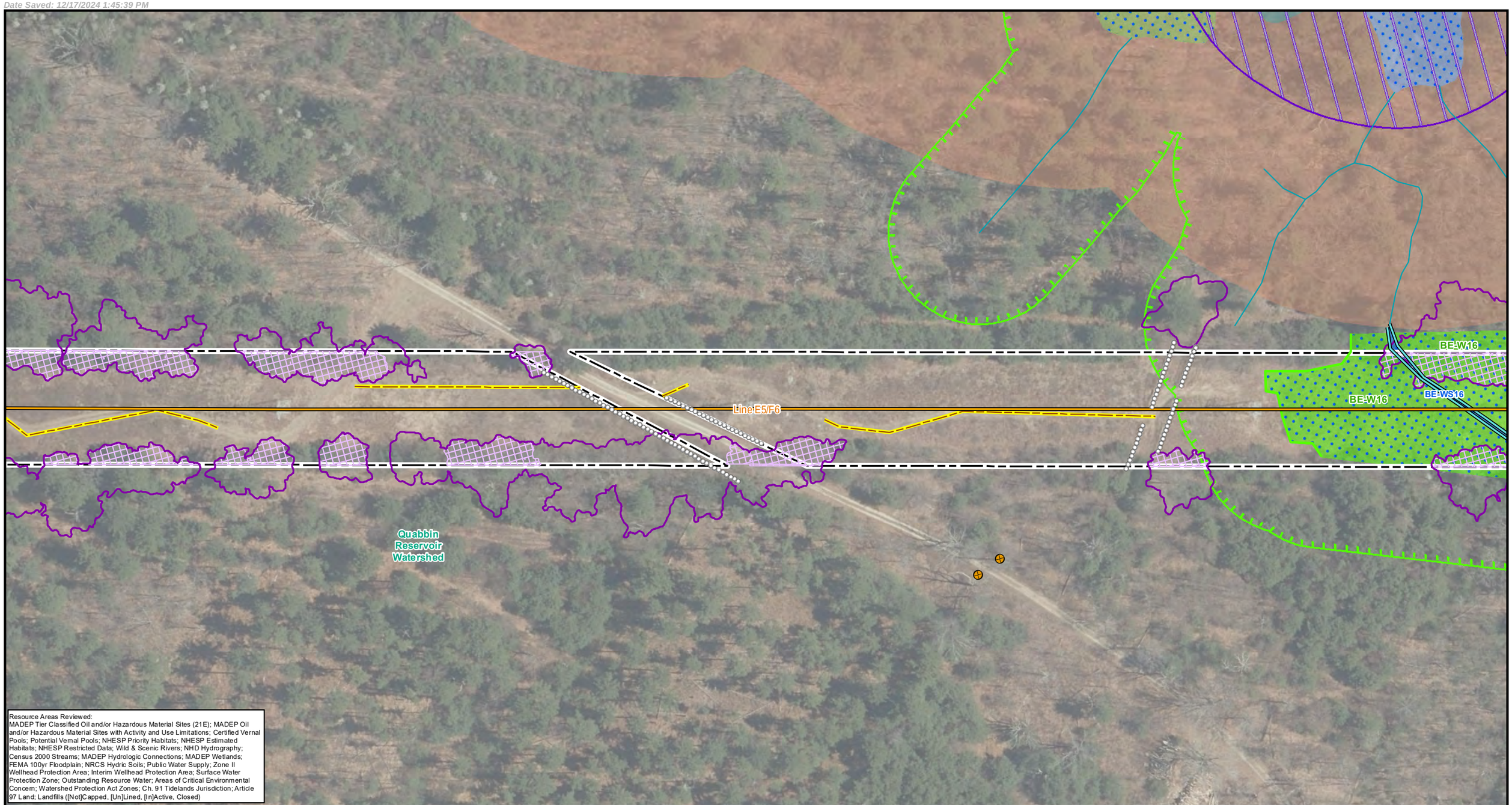

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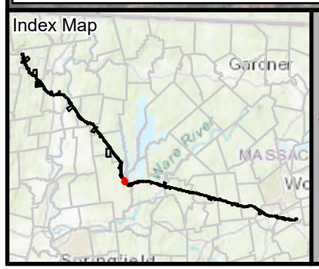

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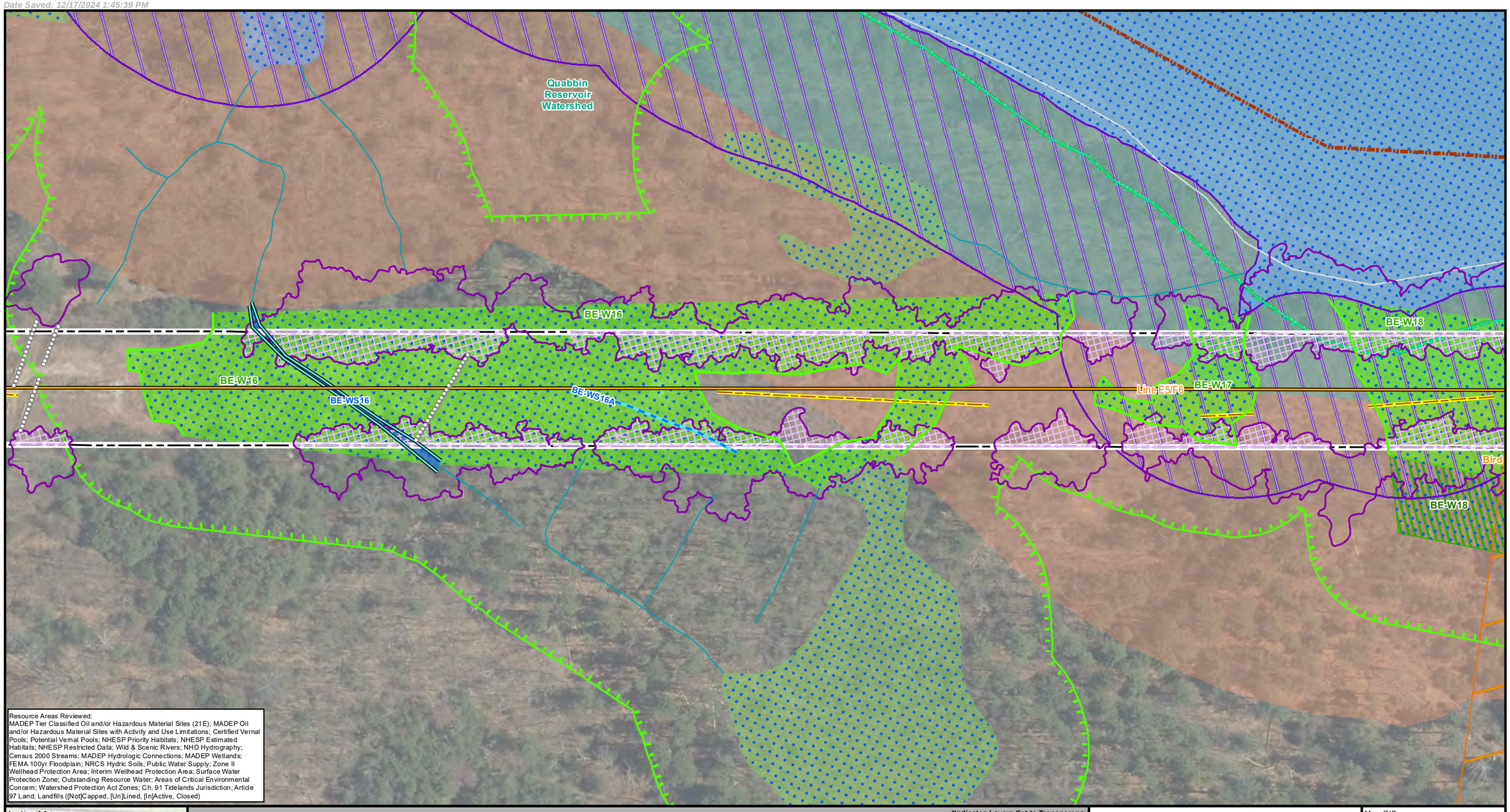

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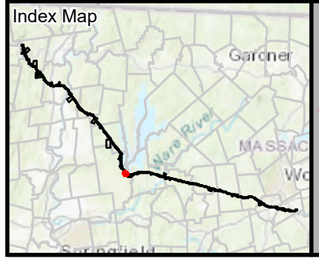

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Belchertown, MA
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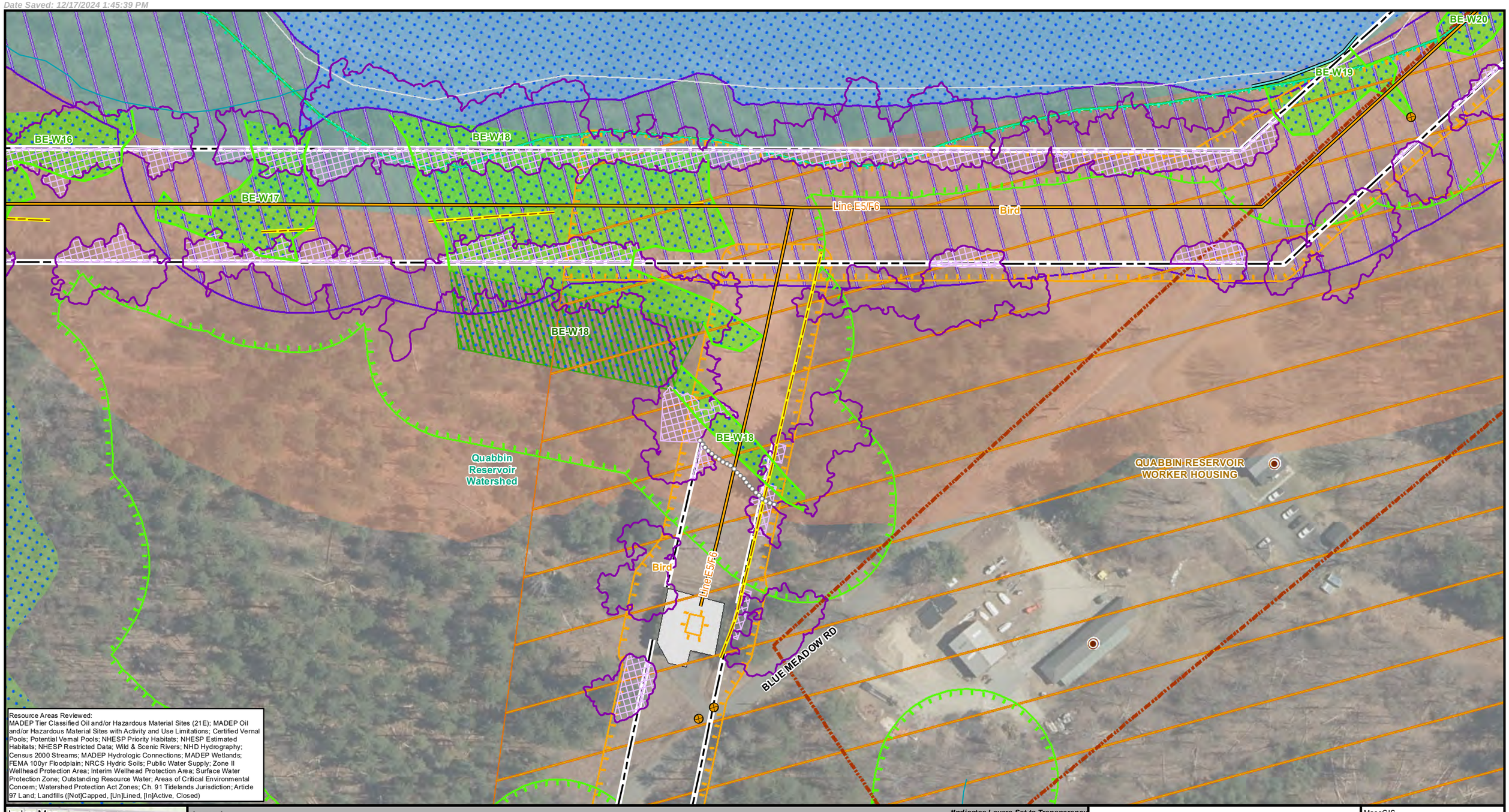

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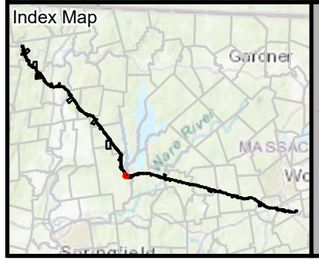

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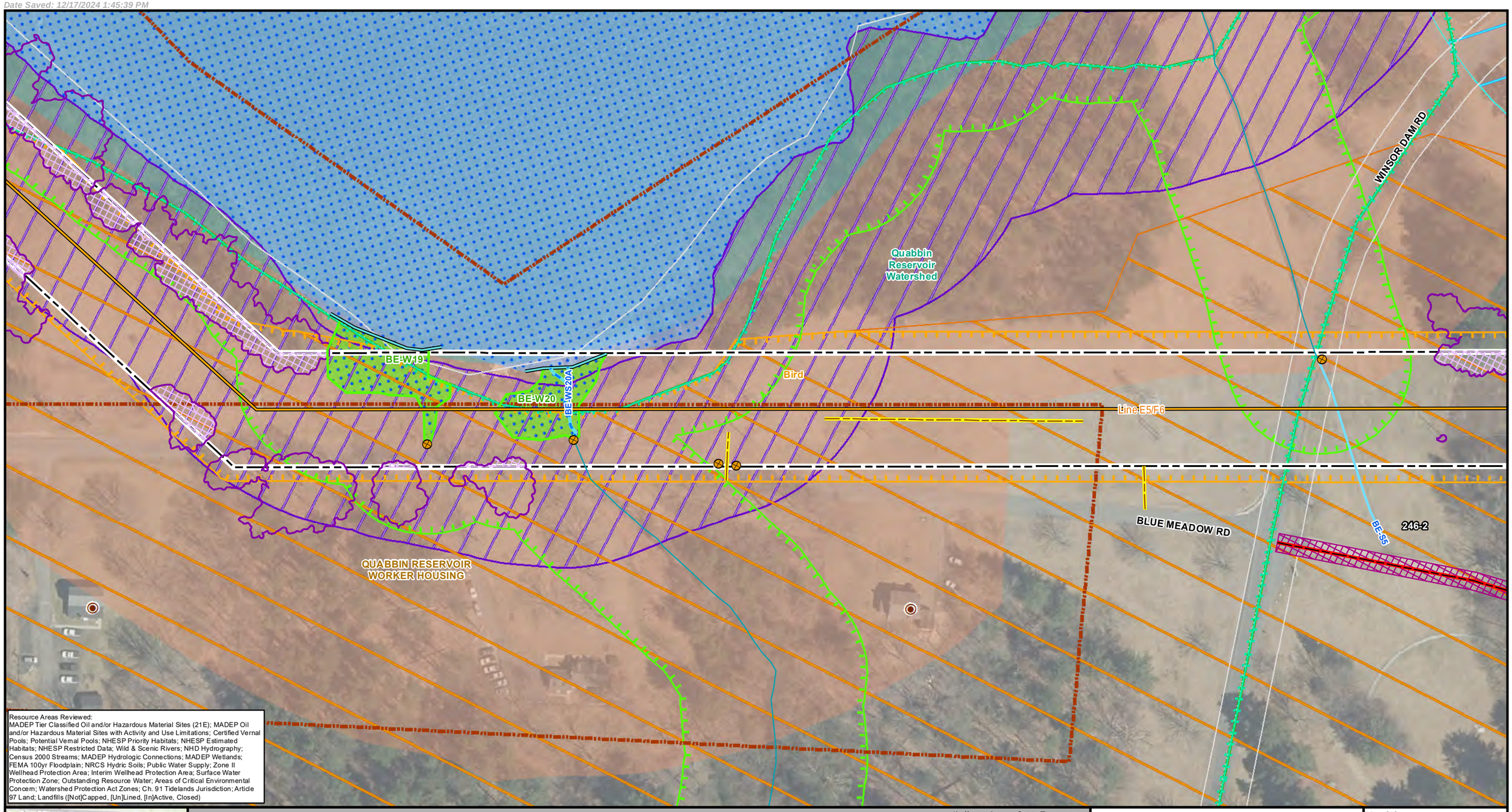

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WINSOR DAM RD

Quabbin Reservoir Watershed

246-2

Bird Line E5/F6

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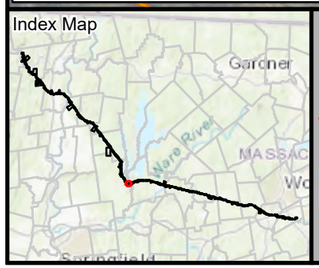

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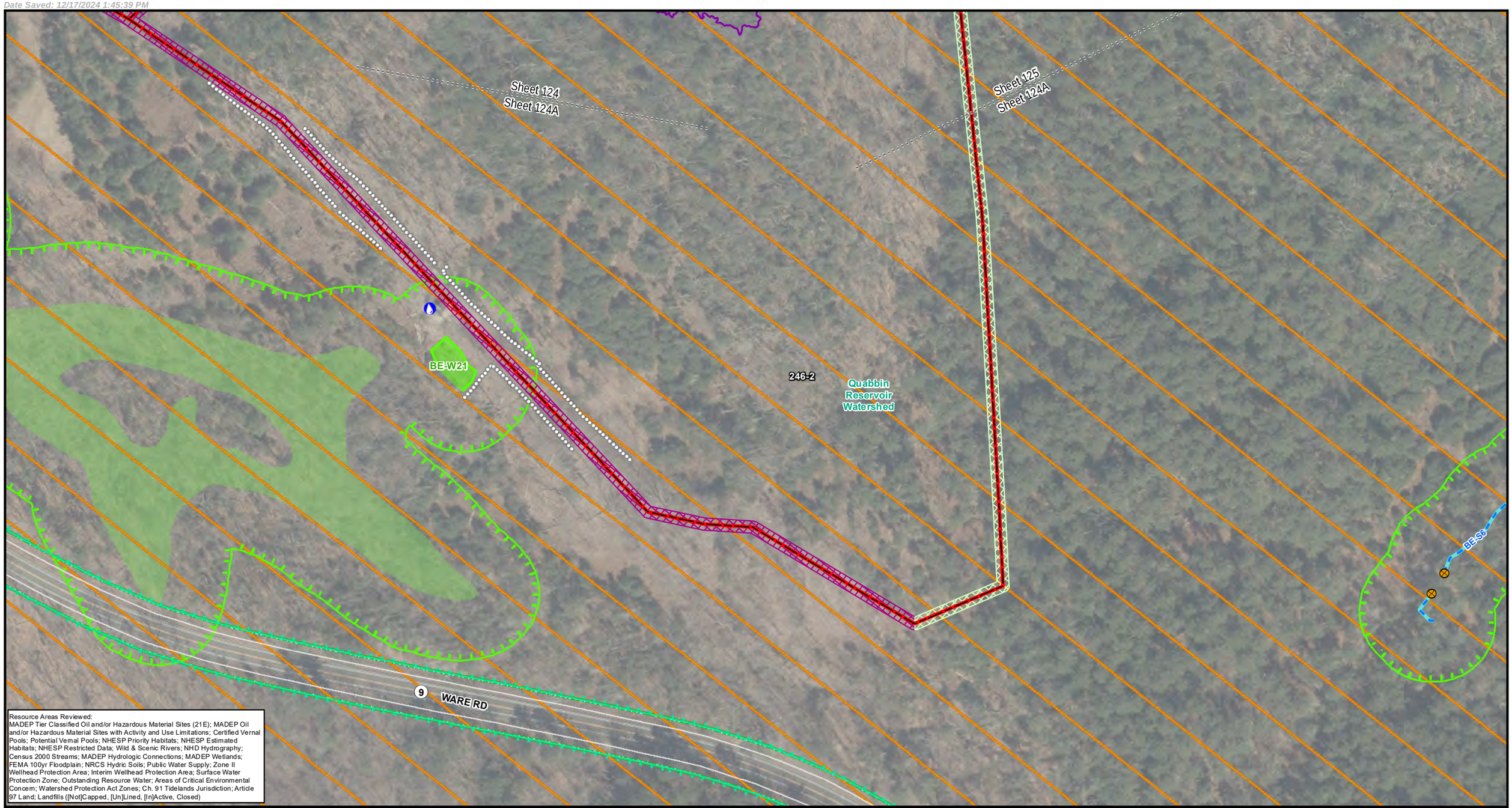

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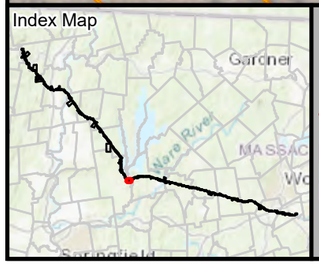

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0 75 150

Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Belchertown, MA
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MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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246-2

Quabbin Reservoir Watershed

Bird

Line E5/F6

Sheet 125
Sheet 124A

BE-W22

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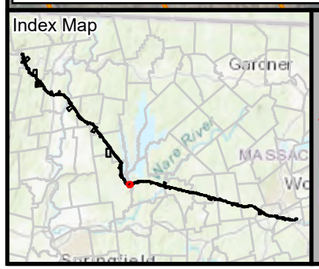

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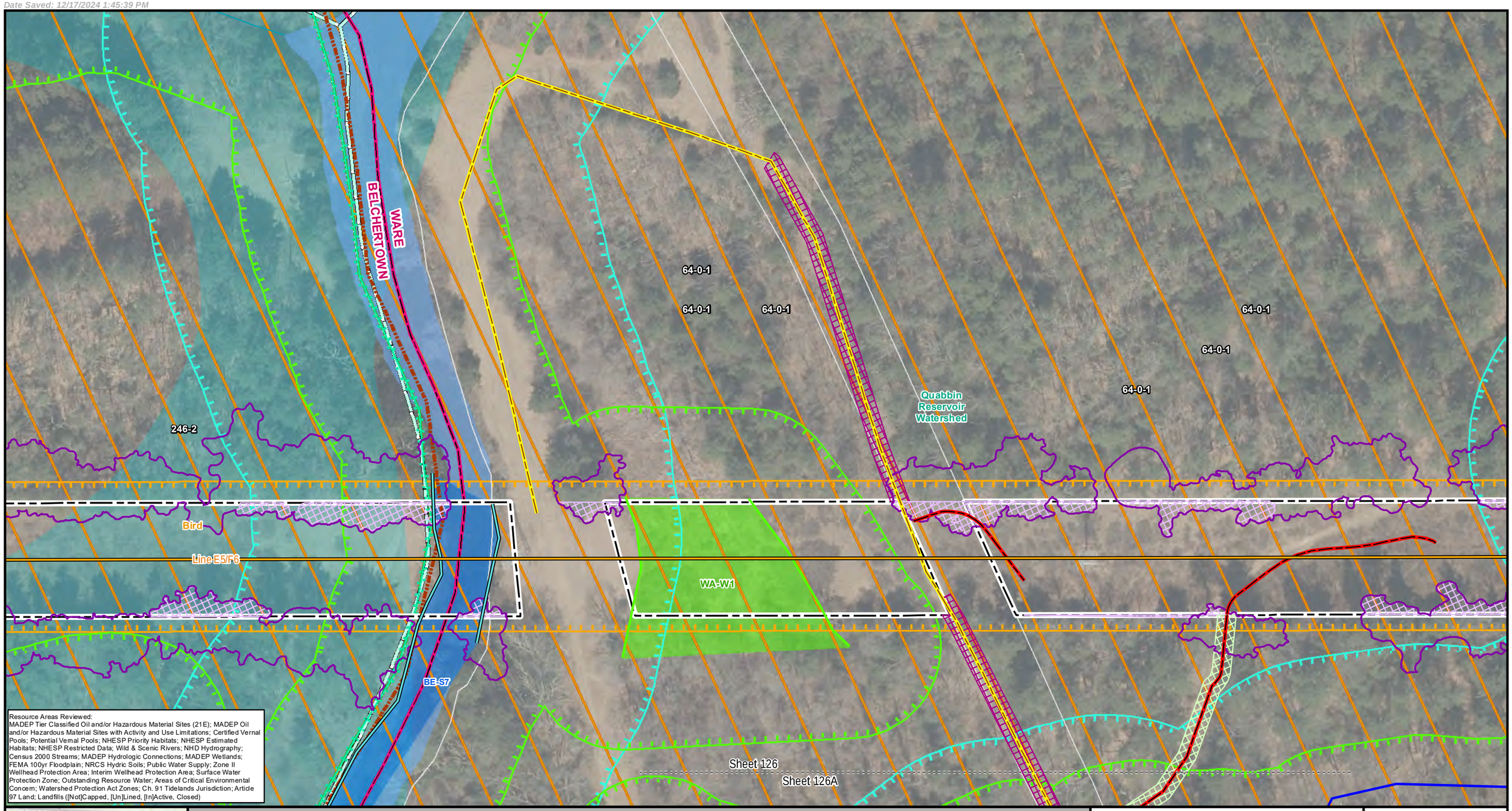

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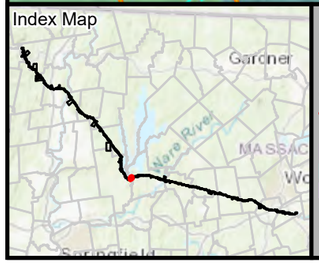

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Belchertown & Ware, MA
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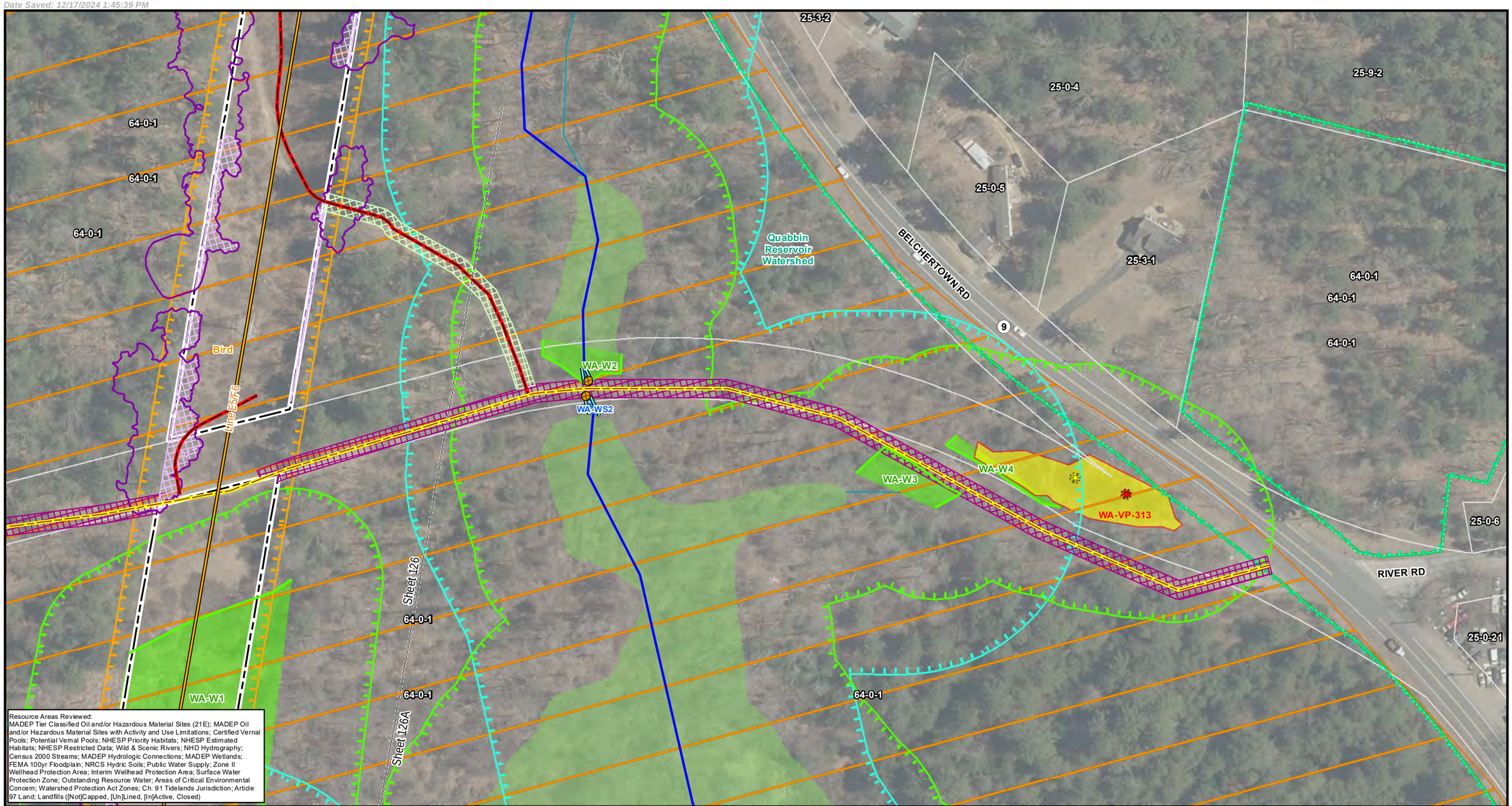

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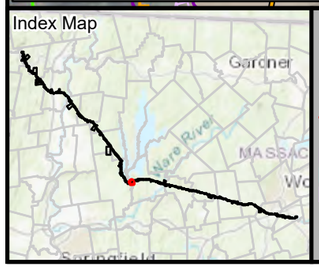

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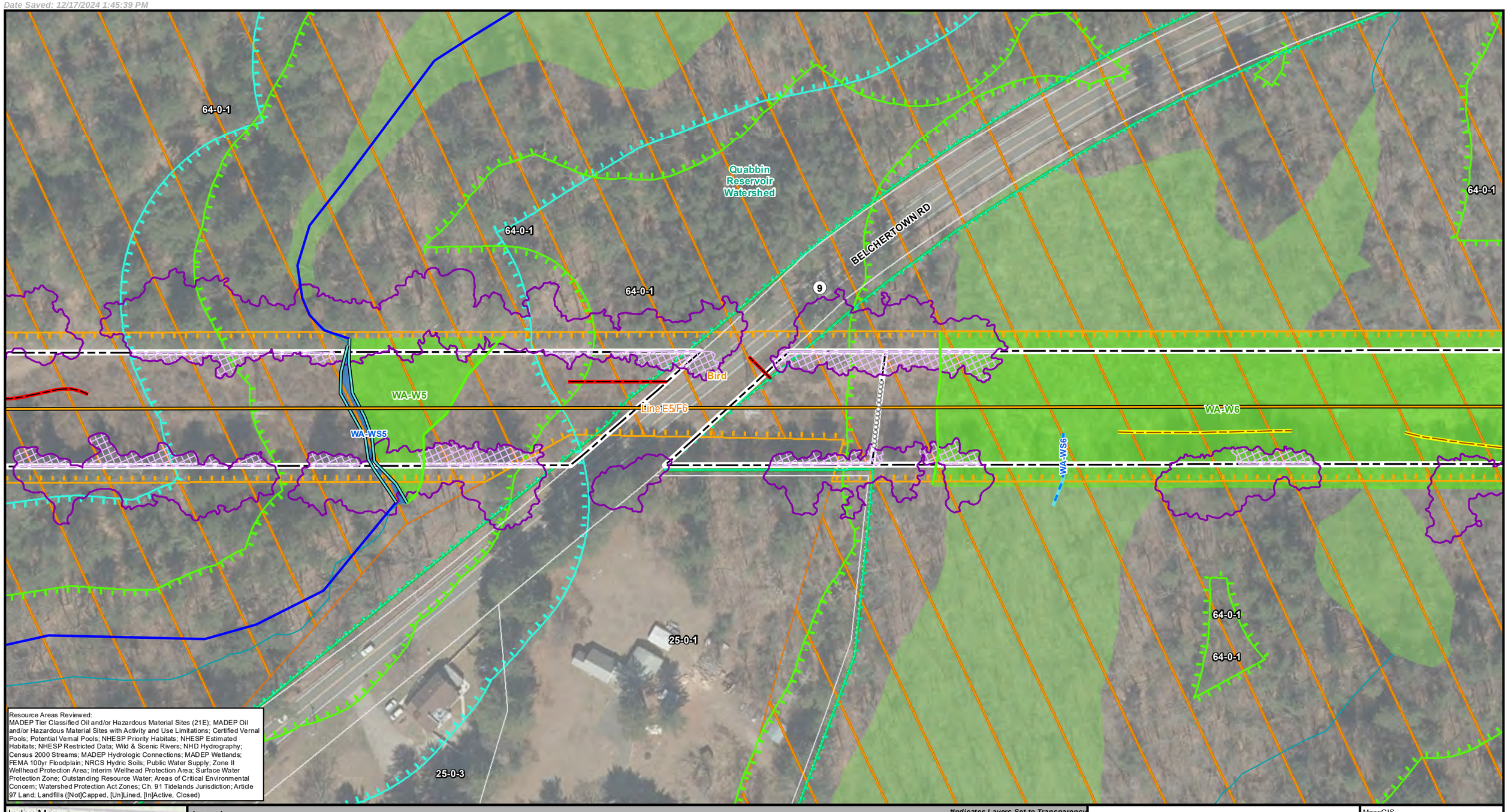

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Article 97 Lands

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N

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0 50 100

Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Ware, MA

MassGIS
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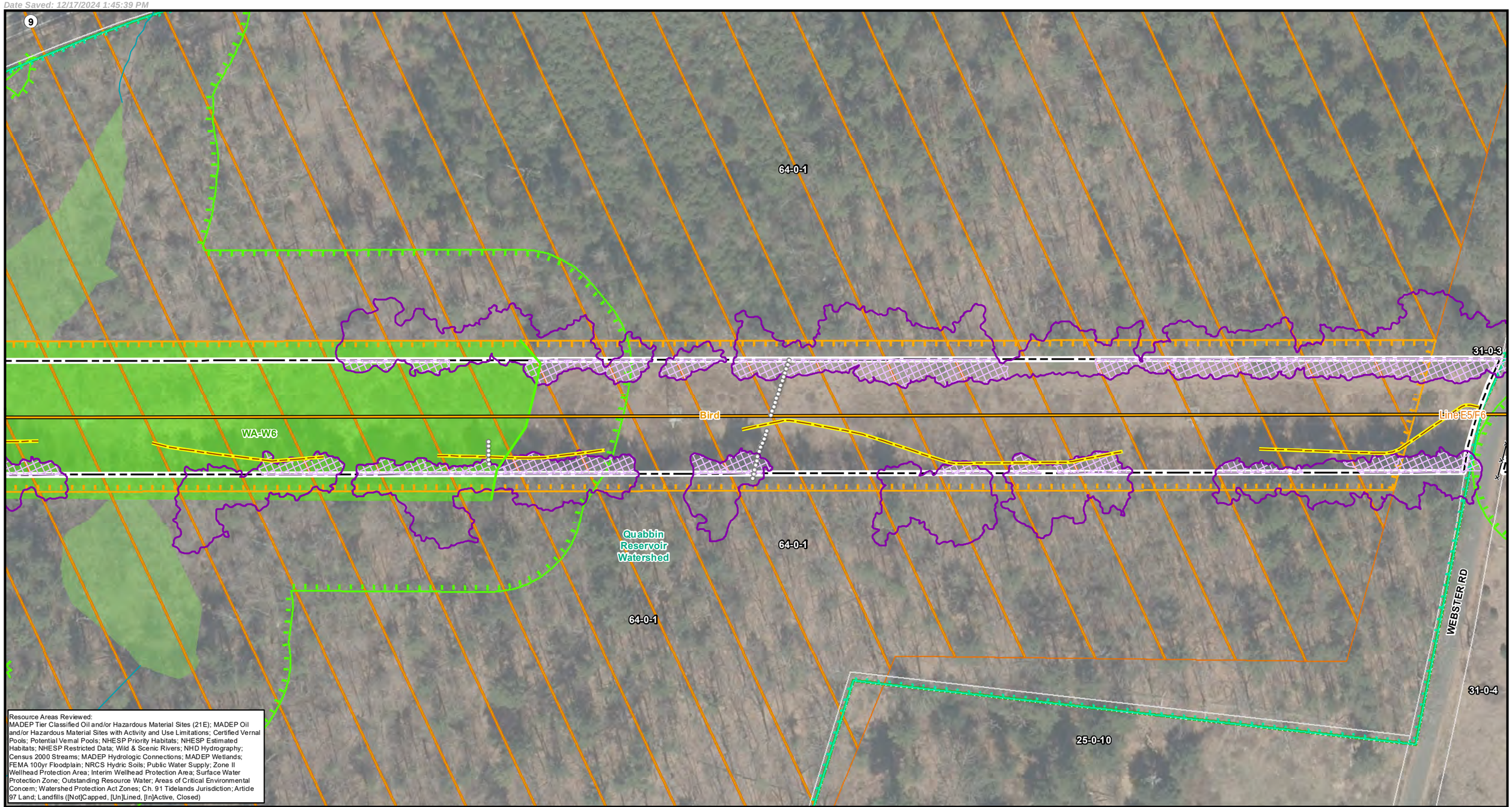

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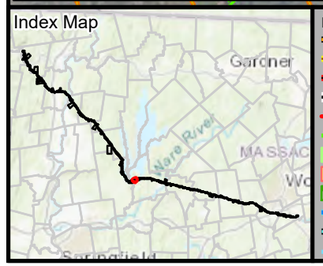

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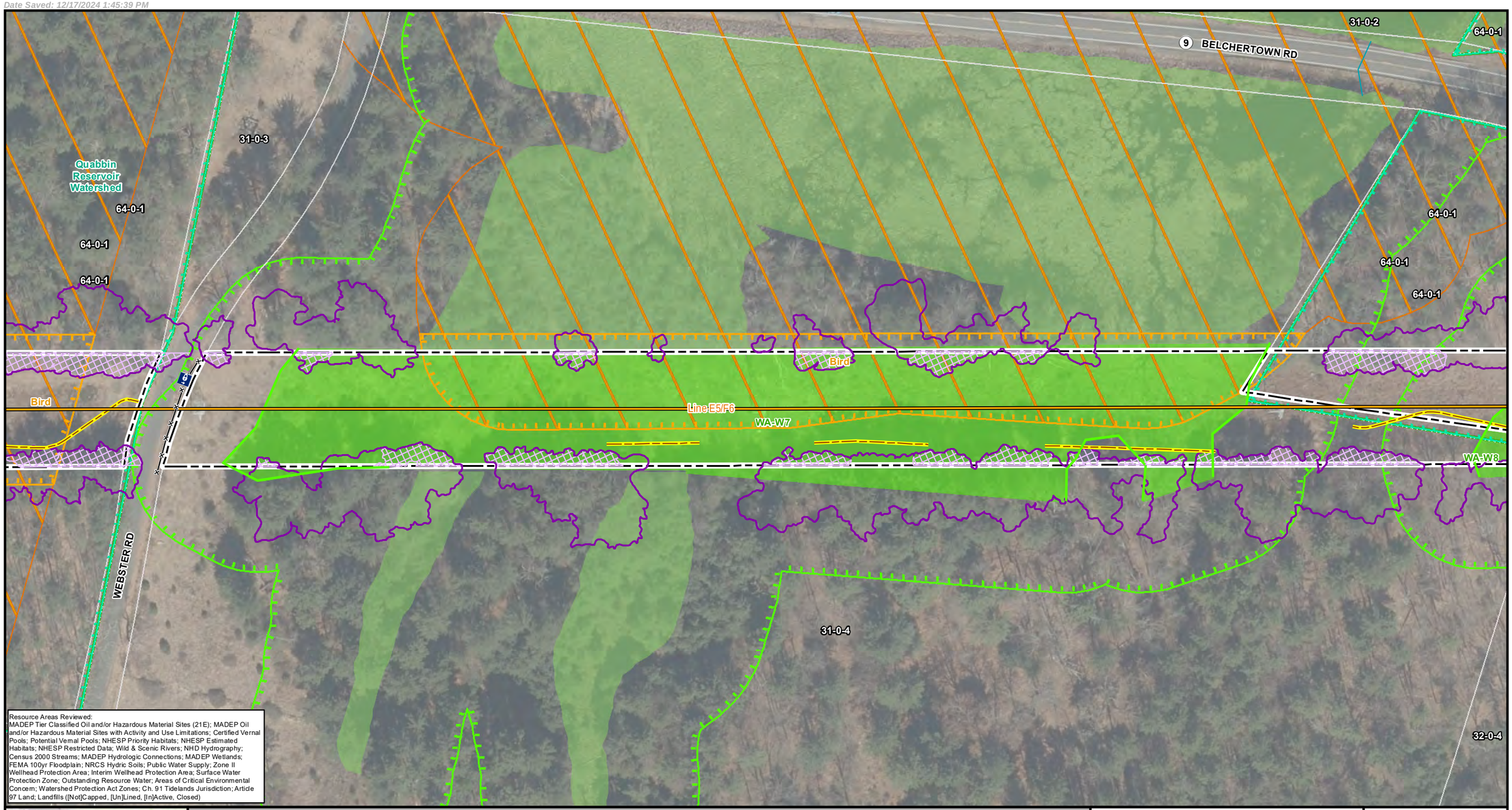

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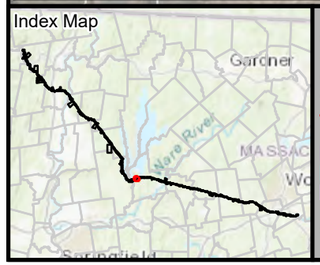

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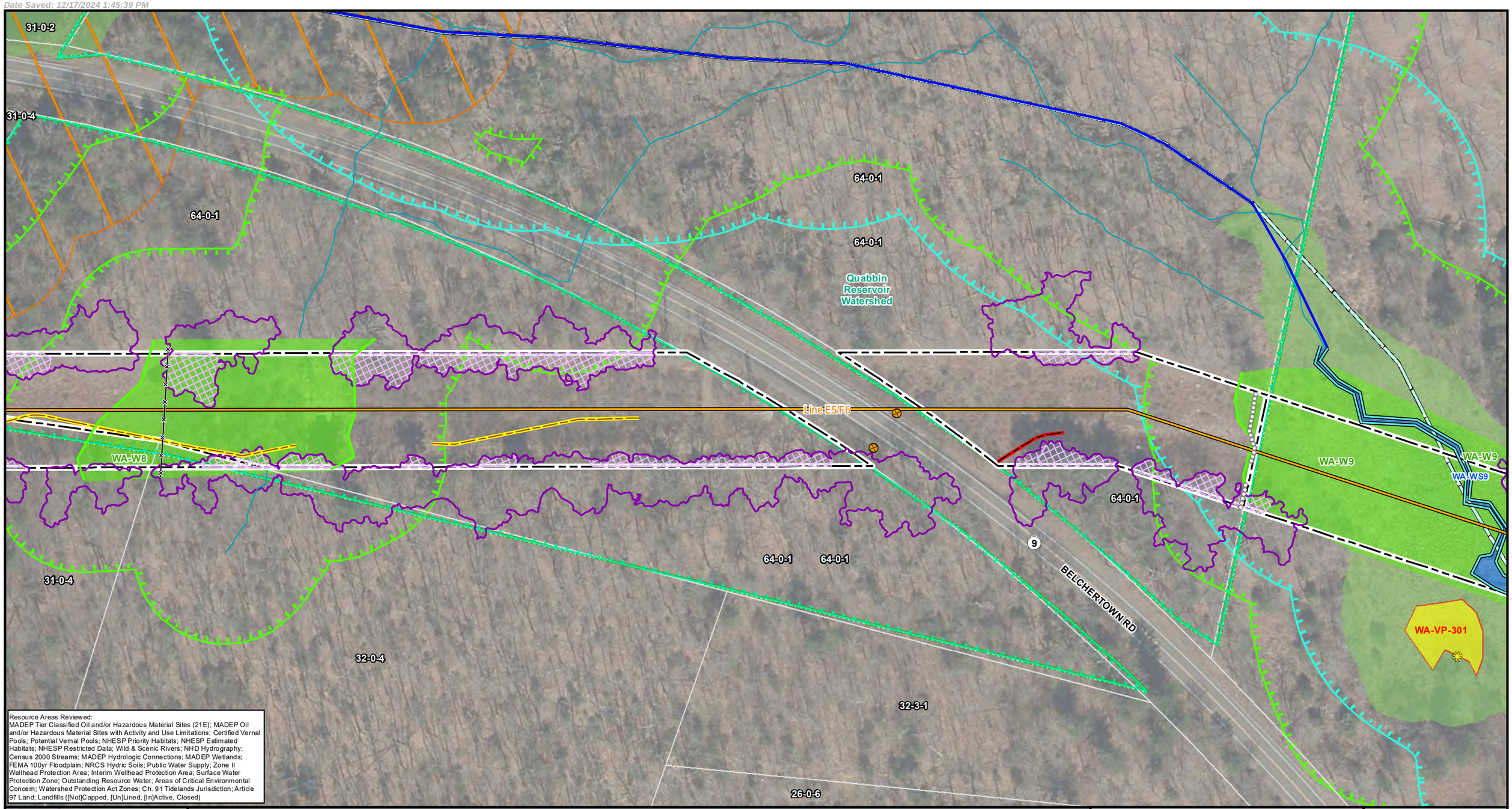

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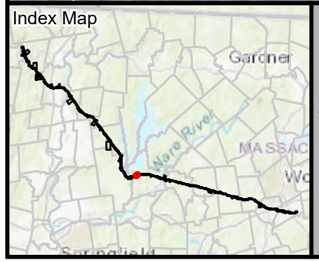

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Ware, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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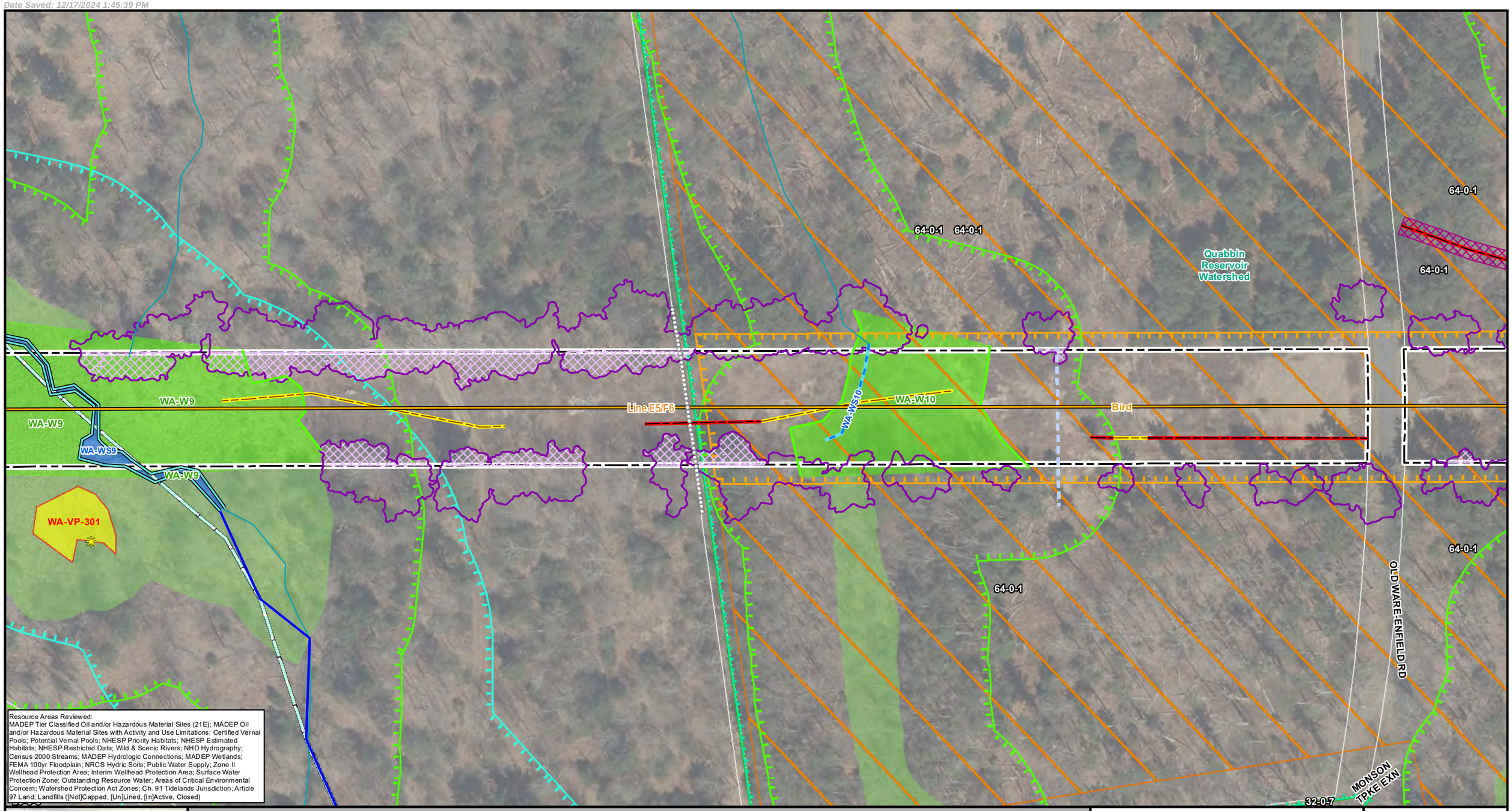

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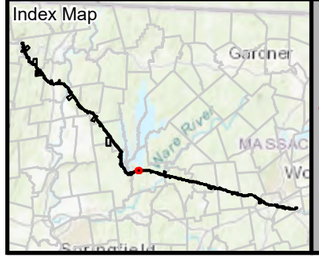

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Article 97 Lands

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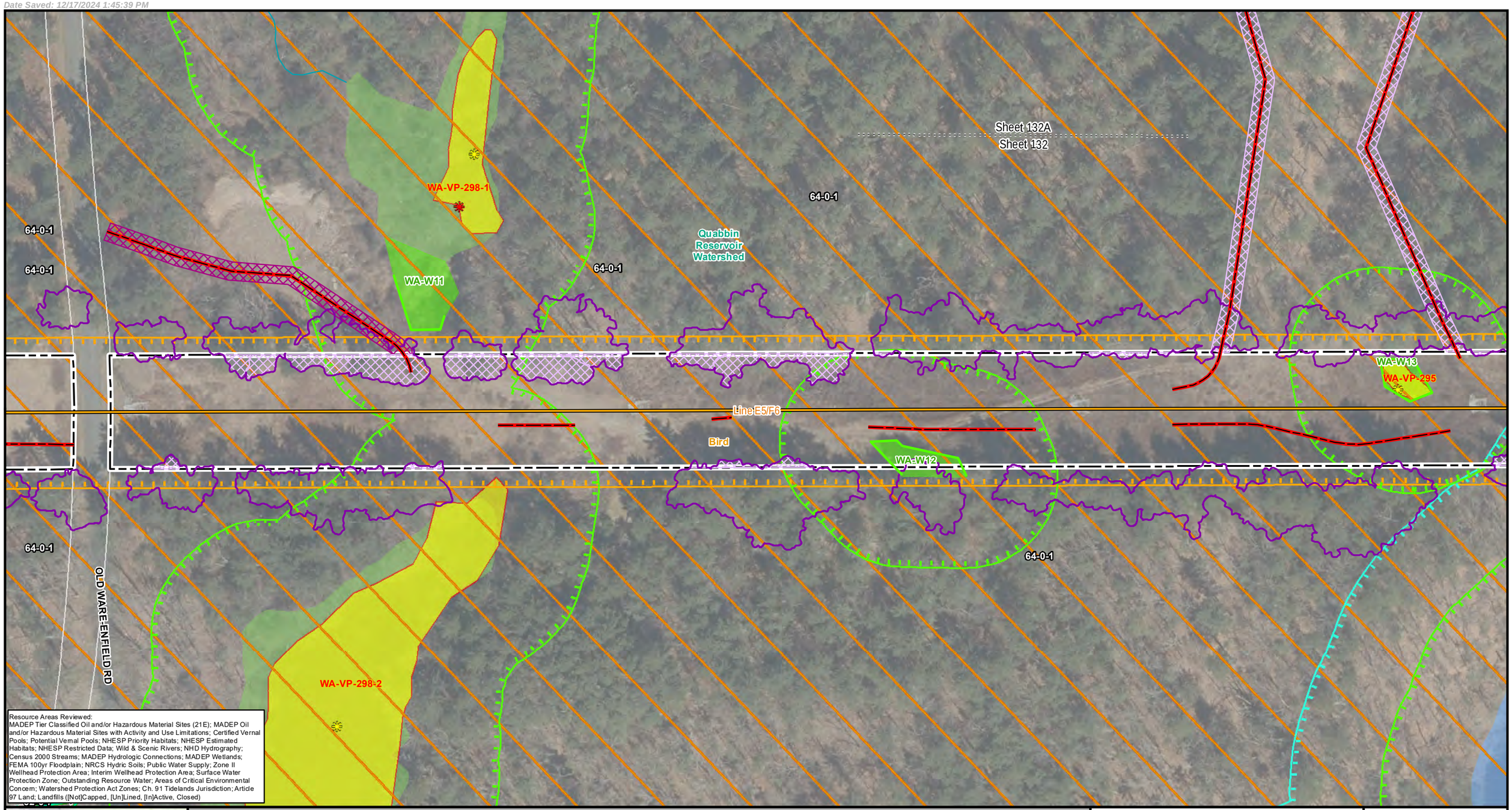

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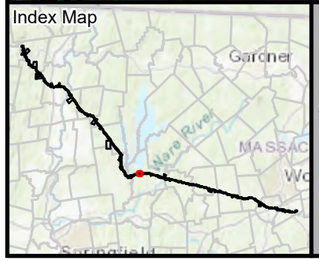

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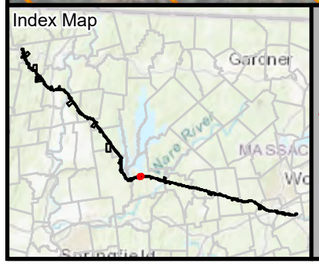

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Environmental Resources Map

Ware, MA
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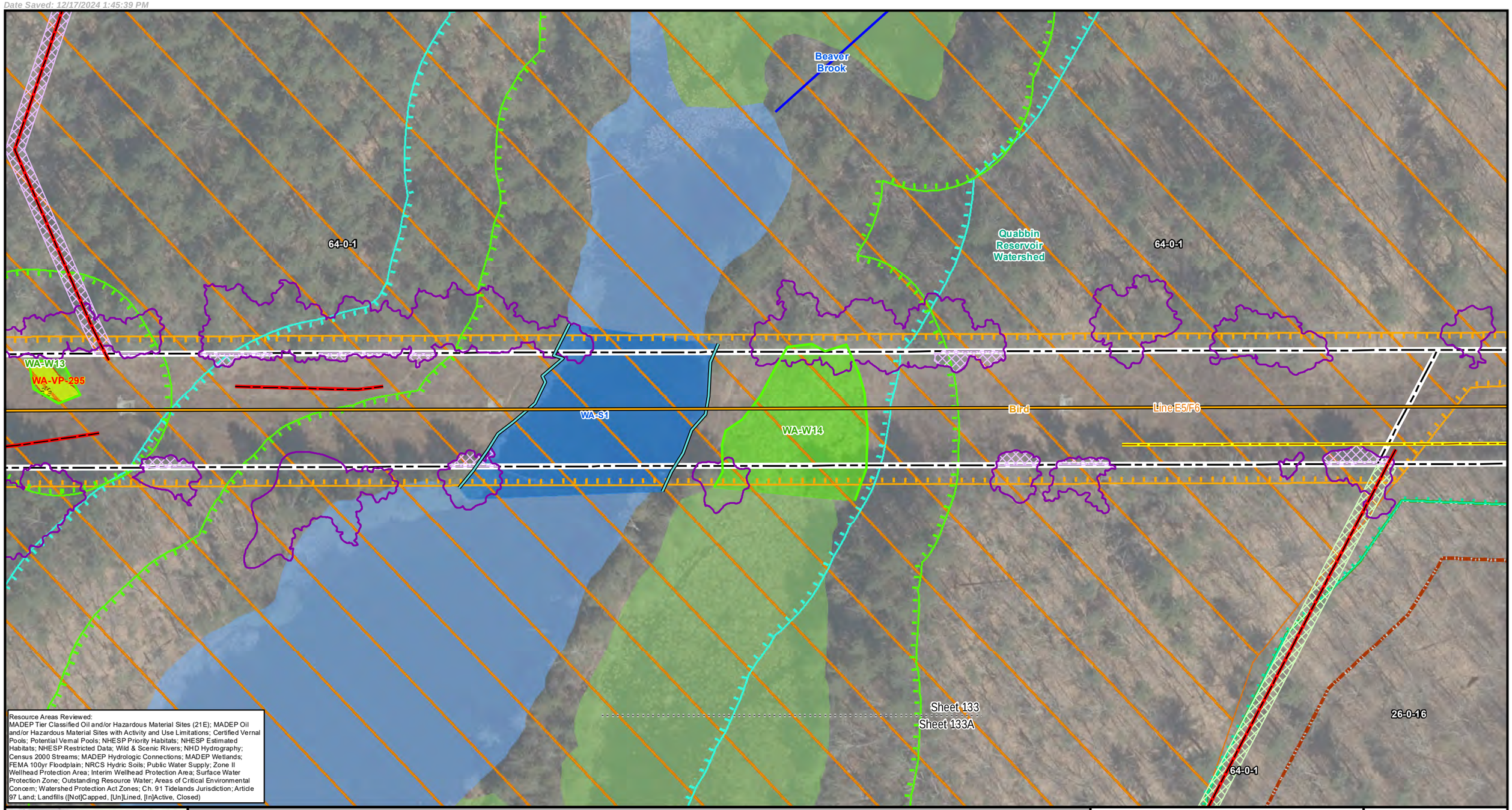

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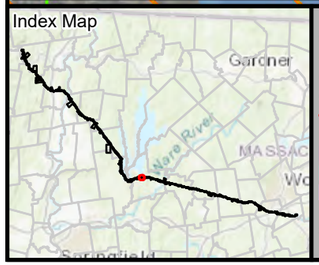

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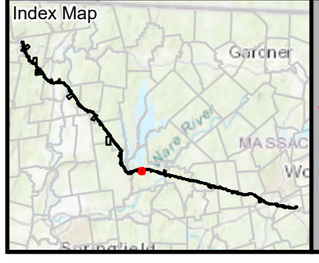

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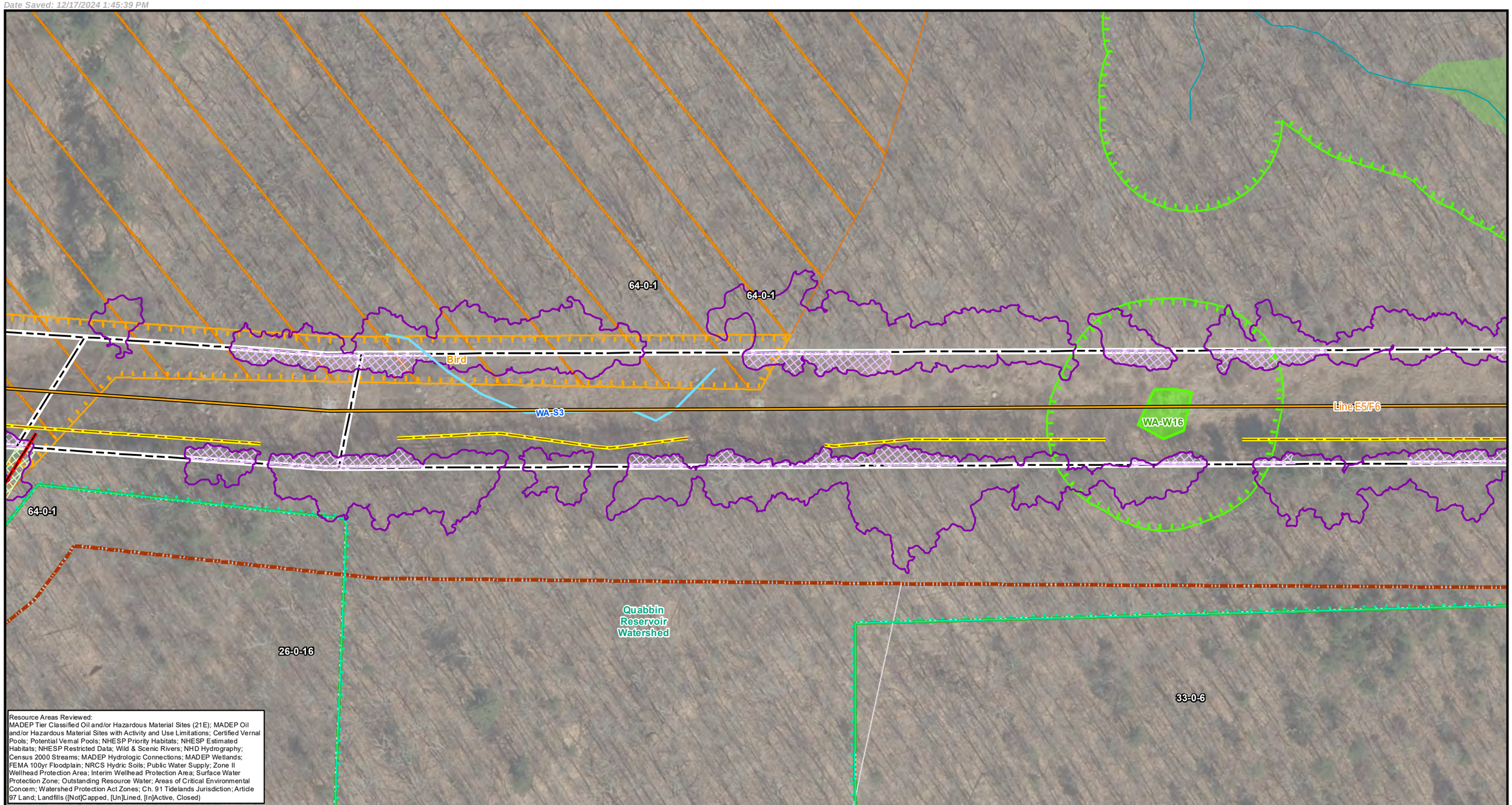

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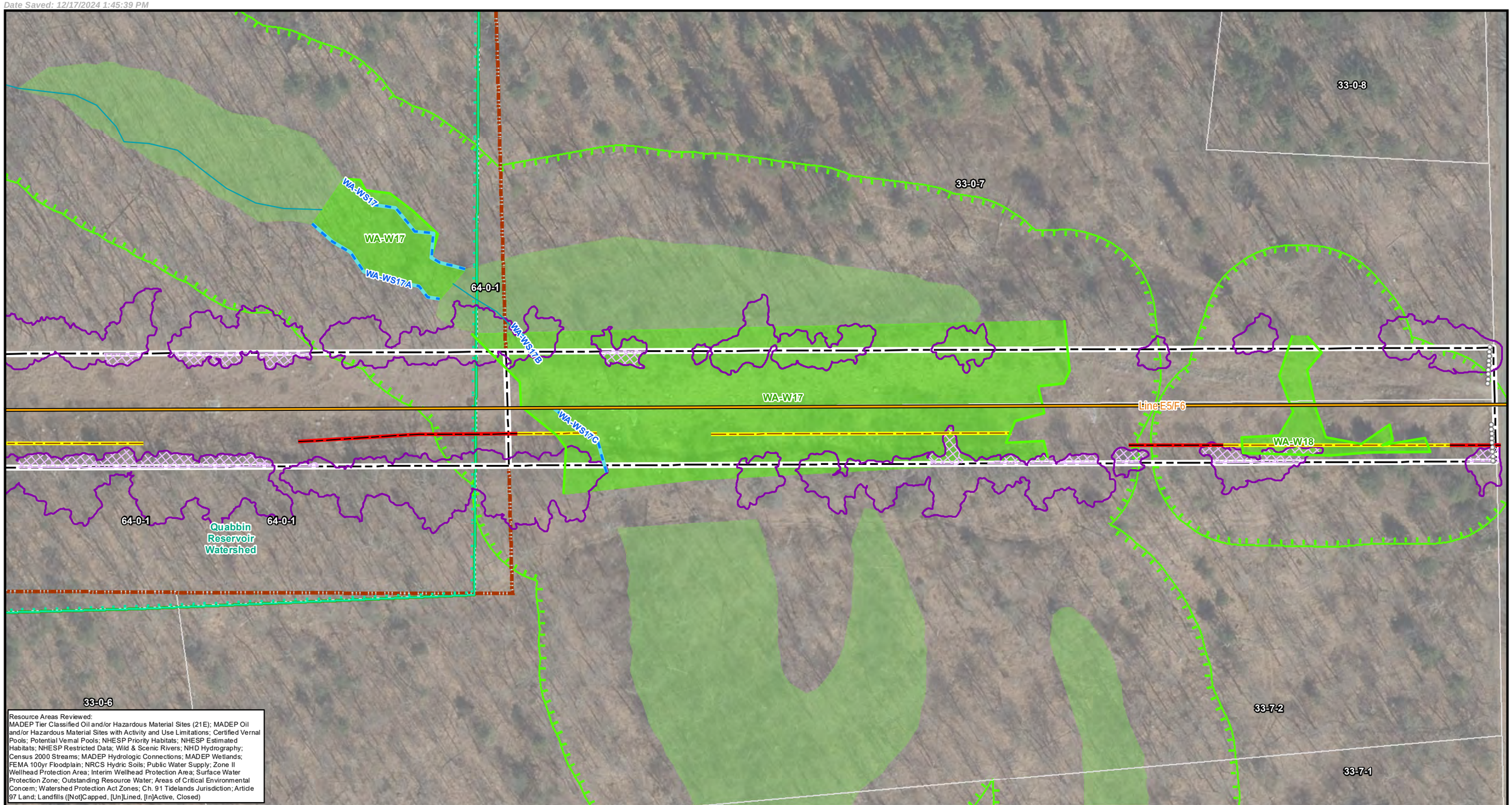

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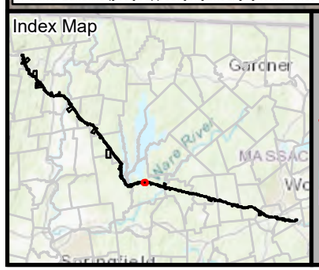

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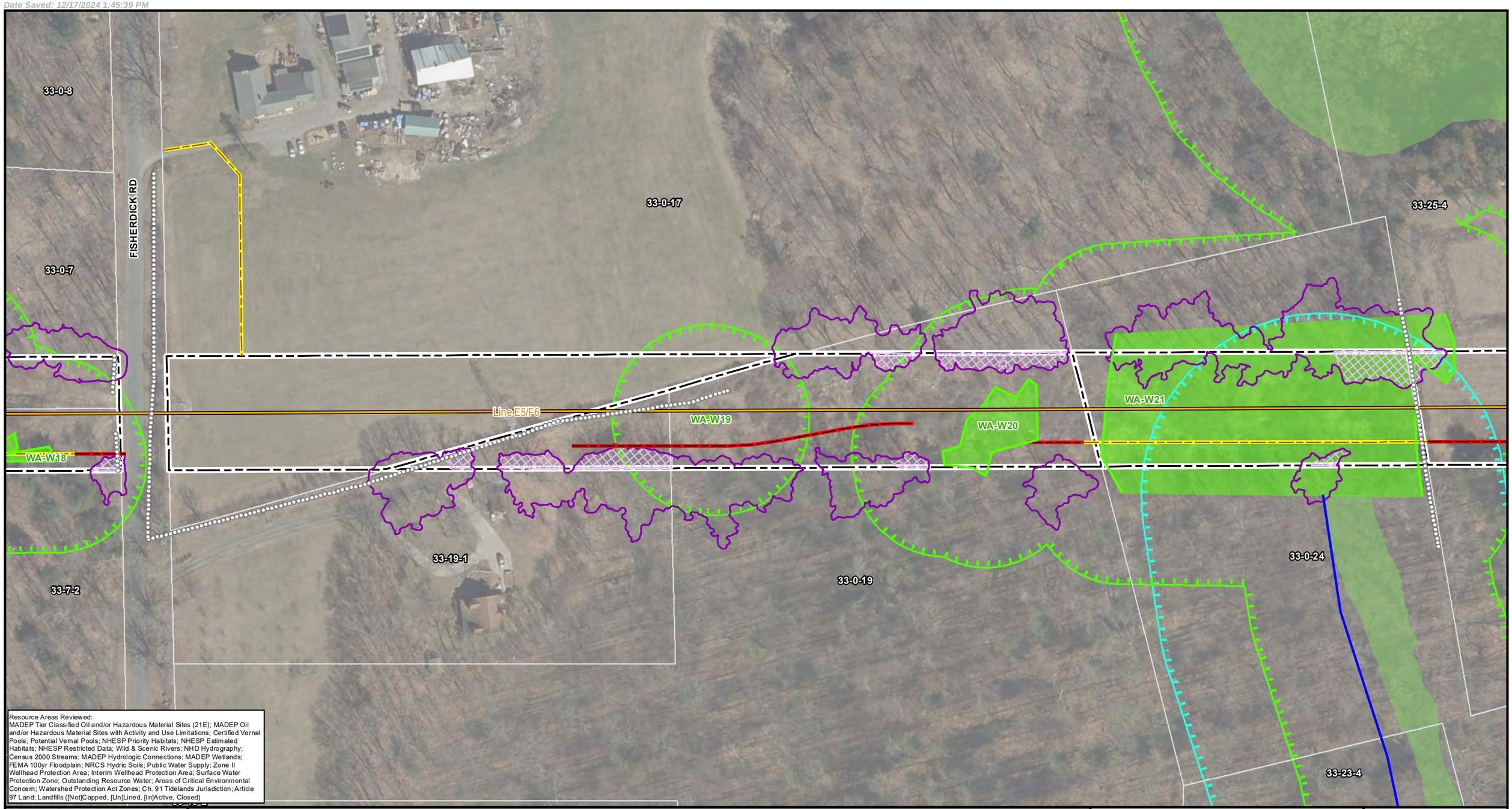

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- Fenceline
- Guardrail
- Stonewall
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- Selective Tree Removal
- Pruning
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- Parcel Boundaries

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N

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0 50 100

Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Ware, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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33-0-37
33-29-2
GREENWICH PLNS RD
33-29-1
33-36-1
33-36-2
33-0-35
33-0-36
33-36-3
WA-W21
33-25-4
33-0-34
WA-W22
WA-WS22
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WA-WS24
WA-W24
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33-0-30
33-0-31
33-0-32
33-0-33
33-0-24
33-23-4
33-23-3
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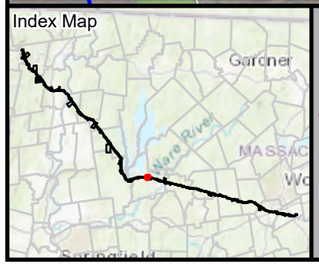

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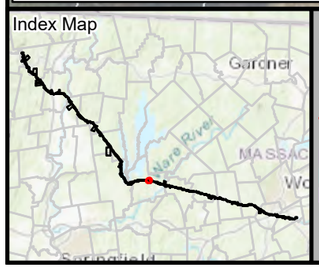

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34-0-4
34-18-1
34-9-1
34-0-7
34-4-5
WA-WS27
WA-W27
Line E5/F6

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Gardner
MASSAC
Springfield

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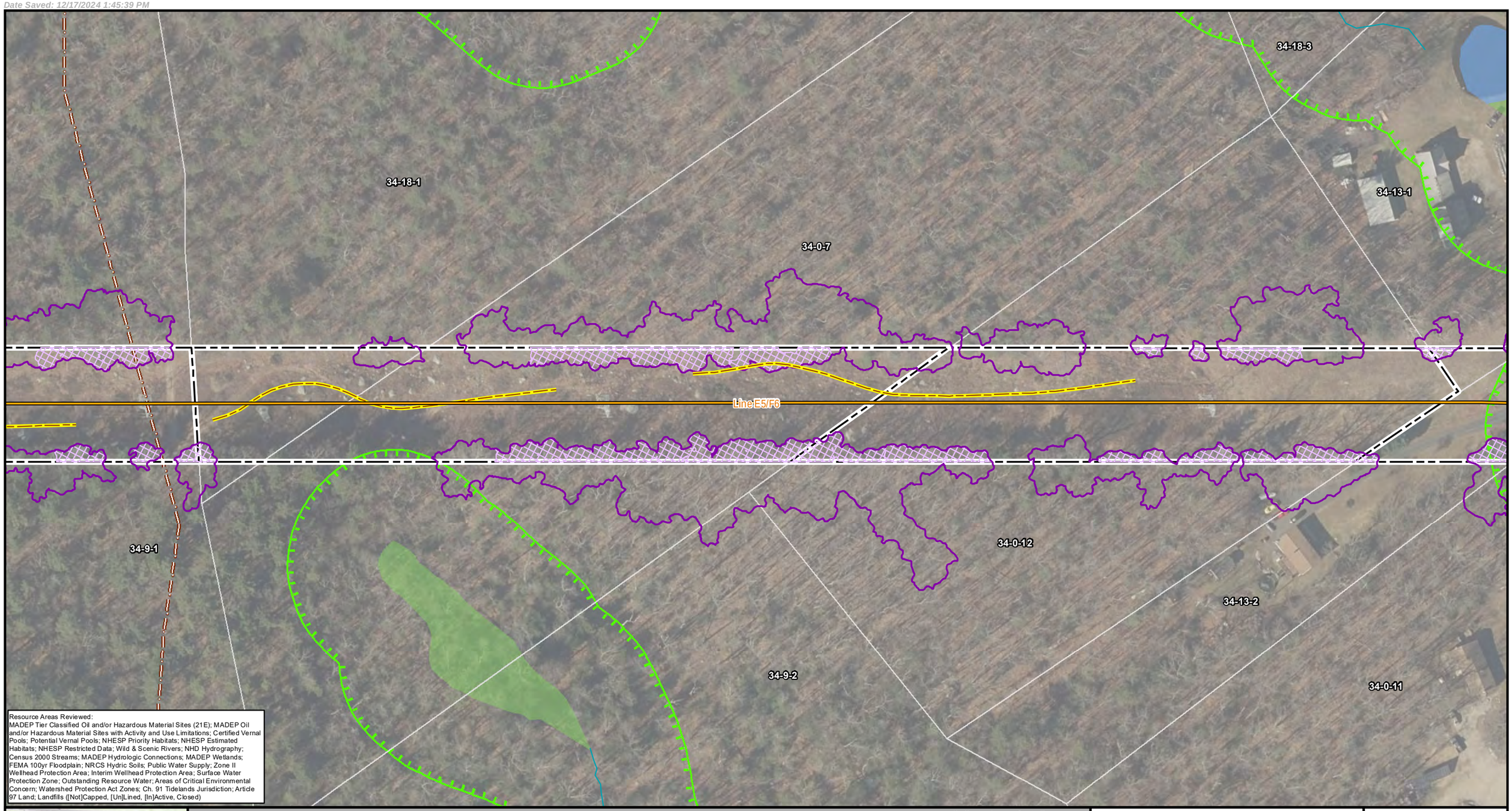

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Environmental Resources Map

Ware, MA

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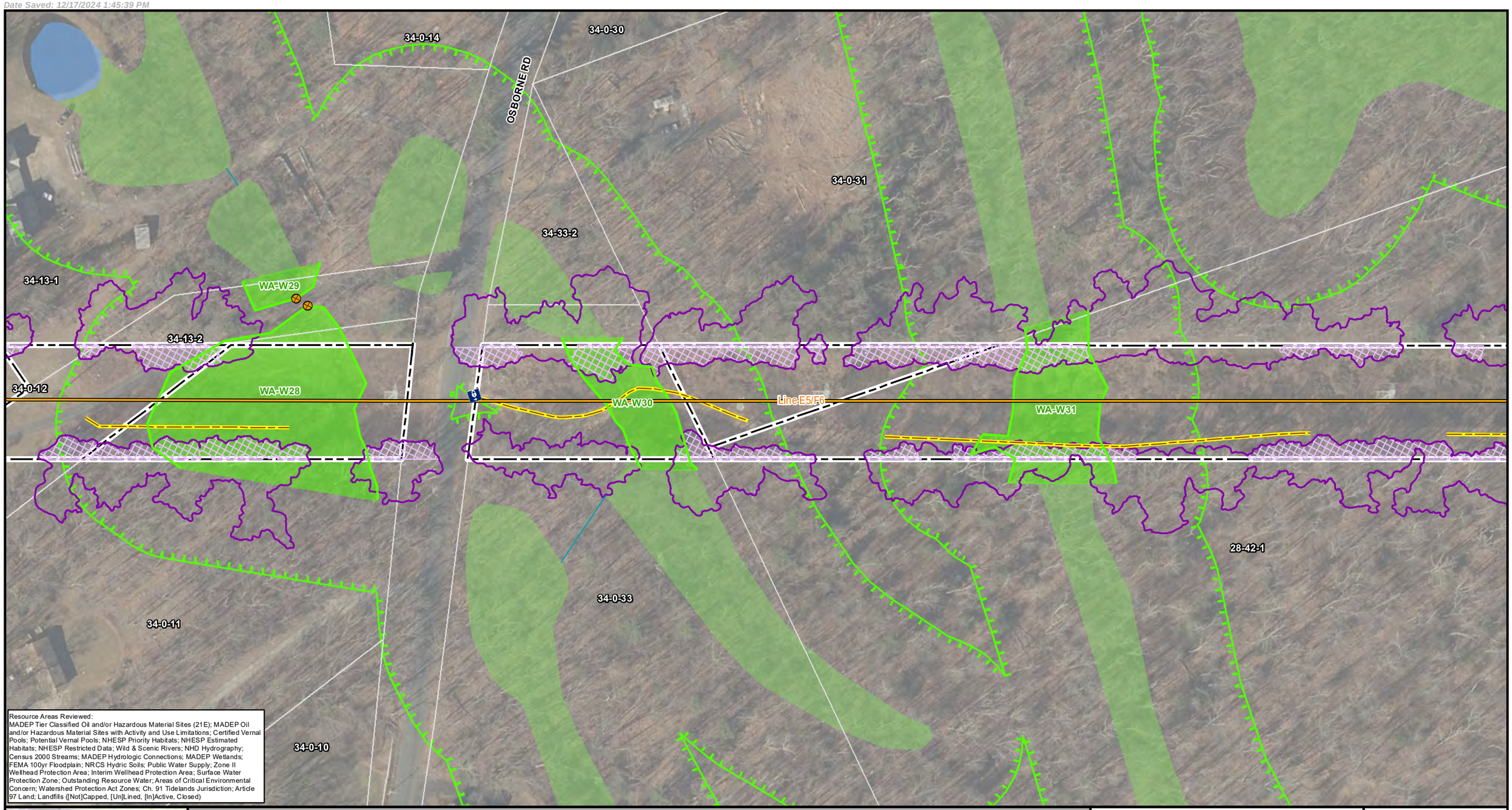

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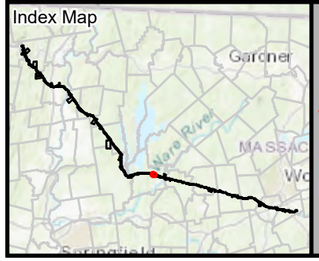

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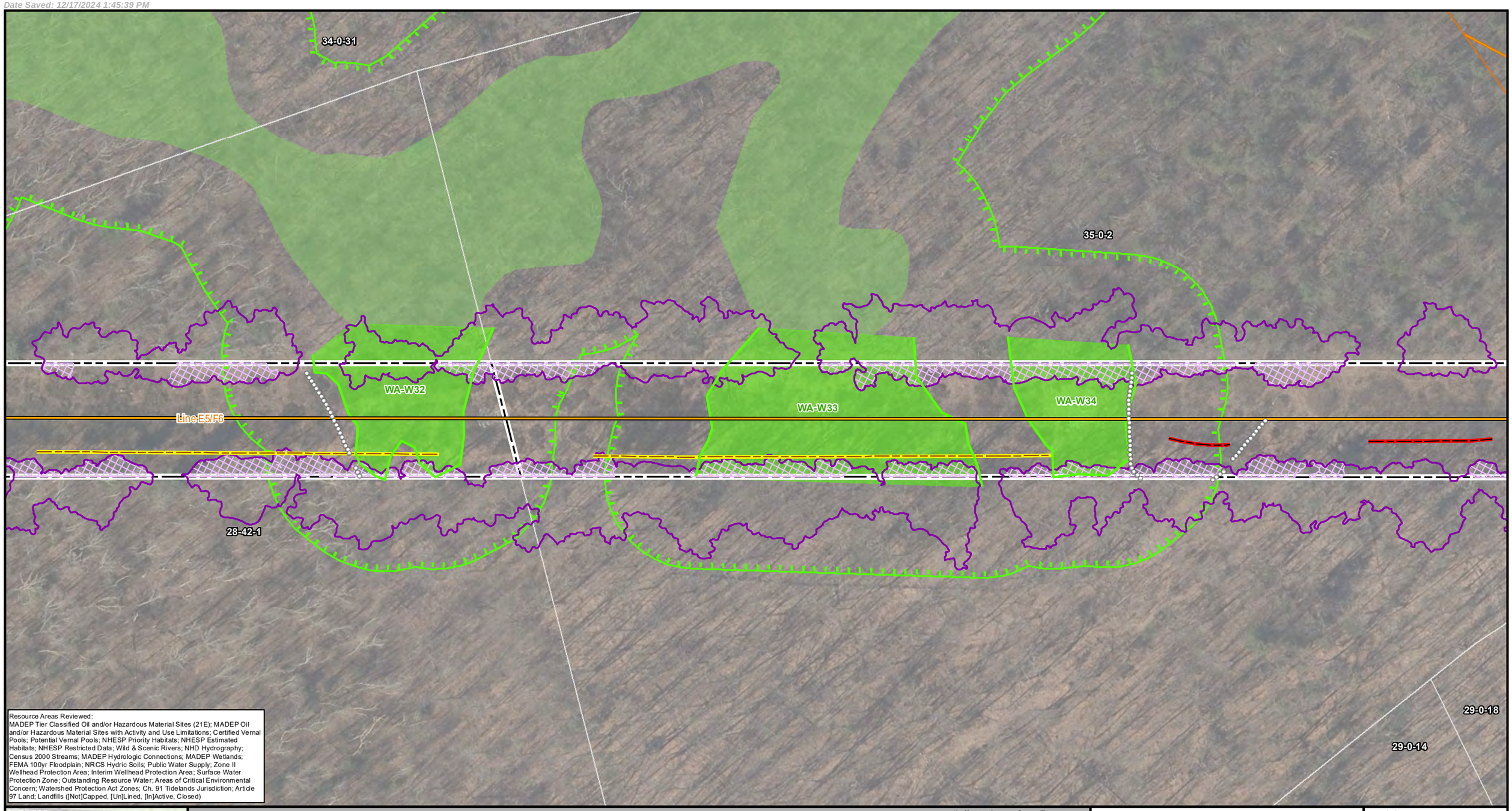

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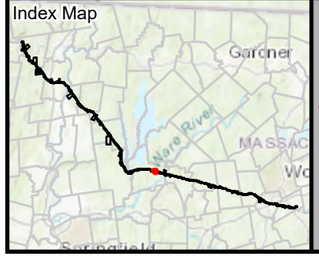

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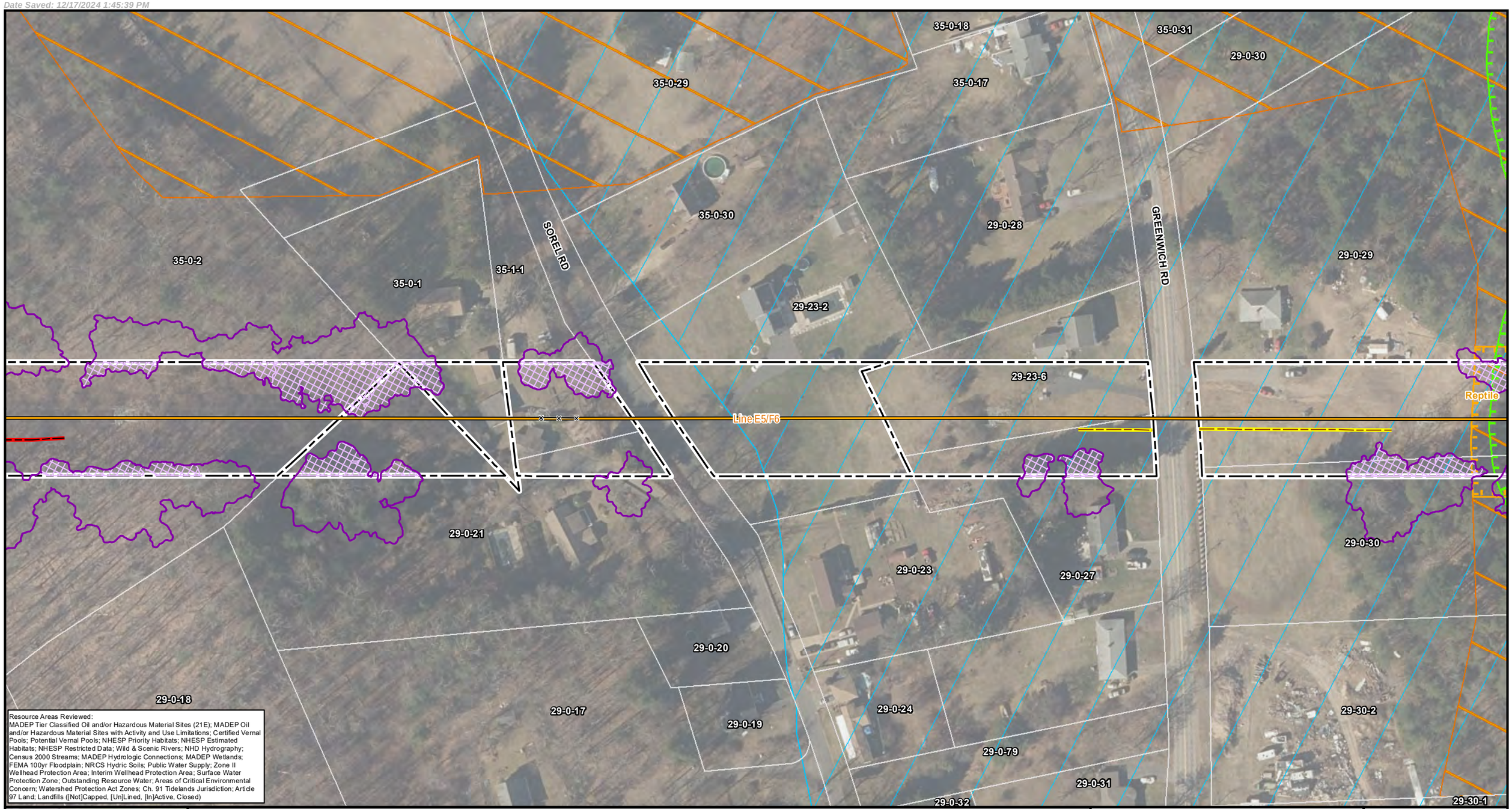

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29-0-30

29-0-29

WA-WS36

29-0-48

WA-W35

WA-W35

Reptile

Line E5/F6

WA-S1

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Muddy Brook

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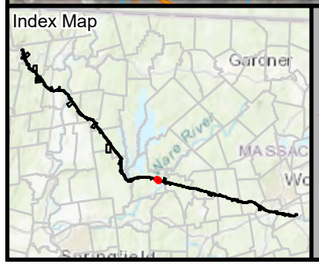

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N

1 inch = 100 feet

0 50 100

Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Ware, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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29-0-77

29-0-48

WA-S4

Reptile

WA-W36

Line E5/F6

WA-W37

WA-S5

SHEEHY RD

Resource Areas Reviewed:
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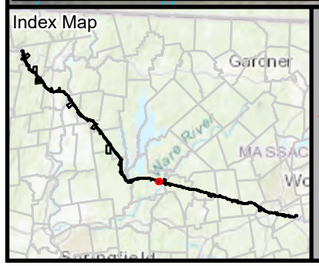

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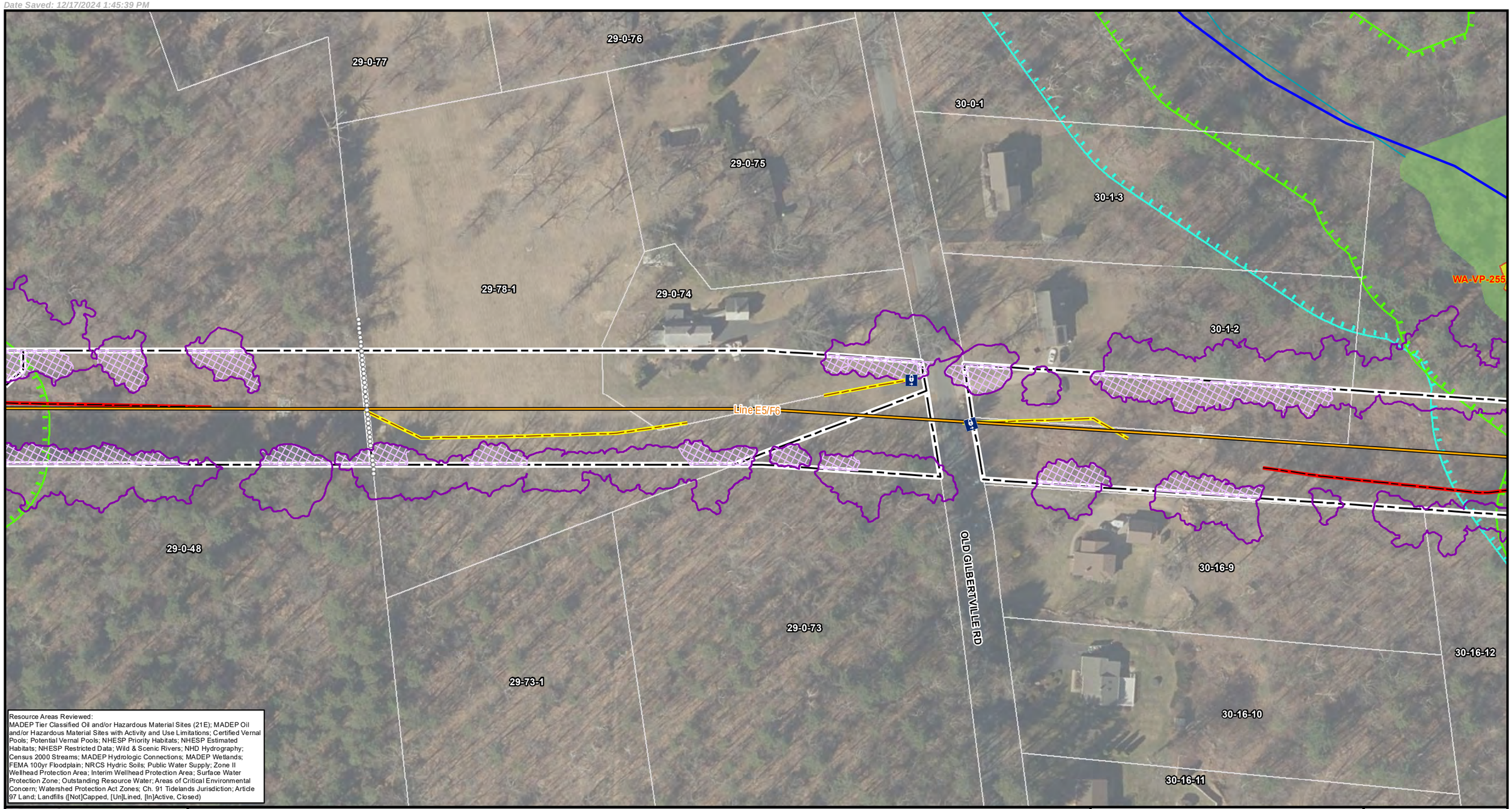

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Environmental Resources Map

Ware, MA

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30-0-1
30-1-3
30-1-2
WA-VP-255
30-17-1
WA-W39
WA-W39
WA-WS39
Line E5/F6
WA-W38
WA-W40
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WA-W41
WA-WS41
30-16-9
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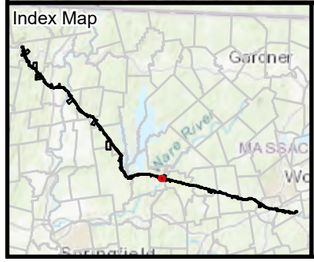

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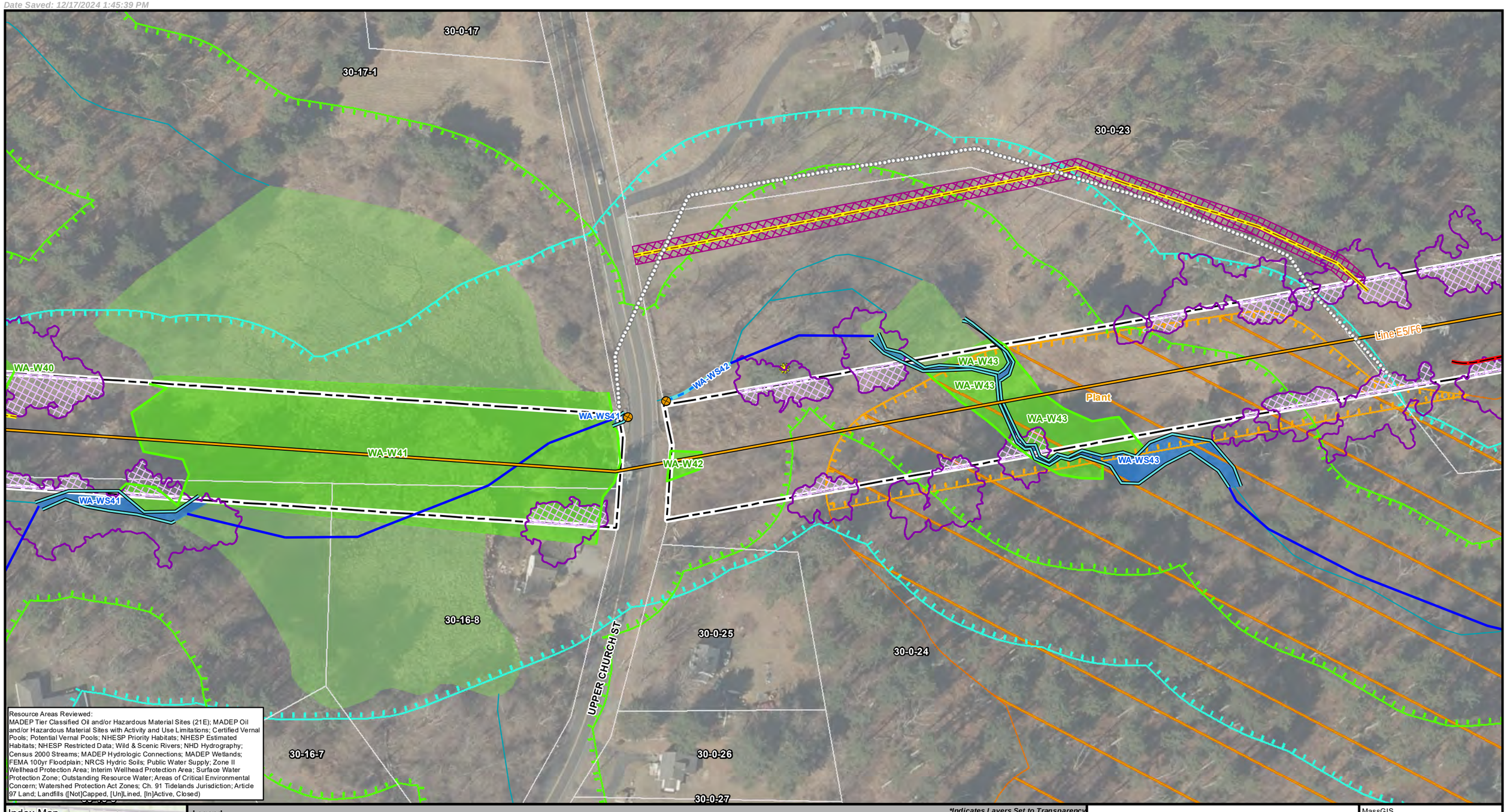

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Environmental Resources Map

Ware, MA

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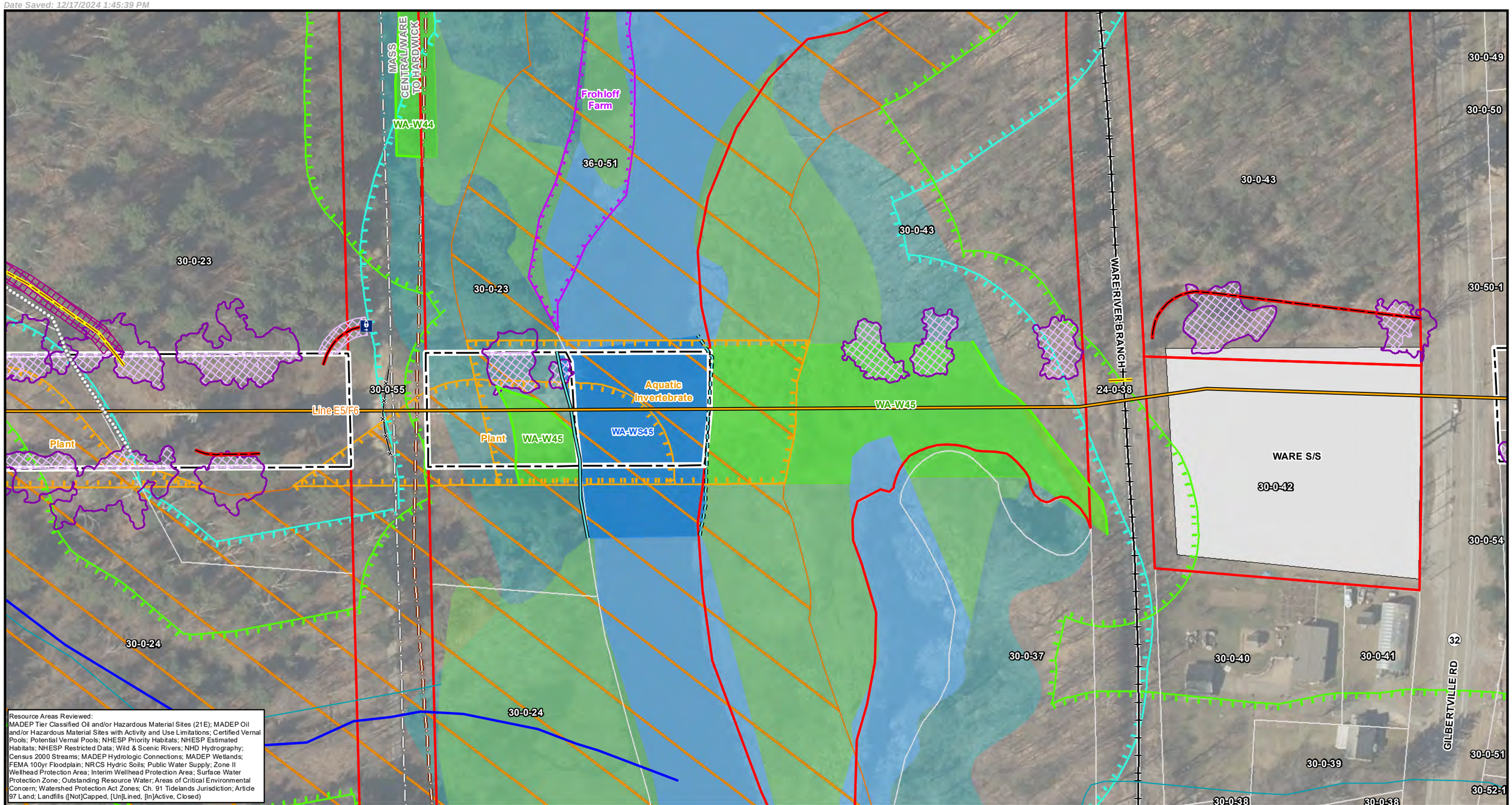

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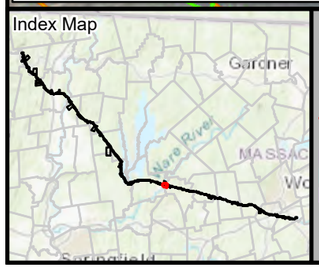

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30-0-49
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WB-S1
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WARE S/S
WEST BROOKFIELD
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32
30-0-40
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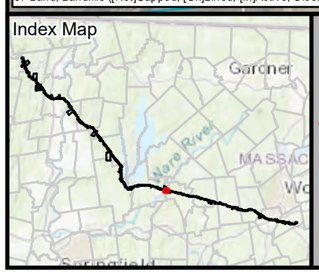

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Environmental Resources Map

Ware & West Brookfield, MA

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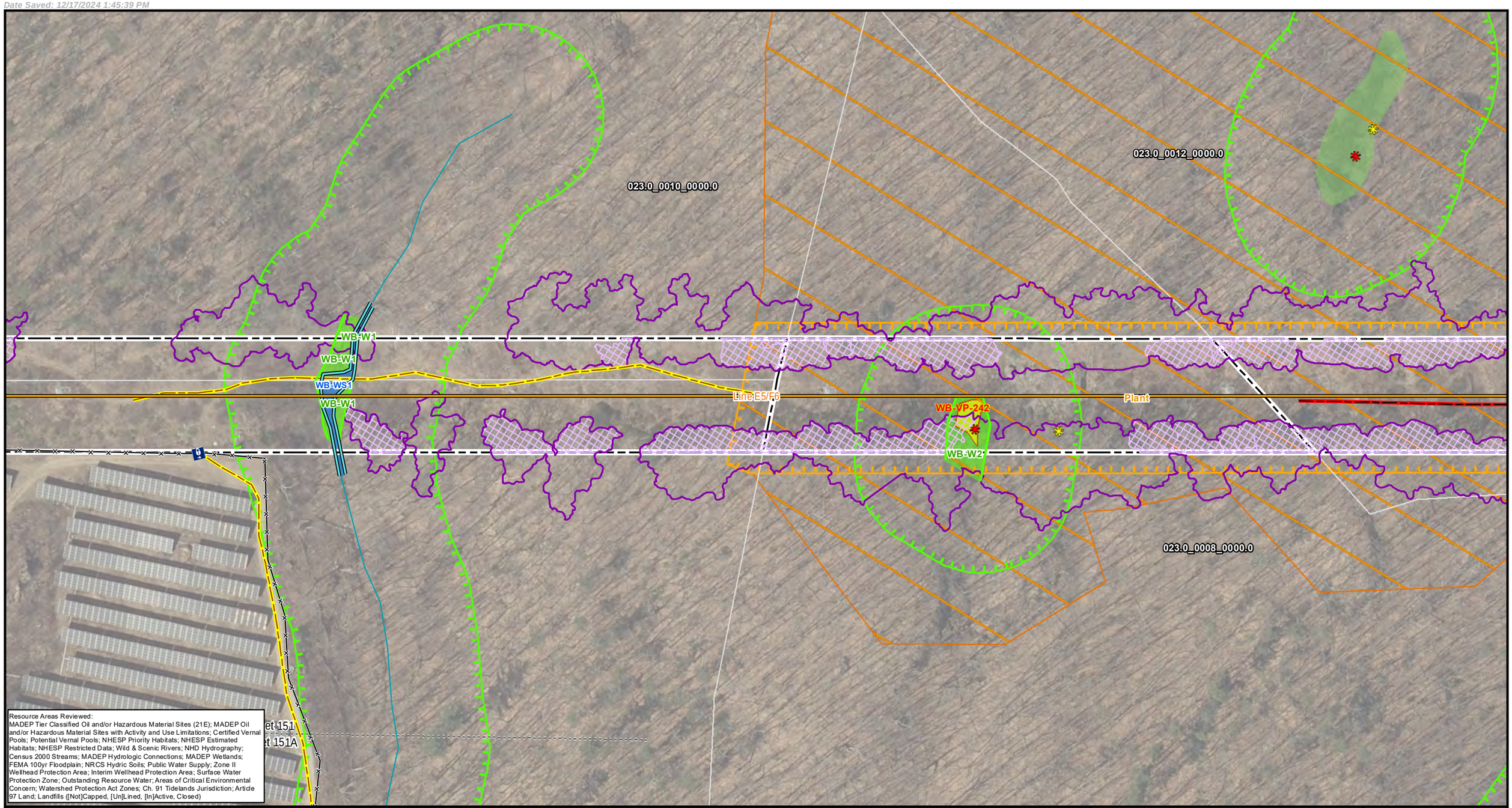

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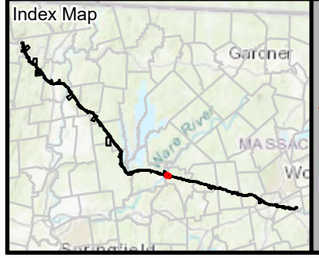

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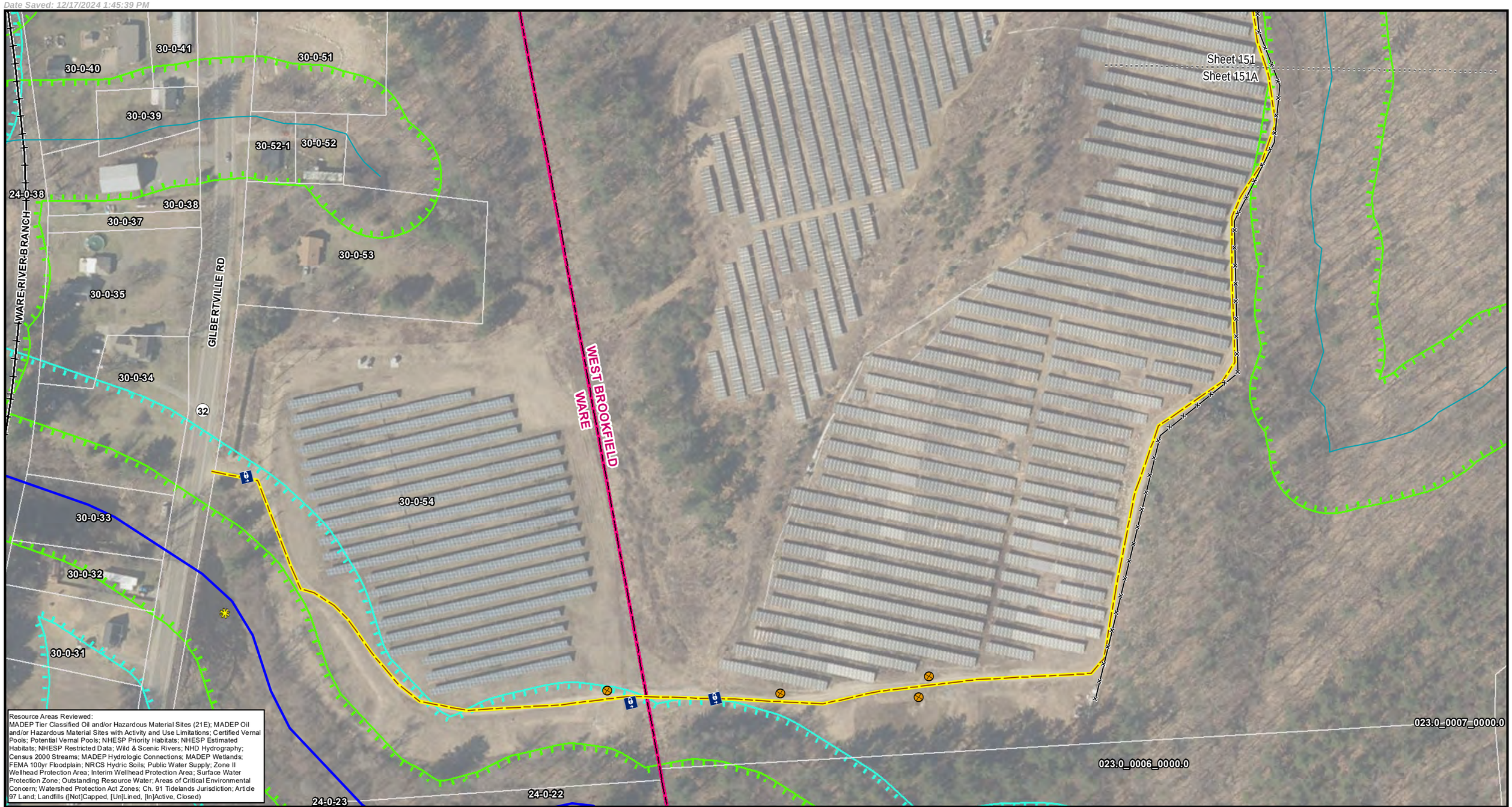

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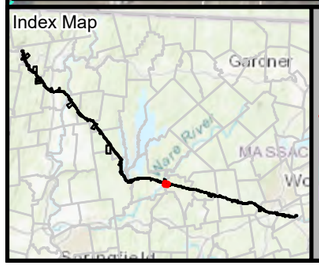

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*Indicates Layers Set to Transparency

N

1 inch = 150 feet
0 75 150
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Ware & West Brookfield, MA
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MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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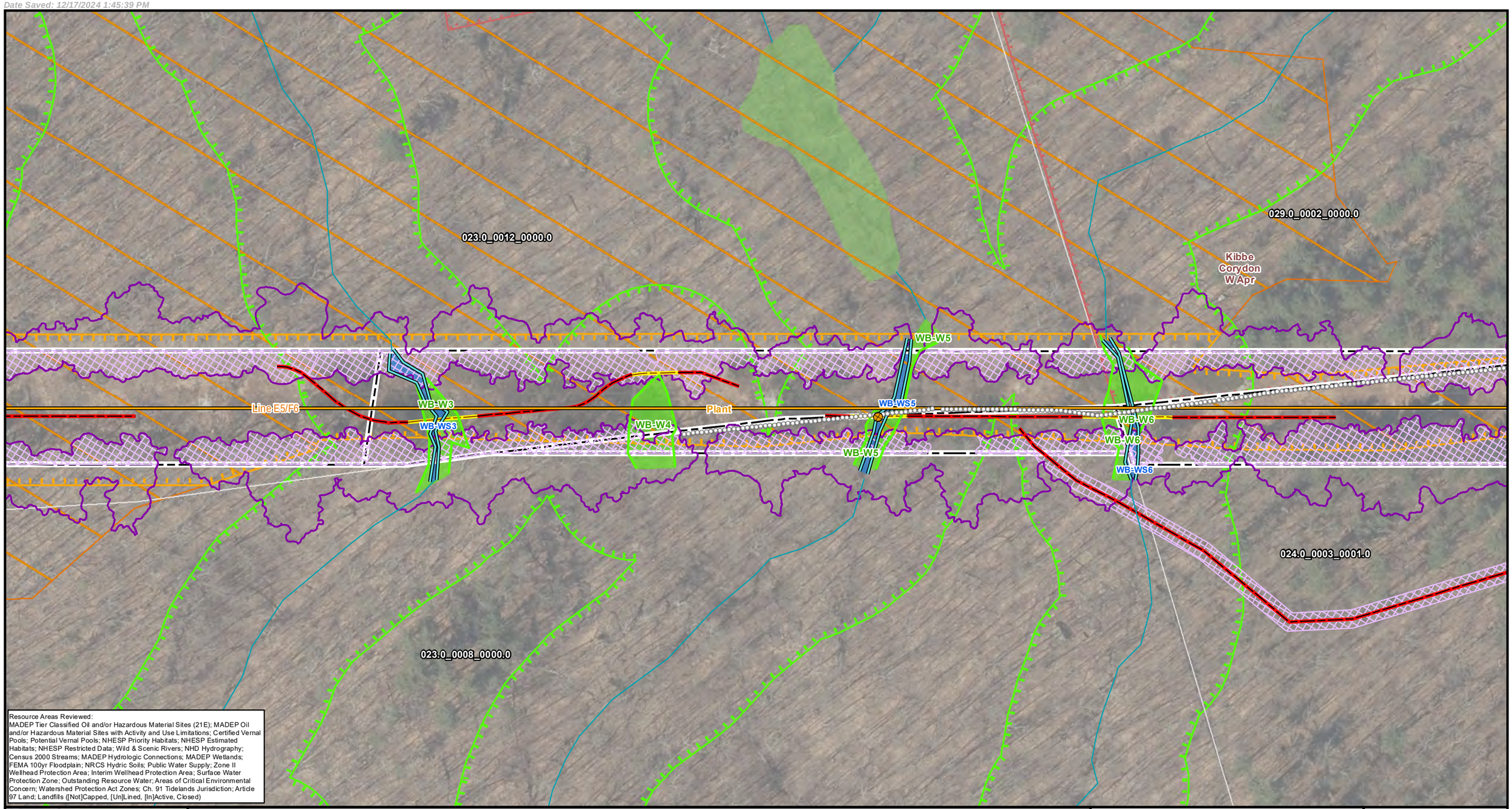

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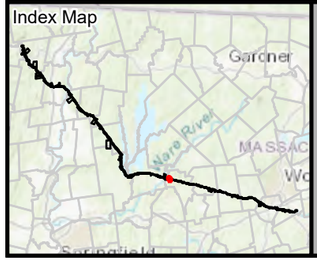

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Article 97 Lands

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Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

West Brookfield, MA

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WB-W9
Plant
Line E5/F6

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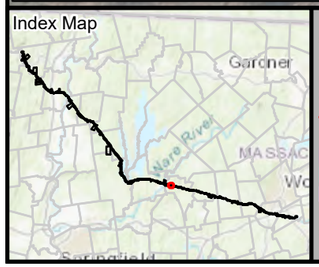

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Article 97 Lands

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Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

West Brookfield, MA

MassGIS
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Article 97 Lands
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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

West Brookfield, MA

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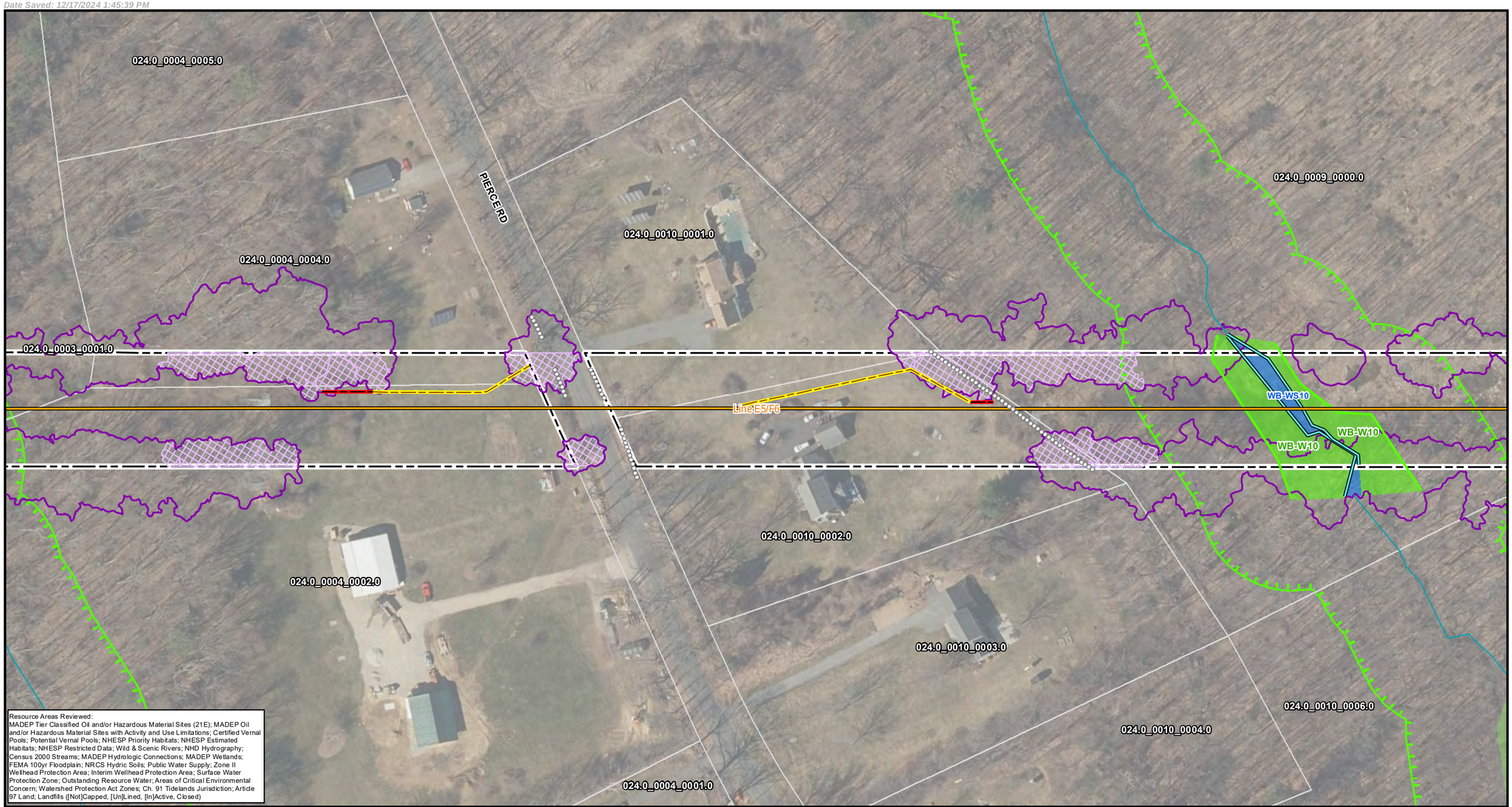

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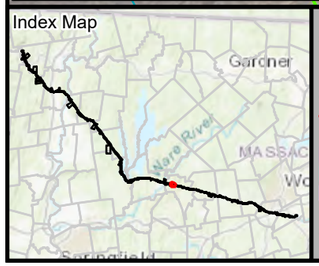

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West Brookfield, MA

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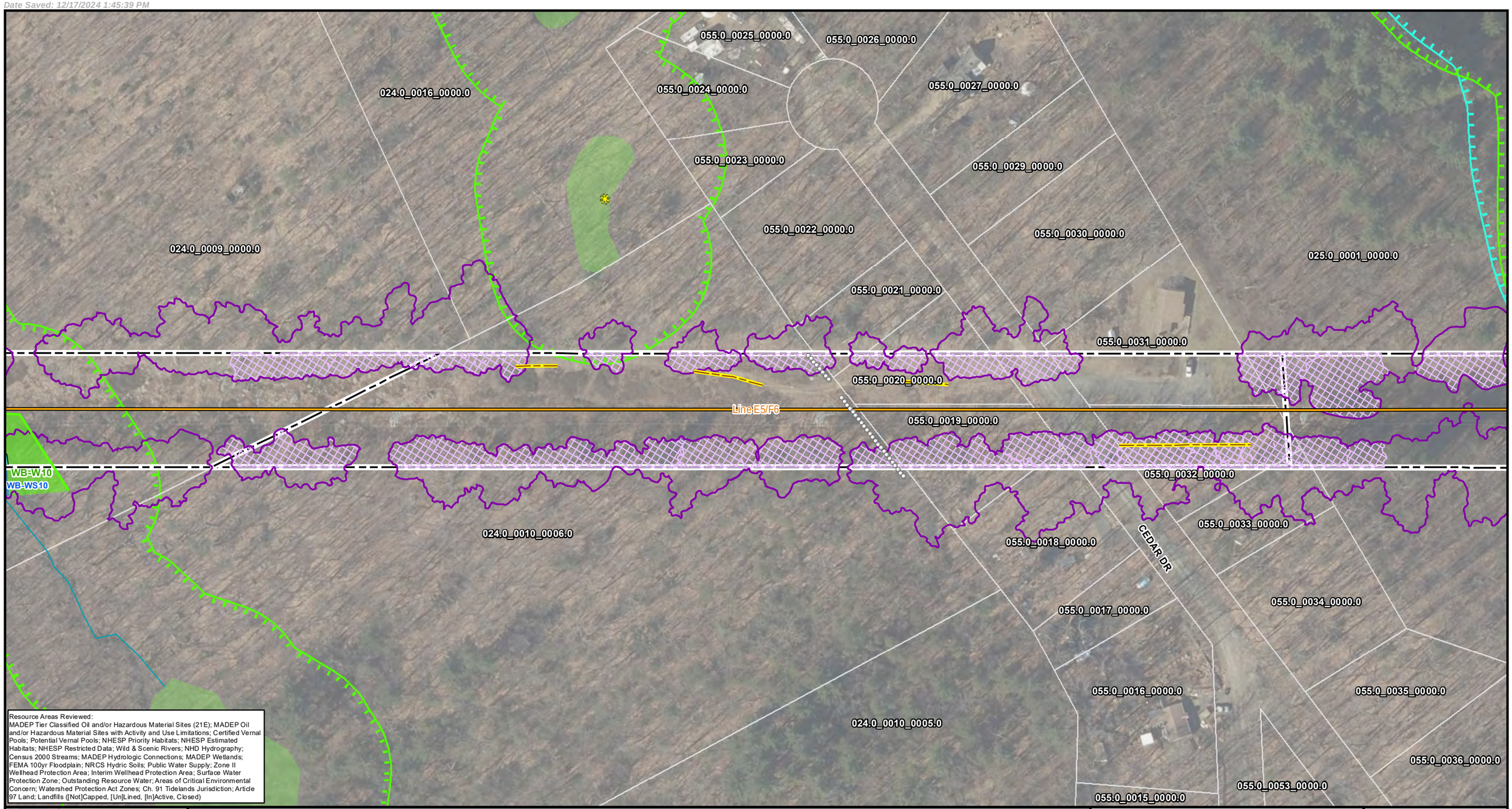

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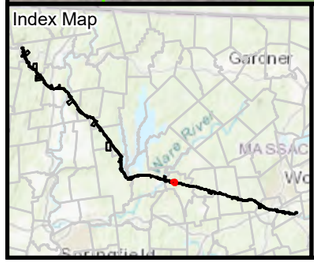

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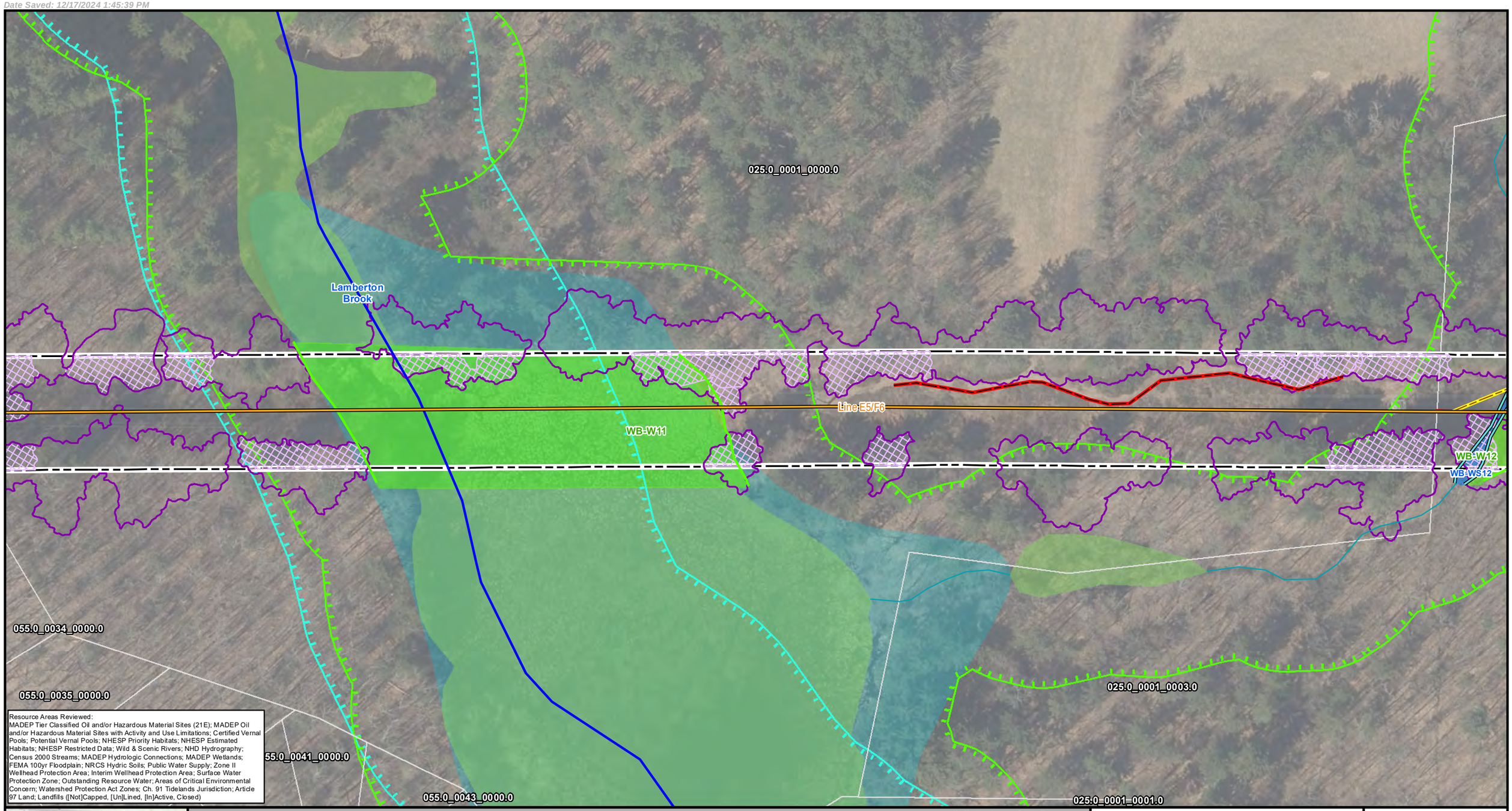

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Environmental Resources Map

West Brookfield, MA

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WB-W12

Line E5/F6

WB-S2

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N

1 inch = 100 feet

0 50 100

Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

West Brookfield, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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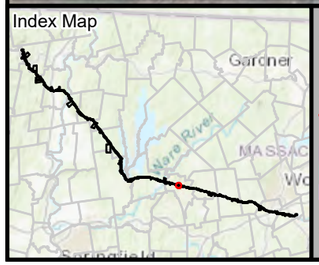

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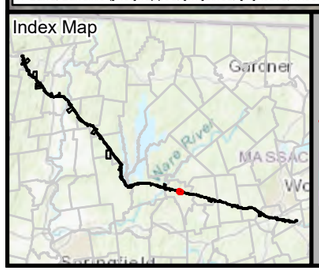

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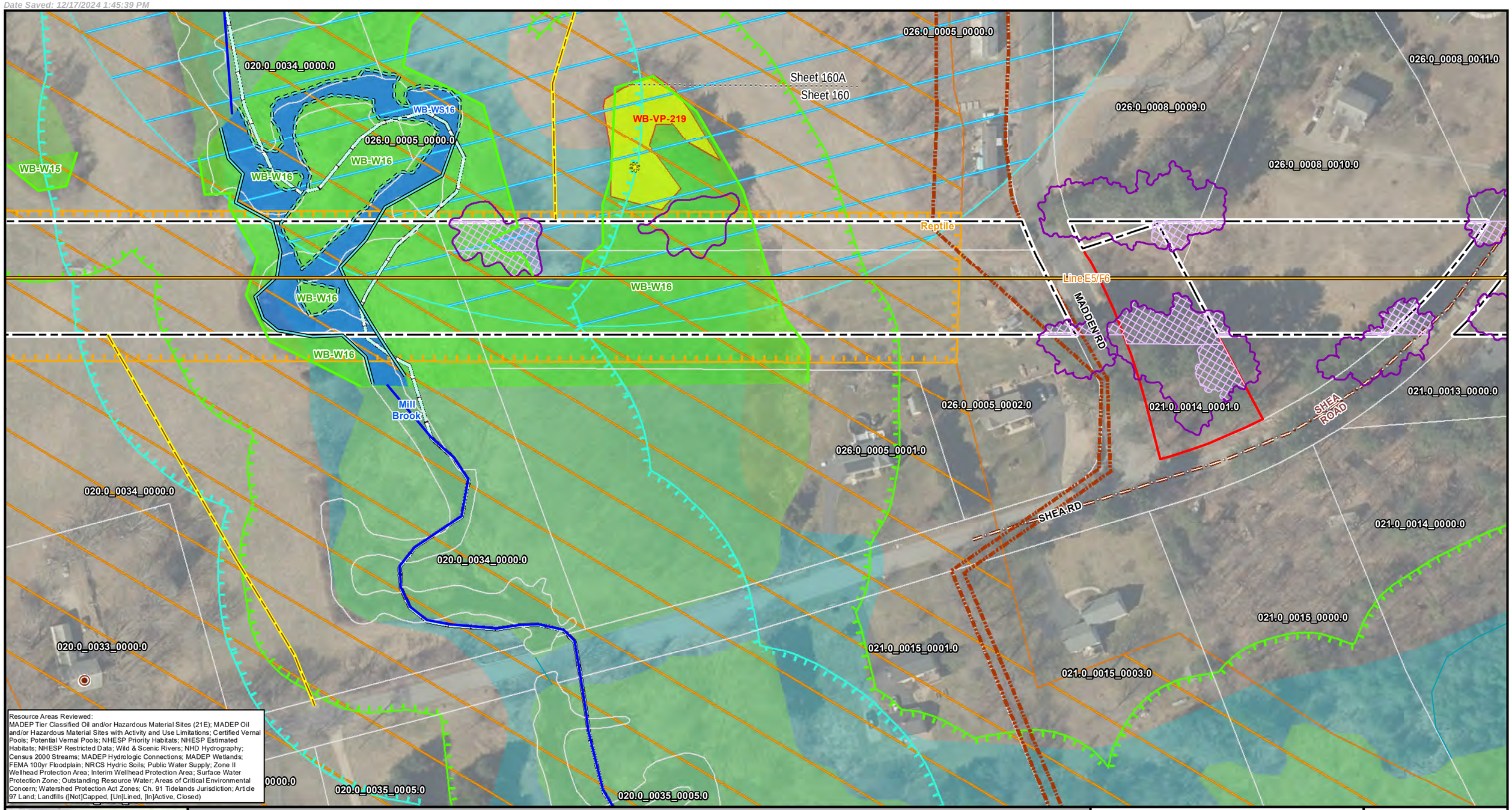

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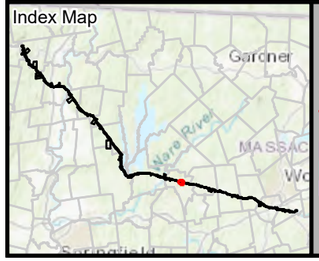

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

West Brookfield, MA

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Index Map
Gardner
Springfield

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Article 97 Lands

- Dept. of Fish & Game

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0 50 100
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

West Brookfield, MA
Page 160A of 240

MassGIS
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West Brookfield State Forest
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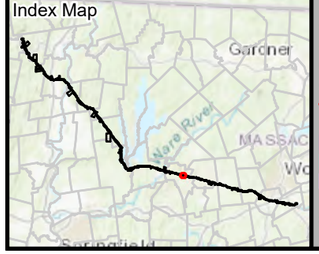

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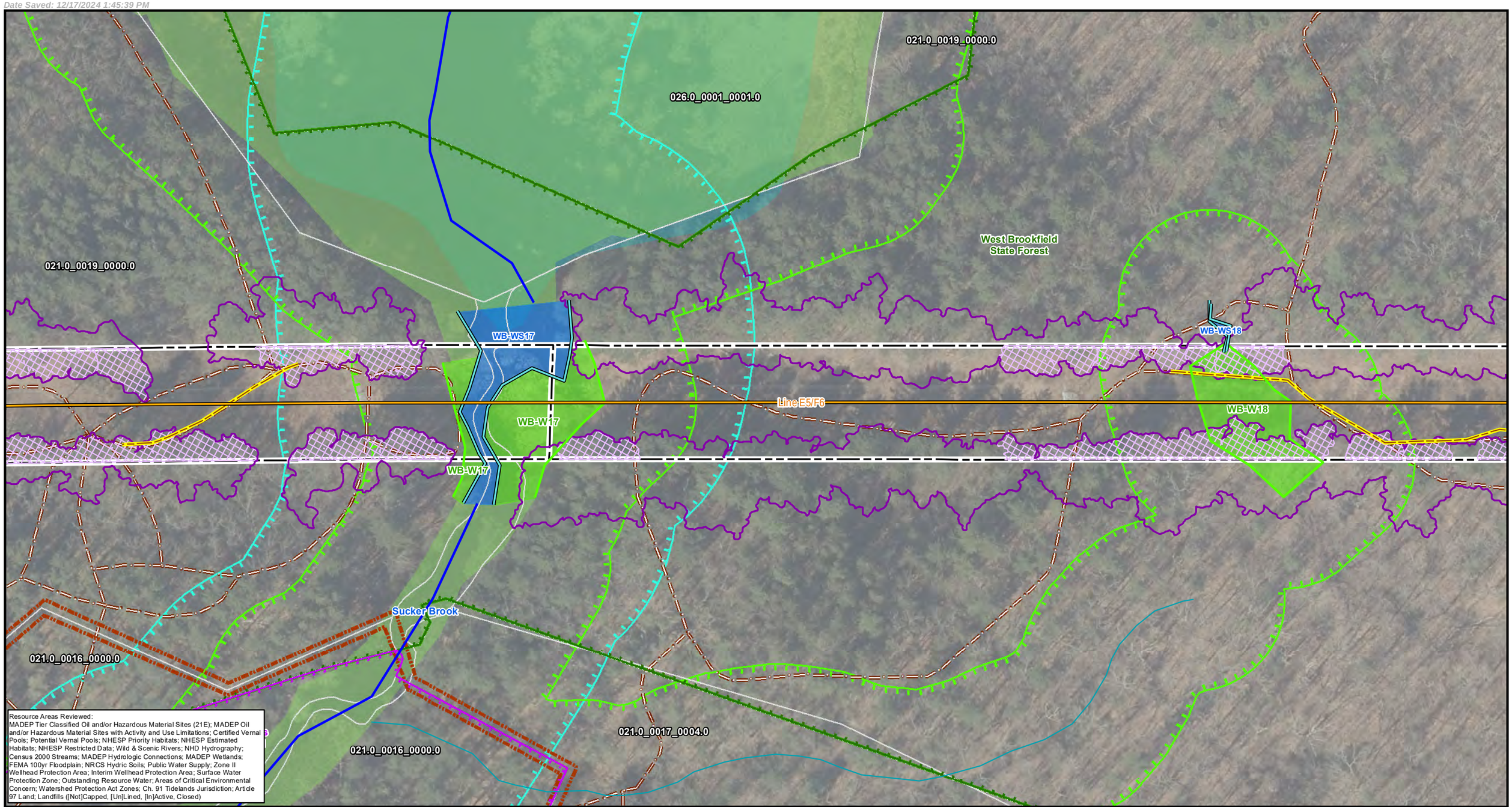

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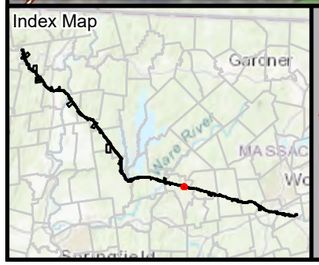

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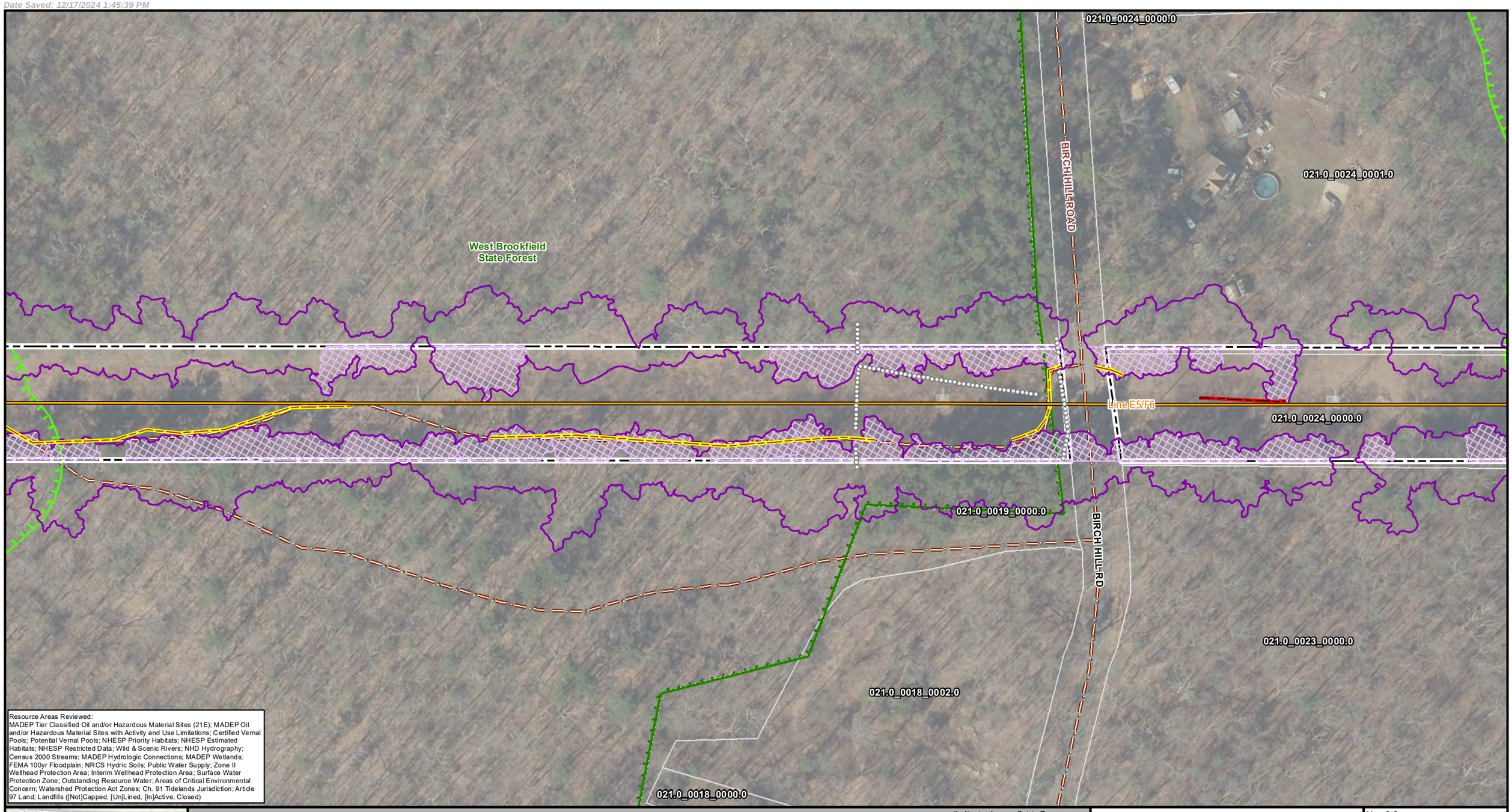

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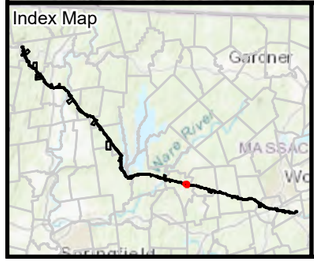

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Article 97 Lands

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Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

West Brookfield, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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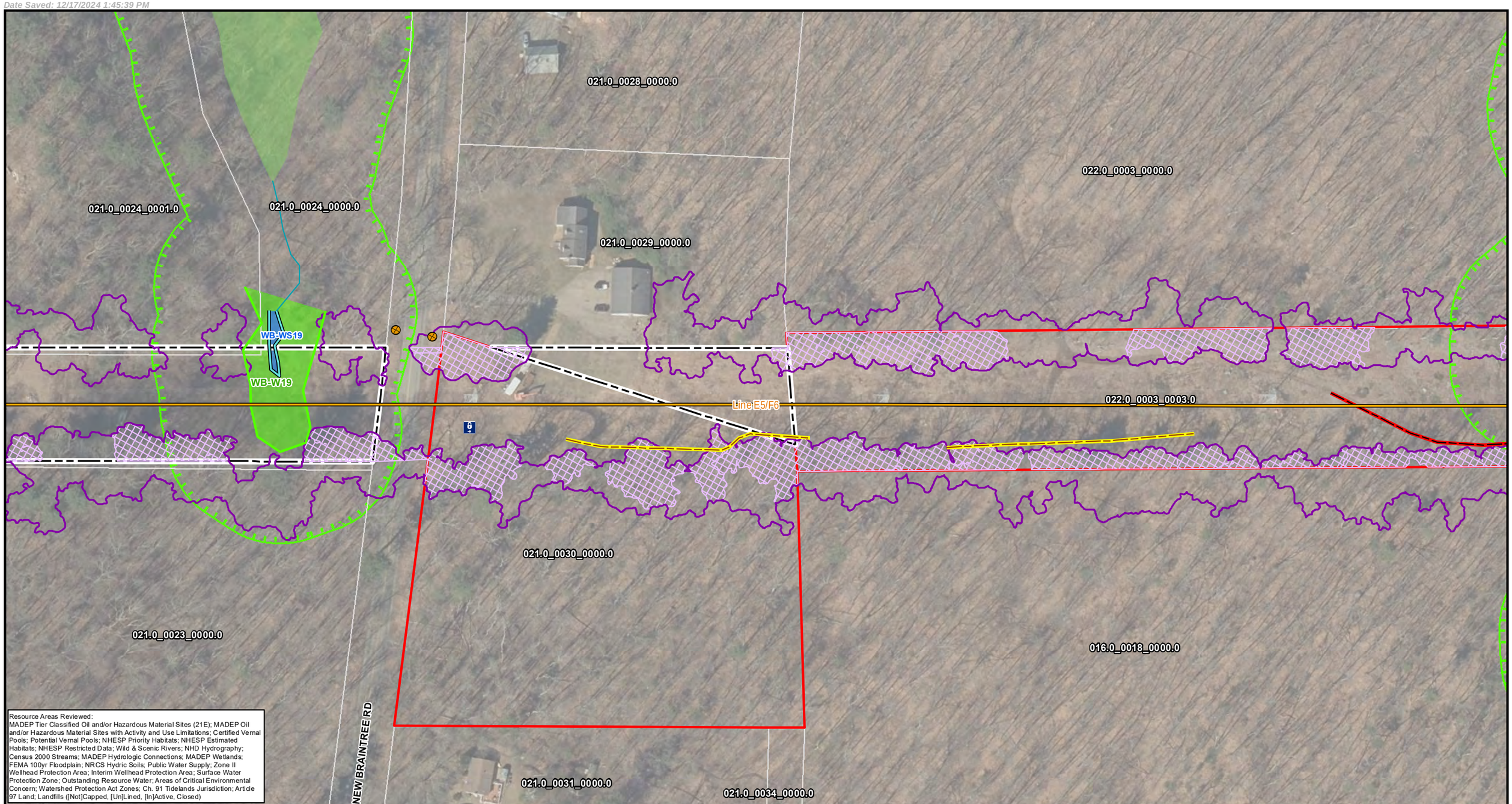

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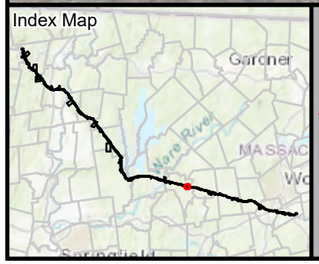

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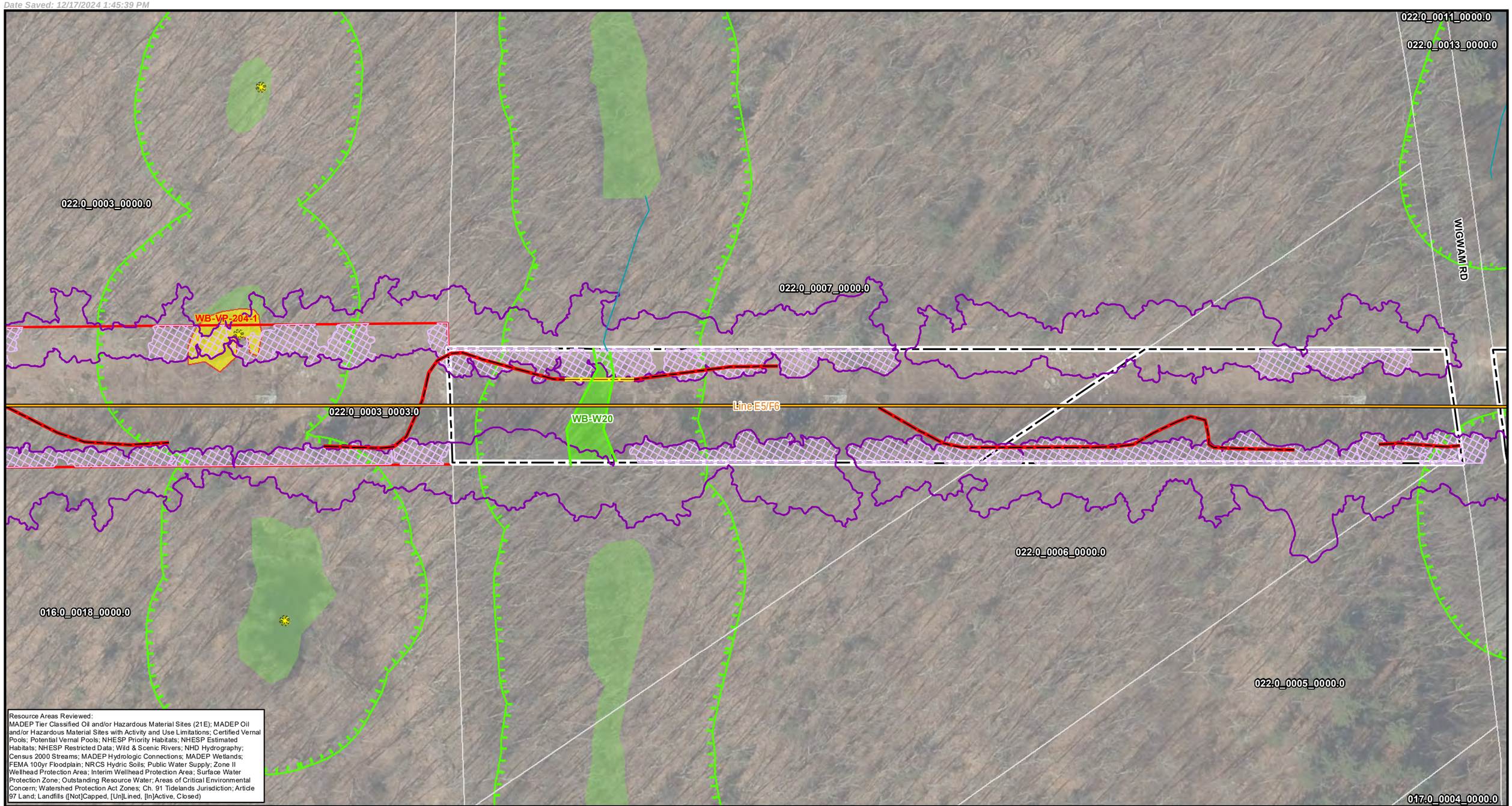

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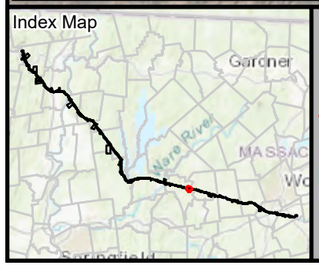

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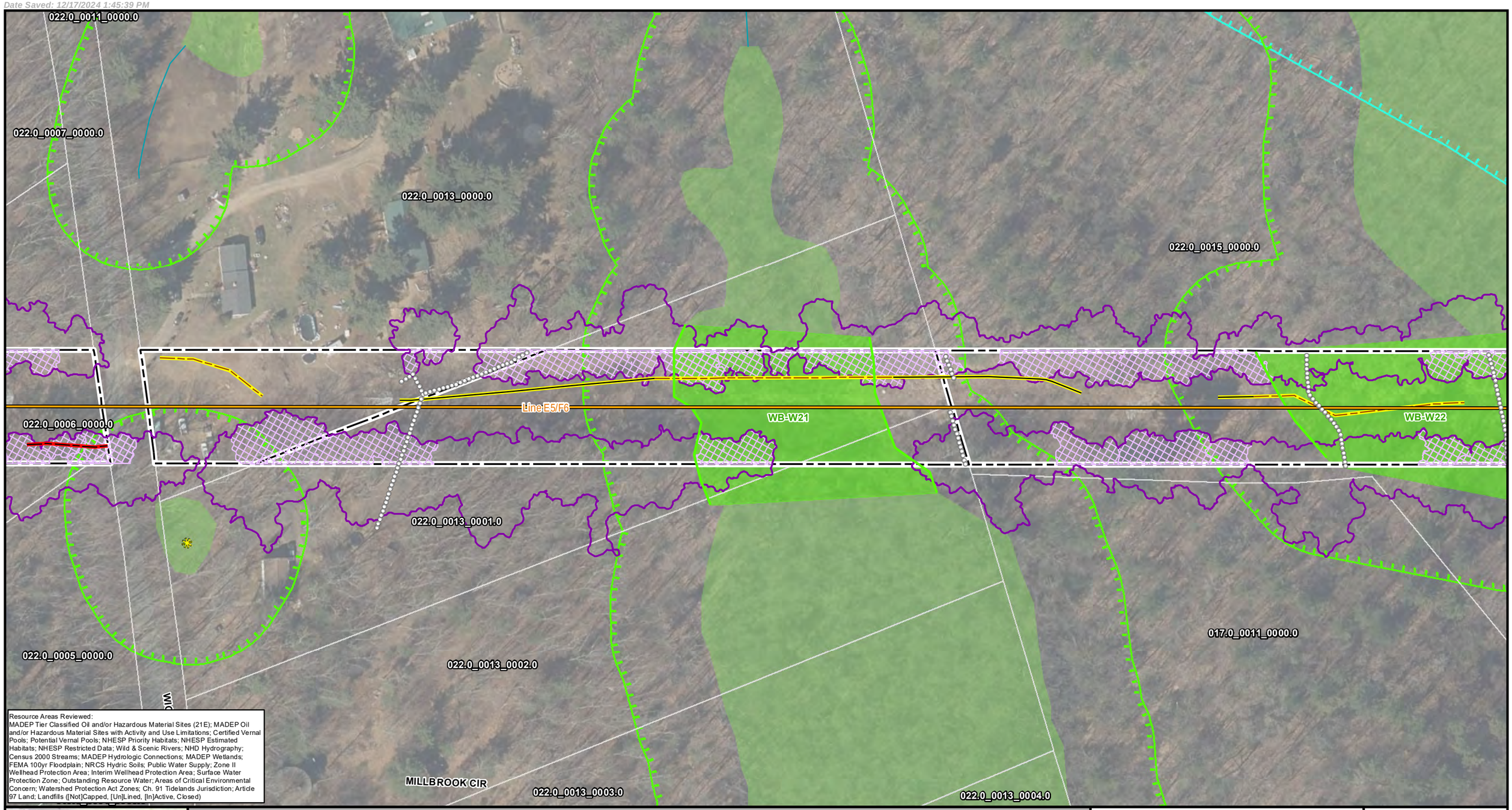

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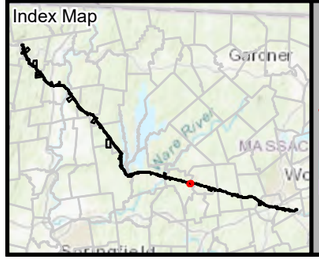

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

West Brookfield, MA

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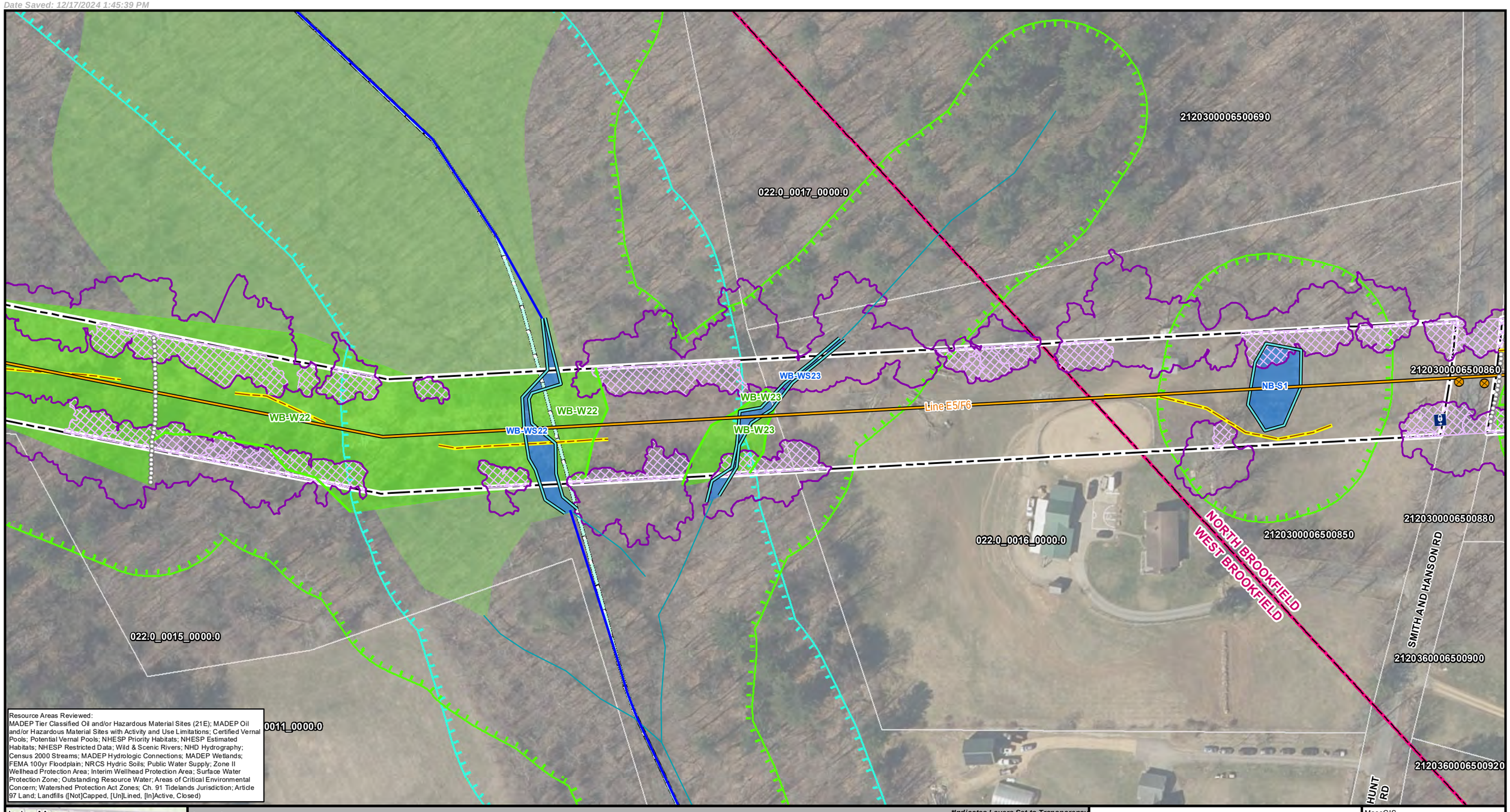

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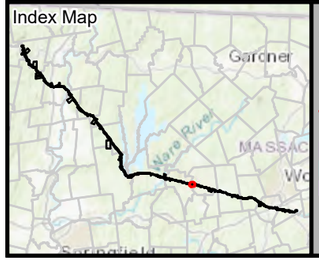

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

West Brookfield & North Brookfield, MA

MassGIS
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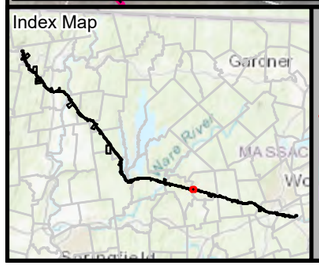

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

North Brookfield, MA

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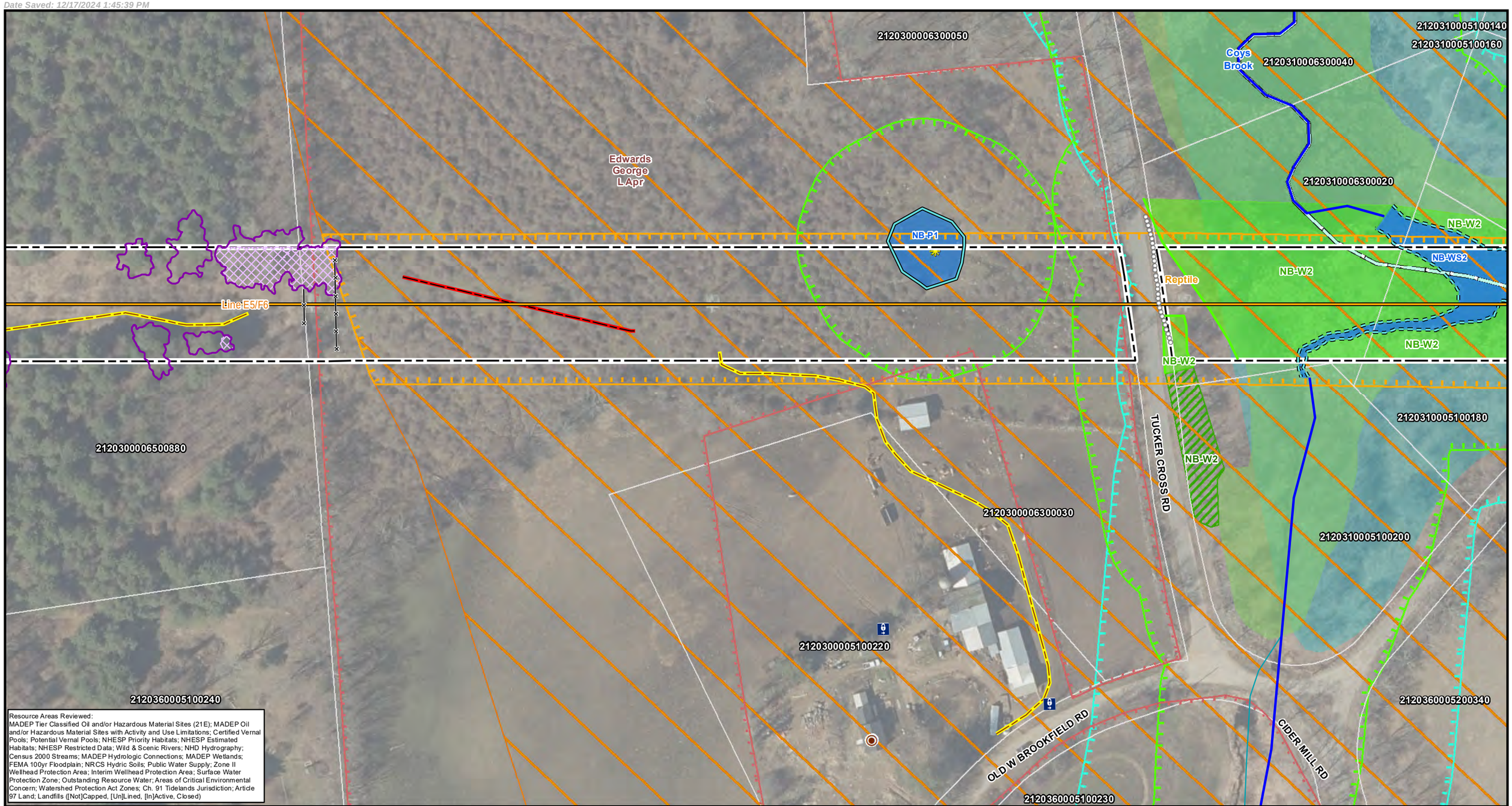

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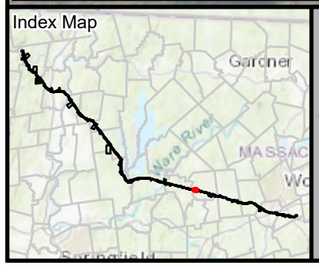

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Coys Brook

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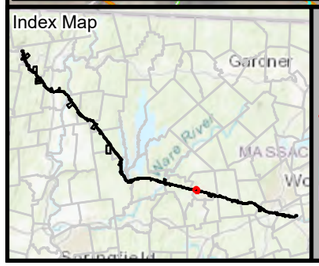

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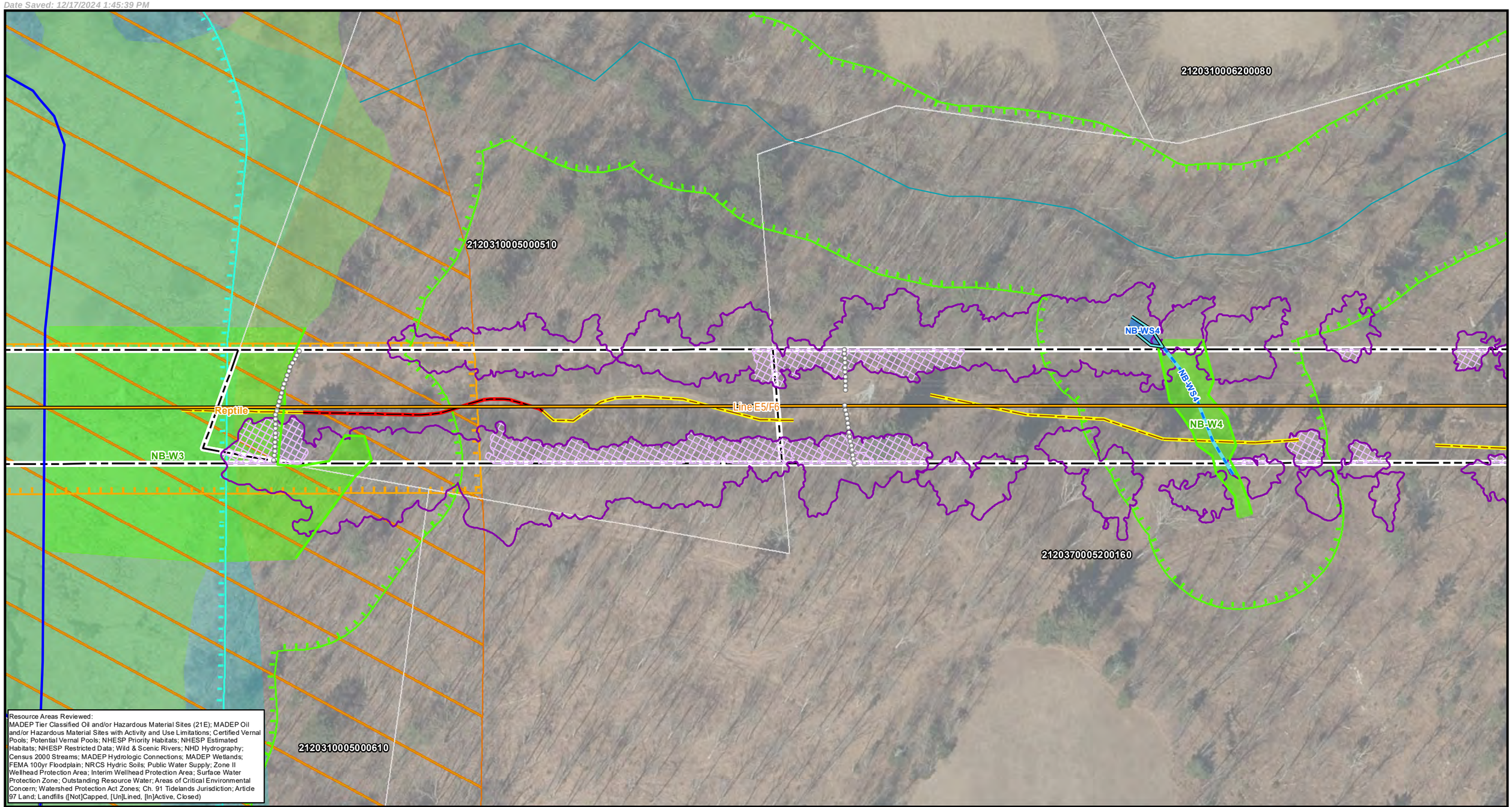

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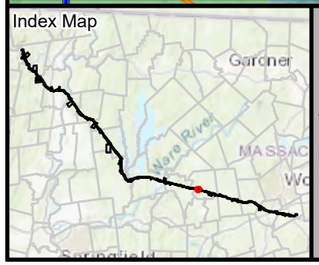

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

North Brookfield, MA

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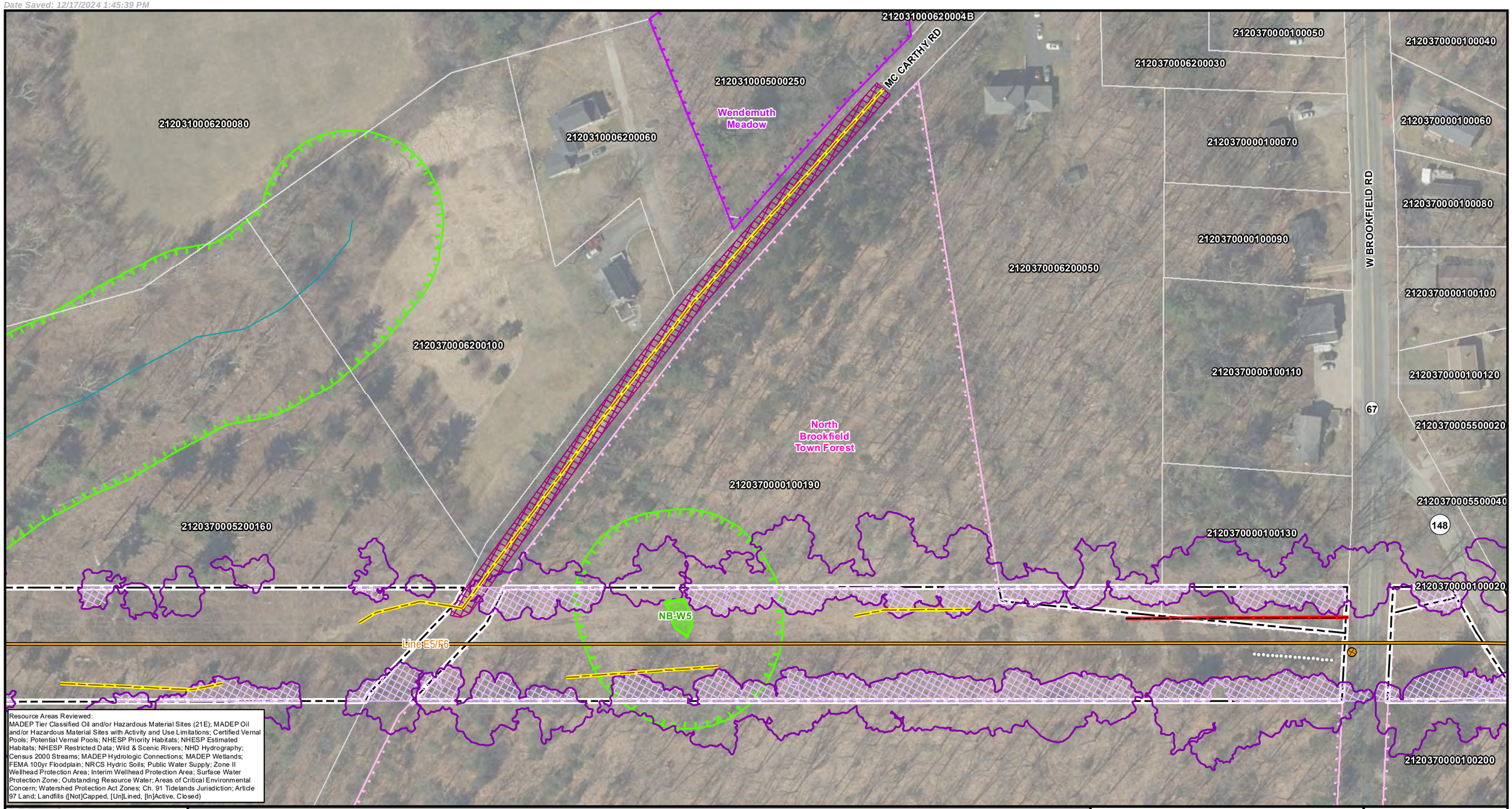

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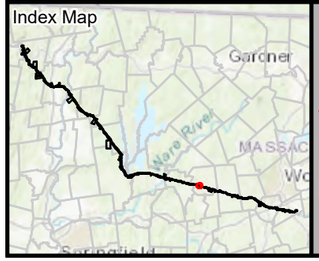

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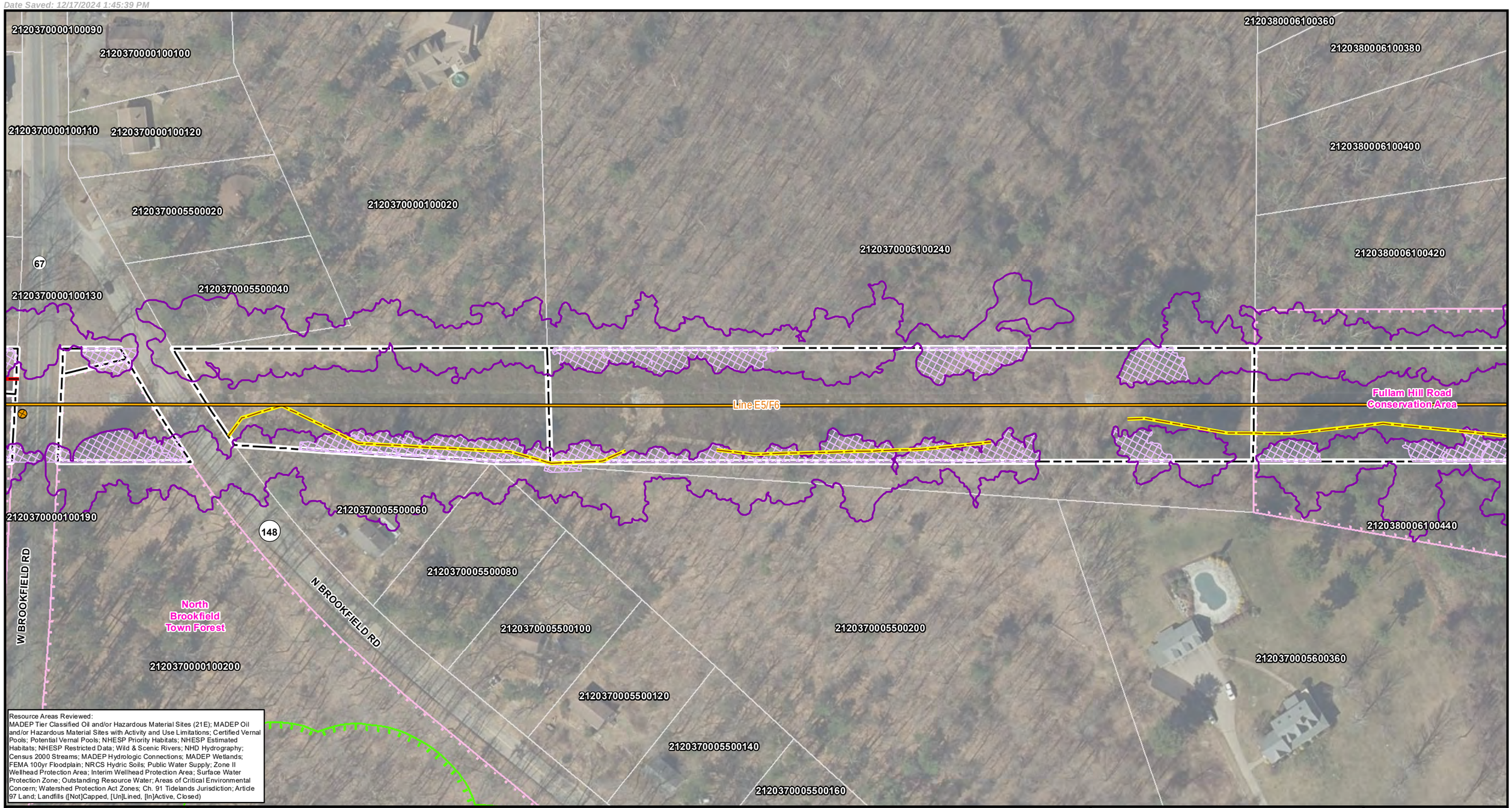

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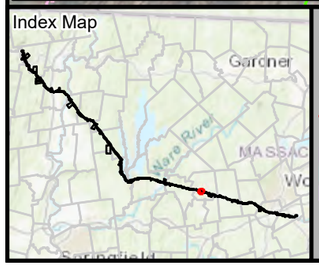

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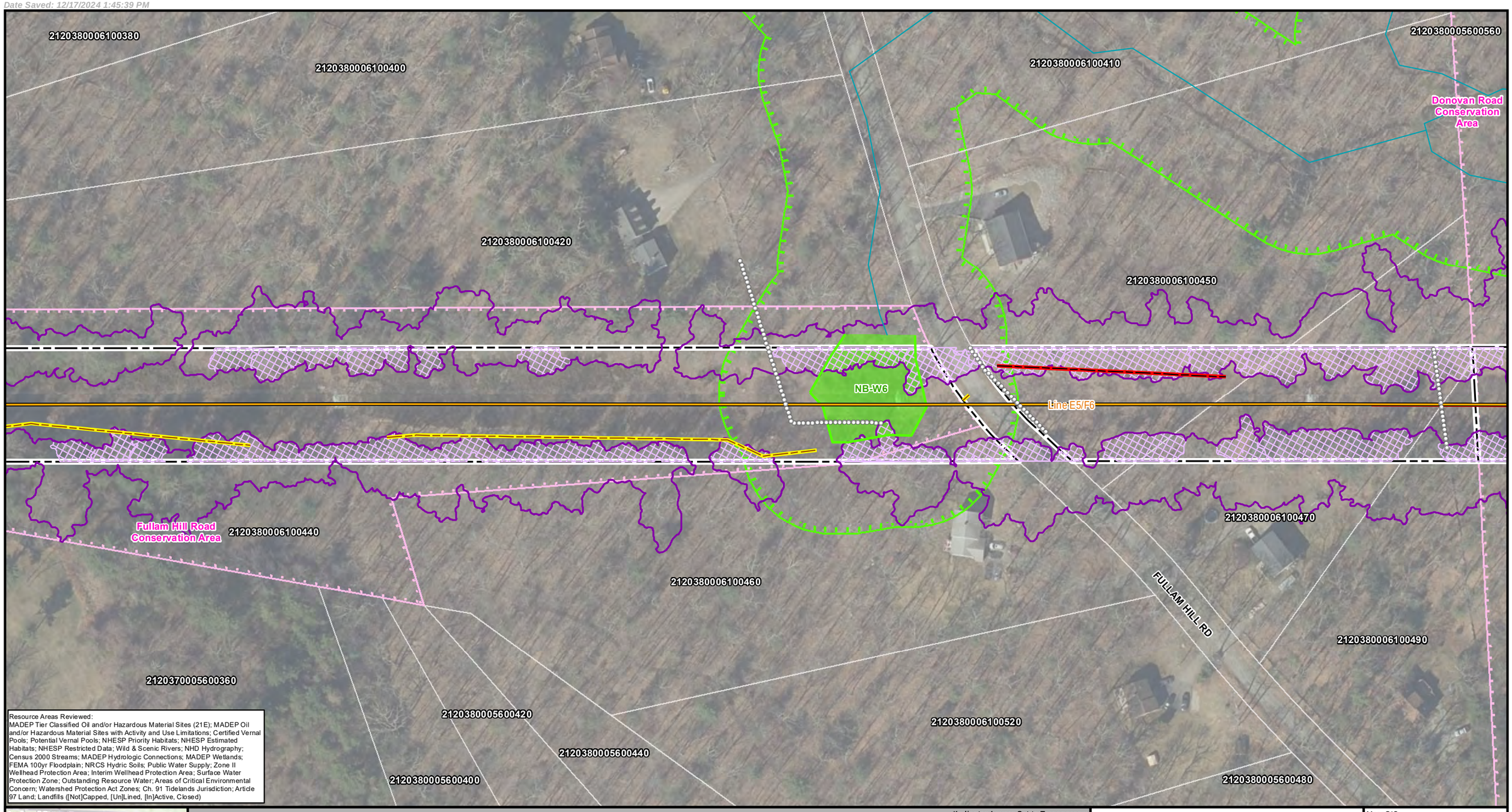

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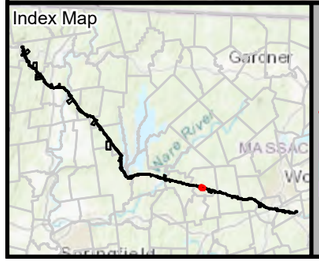

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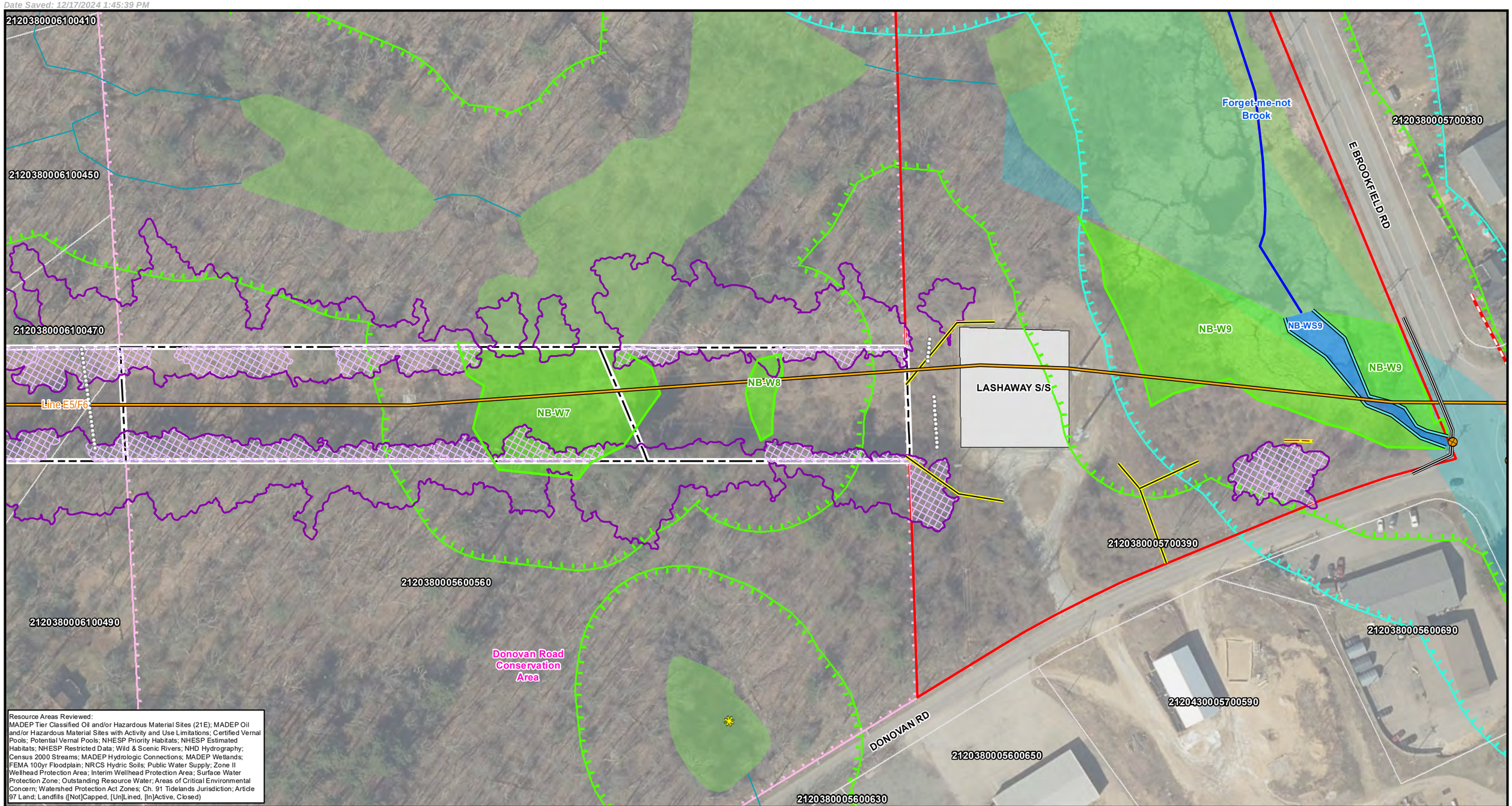

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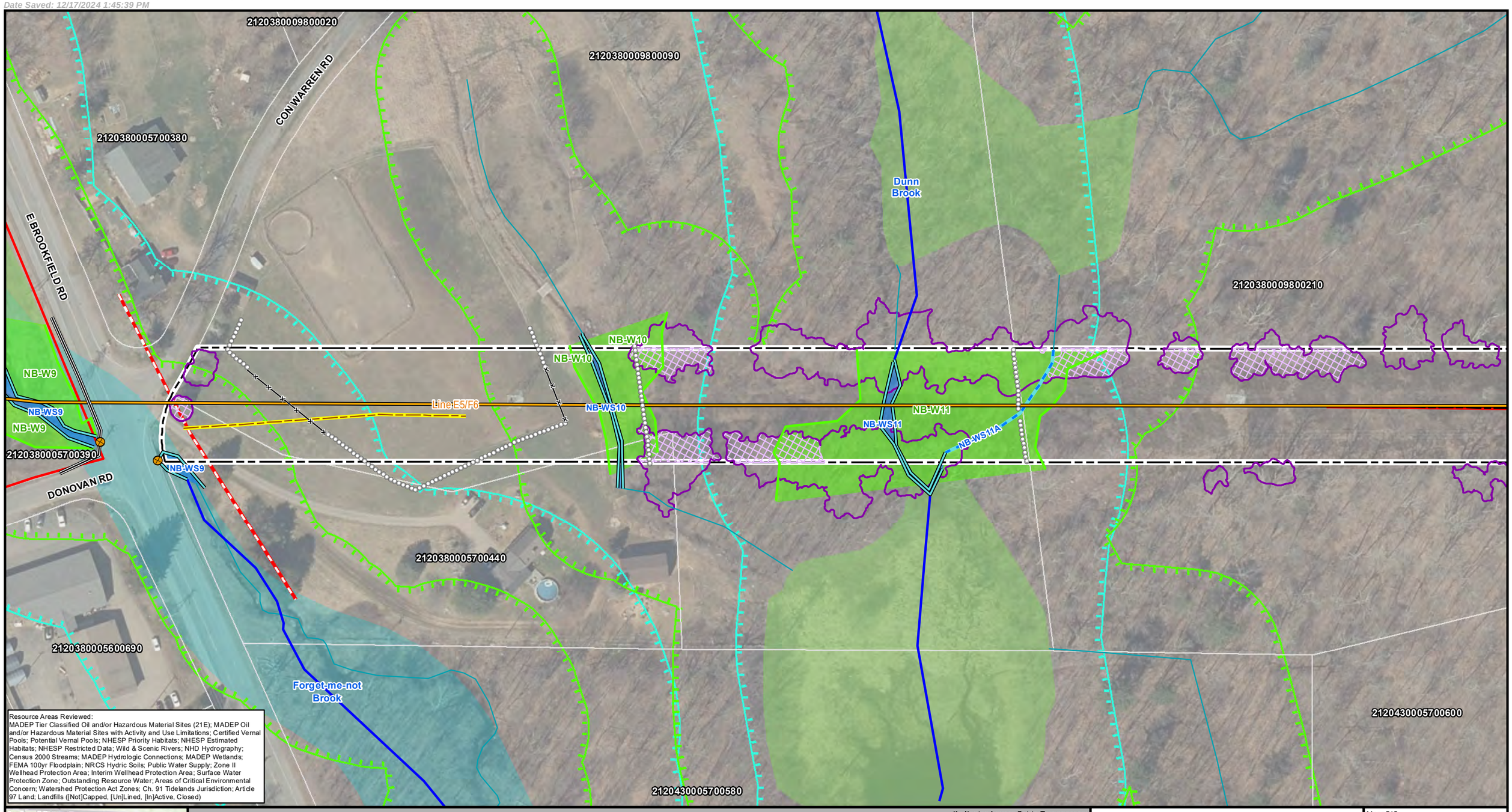

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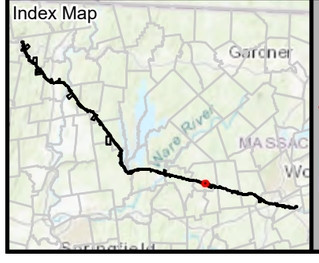

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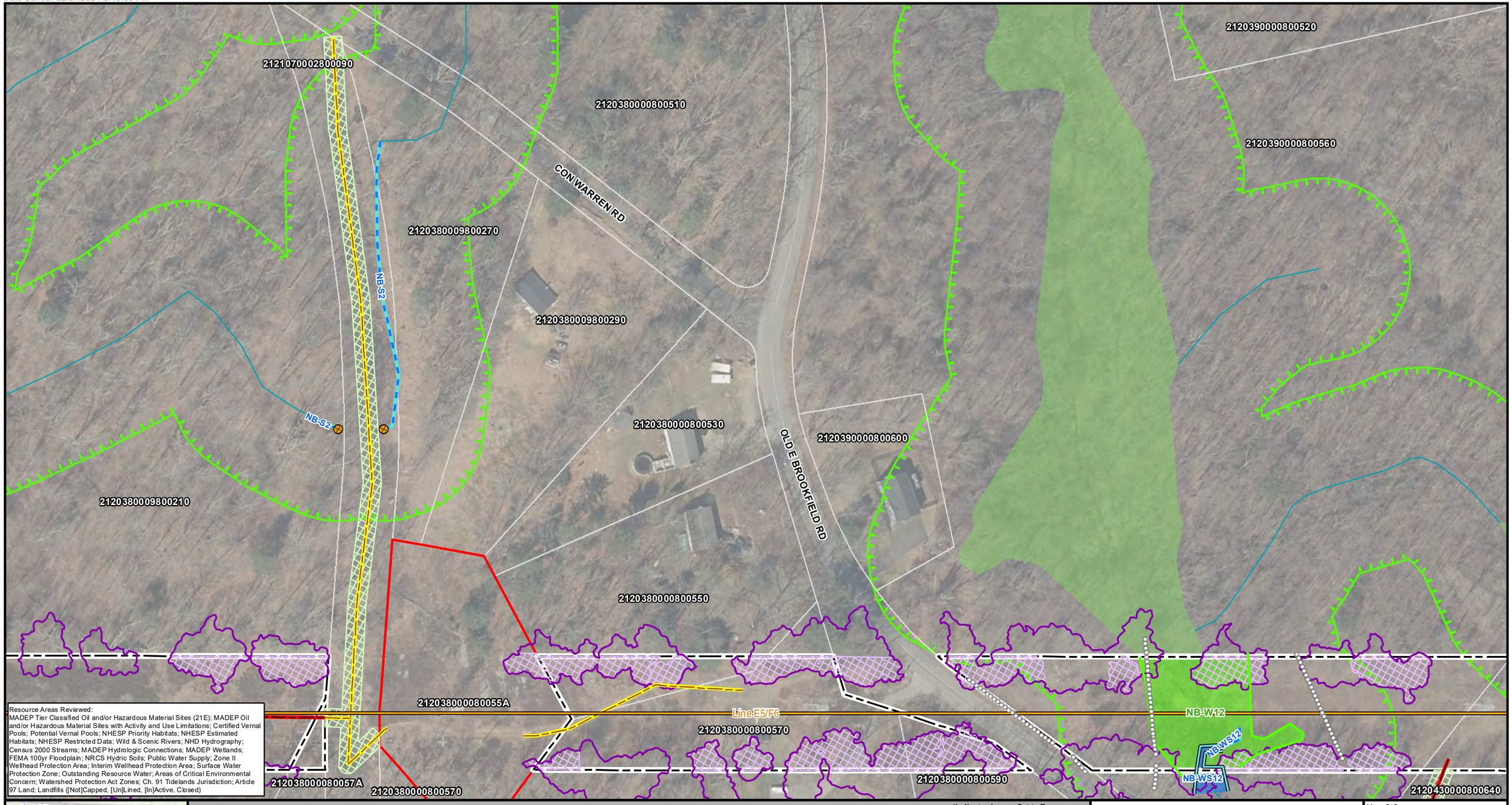

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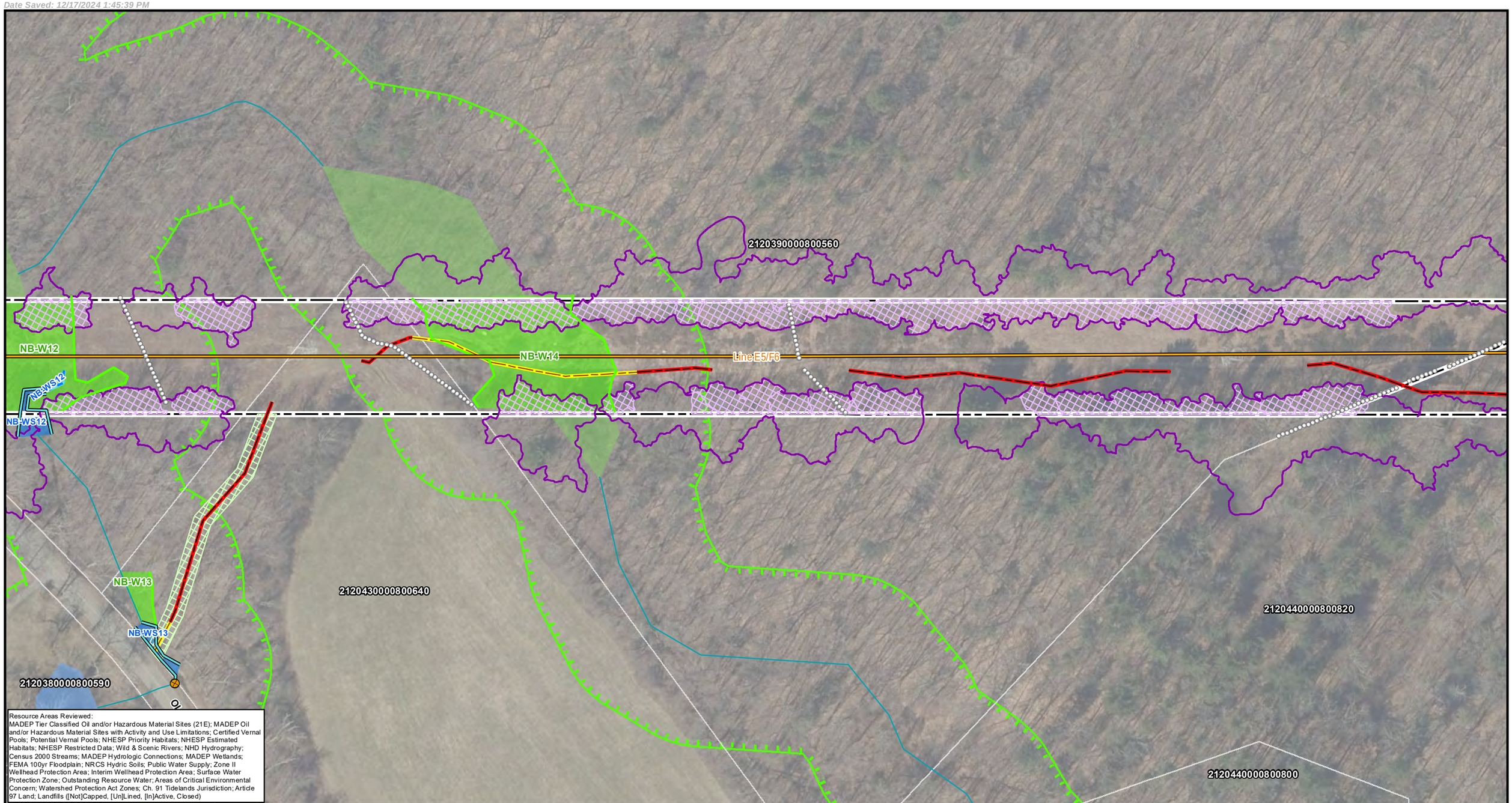

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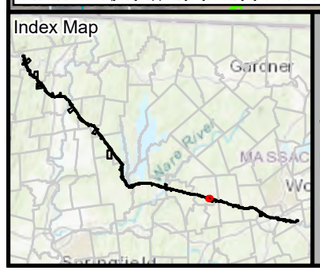

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

North Brookfield, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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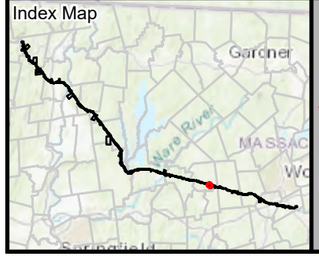

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Environmental Resources Map

North Brookfield, MA

MassGIS
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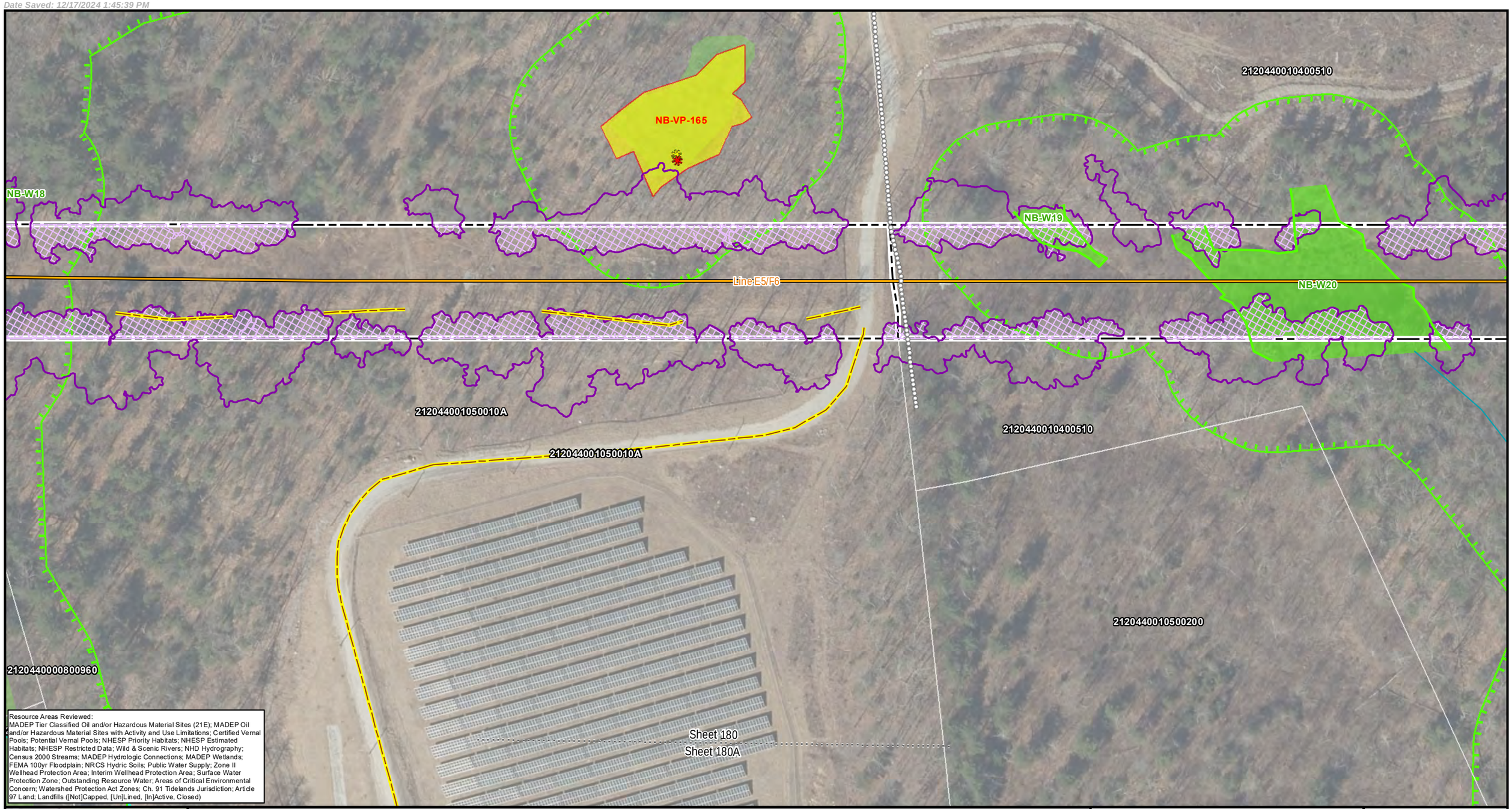

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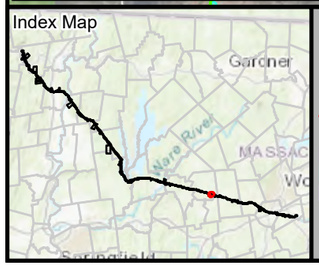

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

North Brookfield, MA
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MassGIS
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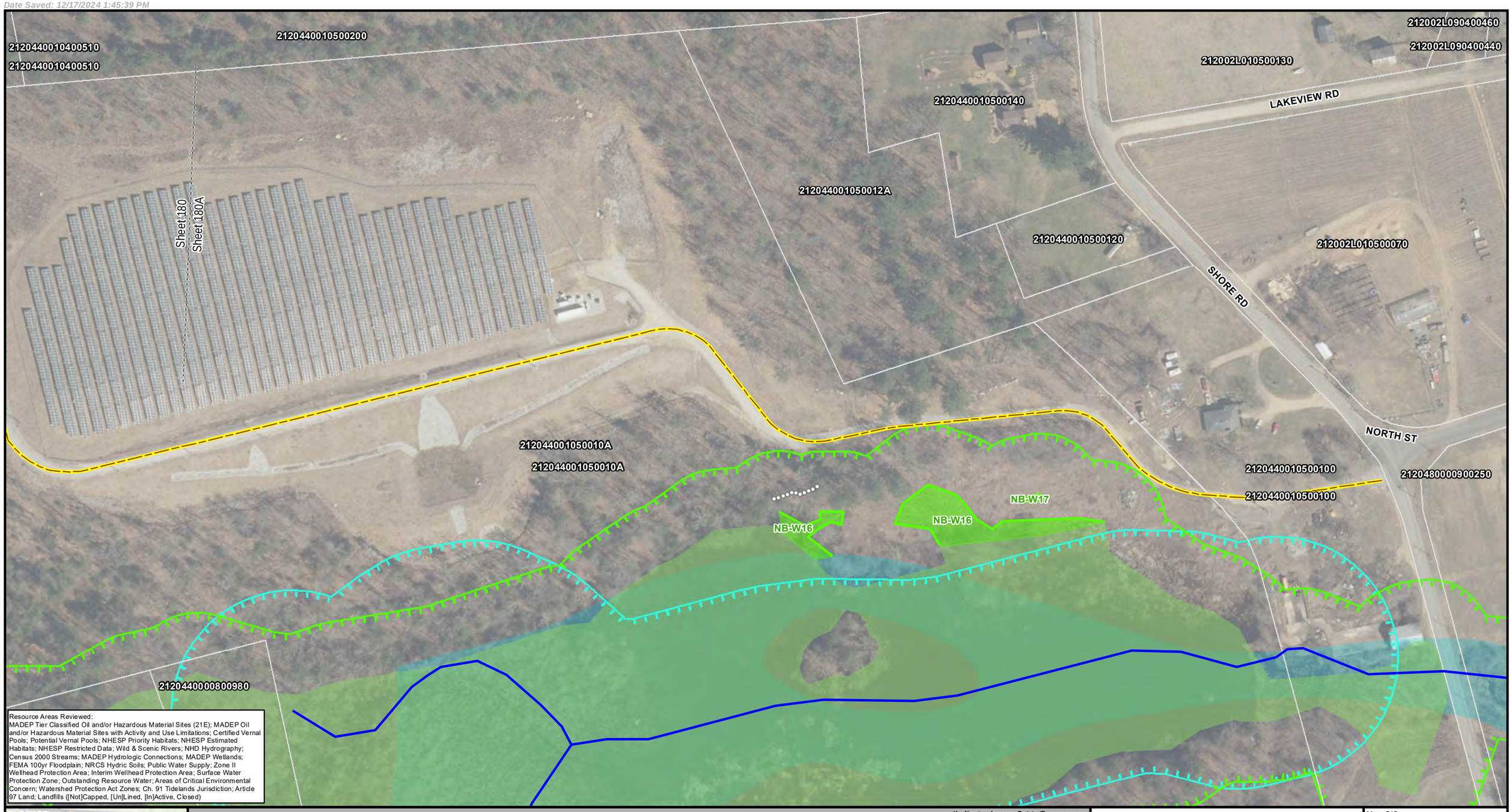

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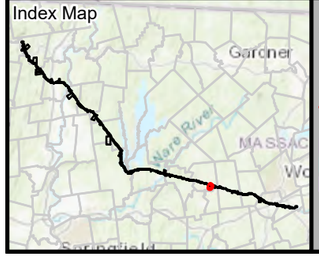

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1 inch = 150 feet
0 75 150
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

North Brookfield, MA
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MassGIS
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SHORE RD
Line E5/F6
NB-W20
NB-S3

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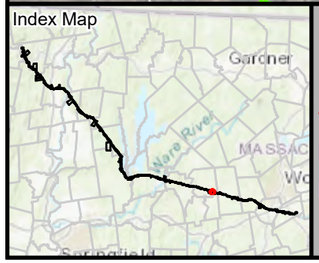

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North Brookfield, MA

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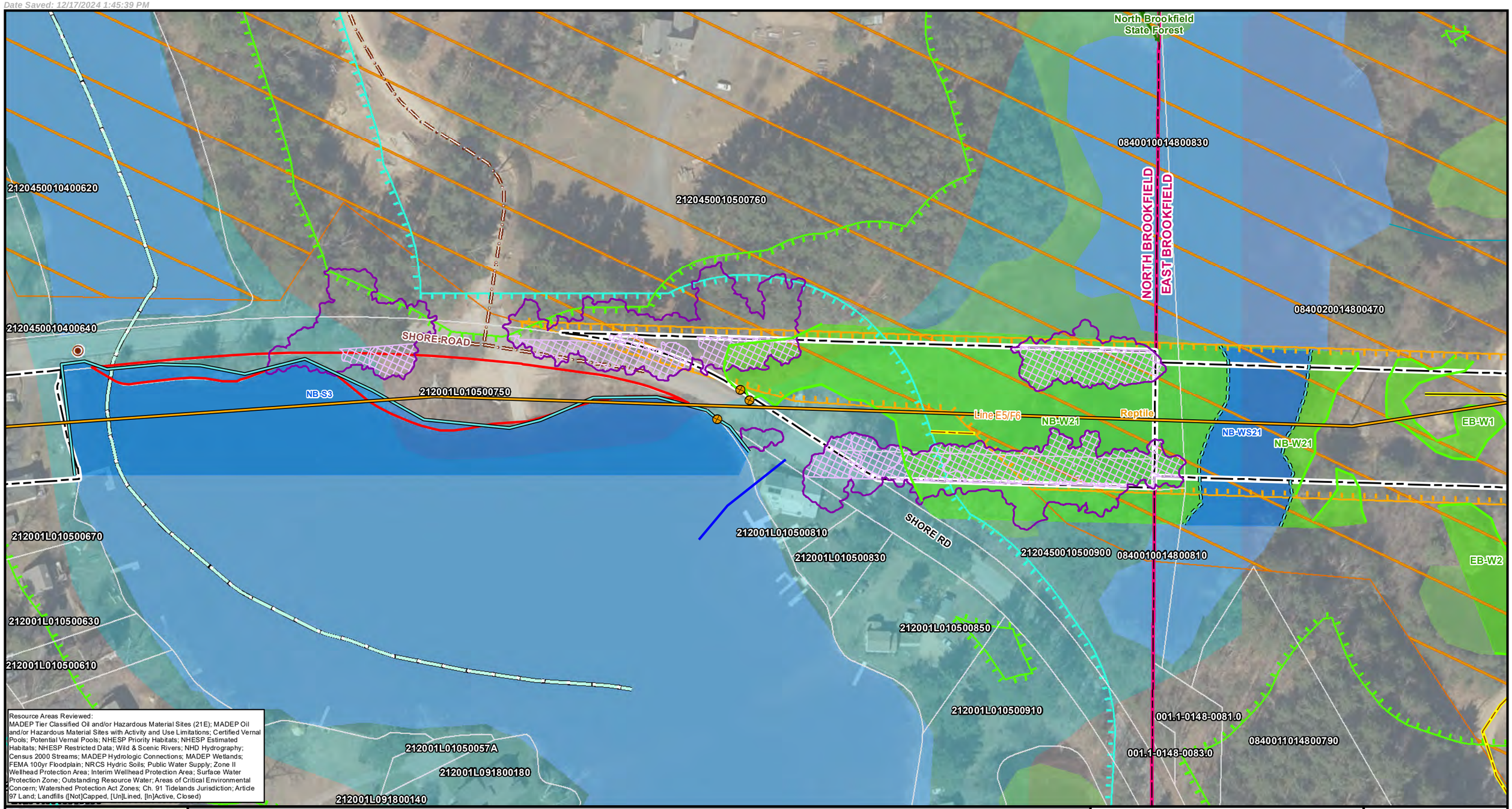

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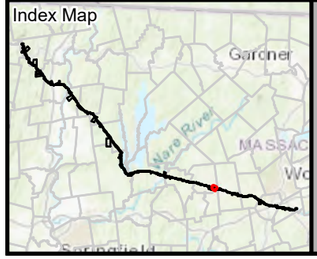

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North Brookfield & East Brookfield, MA

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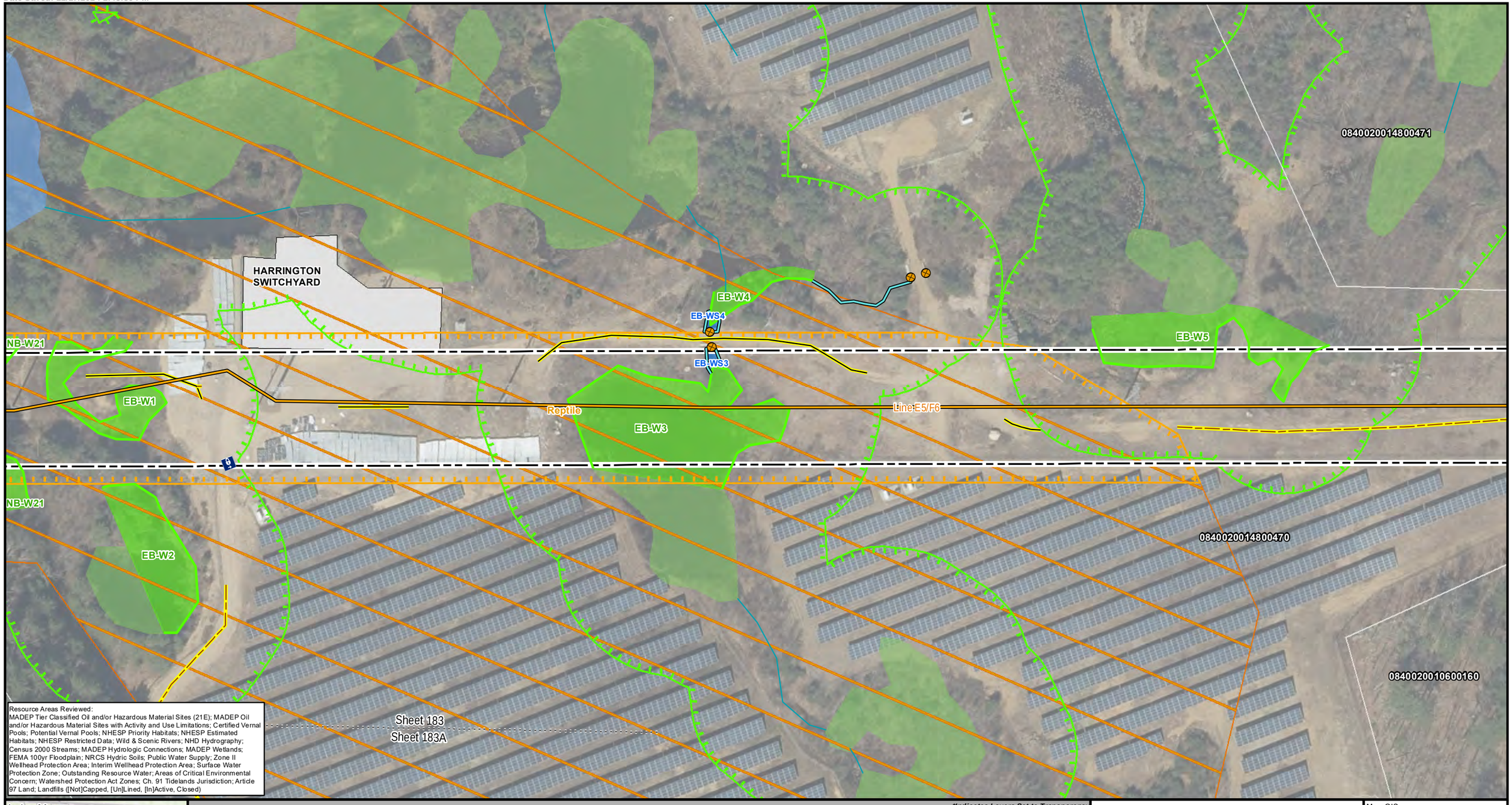

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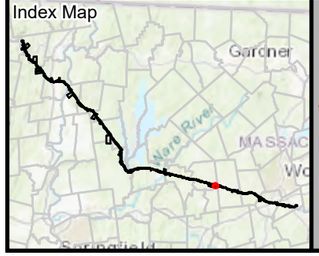

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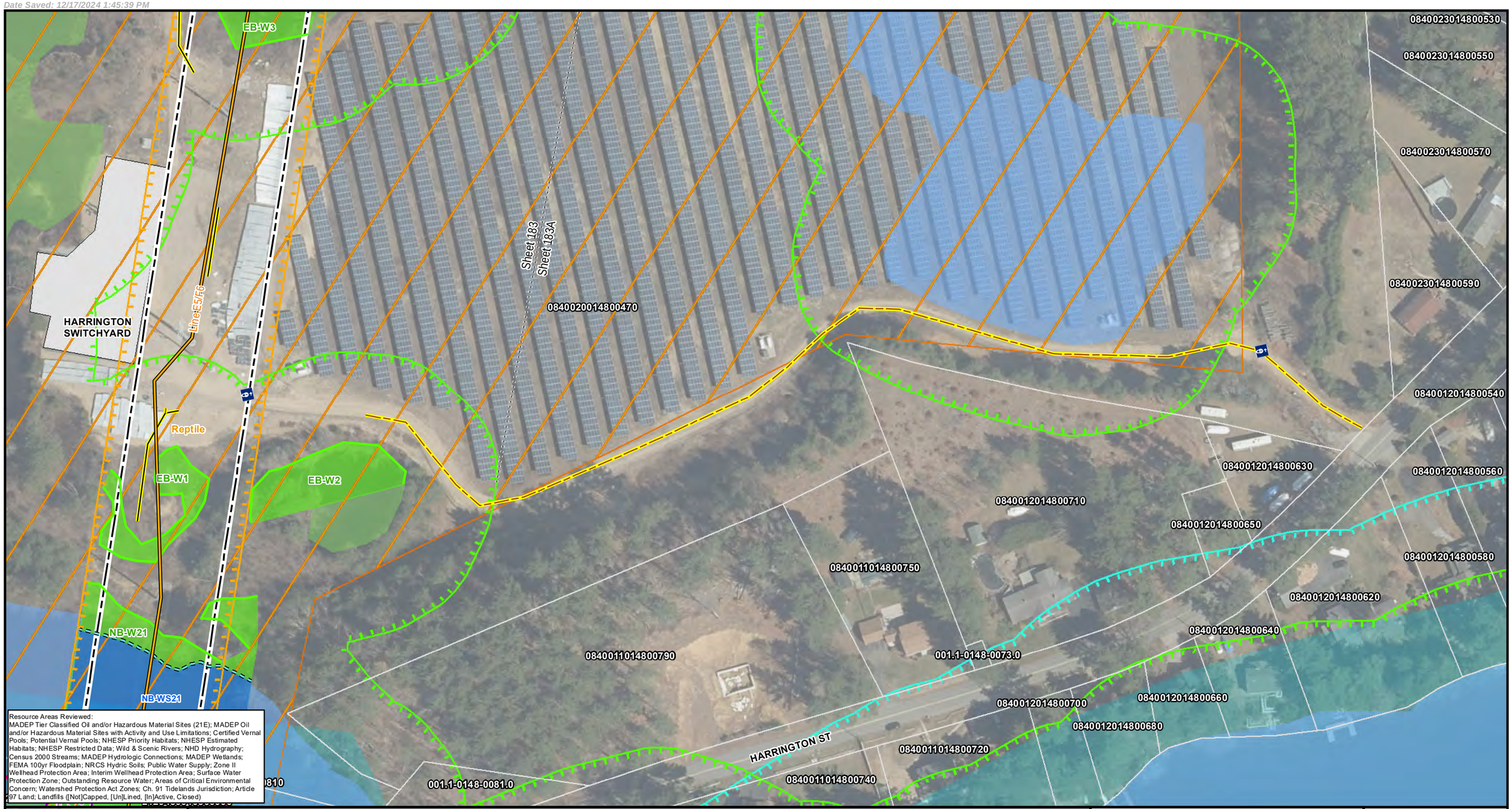

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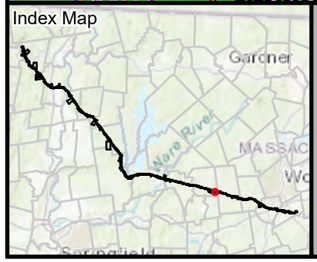

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

East Brookfield, MA
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MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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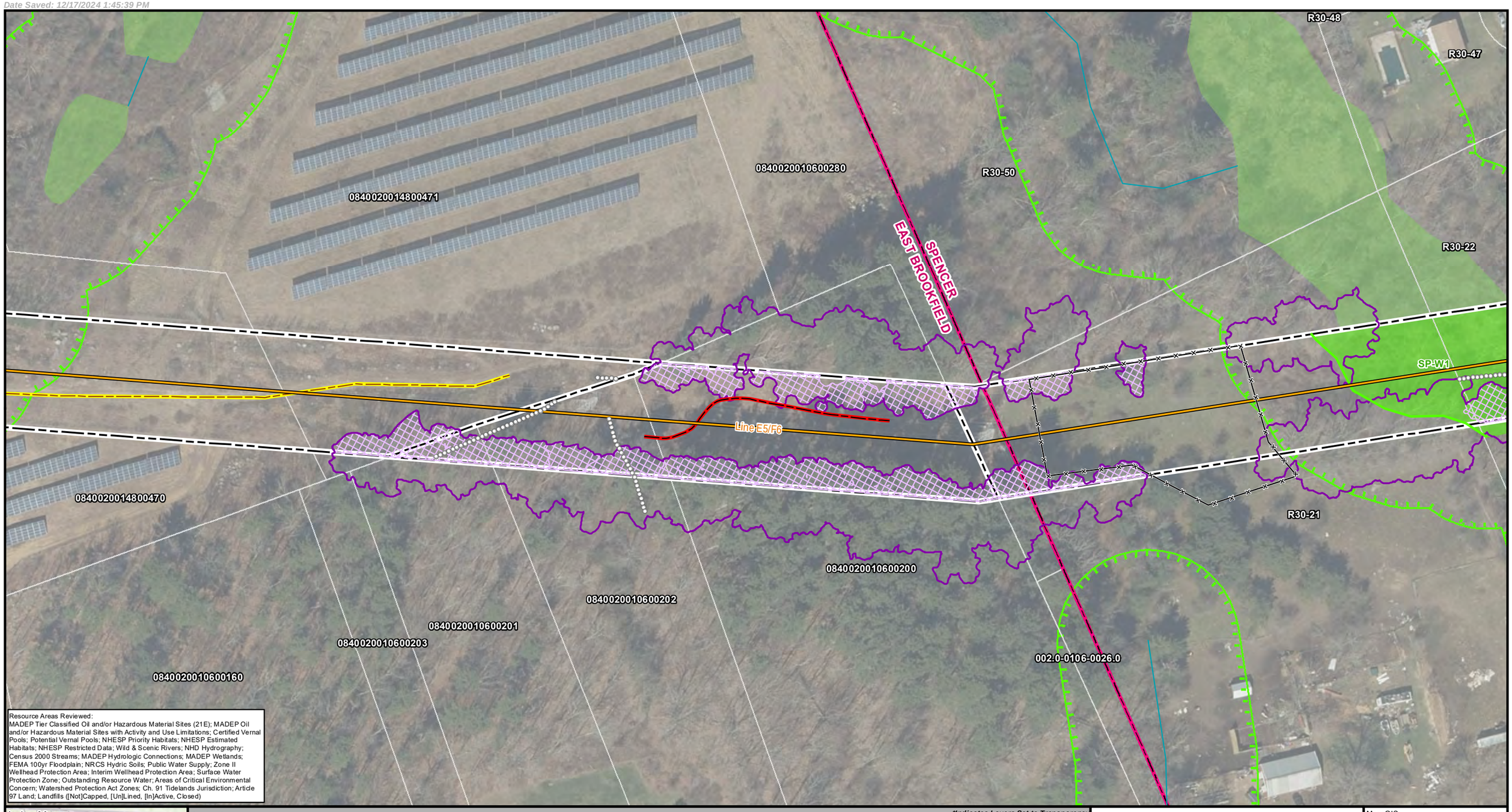

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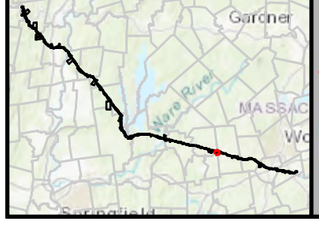

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Environmental Resources Map

East Brookfield & Spencer, MA

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R30-50
R30-39-1
R30-29
R30-28
R30-39
R30-14
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SP-WS1
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R30-21
R30-16
R30-24
R30-22
R30-16-2
SMITHVILLE RD
R30-16-3
R30-17

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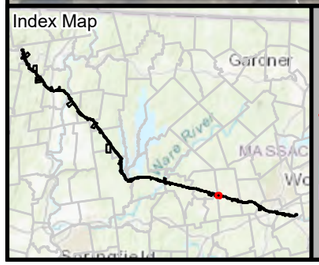

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Spencer, MA

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Sheet 186

R30-14
R30-7
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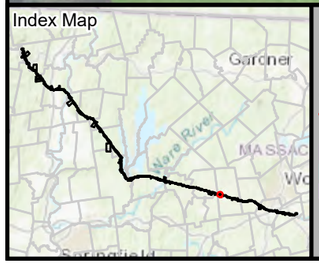

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Environmental Resources Map

Spencer, MA

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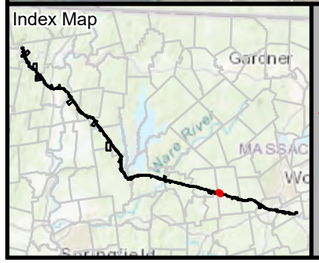

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Environmental Resources Map

Spencer, MA
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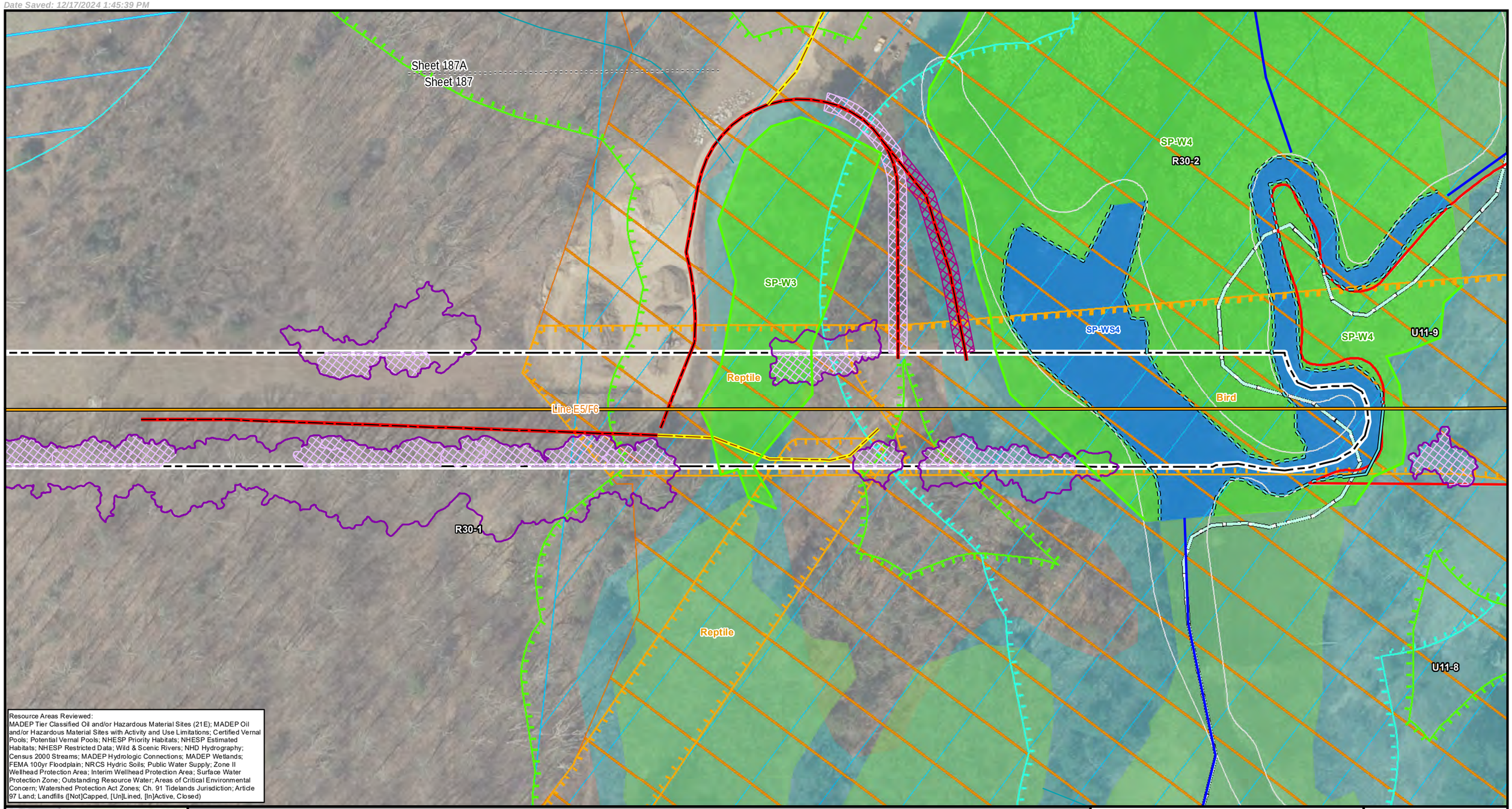

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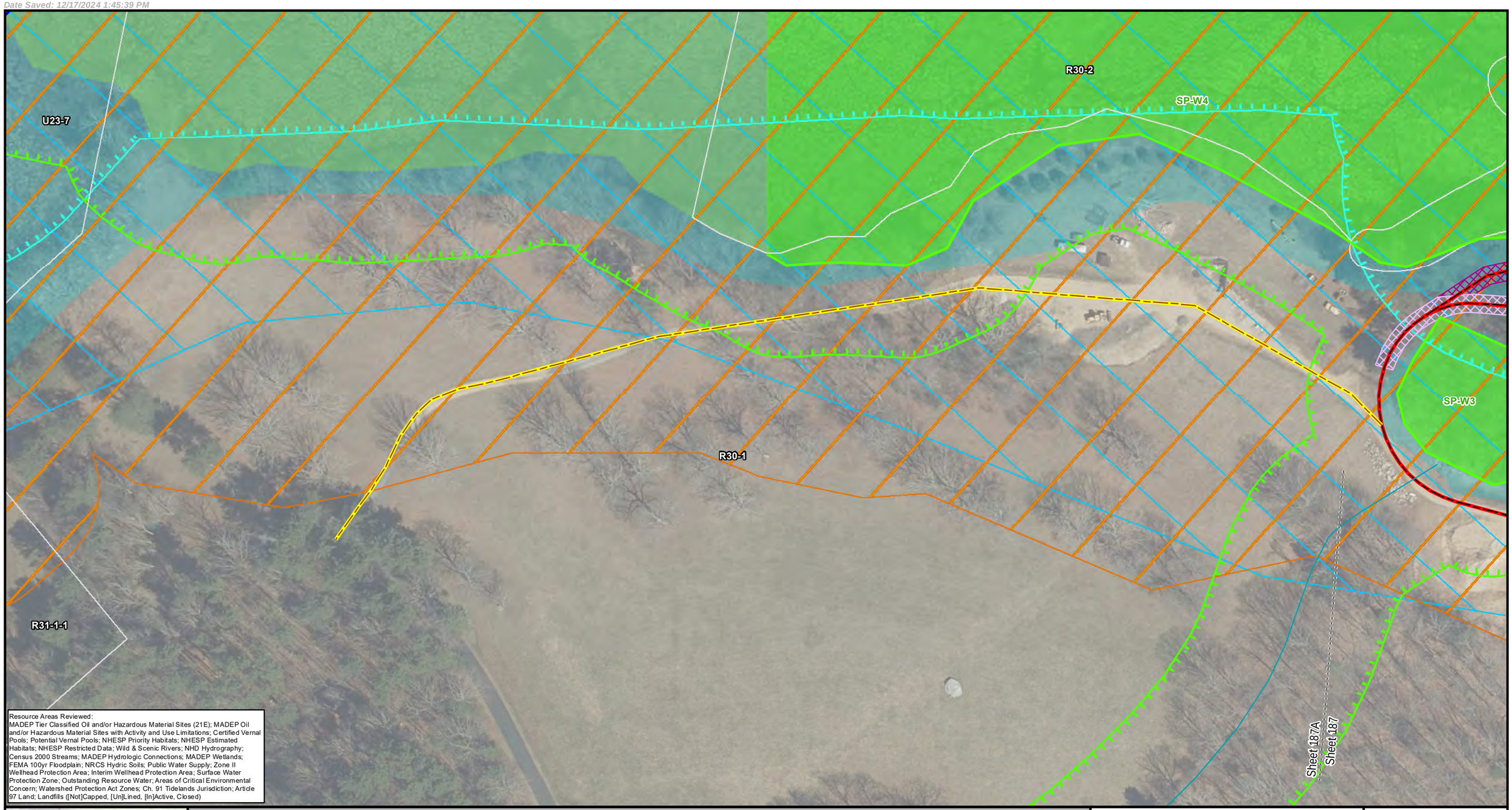

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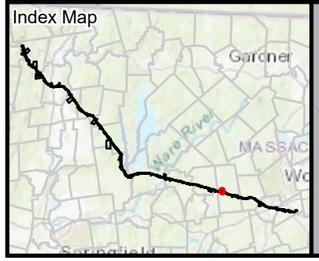

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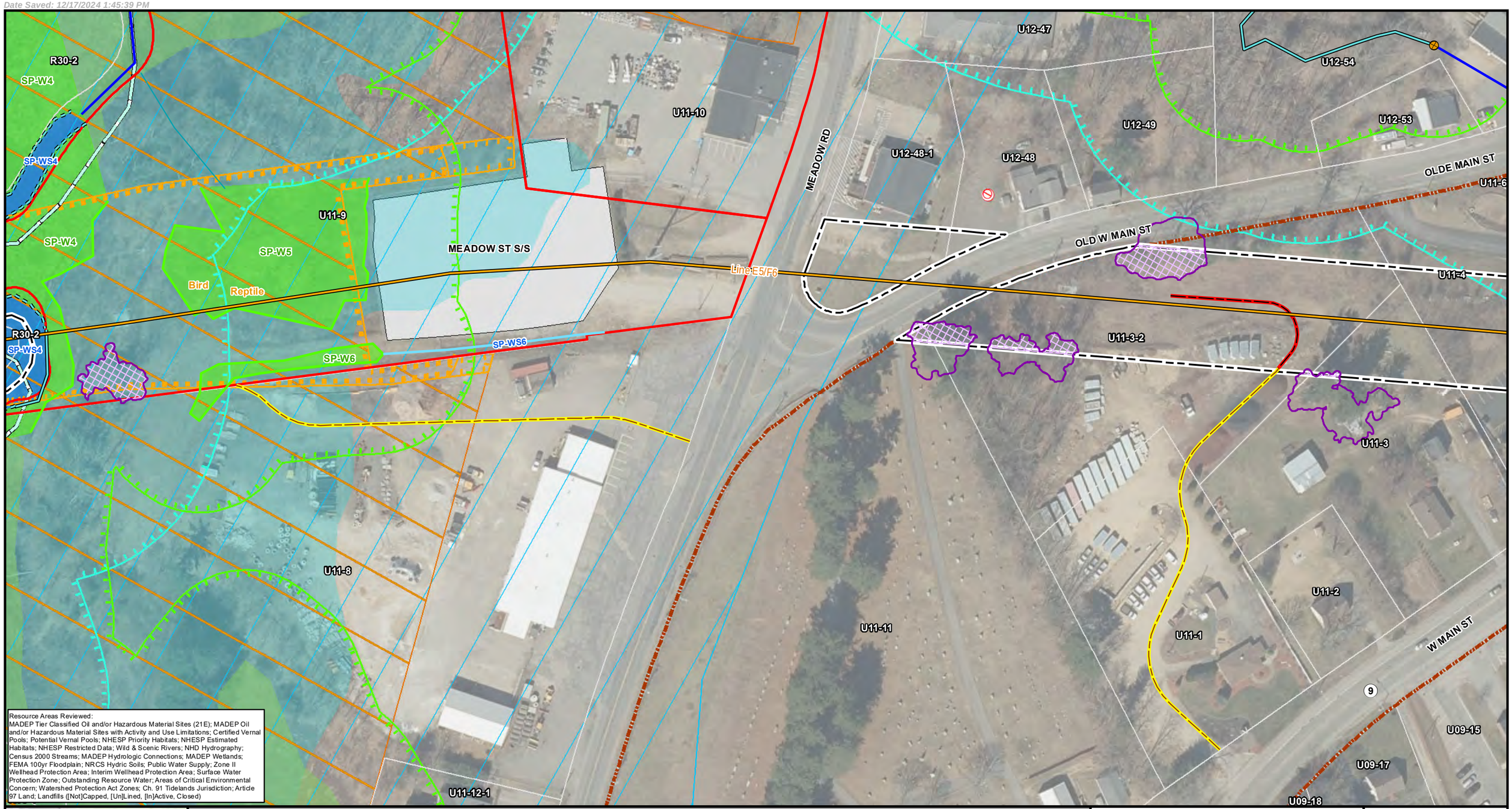

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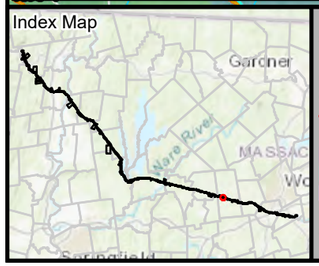

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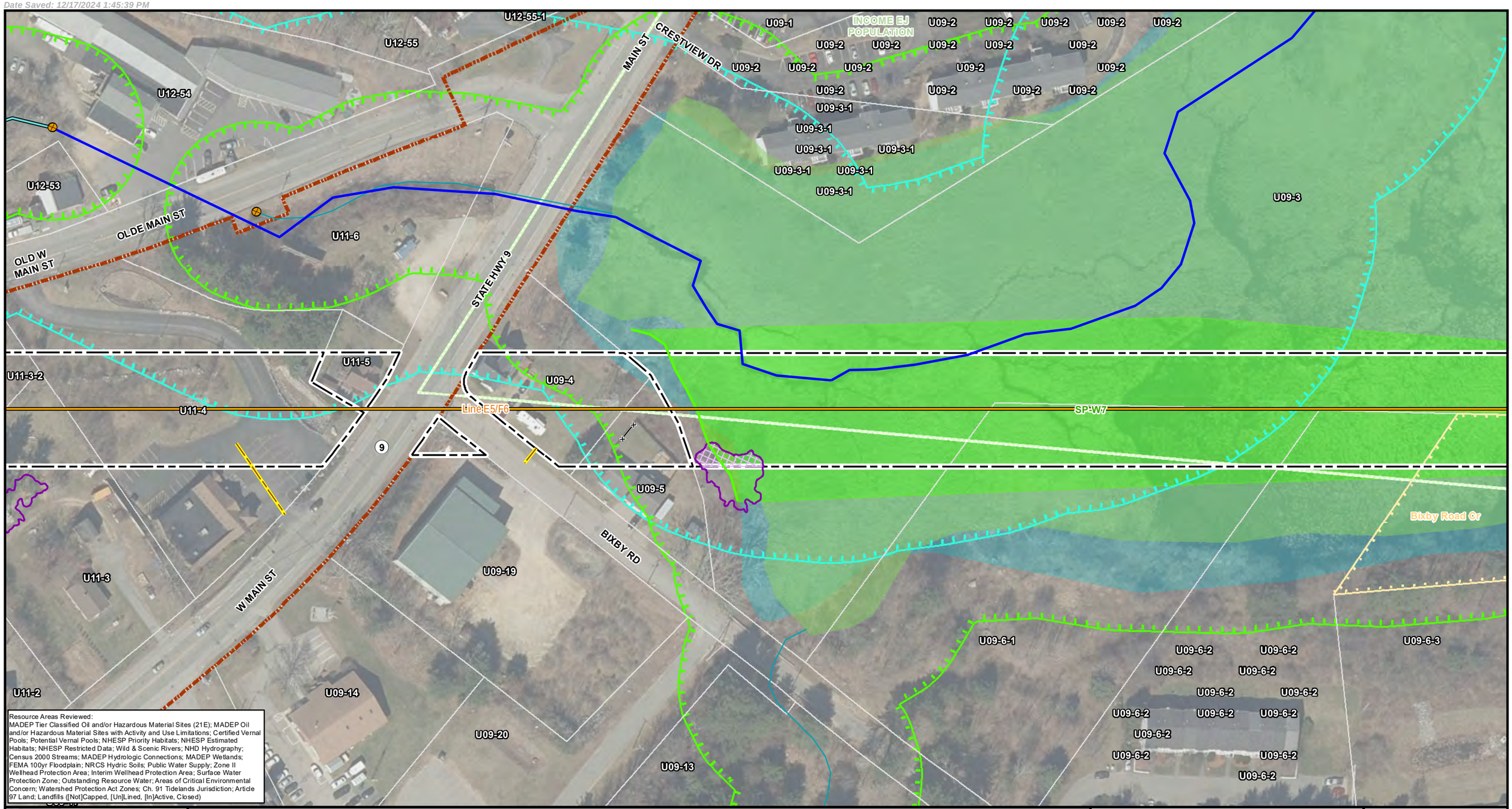

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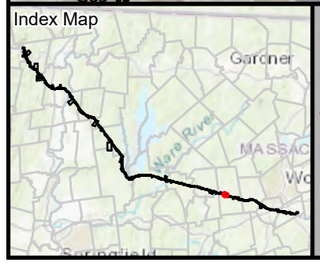

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Spencer, MA

MassGIS
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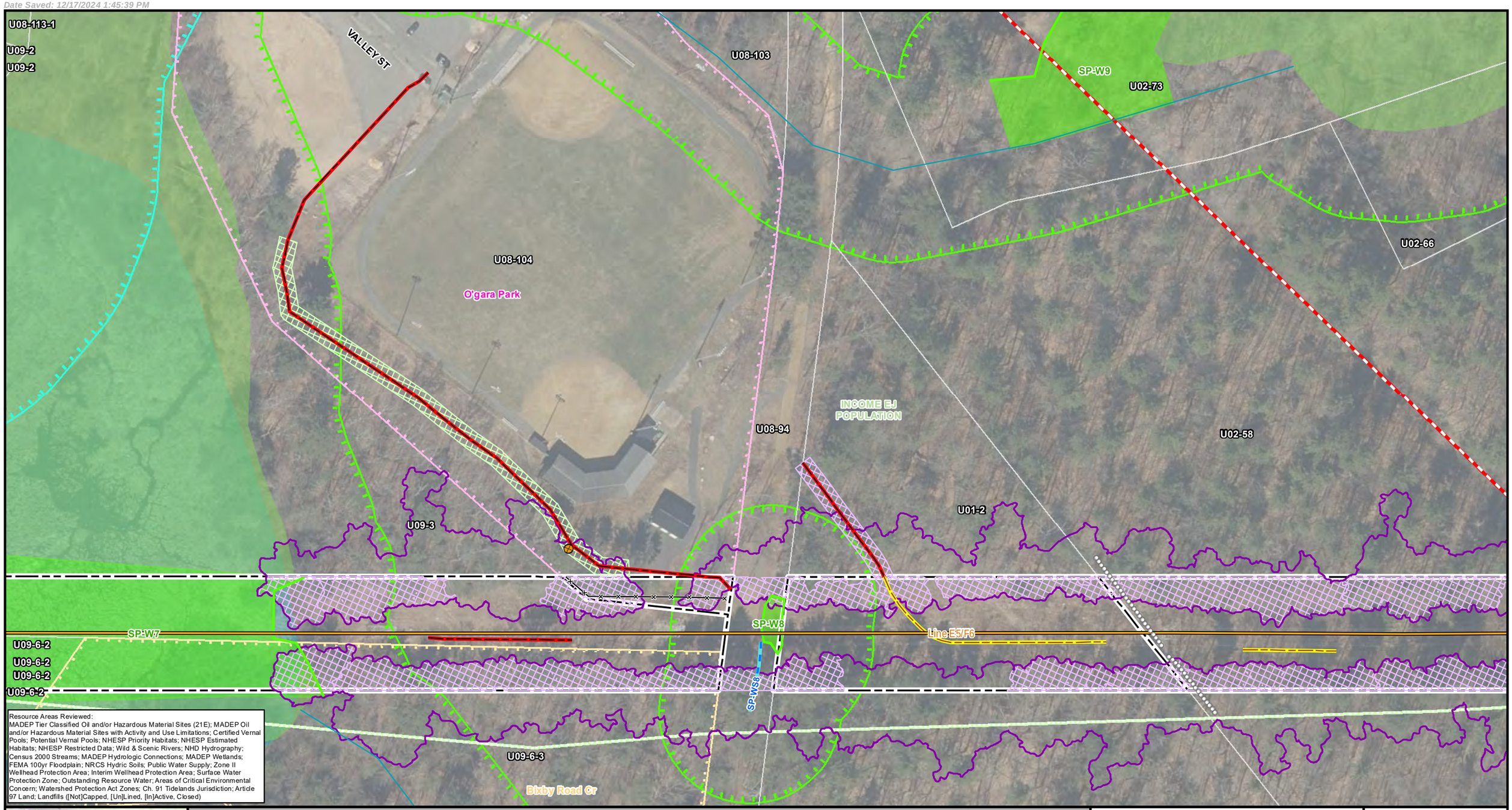

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Spencer, MA

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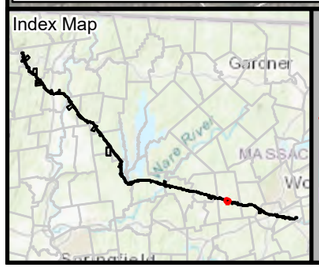

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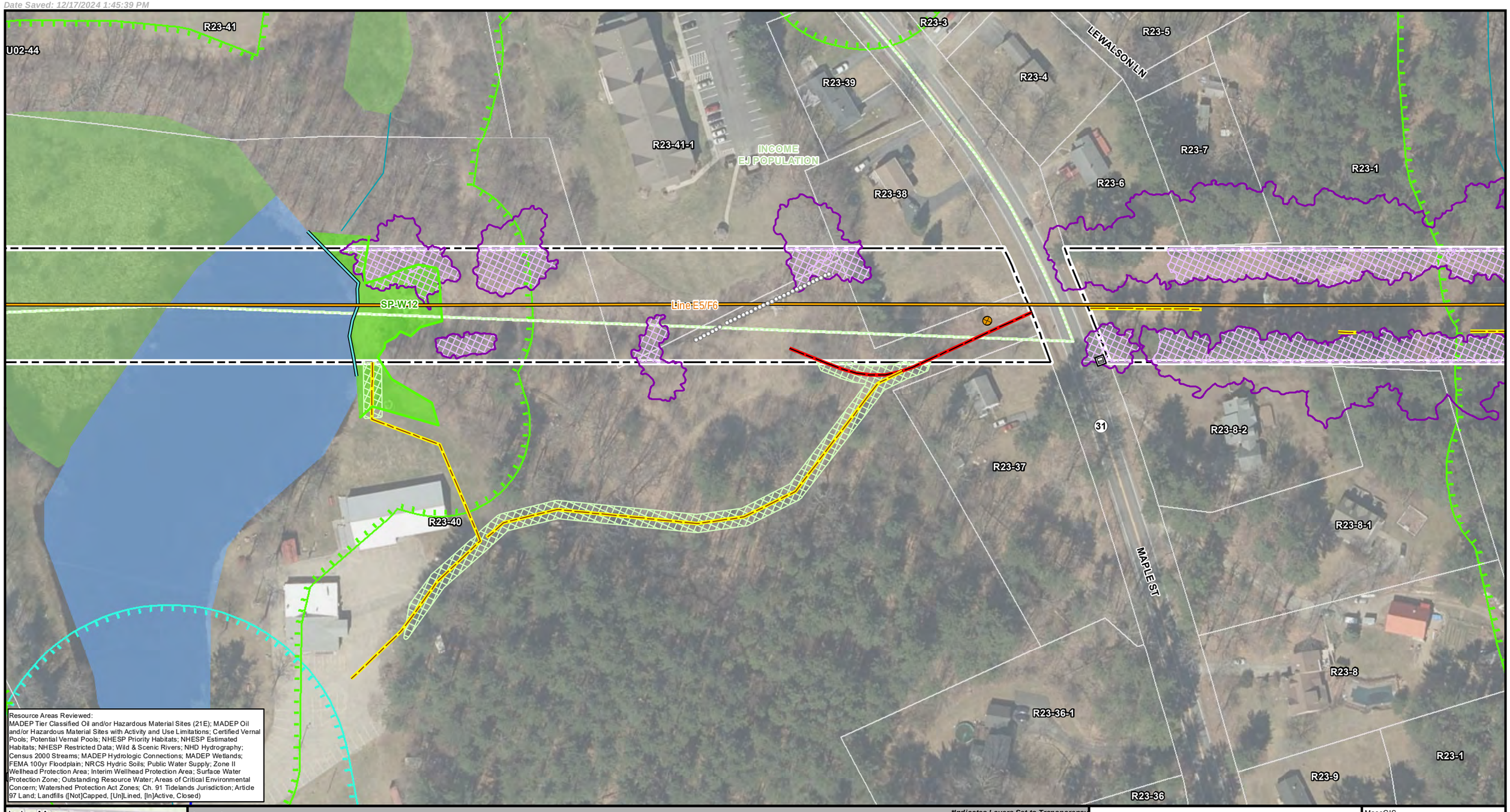

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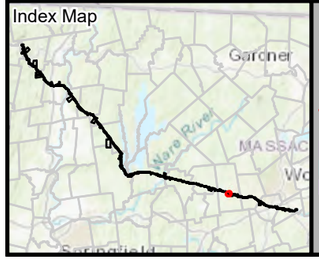

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Environmental Justice Populations 2020

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Spencer, MA

MassGIS
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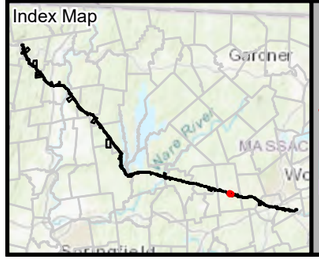

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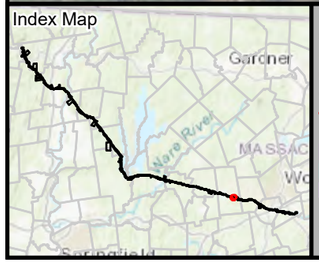

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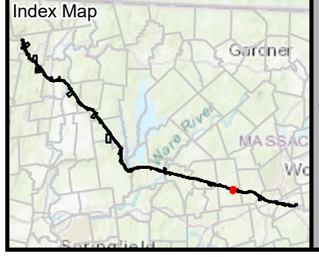

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Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

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MassGIS
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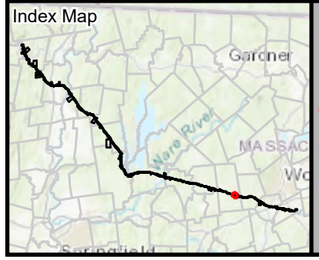

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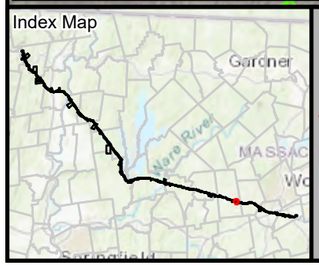

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Environmental Resources Map

Spencer, MA
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MassGIS
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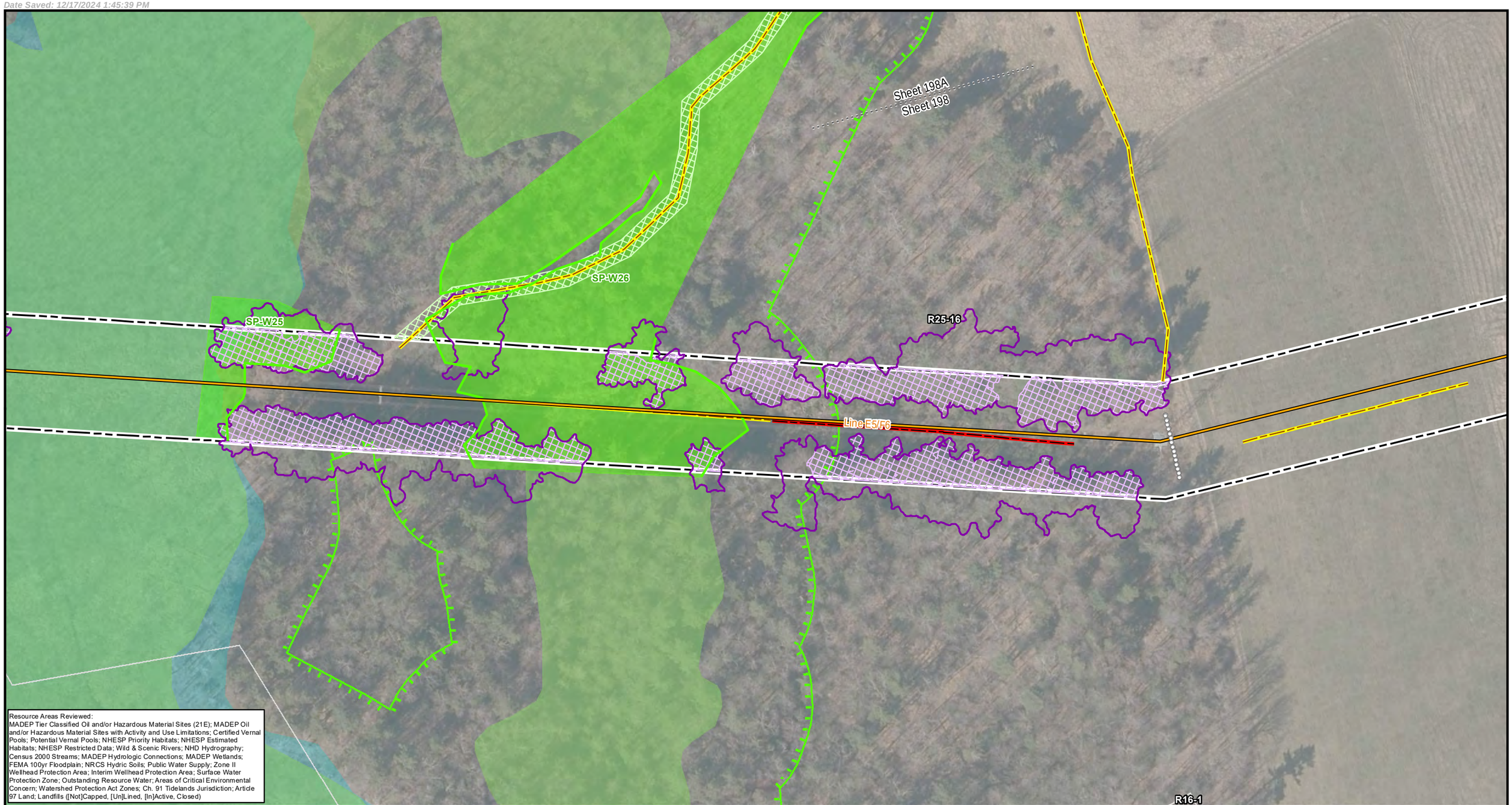

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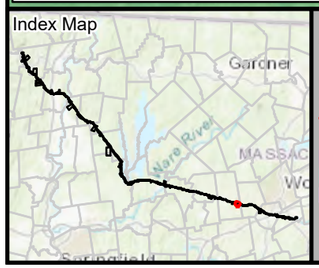

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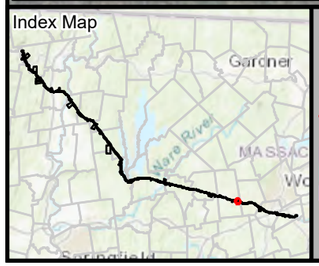

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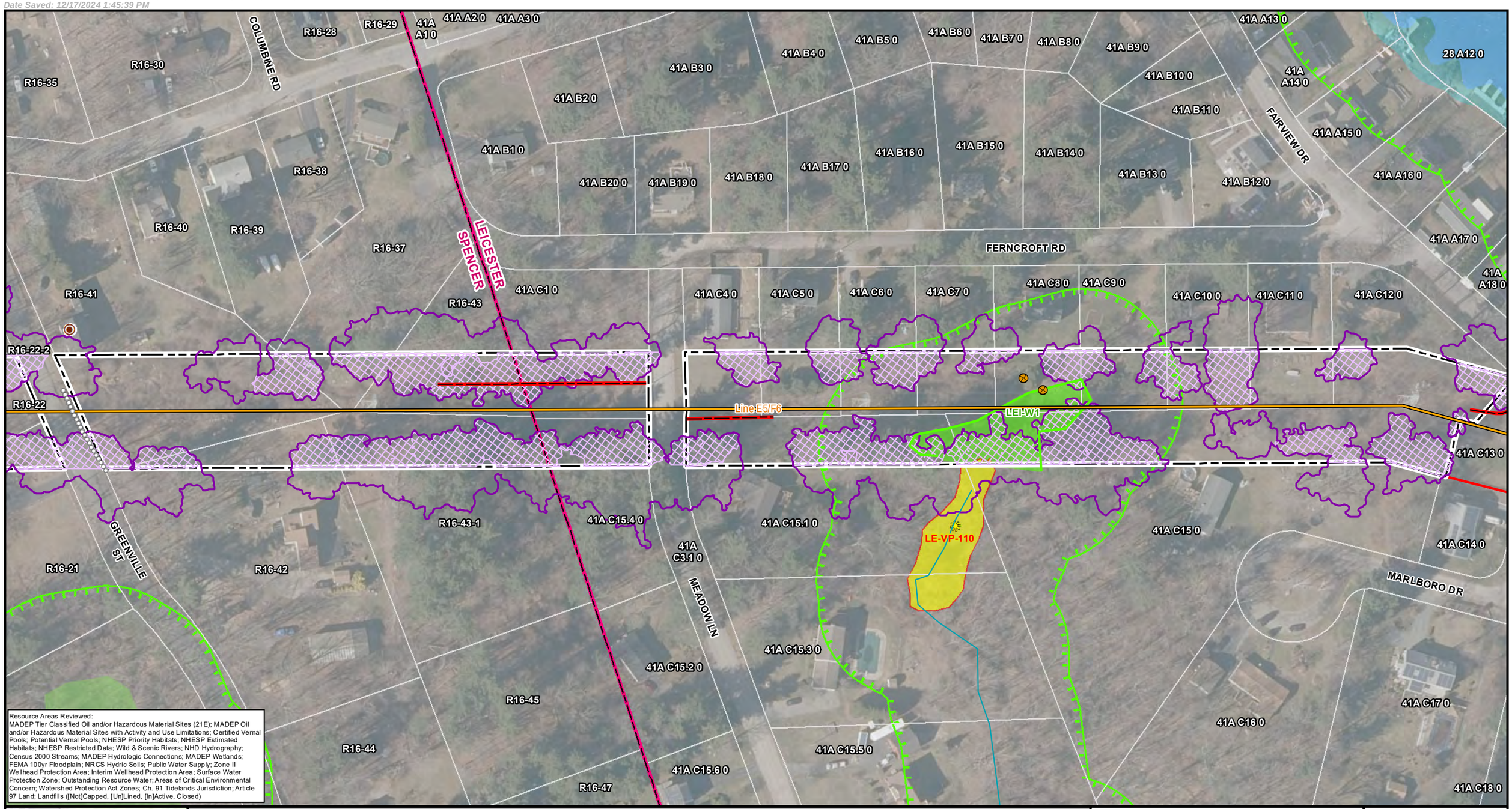

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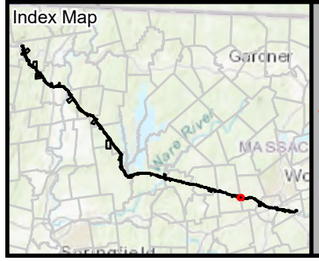

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Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Spencer & Leicester, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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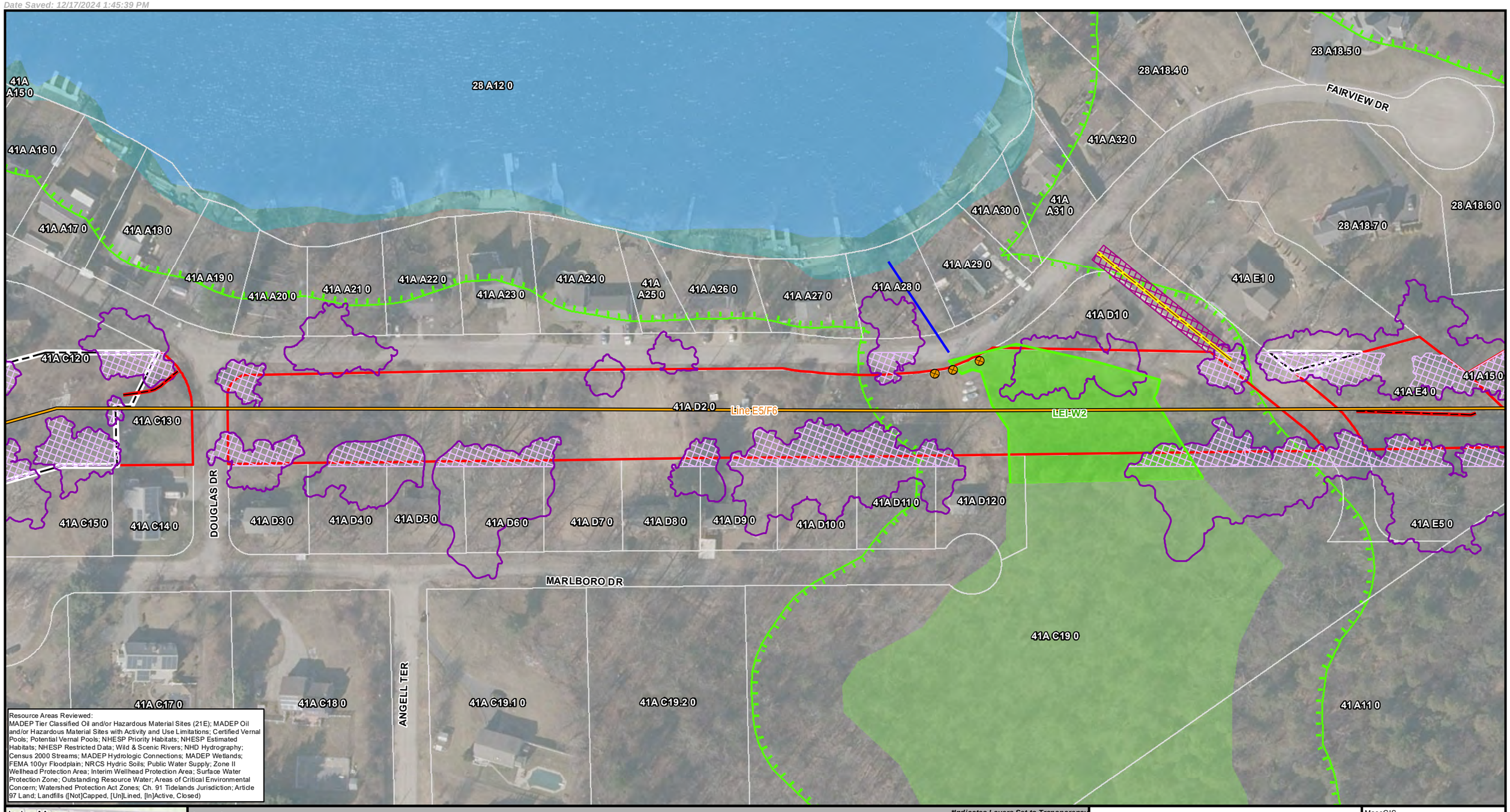

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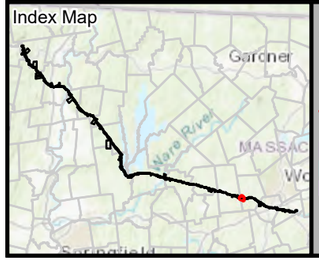

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Environmental Resources Map

Leicester, MA

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Brook
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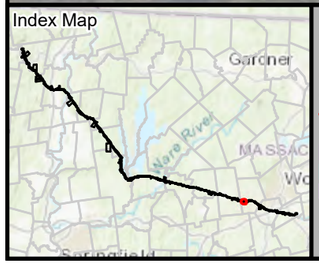

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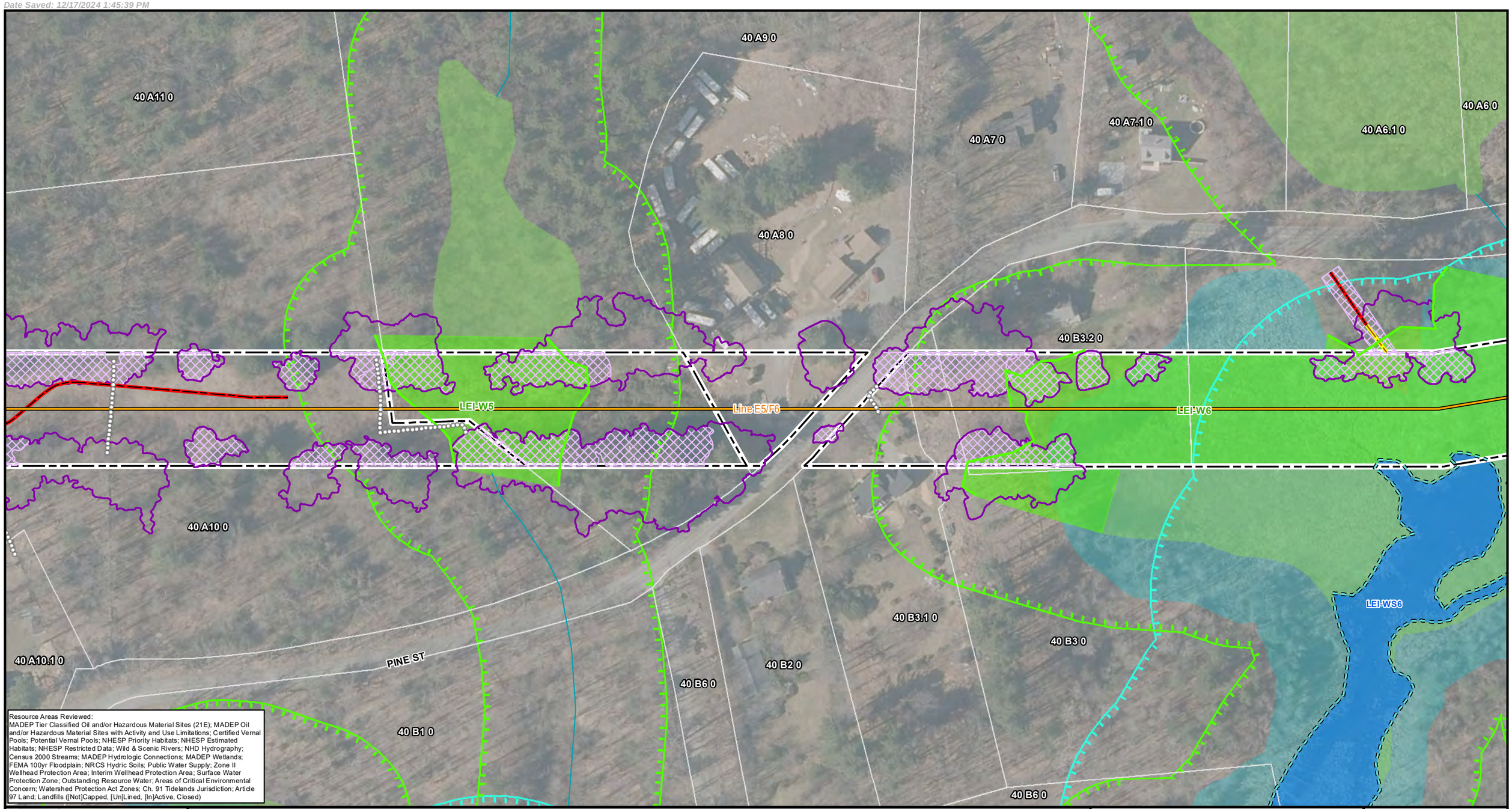

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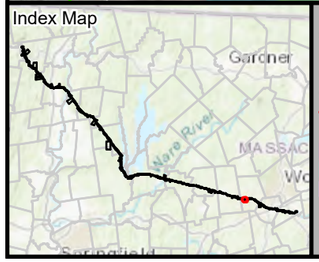

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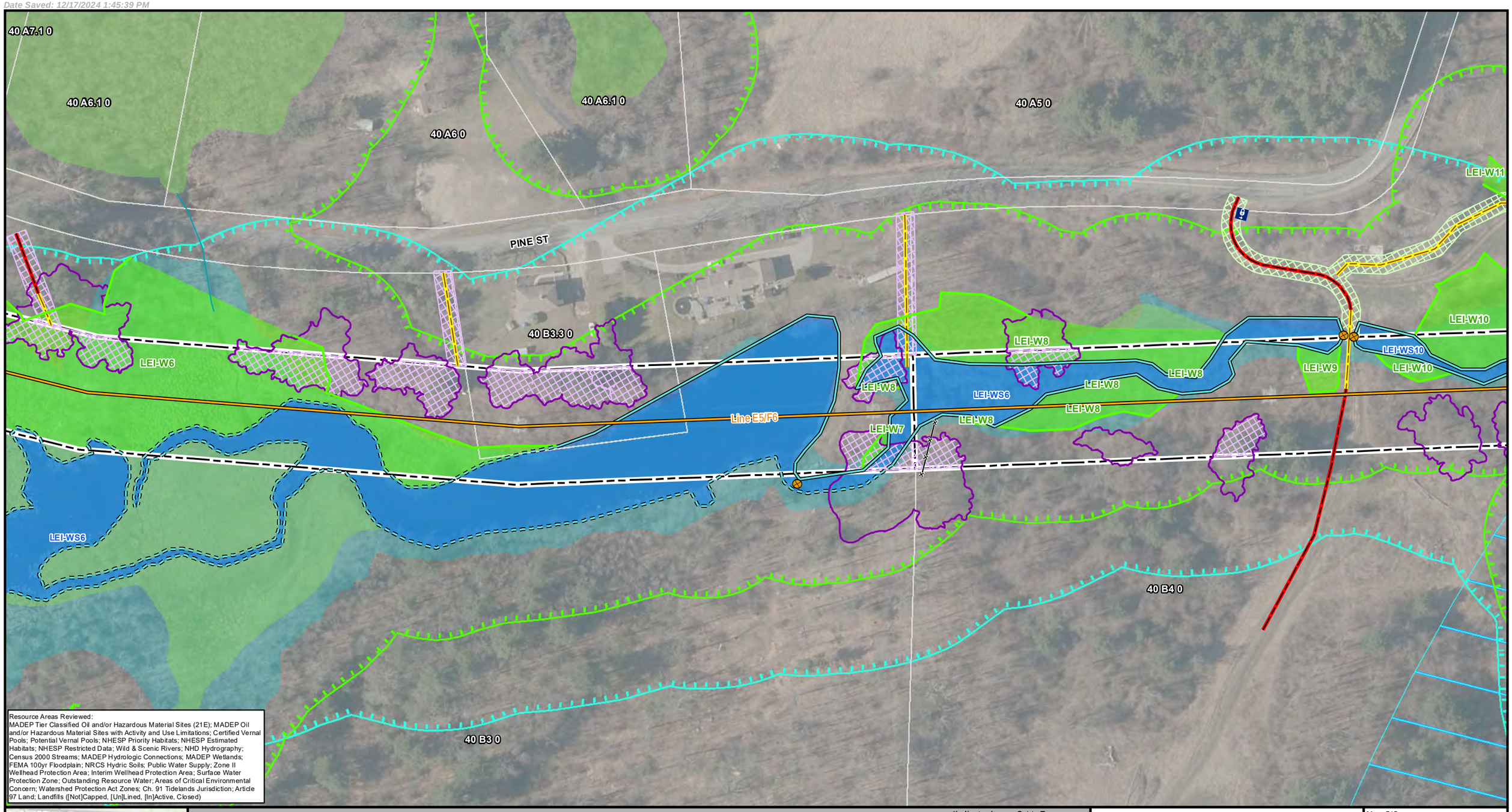

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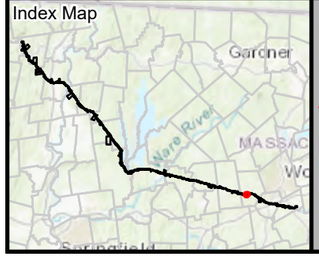

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Leicester, MA

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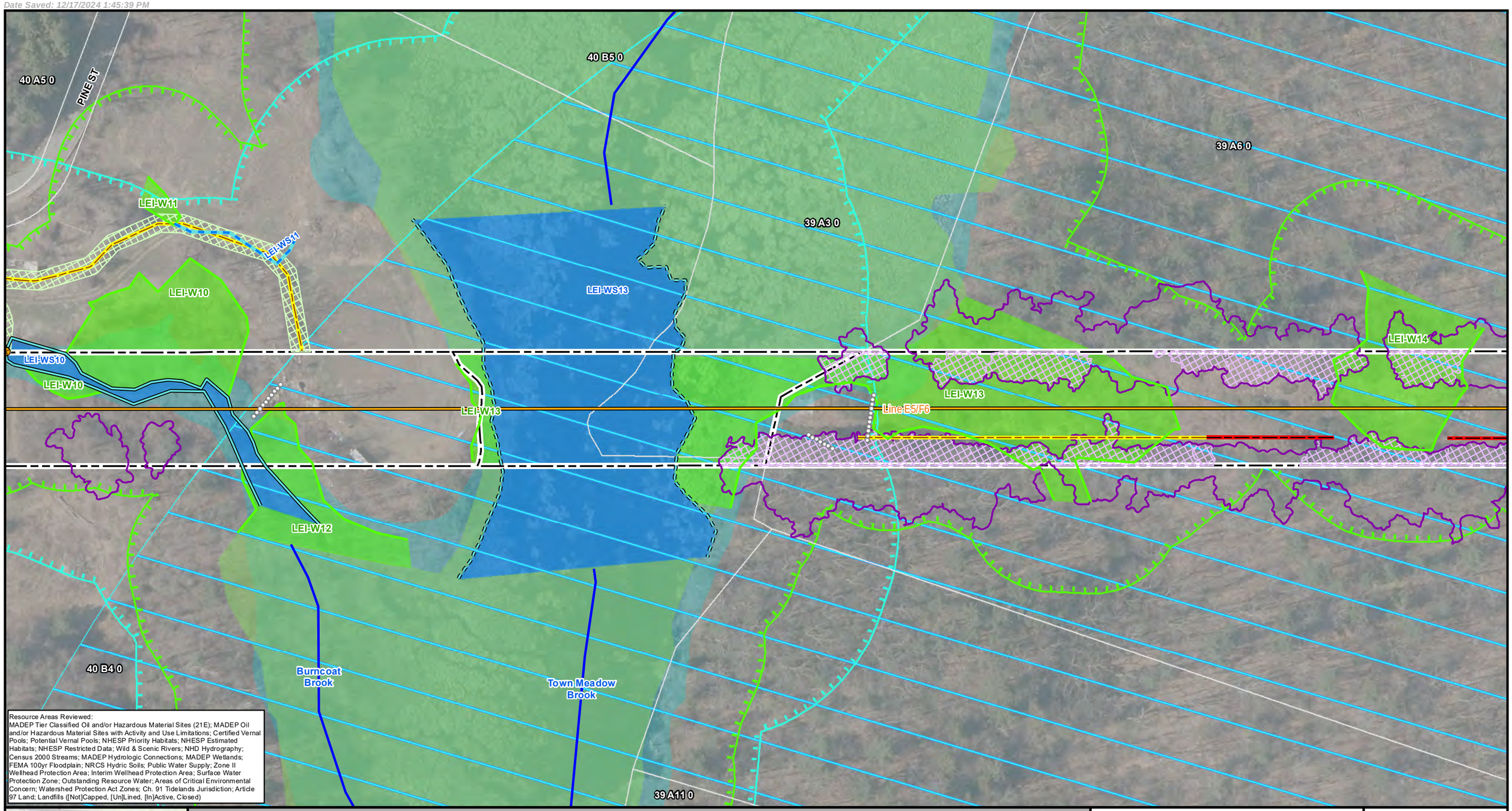

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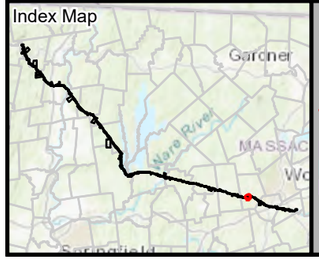

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Leicester, MA
Page 205 of 240

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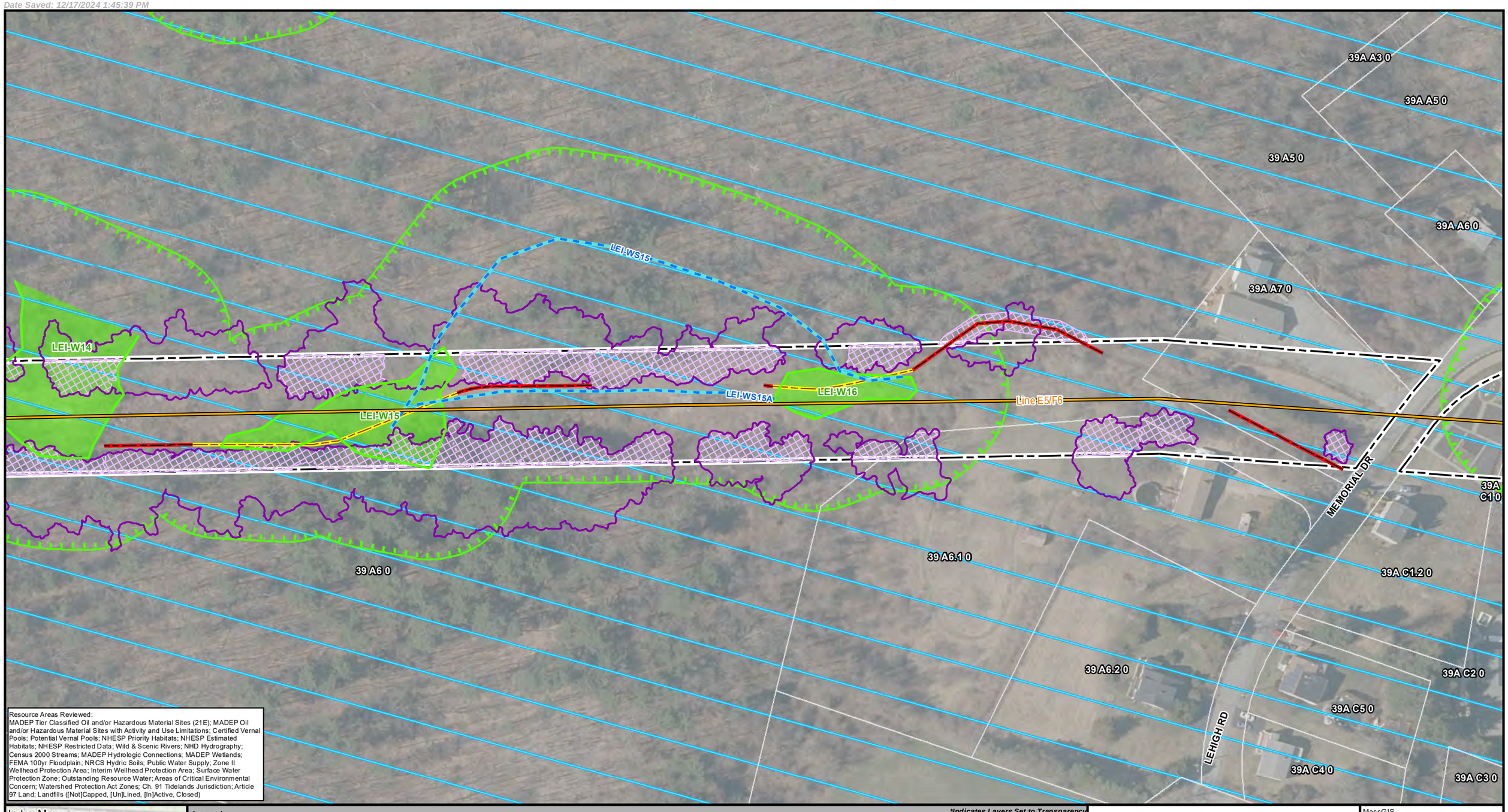

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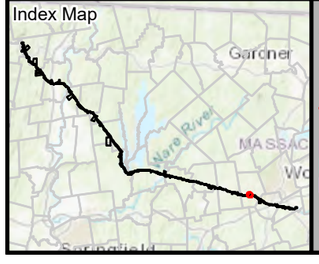

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- Existing Treeline
- Tree Removal
- Selective Tree Removal
- Pruning
- Town Boundary
- Parcel Boundaries

*Indicates Layers Set to Transparency

N

1 inch = 100 feet

0 50 100

Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Leicester, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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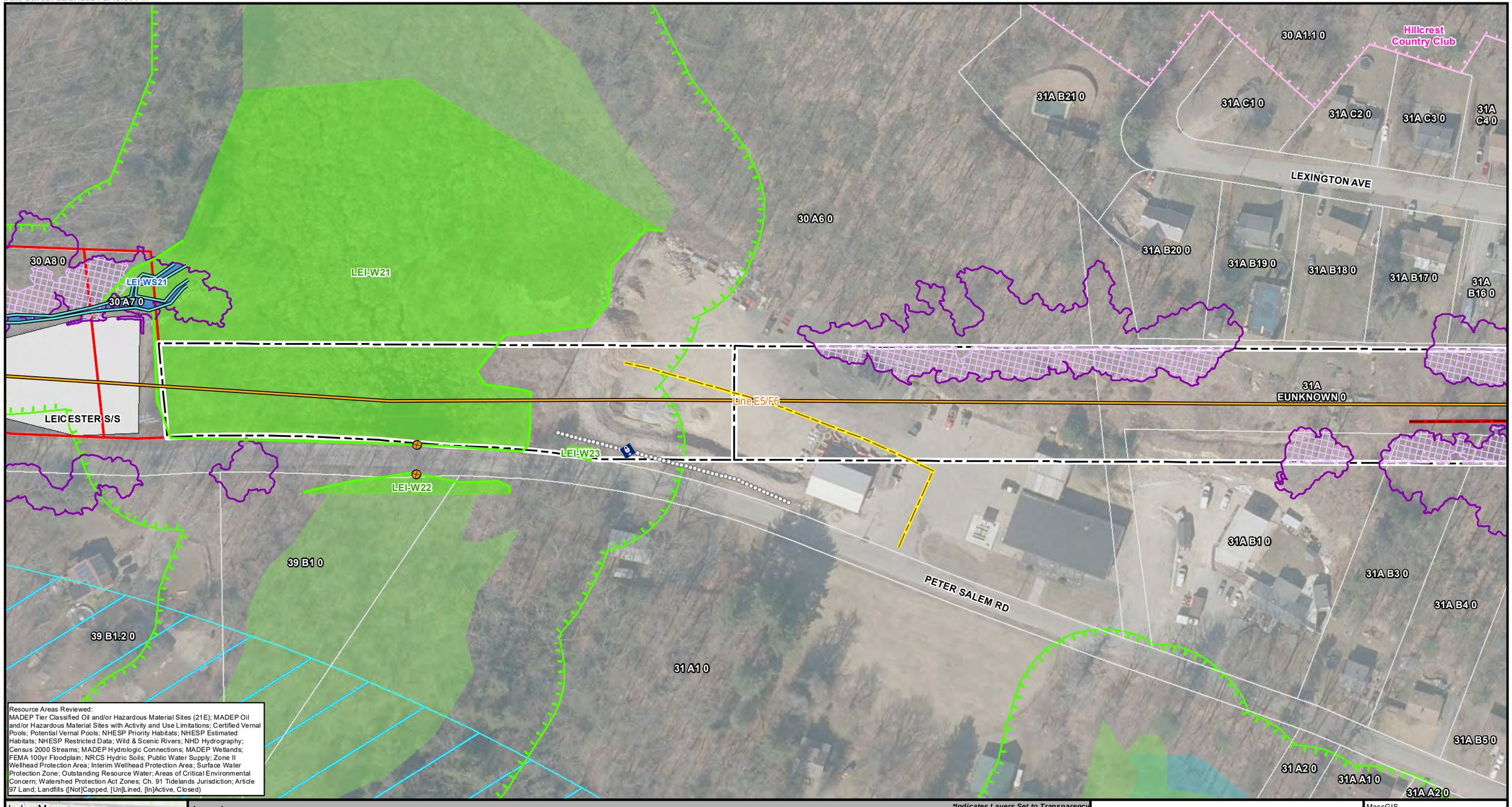

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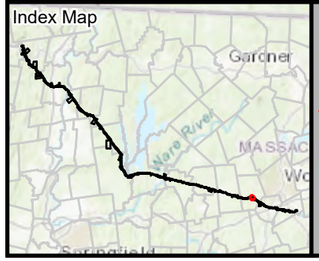

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- Municipal

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30 A1.1 0
30 A1.1 0
Hillcrest Country Club
31A D4 0
31A D5 0
31A C2 0
31A C3 0
31A C4 0
31A D1 0
31A D2 0
31A D3 0
LEXINGTON AVE
31A B18 0
31A B17 0
31A B16 0
31A B15 0
31A B14 0
31A B13 0
31A EUNKNOWN 0
Line E5/F6
31A EUNKNOWN 0
31A B11 0
31A B1 0
31A B10 0
31A B3 0
31A E2 0
31A B4 0
31A B5 0
31A B9 0
BUNKER HILL RD
31A E1 0
31A E3 0
31A E4 0
31A B8 0
31A E5 0
PITCAIRN AVE
31A F2 0
31A B7 0
31A F3 0
31A E6 0
31A E7 0
31A F1 0
31A F4 0
31 B24.2 0
31 B24 0
31 B21 0
LEI-W24
LEI-WS24
LEI-W24
31 B24.1 0
31 B23 0
Grindstone Brook

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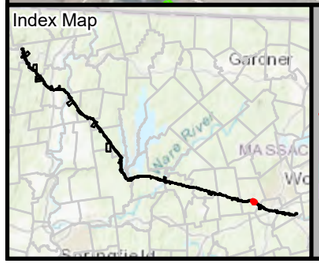

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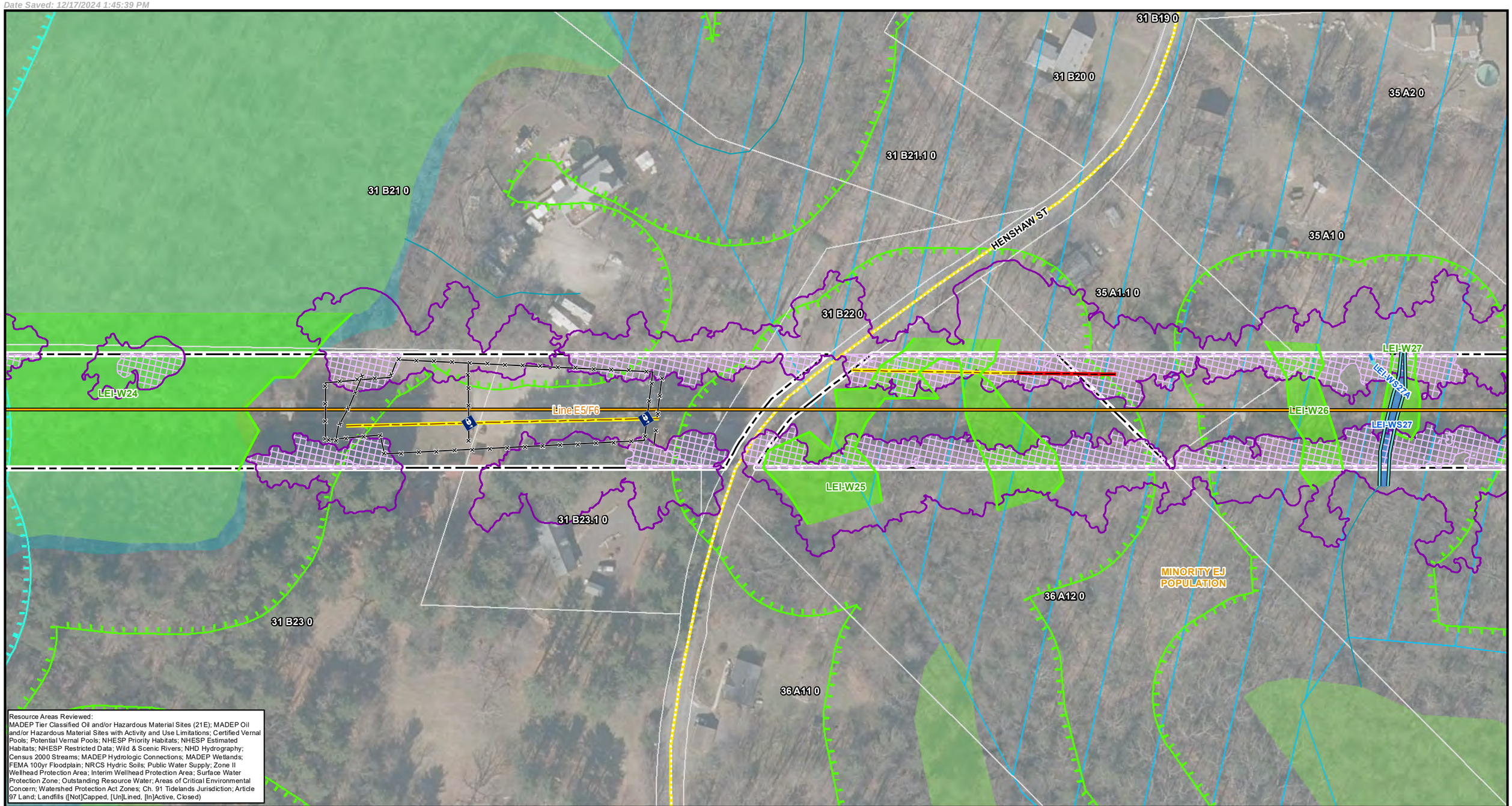

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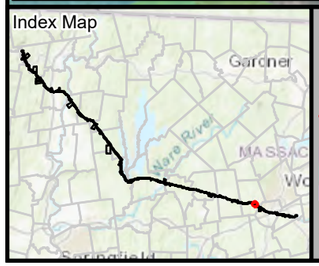

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Environmental Justice Populations 2020

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35 B1.1 0
35 B1 0
35 B2.1 0
BOUTILIER RD
35 B3 0
35 A2 0
35 A2.2 0
36 A1.4 0
35 A2.1 0
MINORITY EJ POPULATION
36 A1.3 0
LEI-W27
LEI-WS27A
LEI-WS27
LEI-W28
LEI-W28
Line E5/F6
LEI-W29
35 A1 0

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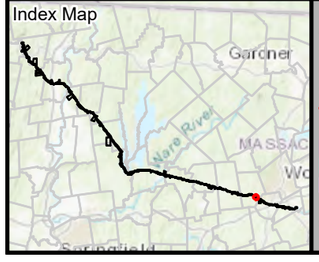

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35 B3 0

35 B3.1 0

MINORITY EJ POPULATION

BOUTILIER RD

LEI-W31

LEI-W30

Line E5/F6

LEI-W29

36 A1.3 0

36 A3 0

36 A1.2 0

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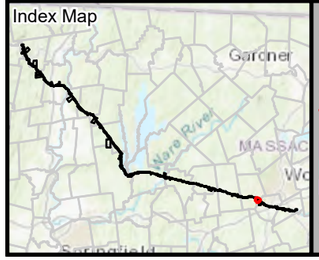

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35 B8.5 0
35 F4 0
35 E2.3 0
35 F2 0
35 B3 0
35 B4 0
35 E2.1 0
36 B2 0
35 B3.1 0
OLD STAFFORD TPKE
STAFFORD ST
MINORITY EJ POPULATION
35 F1 0
35 E2.2 0
35 E2 0
LEI-W30
Line E5/F6
LEI-W32
LEI-WS32
21_13
36 A2 0
36 A1 0
36 A1.3 0
36 B1 0
36 A1.1 0

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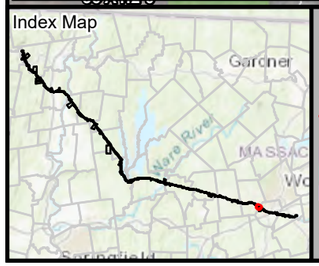

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21_25
21_28
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21_22
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21_21
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36 B2 0
21_19
LEICESTER ST
21_11
21_20
Line E5/F6
AU-W1
21_10
21_9
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21_18
21_13
21_14
21_17
Sheet 214
Sheet 214A
21_16

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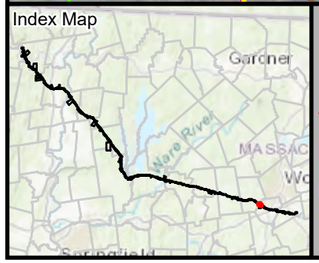

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- Guardrail
- Stonewall
- Existing Treeline
- Tree Removal
- Selective Tree Removal
- Pruning
- Town Boundary
- Parcel Boundaries

Environmental Justice Populations 2020

- Minority

*Indicates Layers Set to Transparency

1 inch = 100 feet
0 50 100
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Leicester & Auburn, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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LEICESTER ST
GROWL HILL RD
ROCHDALE ST
HENSHAW ST
Henshaw Street Land
Kinnear Brook
Line E5/F6
AU-W1
AU-W2
AU-W3
AU-WS2
AU-VP-73
Sheet 214
Sheet 214A
MINORITY EJ POPULATION
AUBURN
LEICESTER
36 B2 0
38 0
21_1
21_2
21_3
21_4
21_5
21_7
21_8
21_9
21_10
21_11
14_1
21_24
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30_36
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29_9
29_11
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29_3
29_4
29_5
29_13

Resource Areas Reviewed:
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Index Map
Gardner
Springfield

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Article 97 Lands
- Municipal

Environmental Justice Populations 2020
- Minority

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N
1 inch = 225 feet
0 110 220
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Auburn & Leicester, MA
Page 214A of 240

MassGIS
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21_26 21_28 21_10 14_1 21_27 21_11 21_10 21_9 22_25 21_20 Line E5/F6 AU-W3 AU-W3 AU-WS3 21_8 21_18 21_7 21_5 22_27 22_26 21_17 LEICESTER ST 22_32 22_28 22_29 21_4 Chapin Brook 22_30 30_30 22_33 21_15 21_2

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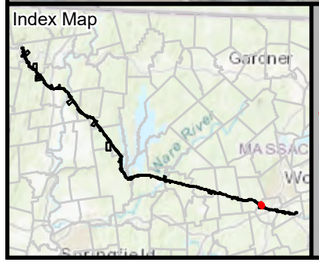

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Auburn, MA

MassGIS
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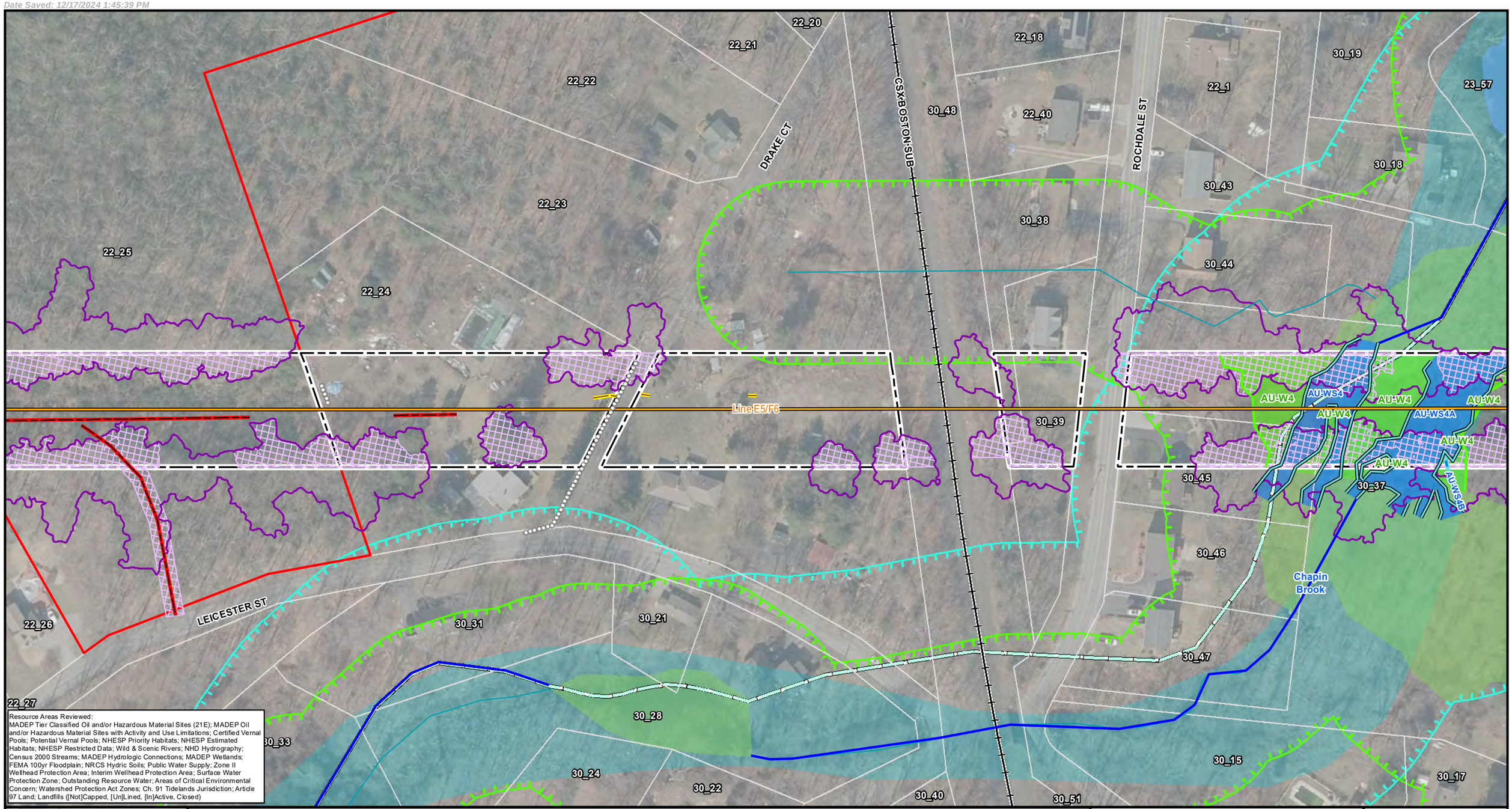

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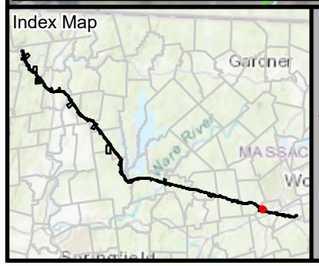

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Auburn, MA

MassGIS
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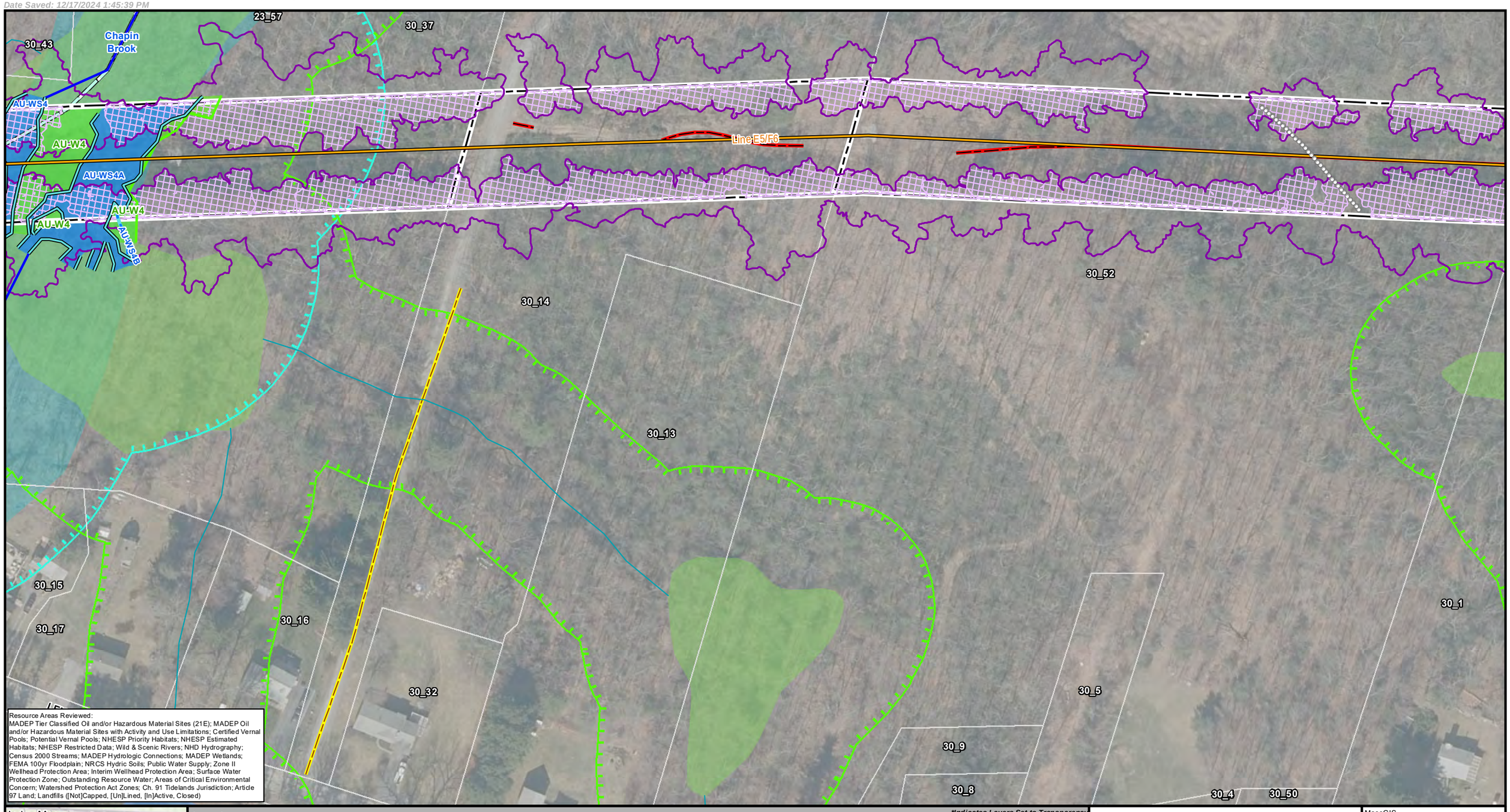

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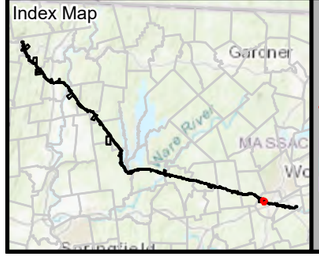

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Auburn, MA

MassGIS
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AU-W5
AU-W6
31_143
31_144
31_146
30_52
AU-W7
30_1
Line E5/F6
39_28
Dark Brook
31_126
39_18
38_2

Resource Areas Reviewed:
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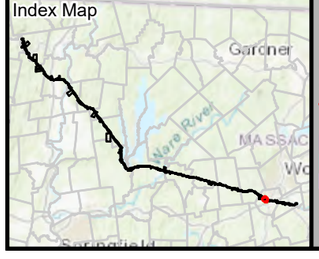

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Auburn, MA

MassGIS
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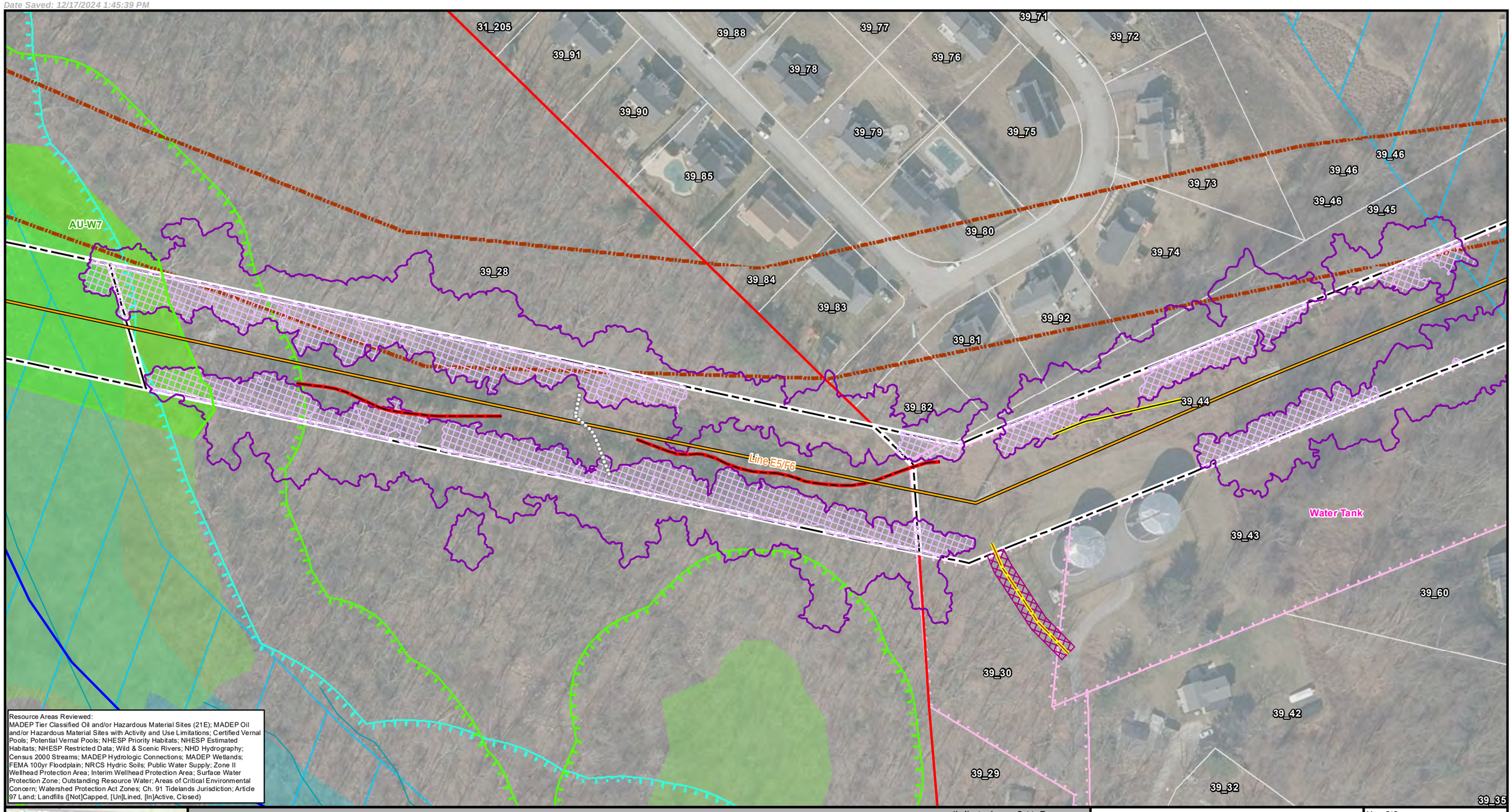

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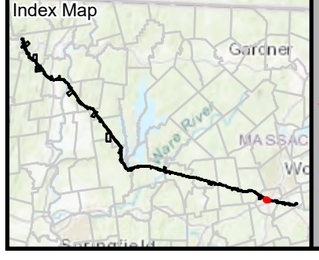

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Article 97 Lands

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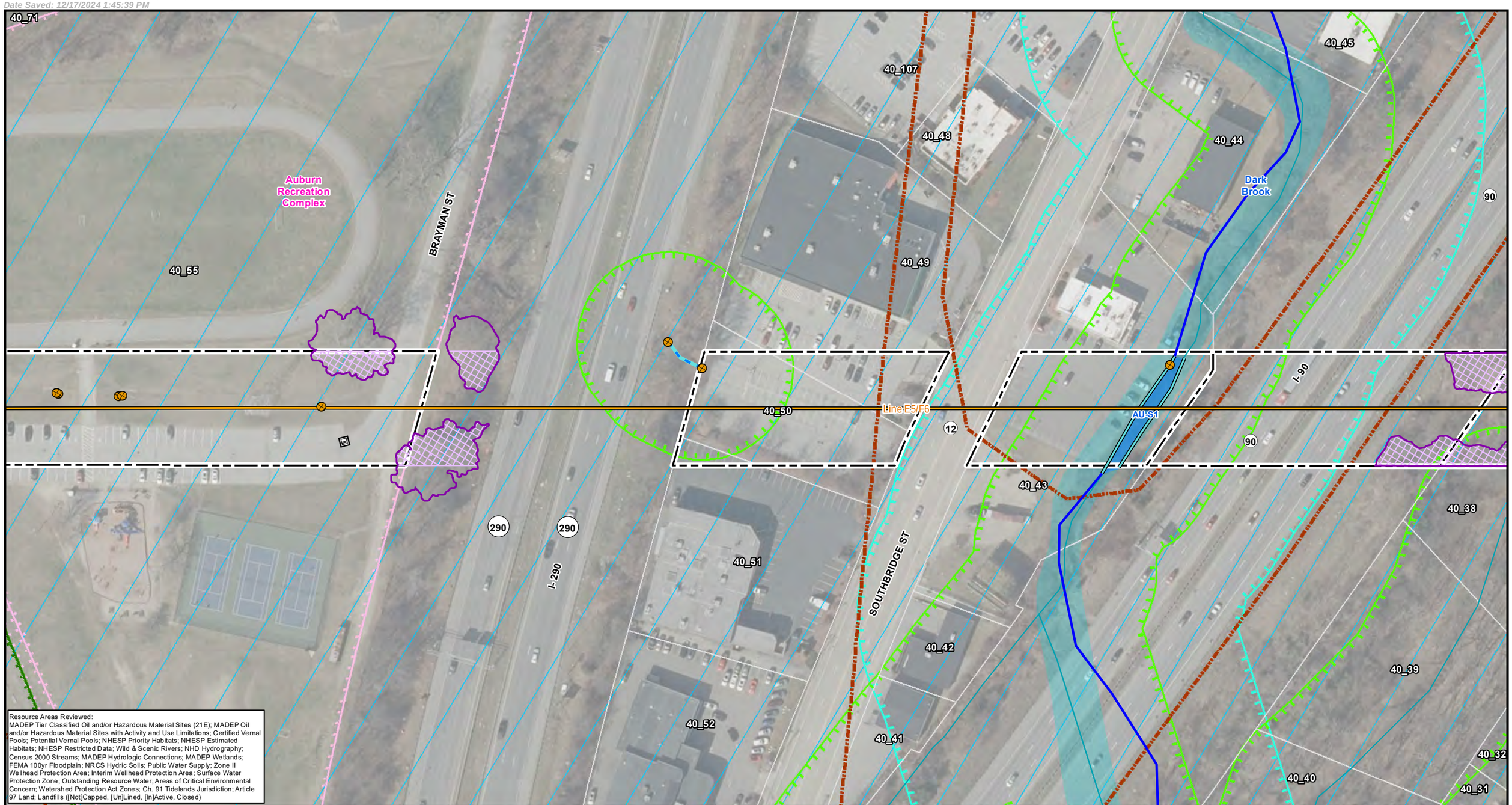

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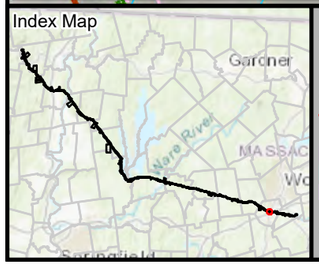

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Article 97 Lands

- DCR-State Parks & Recreation
- Municipal

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Auburn, MA

MassGIS
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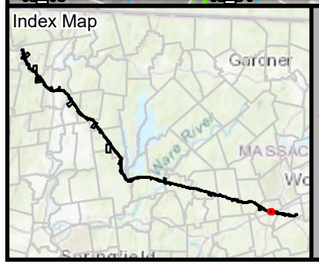

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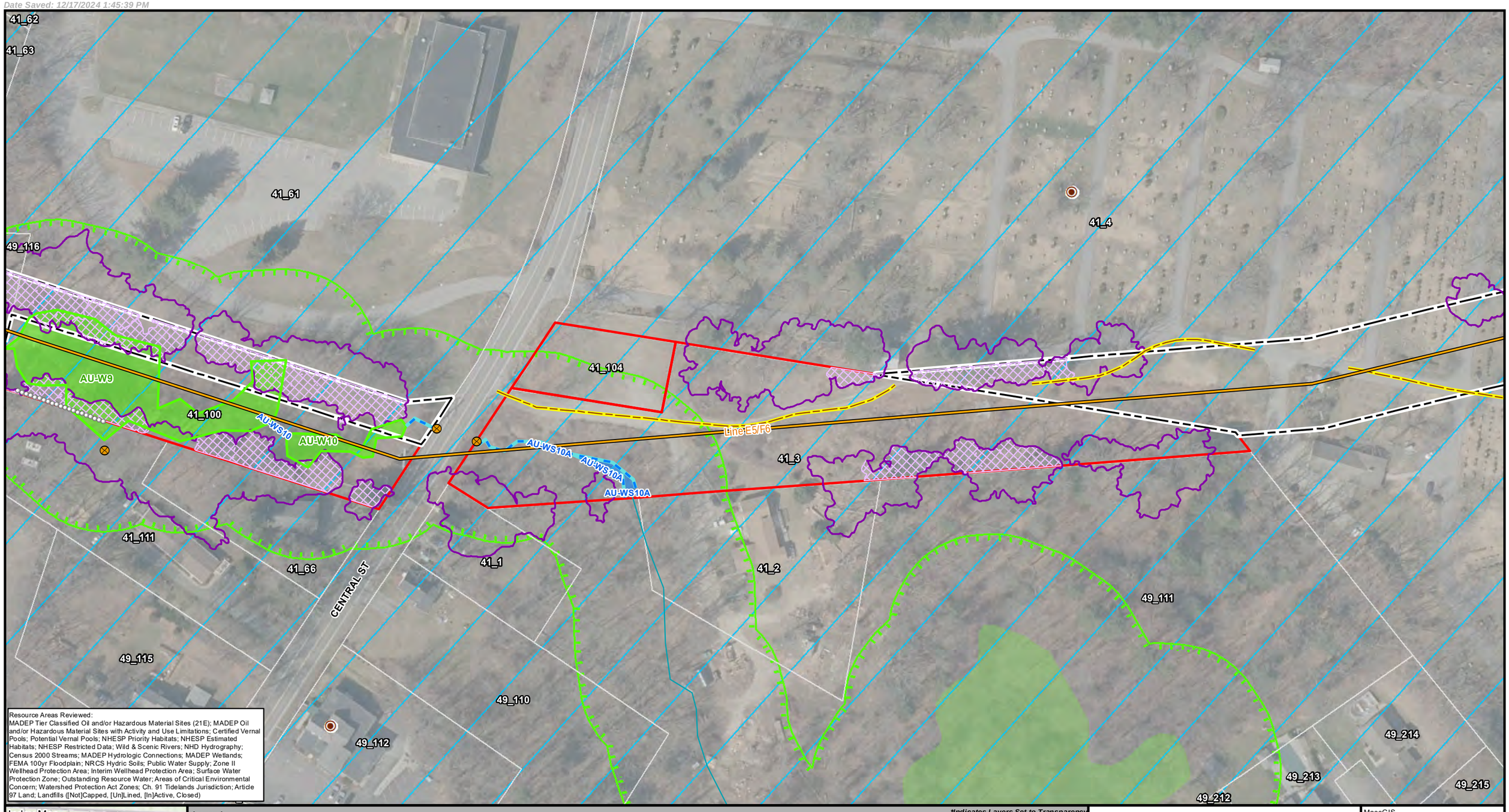

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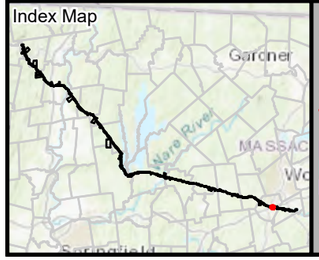

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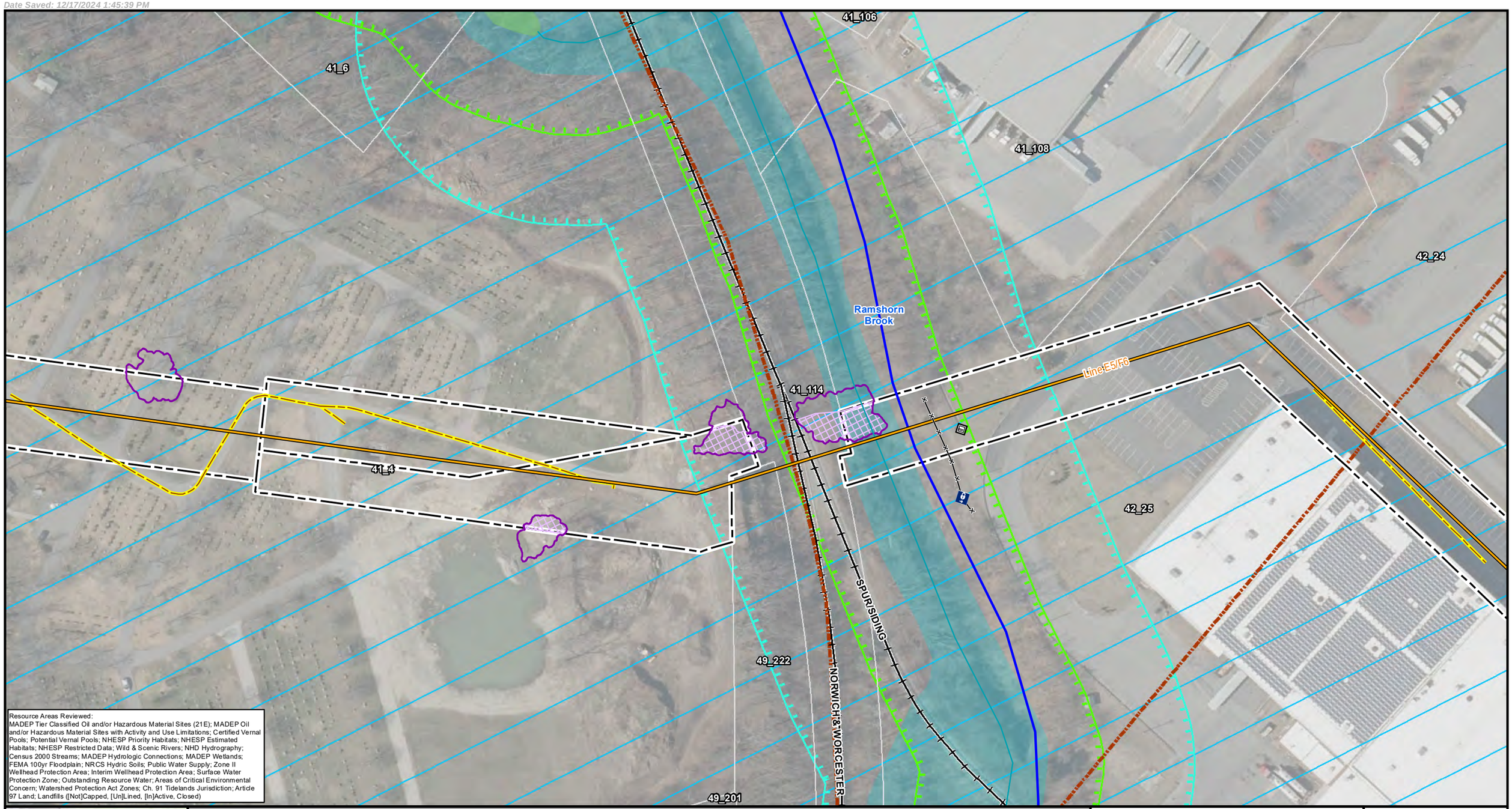

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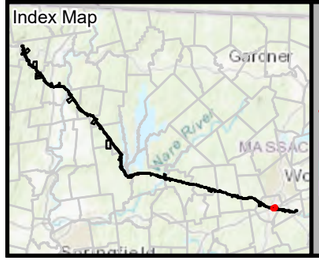

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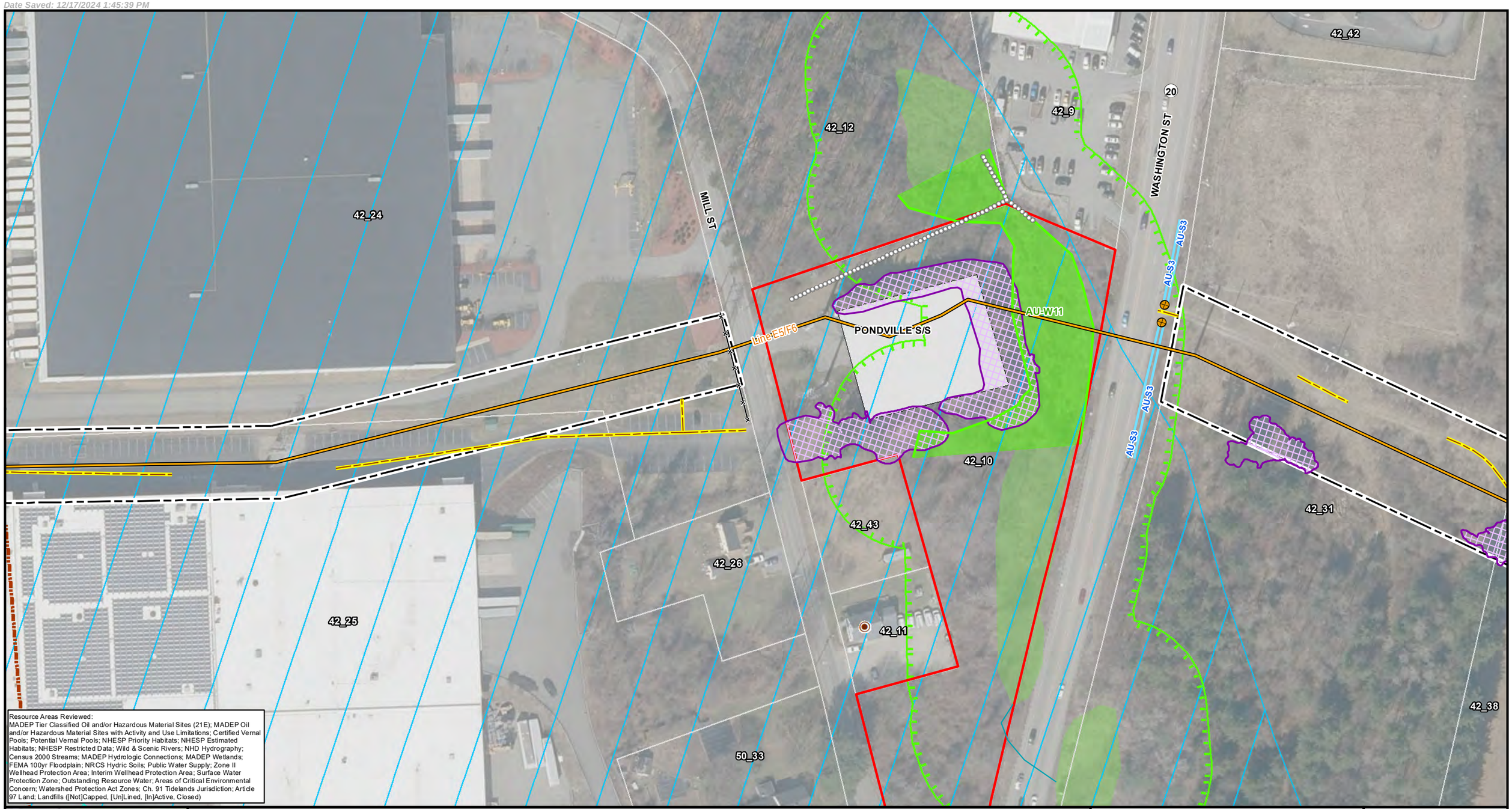

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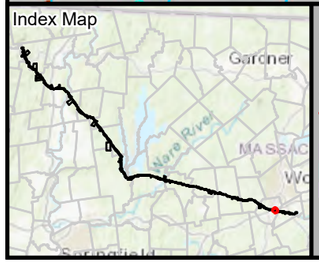

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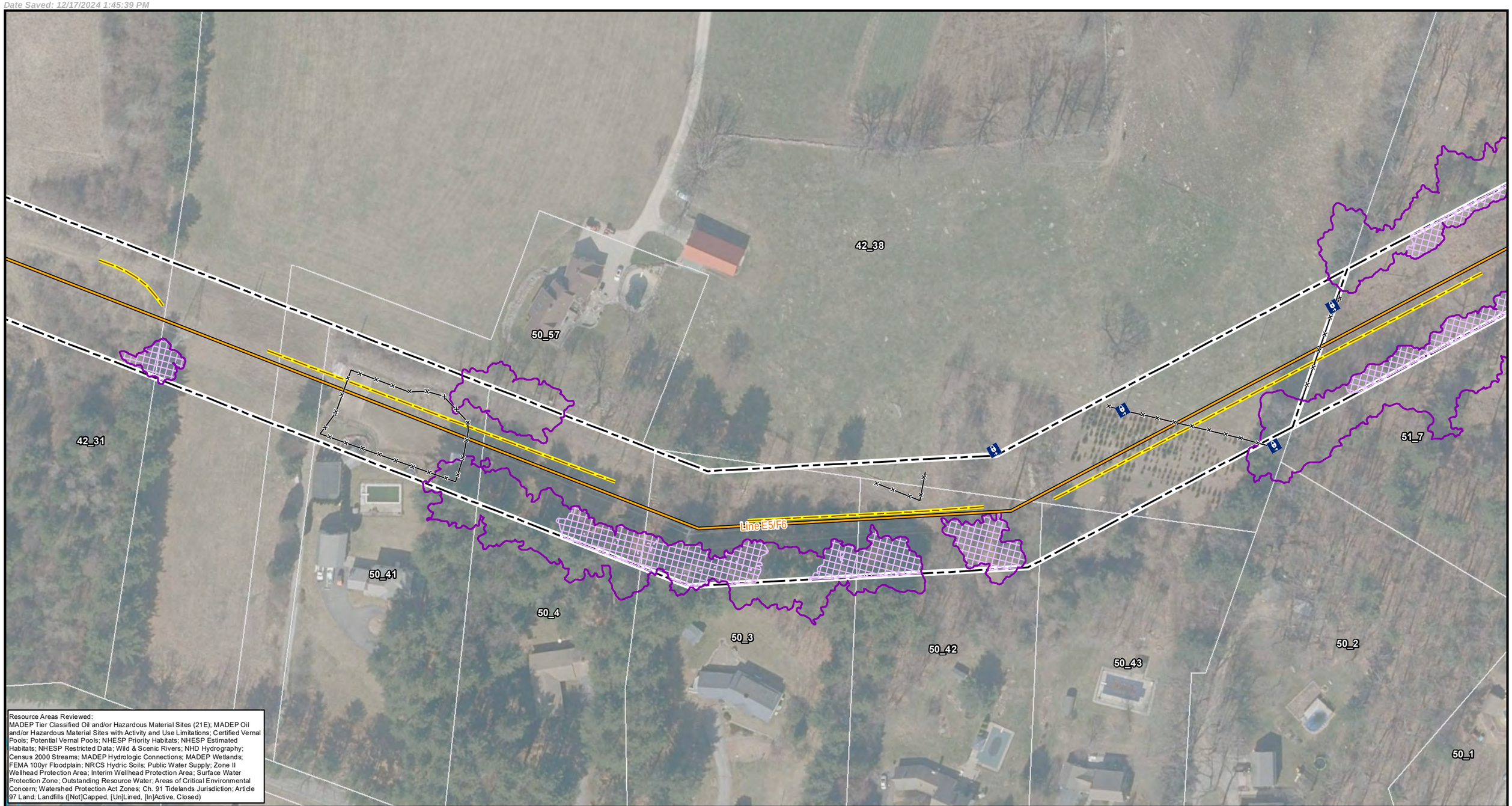

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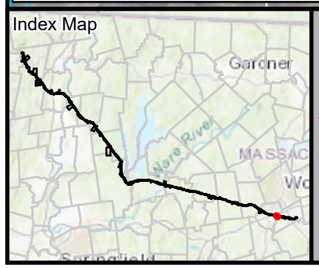

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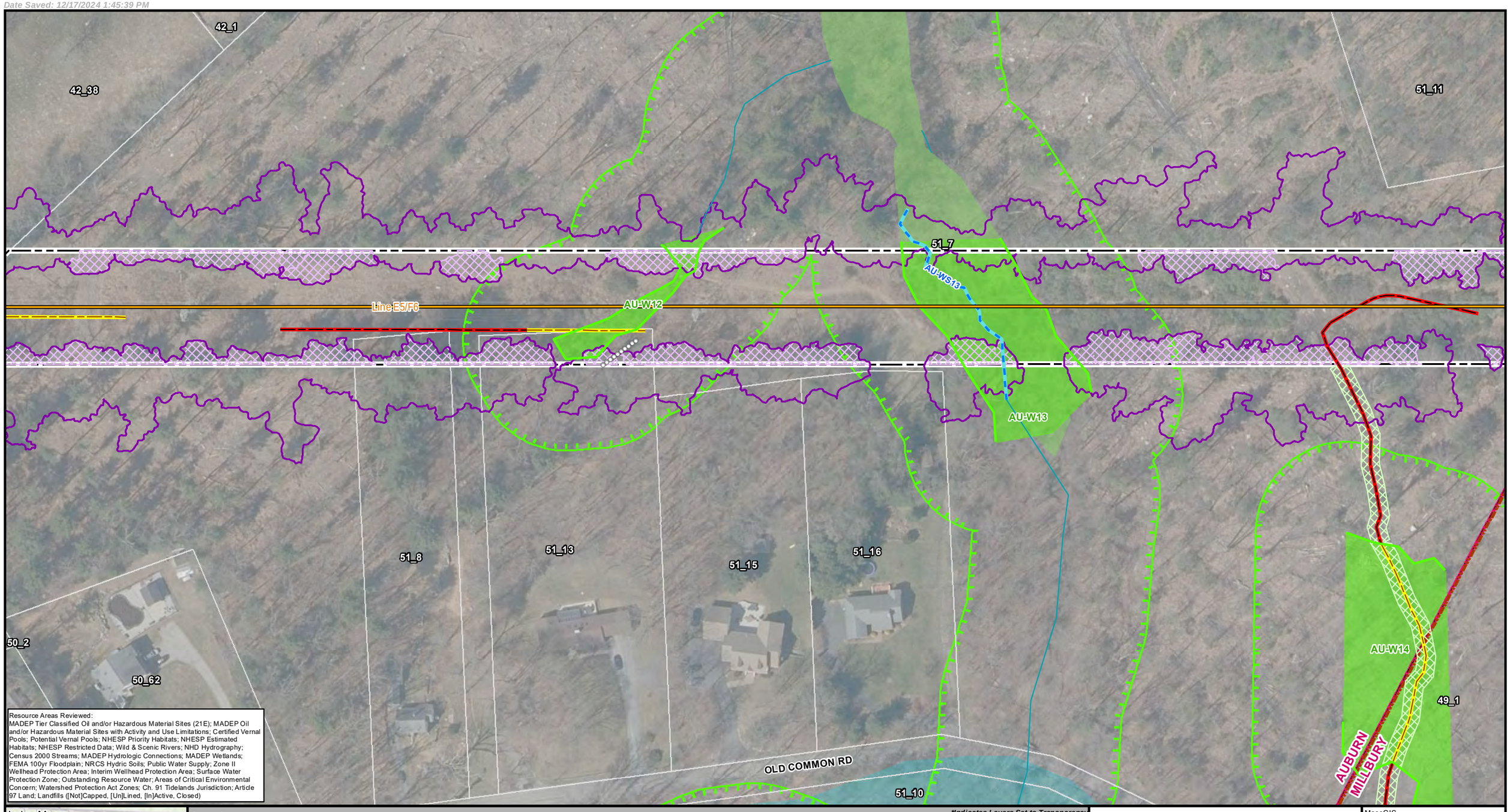

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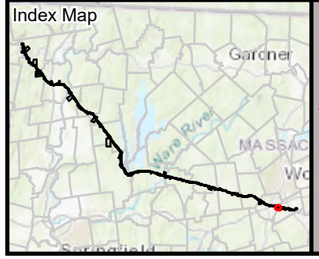

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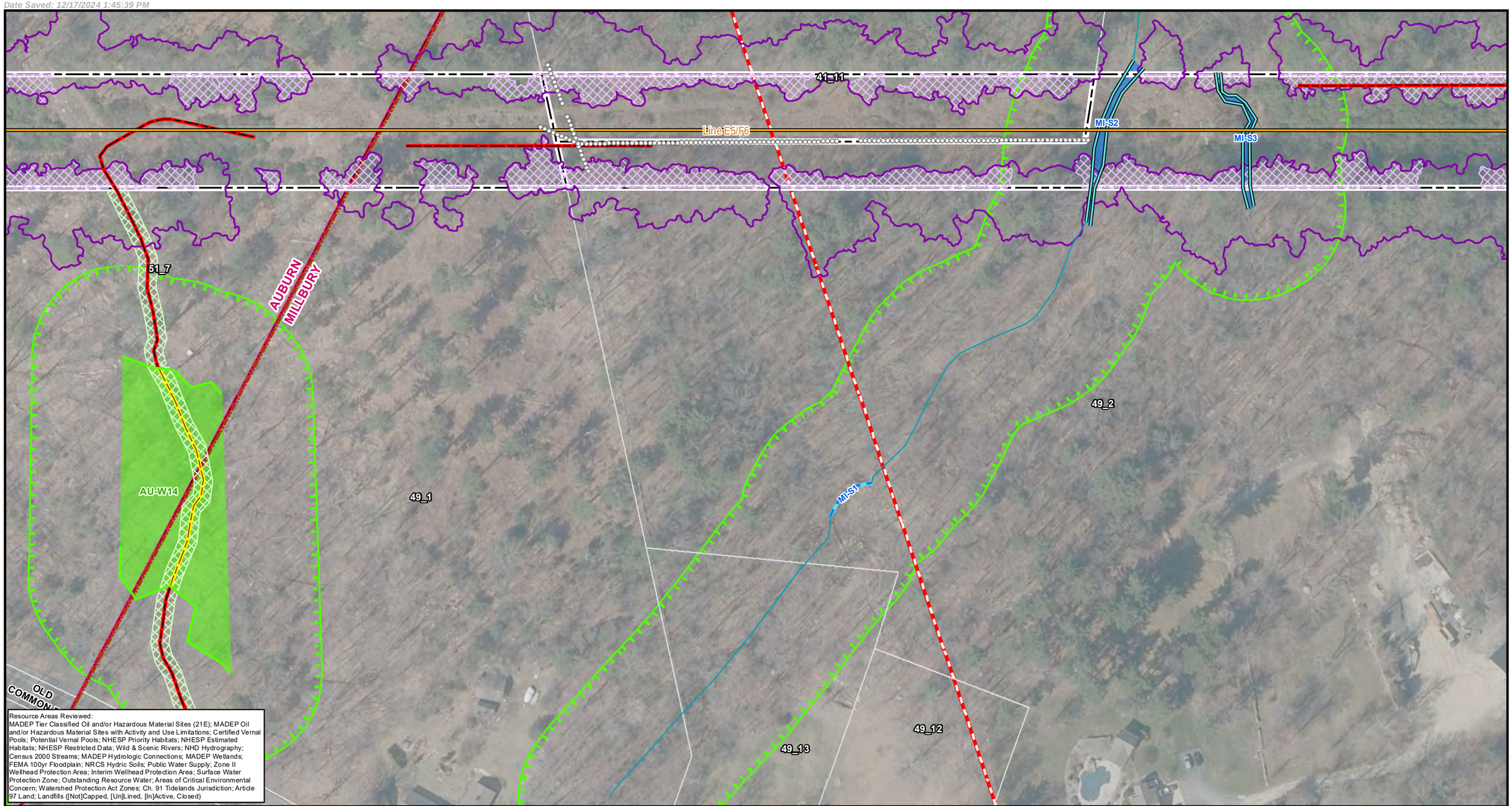

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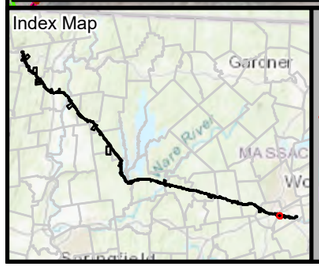

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Auburn & Millbury, MA

MassGIS
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MI-WS1B
MI-W2
MI-WS2
MI-WS1
MI-W1
Line E5/F6
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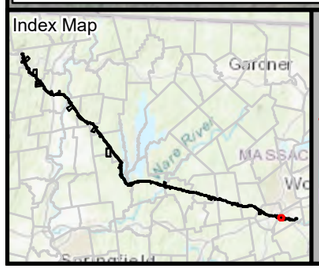

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Environmental Resources Map

Millbury, MA

MassGIS
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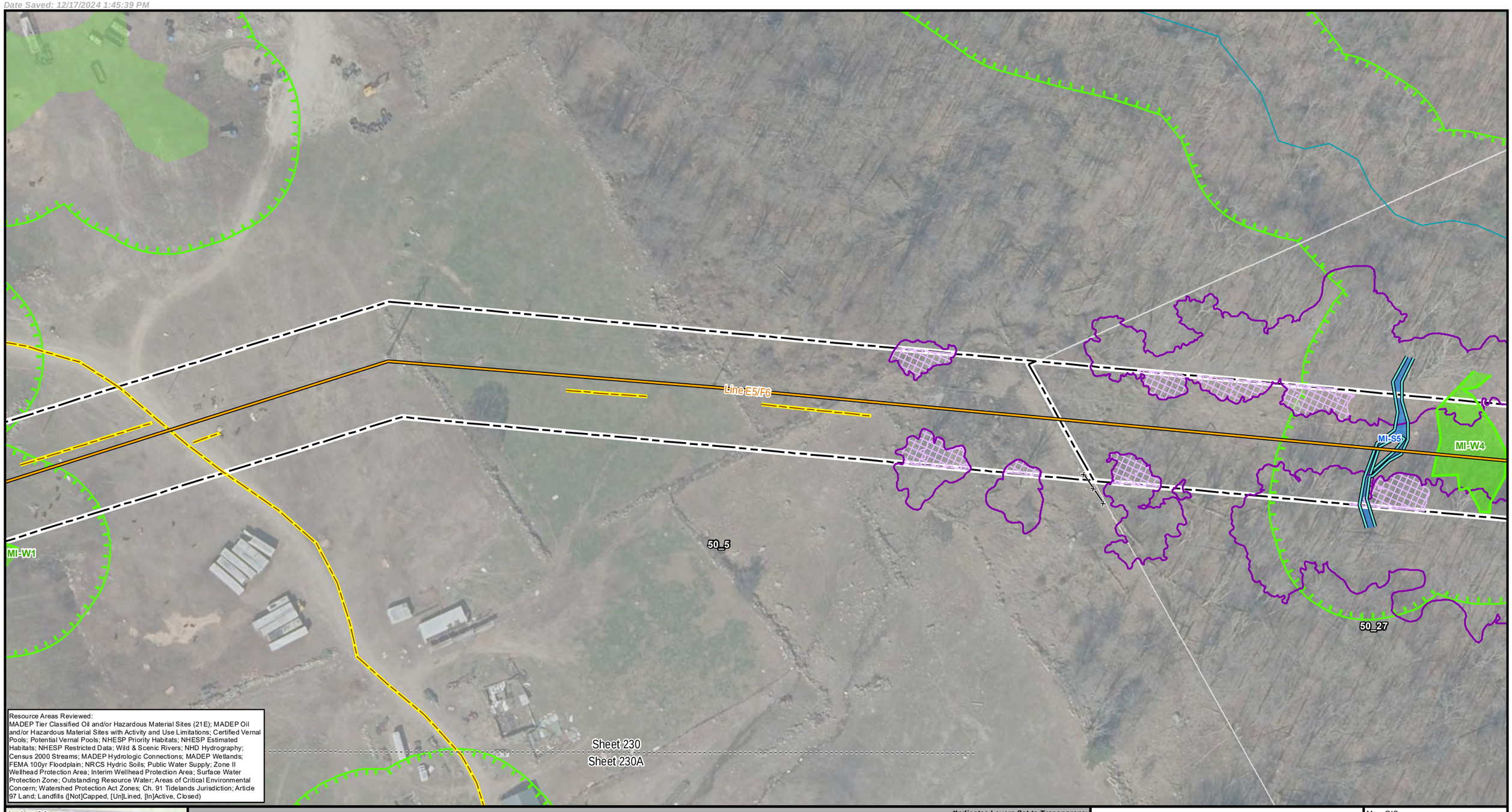

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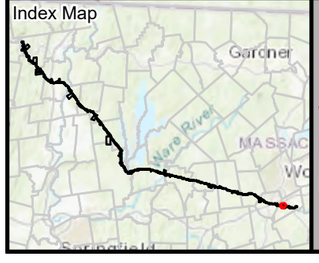

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Millbury, MA

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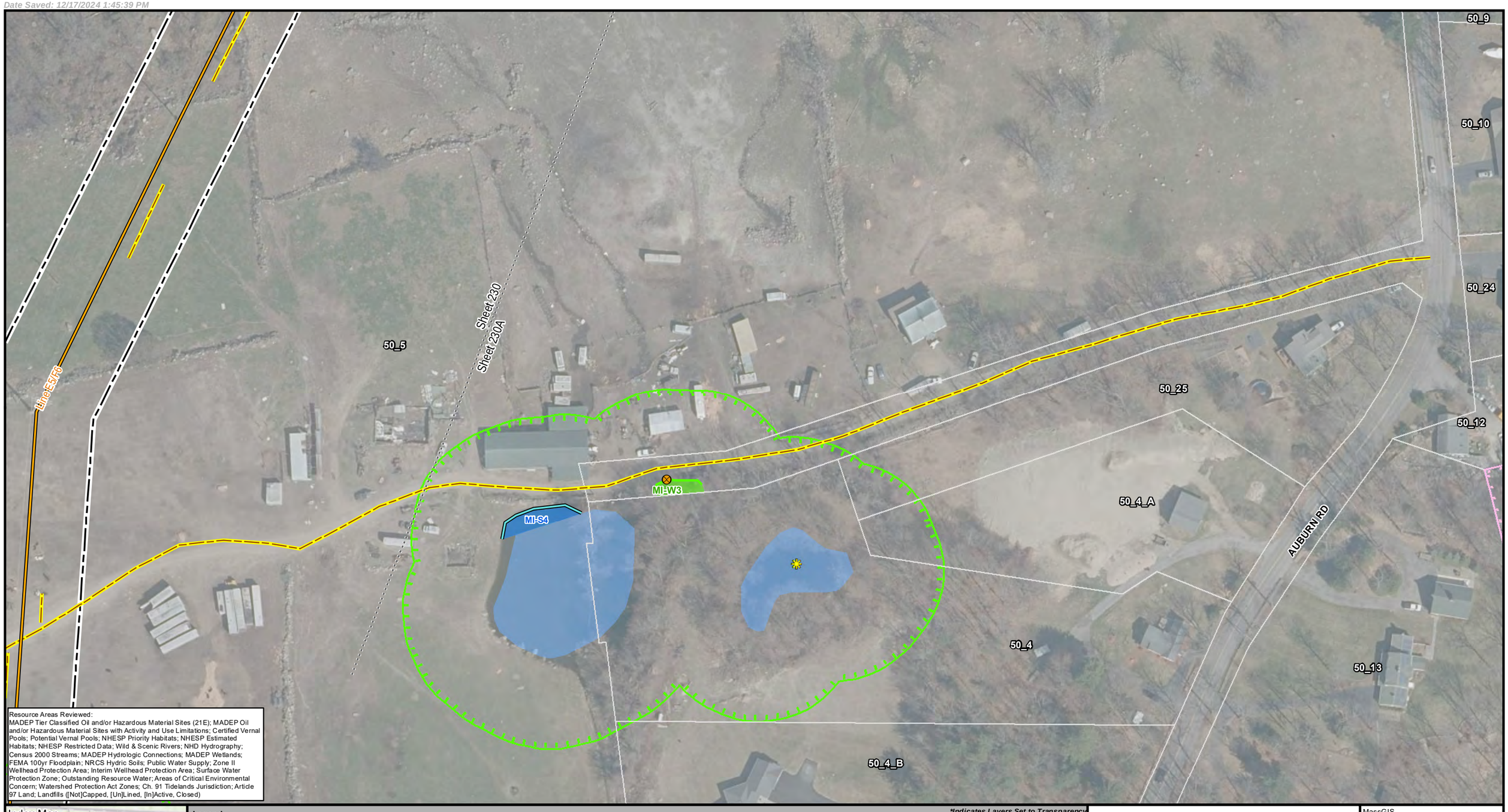

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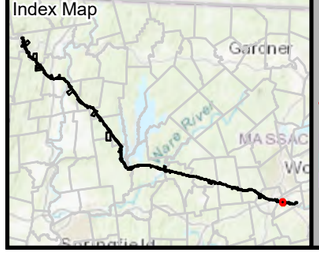

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Millbury, MA

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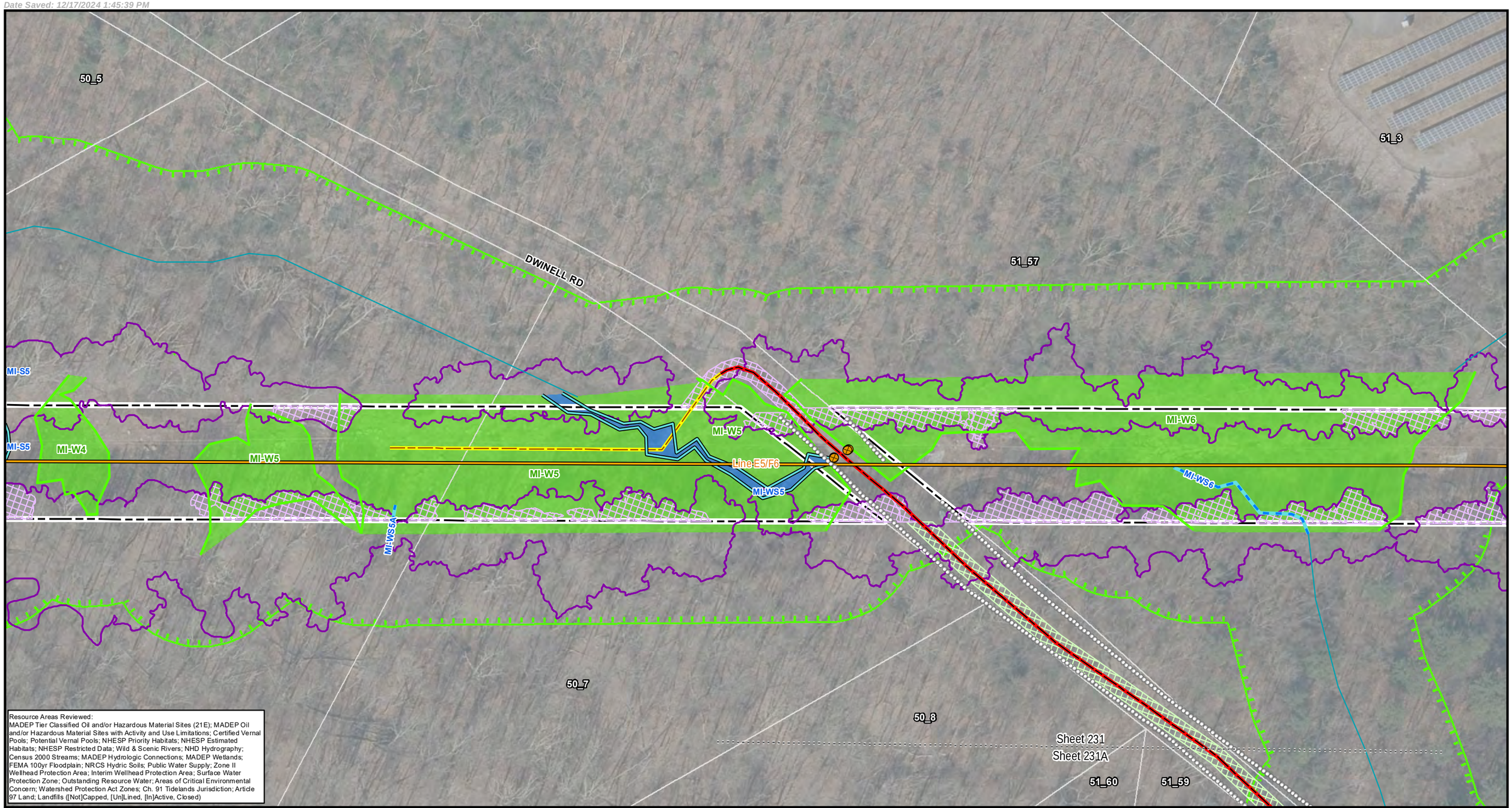

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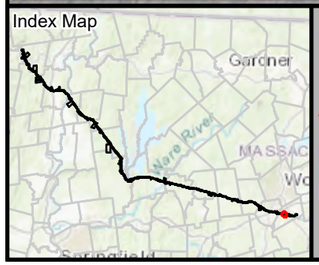

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Environmental Resources Map

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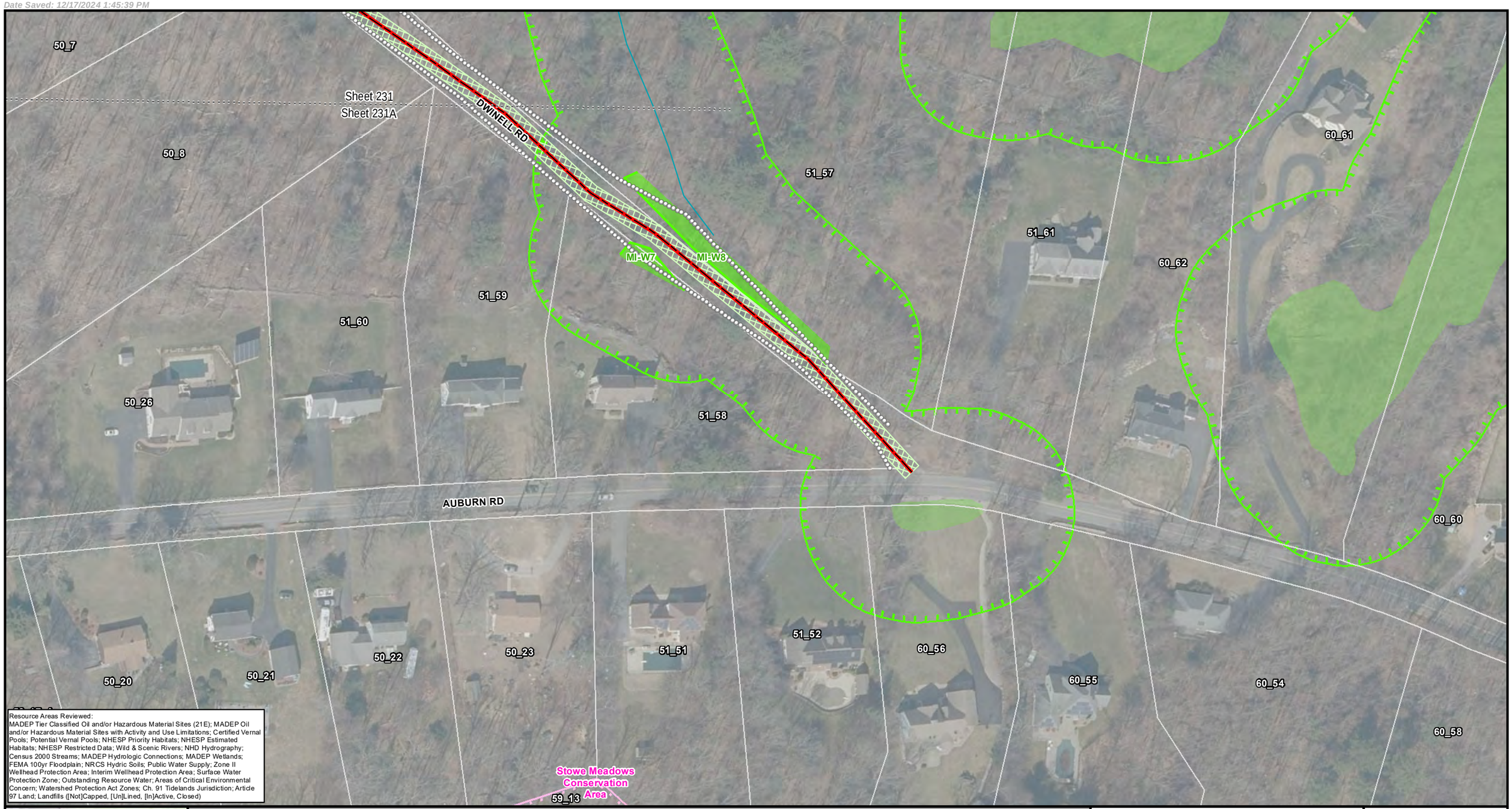

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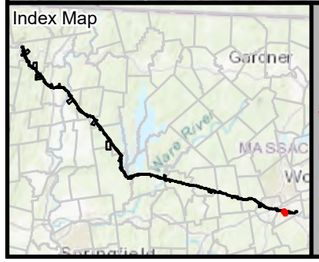

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Environmental Resources Map

Millbury, MA
Page 231A of 240

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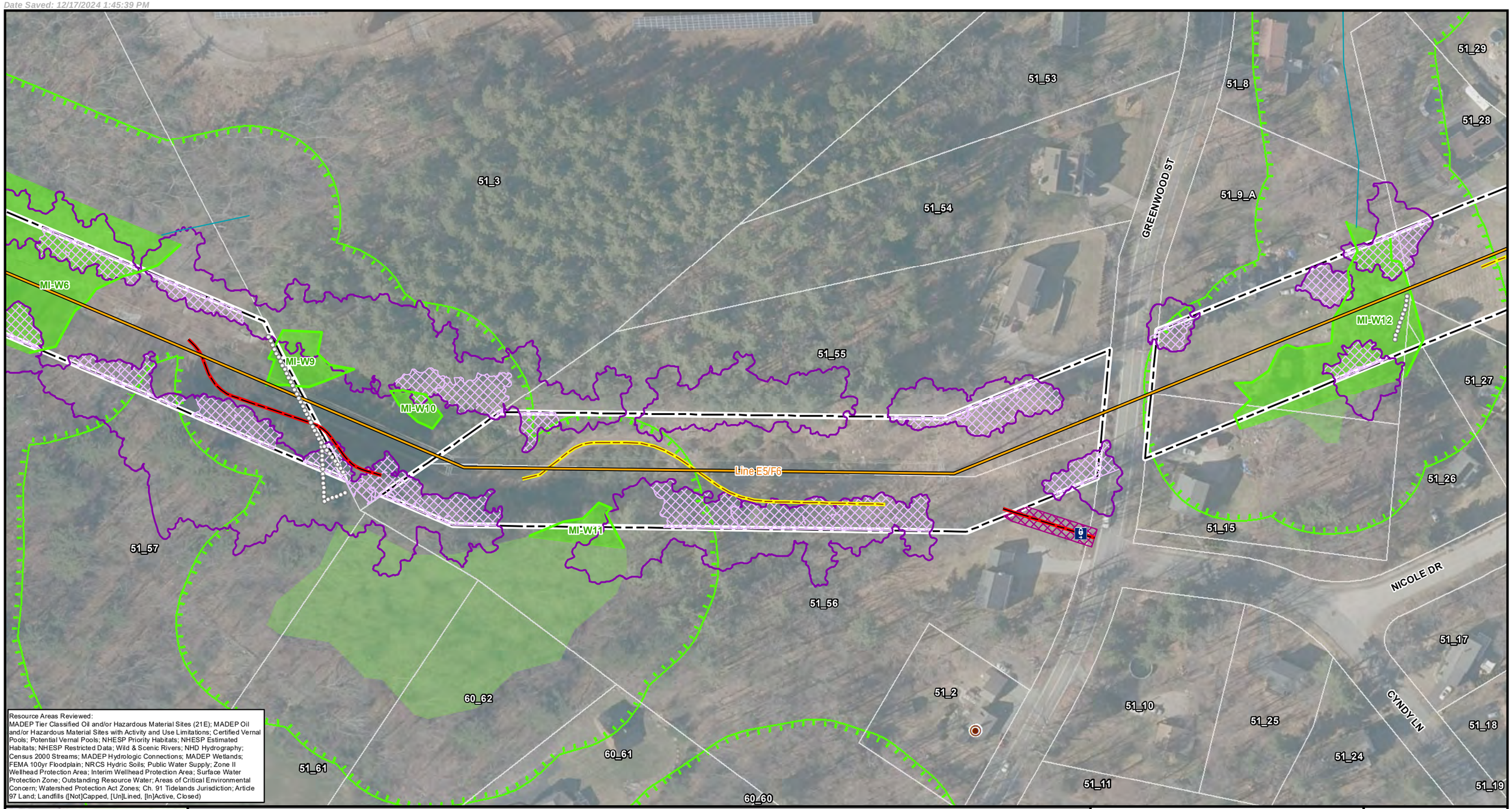

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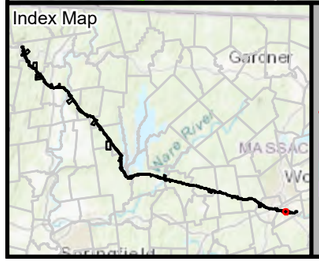

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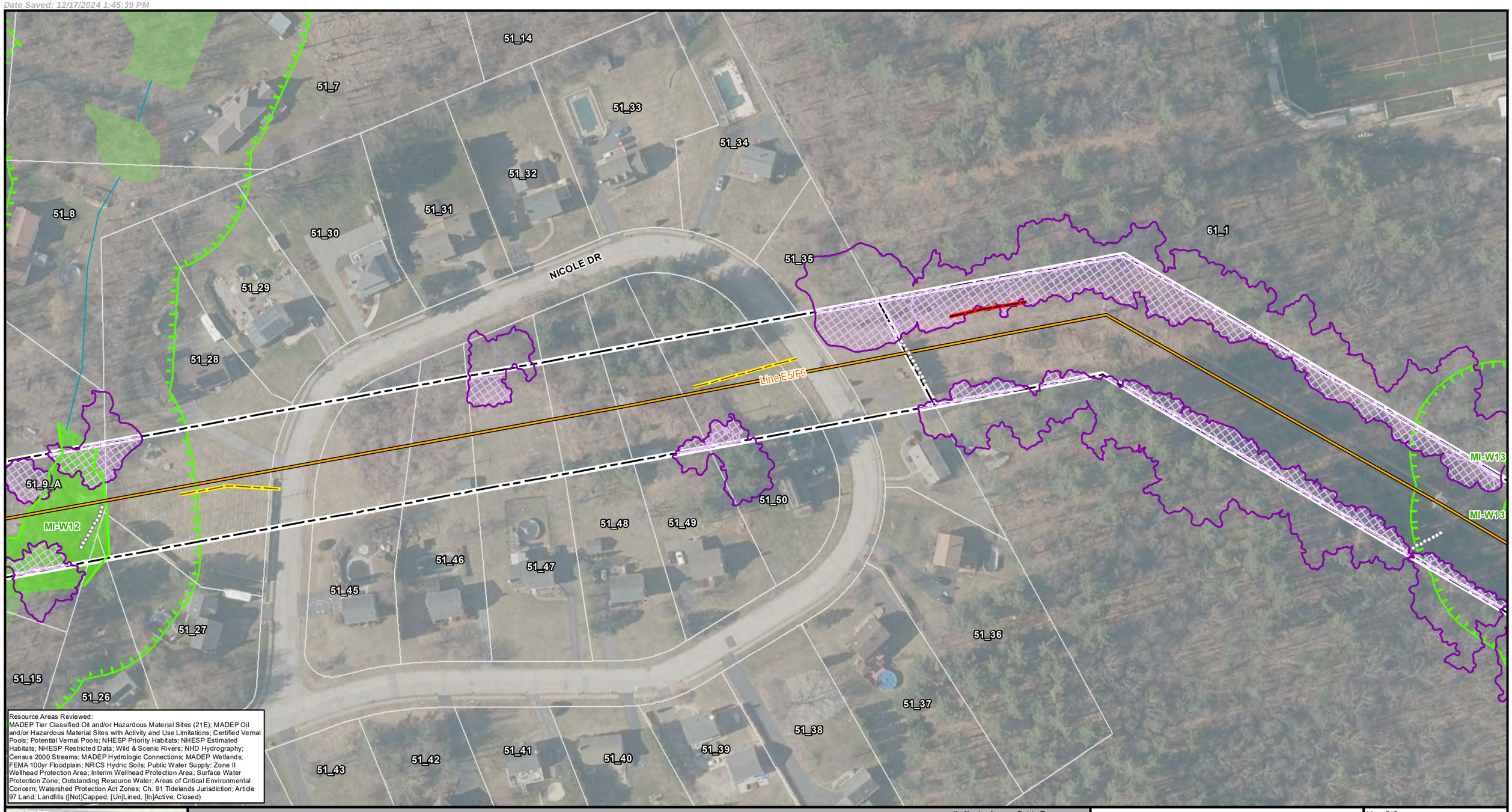

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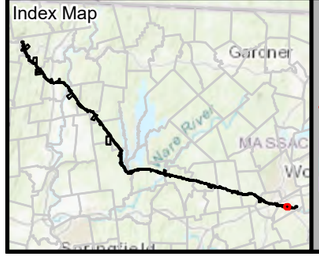

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Millbury, MA

MassGIS
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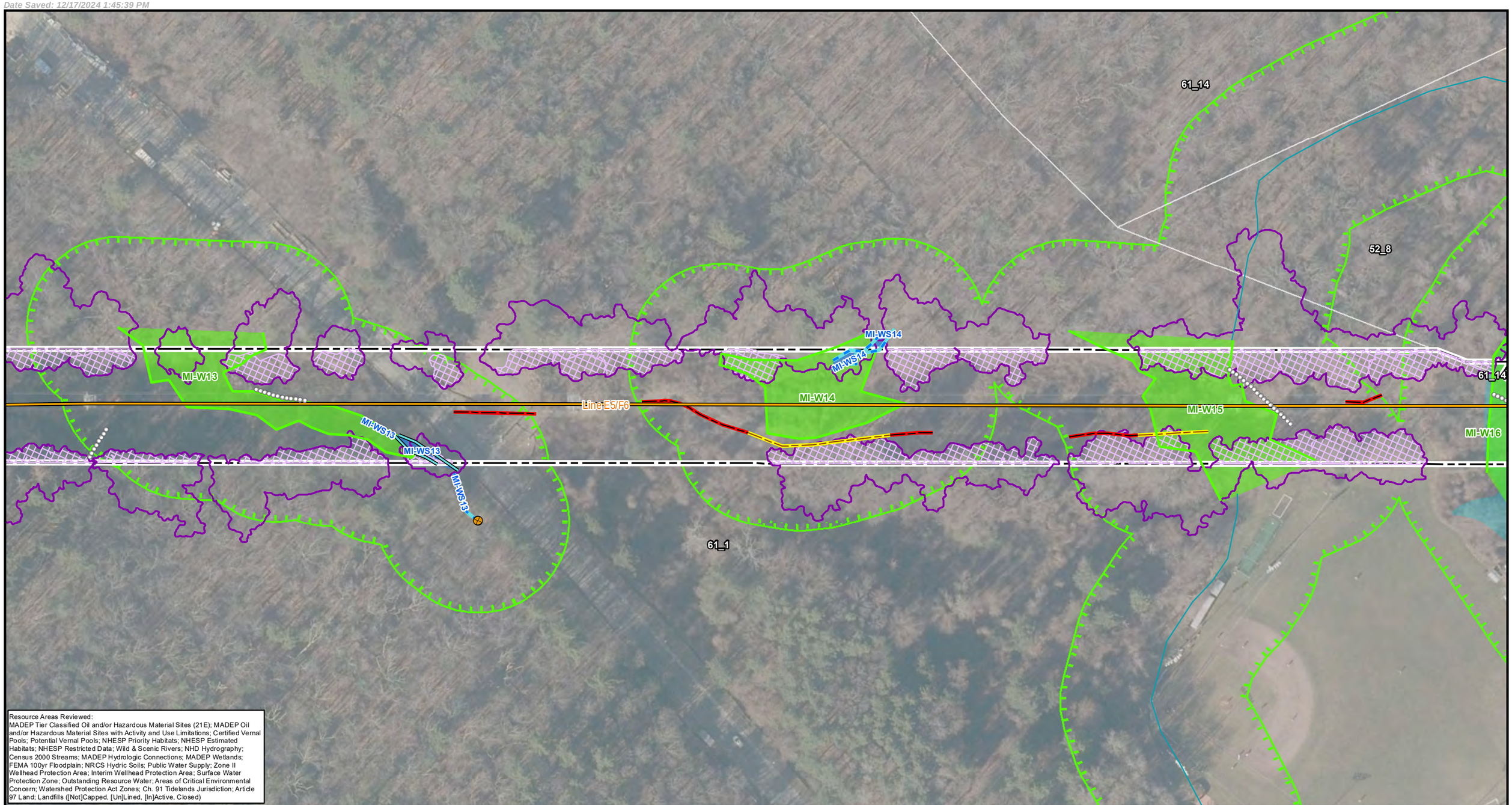

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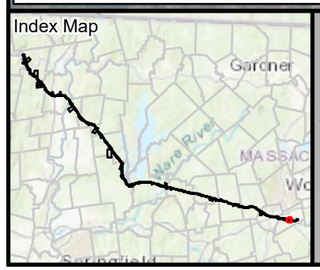

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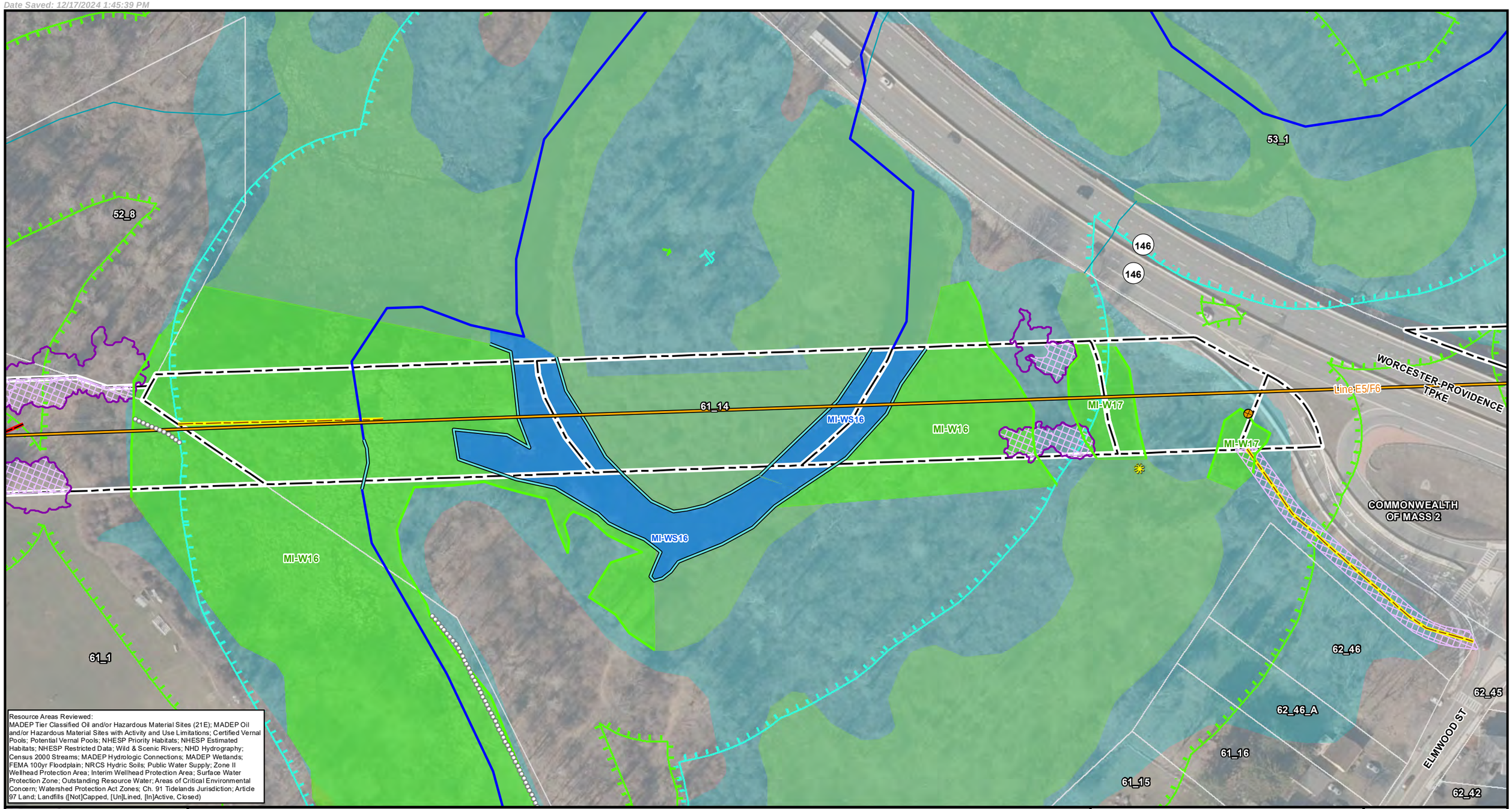

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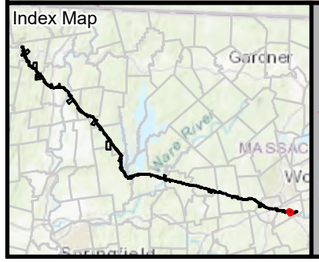

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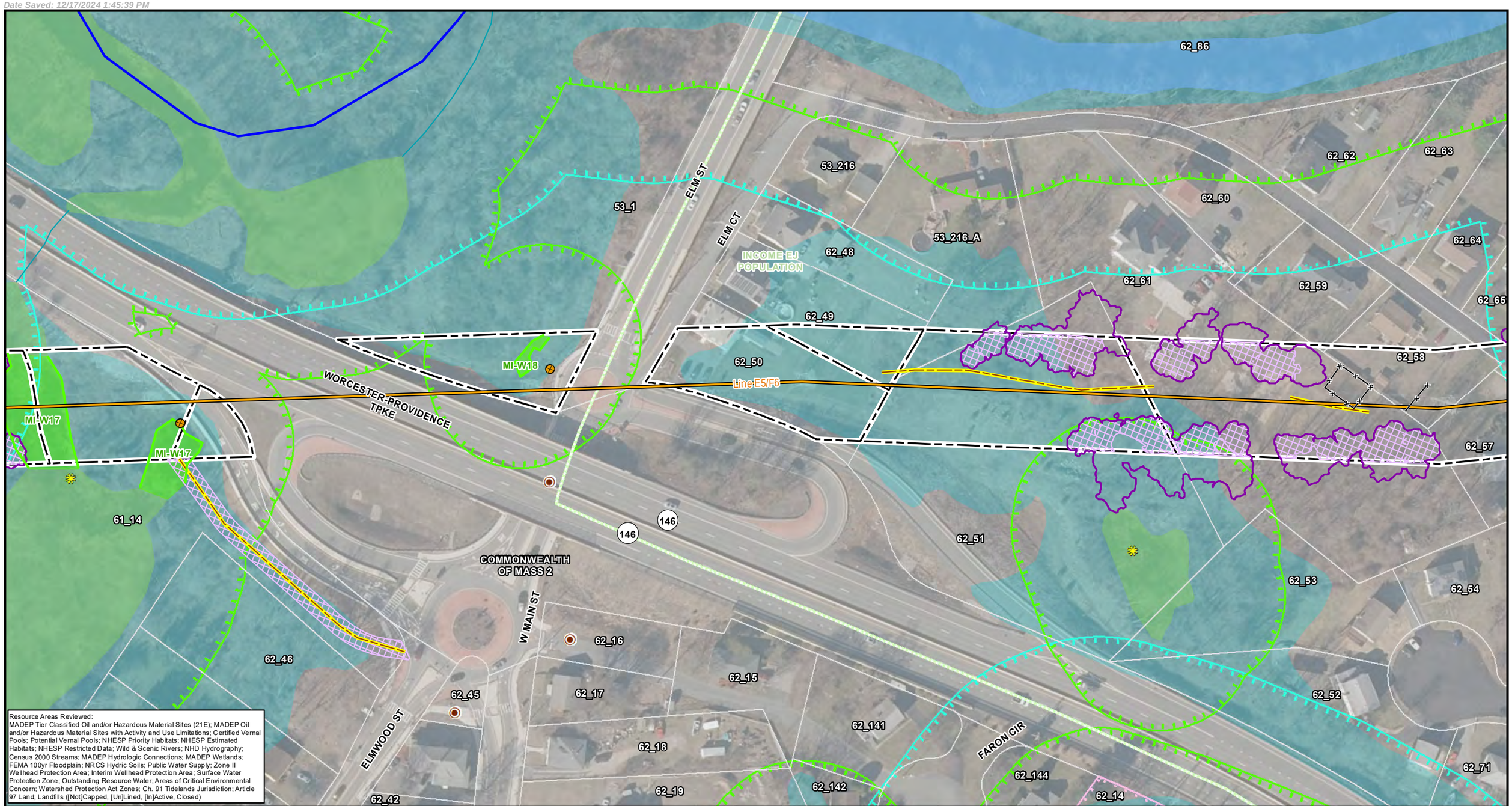

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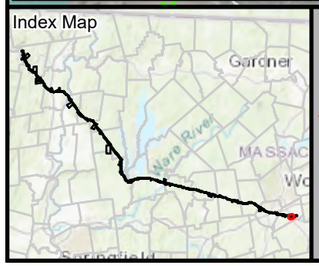

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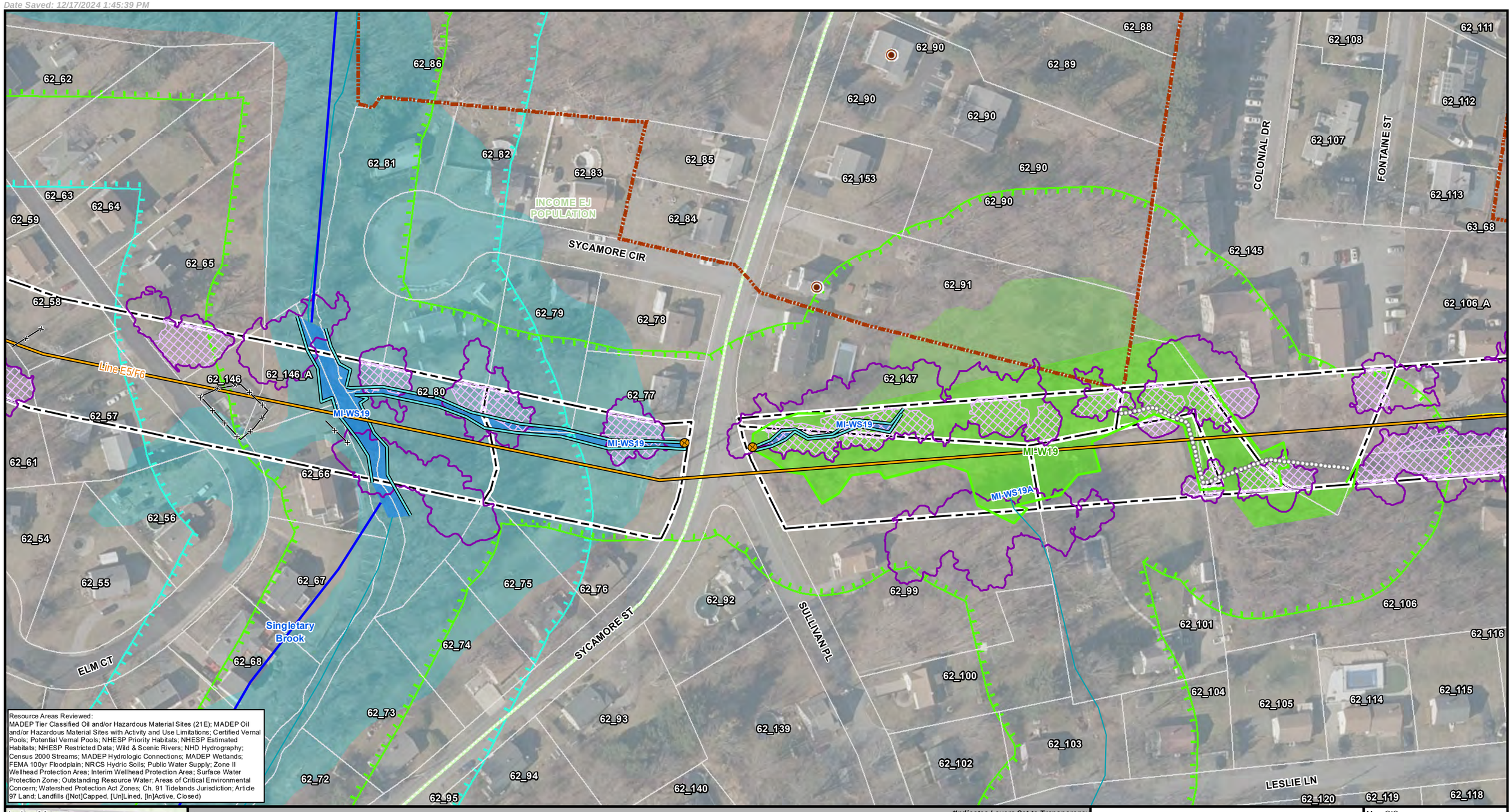

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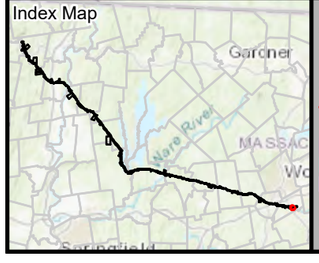

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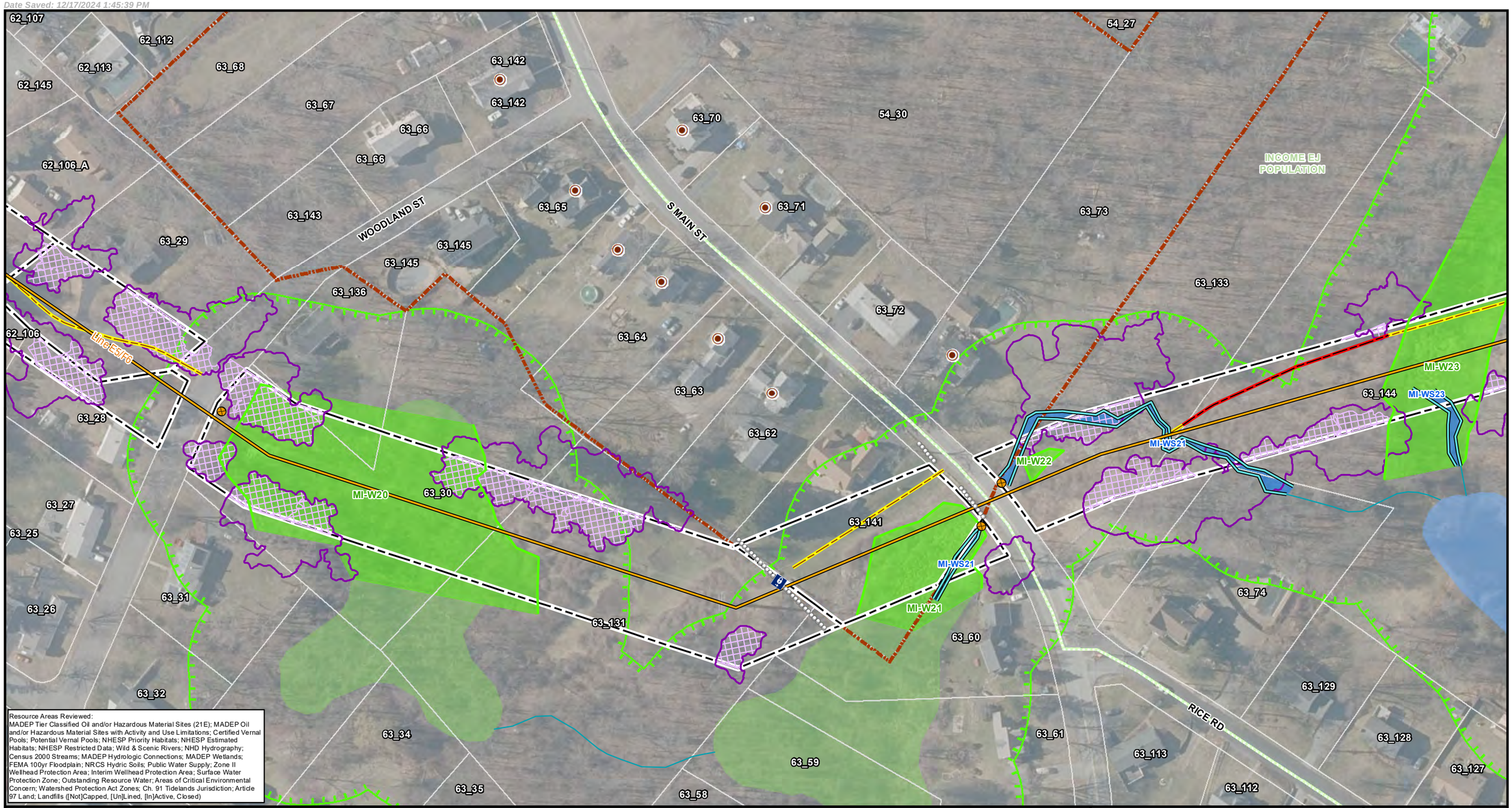

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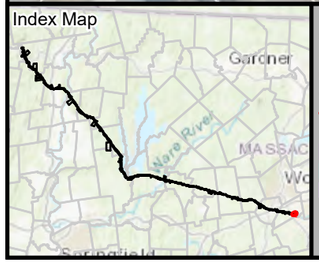

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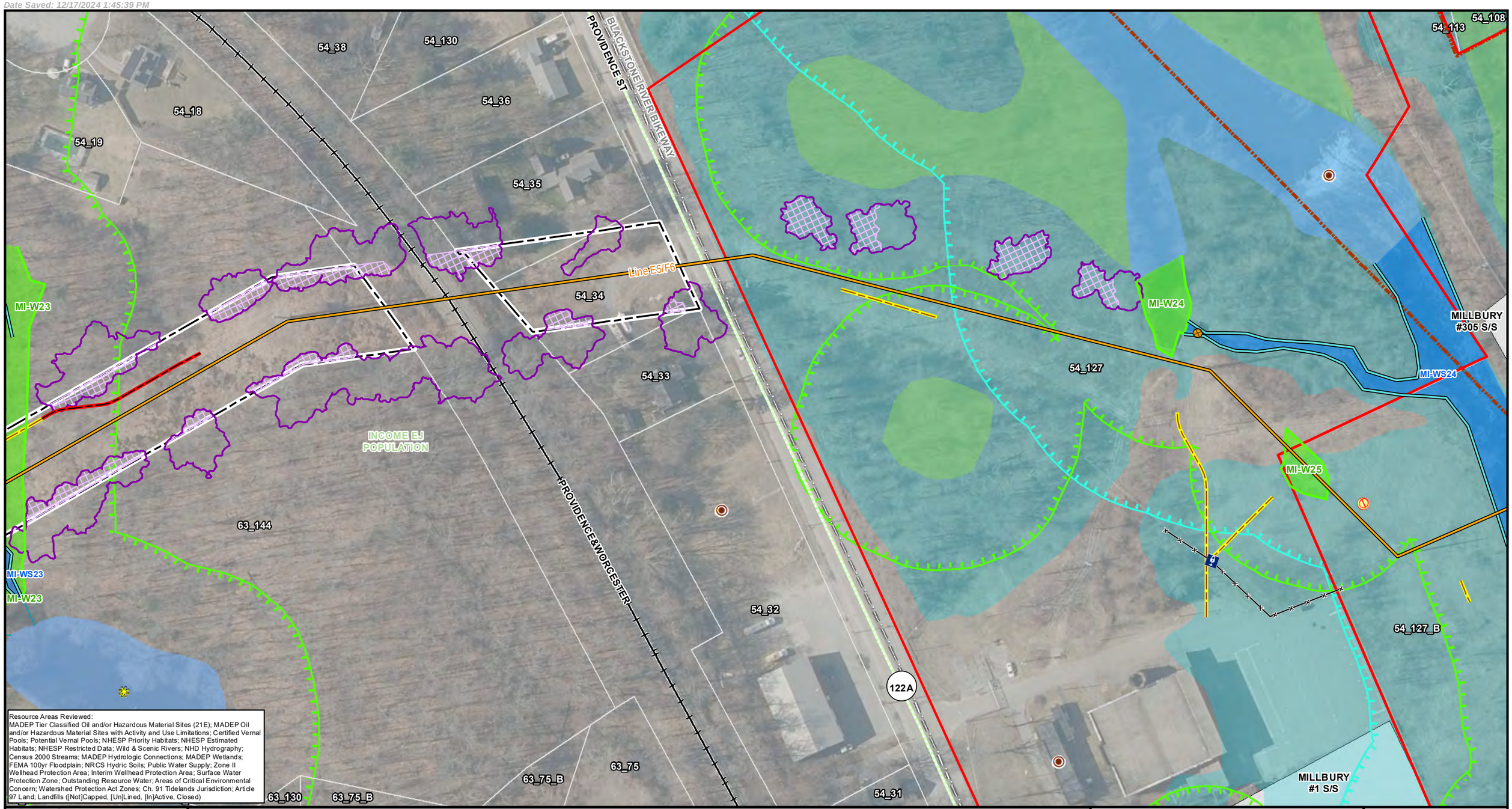

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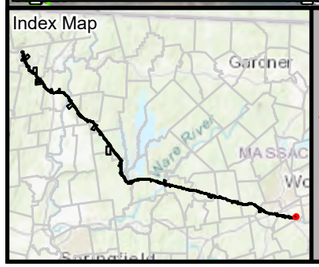

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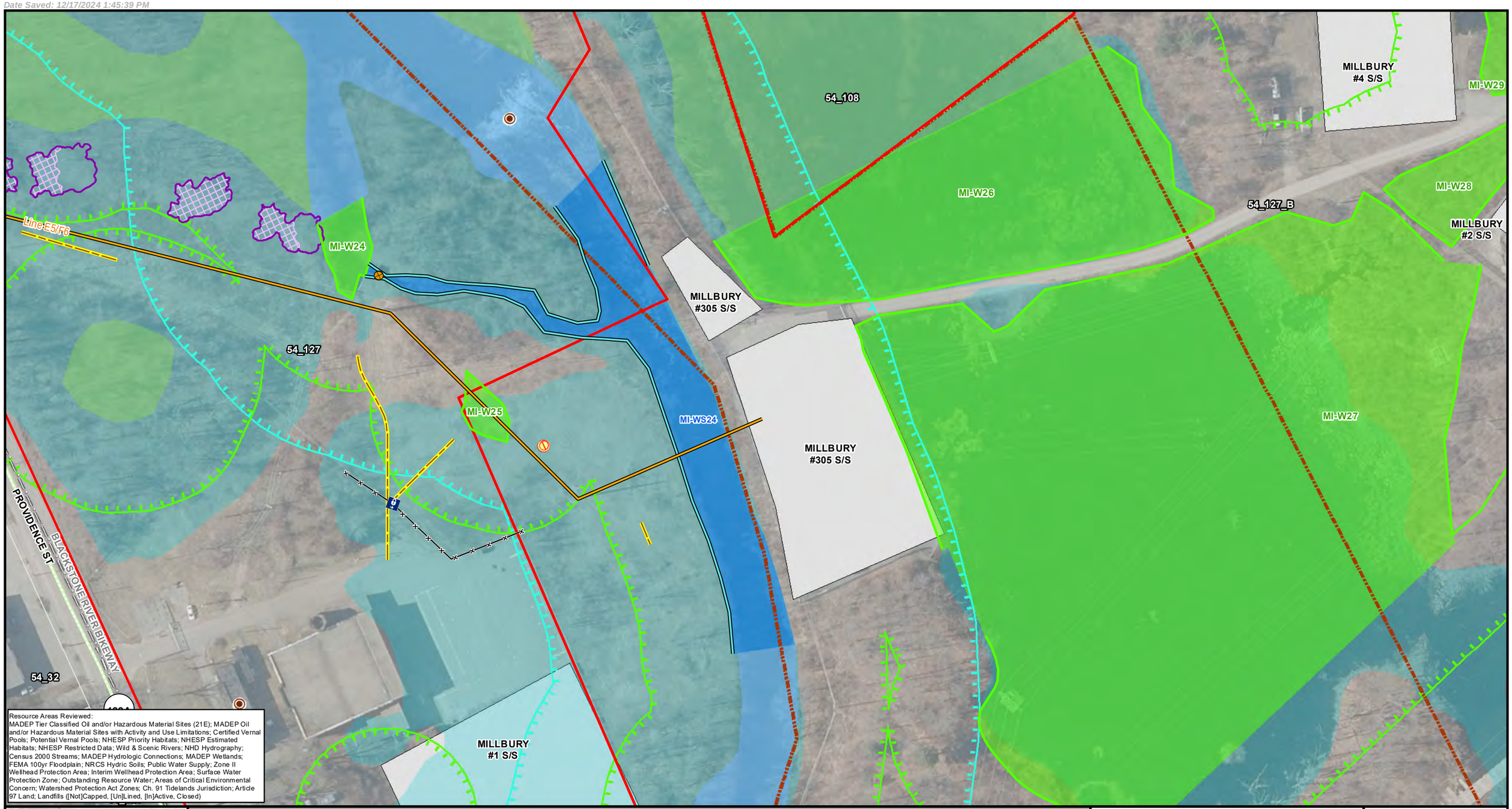

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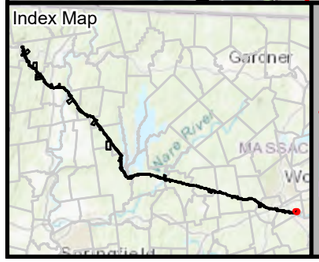

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- NHESP Priority & Estimated Habitats
- NHESP Restricted Data
- Interim Wellhead Protection Area
- Surface Water Protection Zone
- Zone II Wellhead Protection Area
- Watershed Protection Act Primary Zone
- Watershed Protection Act Secondary Zone
- Certified Vernal Pools
- Potential Vernal Pools
- Public Water Supply
- MADEP 21E Site
- MADEP AUL Site
- MHC Historic Point
- MHC Historic Area
- DCR Owned Property
- Culvert
- Catch Basin
- Access Gate
- Railroad
- Hiking Trails
- Approximate Pipeline
- Fenceline
- Guardrail
- Stonewall
- Existing Treeline
- Tree Removal
- Selective Tree Removal
- Pruning
- Town Boundary
- Parcel Boundaries

Environmental Justice Populations 2020

- Income

*Indicates Layers Set to Transparency

N

1 inch = 100 feet

0 50 100

Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Millbury, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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BSC Project Number: 100181.00

Central to Western Massachusetts Energy Improvement Project

Shelburne, Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn & Millbury, MA

Land Use Along the Project Route

December 13, 2024



PREPARED FOR:

nationalgrid

170 Data Drive
Waltham, MA 02451

INDEX OF FIGURES

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1 - 59 - MAP SHEETS

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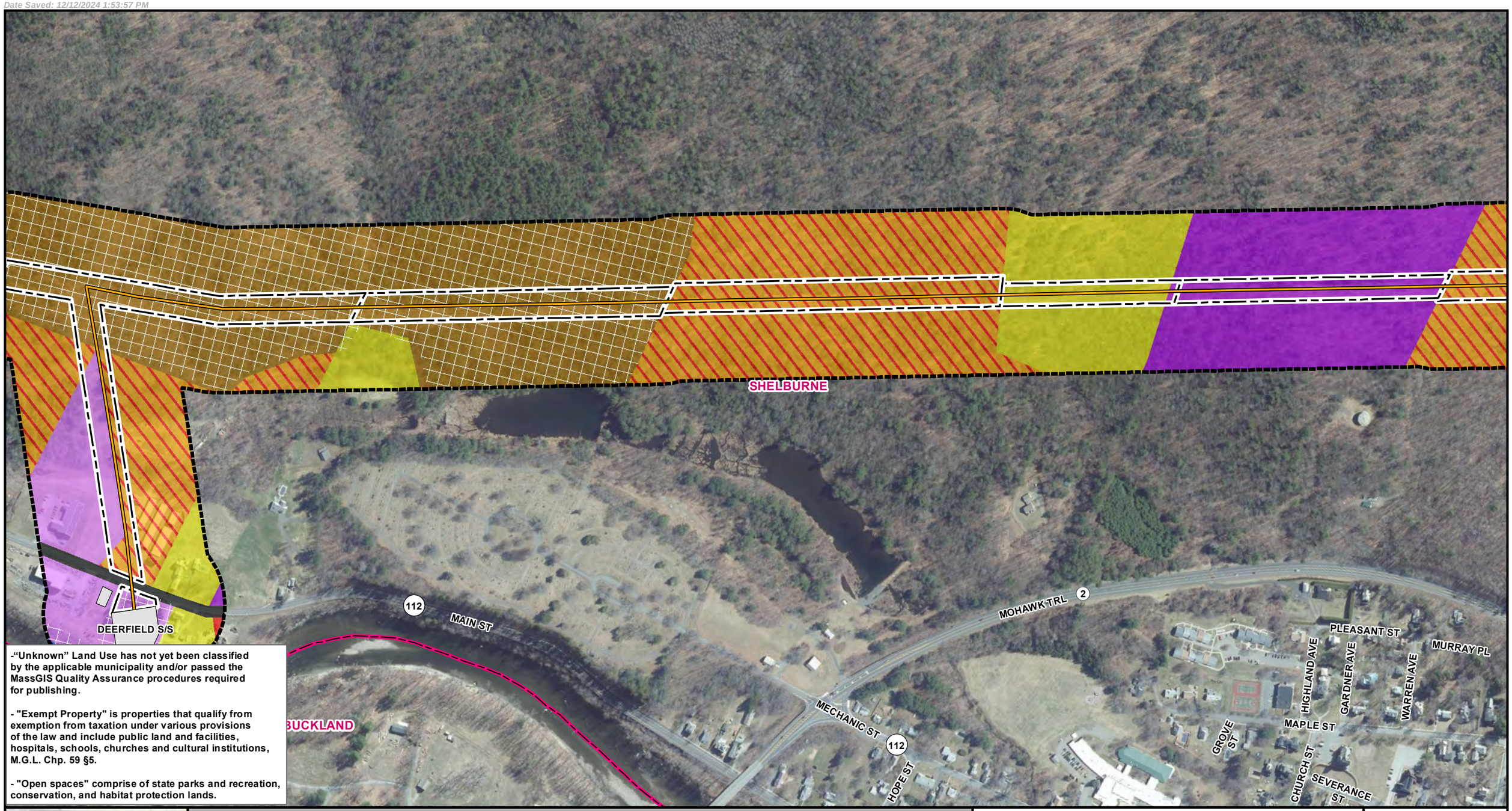
NOT CONSTRUCTION

PREPARED BY:

BSC GROUP

1 Mercantile Street Suite 601
Worcester, MA 01608



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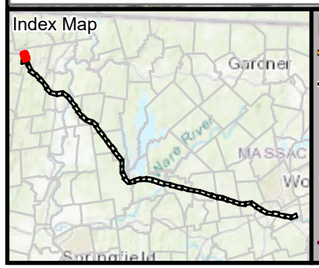

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Land Use Along the Project Route

Buckland & Shelburne, MA

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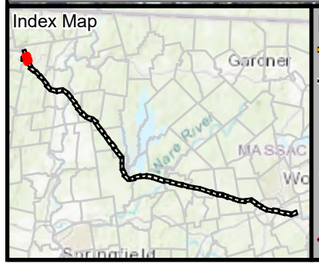

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Shelburne, MA

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CLEMENT ST
SEARS ST
BAKER AVE
MAIN ST
BRIDGE ST
HIGH ST
2A
MASONIC AVE
MURRAY PL
DEERFIELD AVE
GREEN ST
SCHOOL ST
ASHFIELD ST
CONWAY ST
DEPOT ST
S MAPLE ST
HALLIGAN AVE
MONROE AVE
KRATT AVE
FRANKLIN ST
ROUND HOUSE HILL RD
N ELM ST
CONWAY RD
SUMMER ST
DEERFIELD #3 S/S
2
SHELBURNE
MOHAWK TRL
BUCKLAND
CRICKET FIELD RD
SOUTH ST
ELM ST
BIRCH RD
S CONWAY RD
GARDNER FALLS RD

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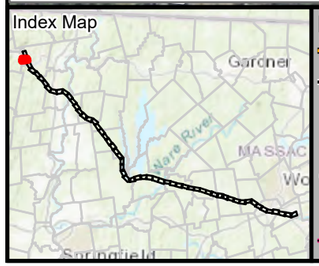

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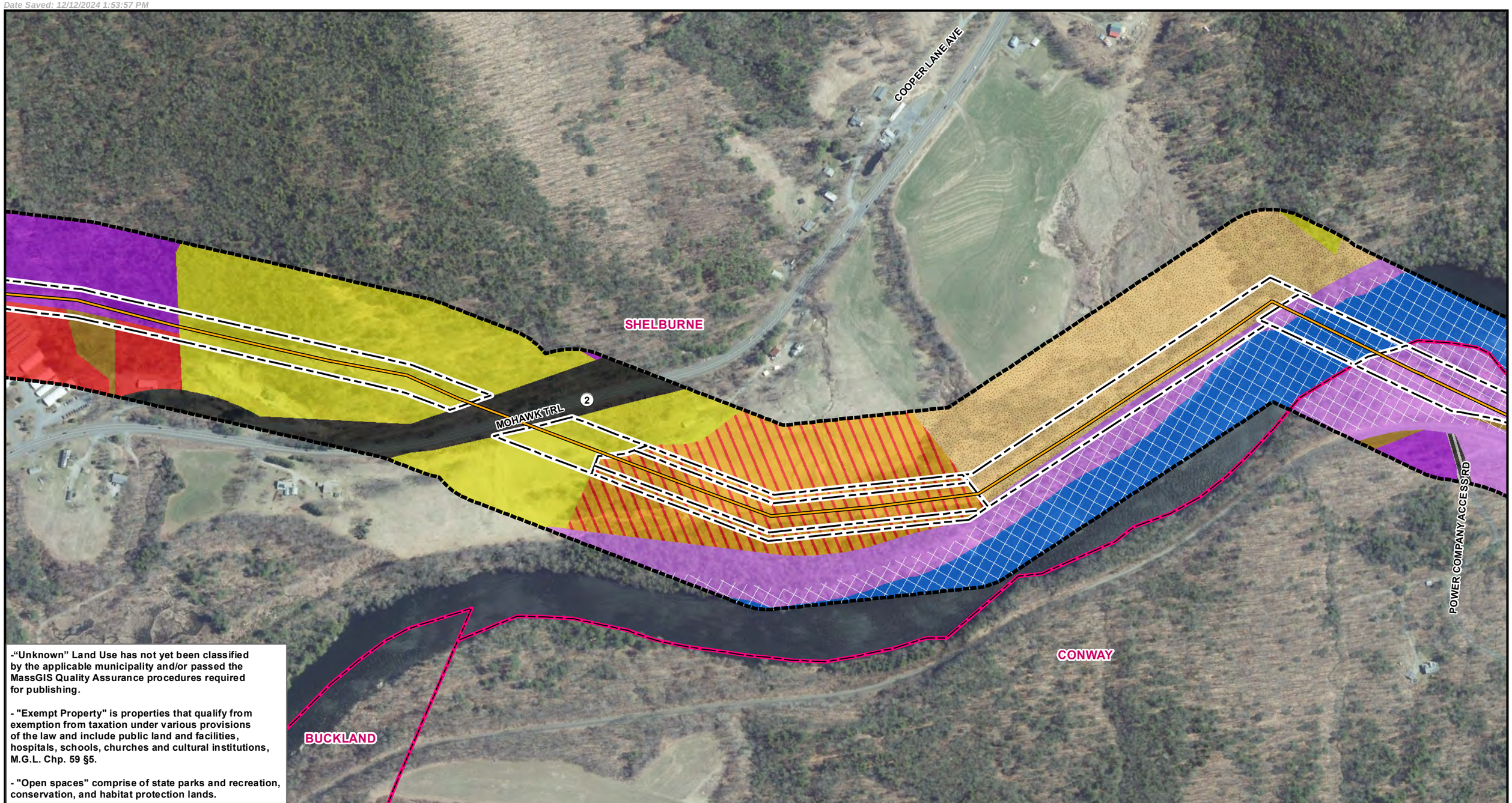

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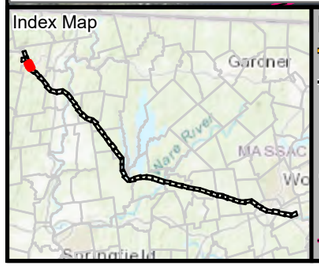

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Land Use Along the Project Route

Shelburne, Buckland & Conway, MA

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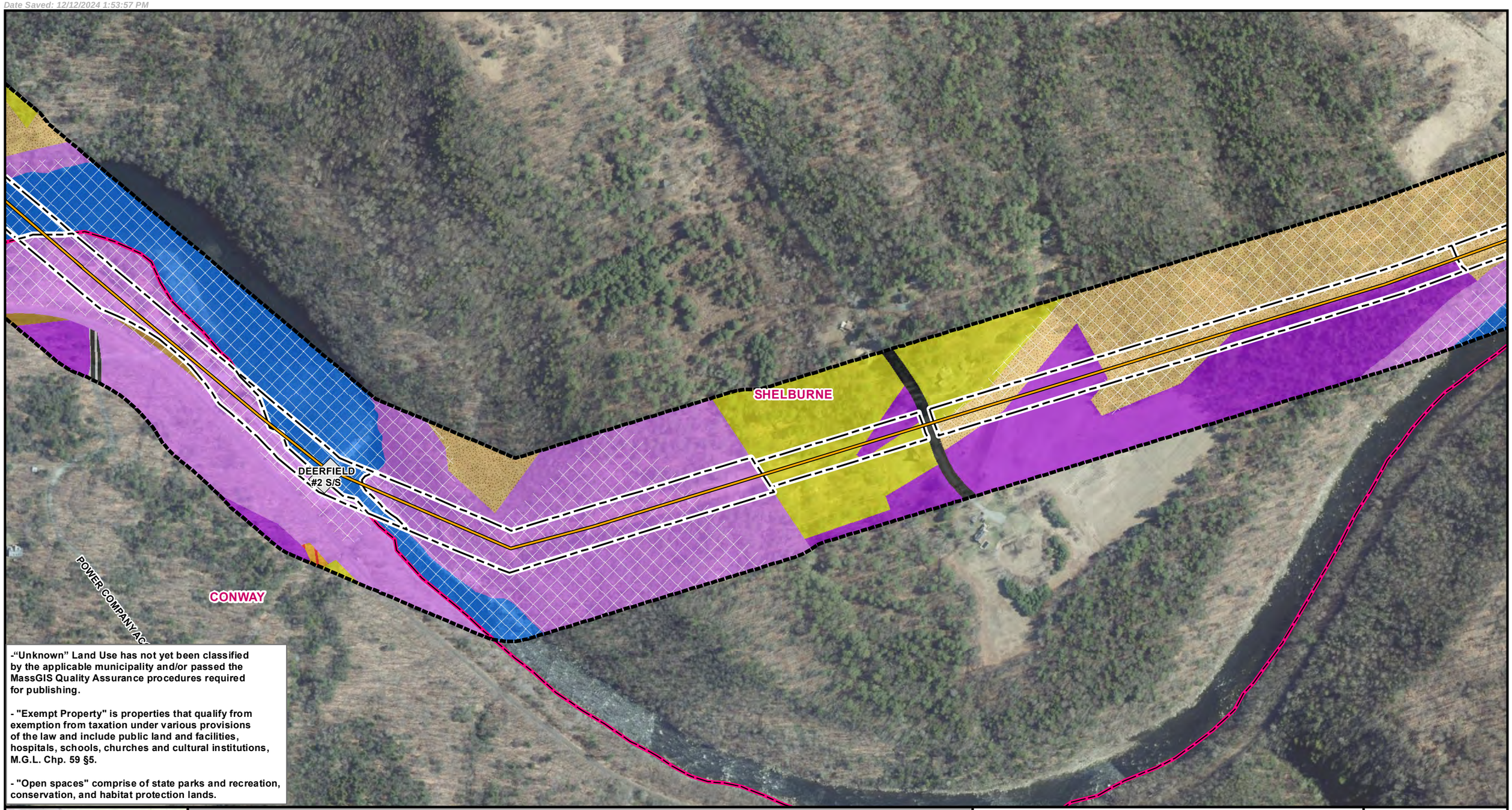

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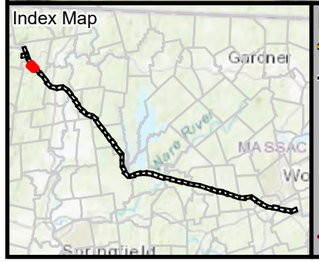

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SHELBURNE

CONWAY

ORCHARD RD

BARDWELL FERRY RD

BARDWELLS RD

WHOLEY RD

BARDWELLS FERRY RD

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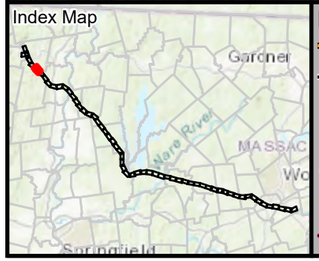

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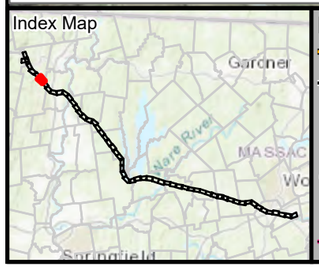

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Land Use Along the Project Route

Shelburne, Conway & Deerfield, MA

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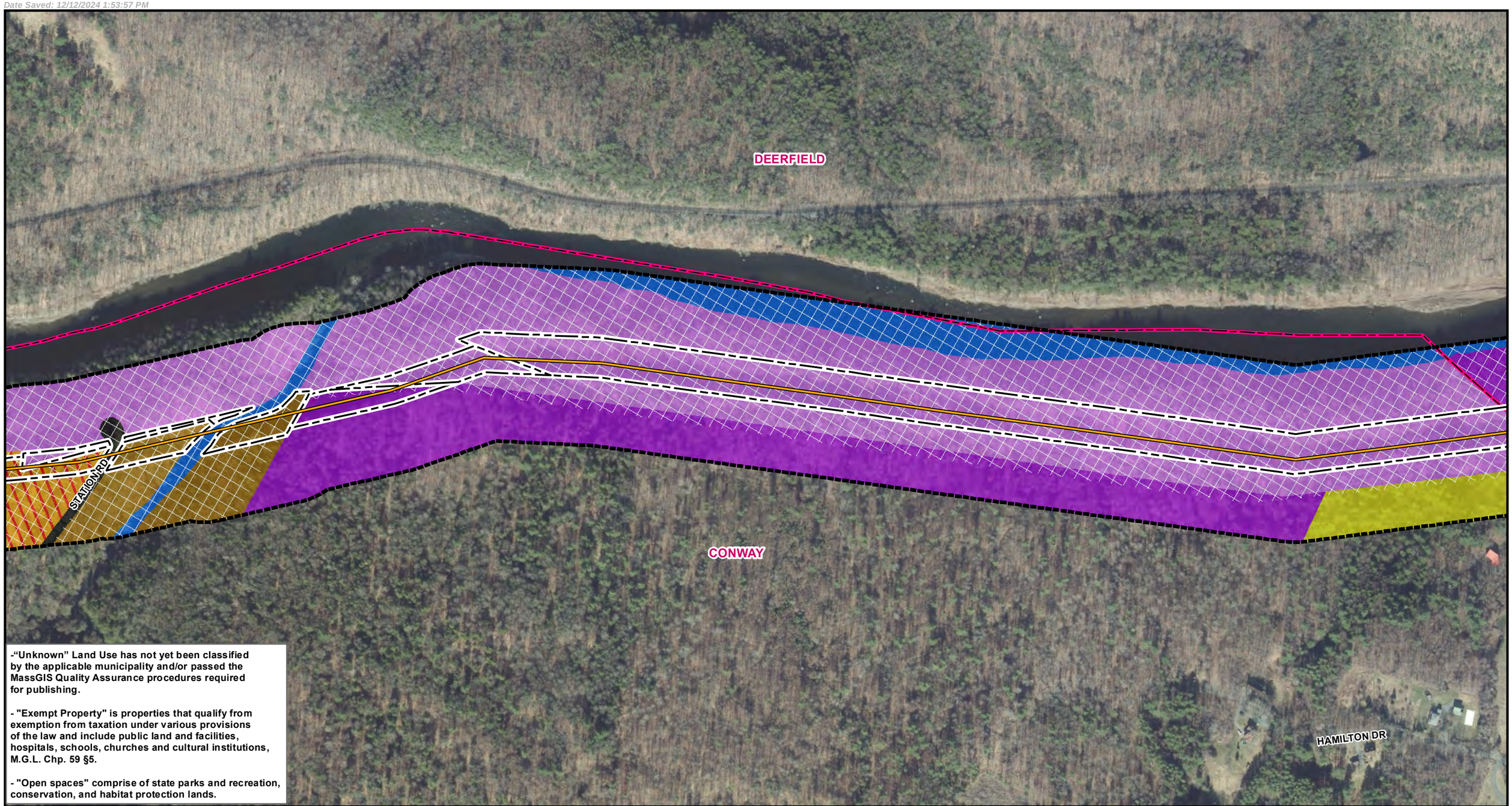

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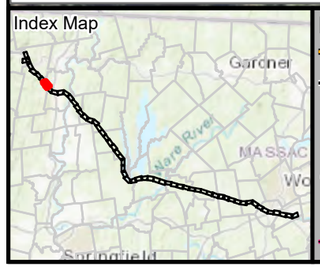

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Land Use Along the Project Route

Deerfield & Conway, MA

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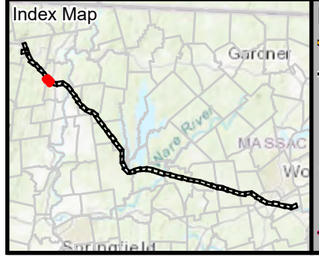

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Conway & Deerfield, MA

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DEERFIELD
91
91
I-91
MILL VILLAGE RD
SANDGULLY RD
MEADOW OAK LN
ALLEN DR
LEE RD

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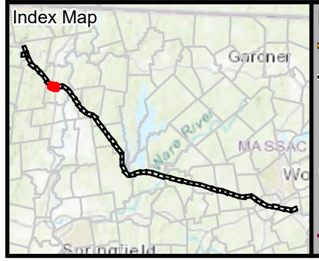

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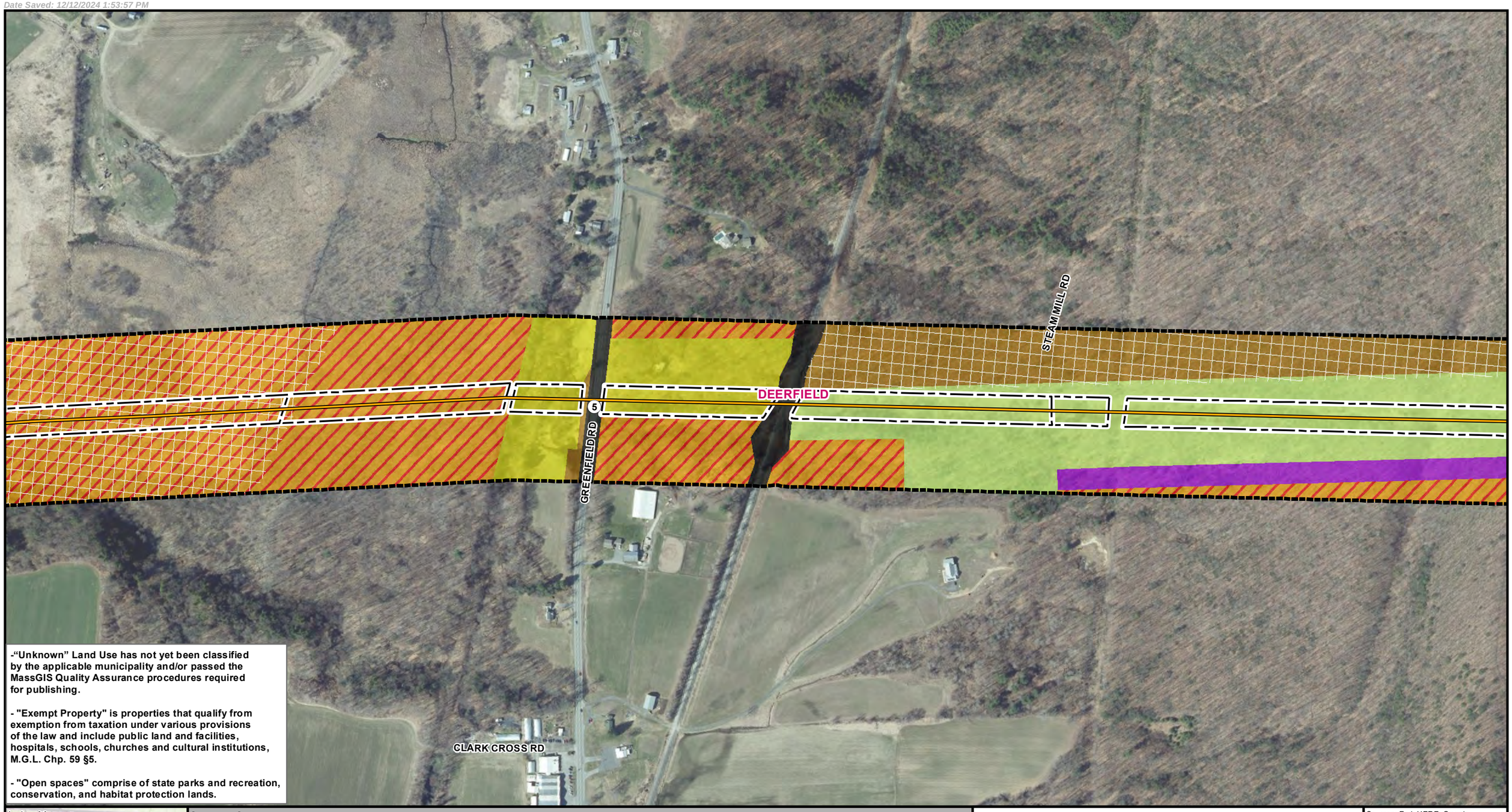

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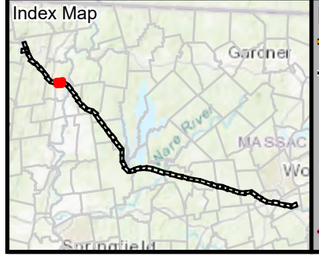

Legend

- Project Route
- Existing Right of Way
- Existing Substation
- National Grid Property
- 300ft Buffer to Existing ROWs
- Open Space
- Town Boundary

Land Use

- Agricultural/Horticultural
- Commercial
- Exempt Property
- Forest Property
- Industrial
- Mixed Use
- Recreational Property
- Residential
- Vacant
- Transportation
- Unknown
- Water

N

1 inch = 400 feet
0 200 400
Feet

**Indicates Layers Set to Transparency*

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Land Use Along the Project Route

Deerfield, MA

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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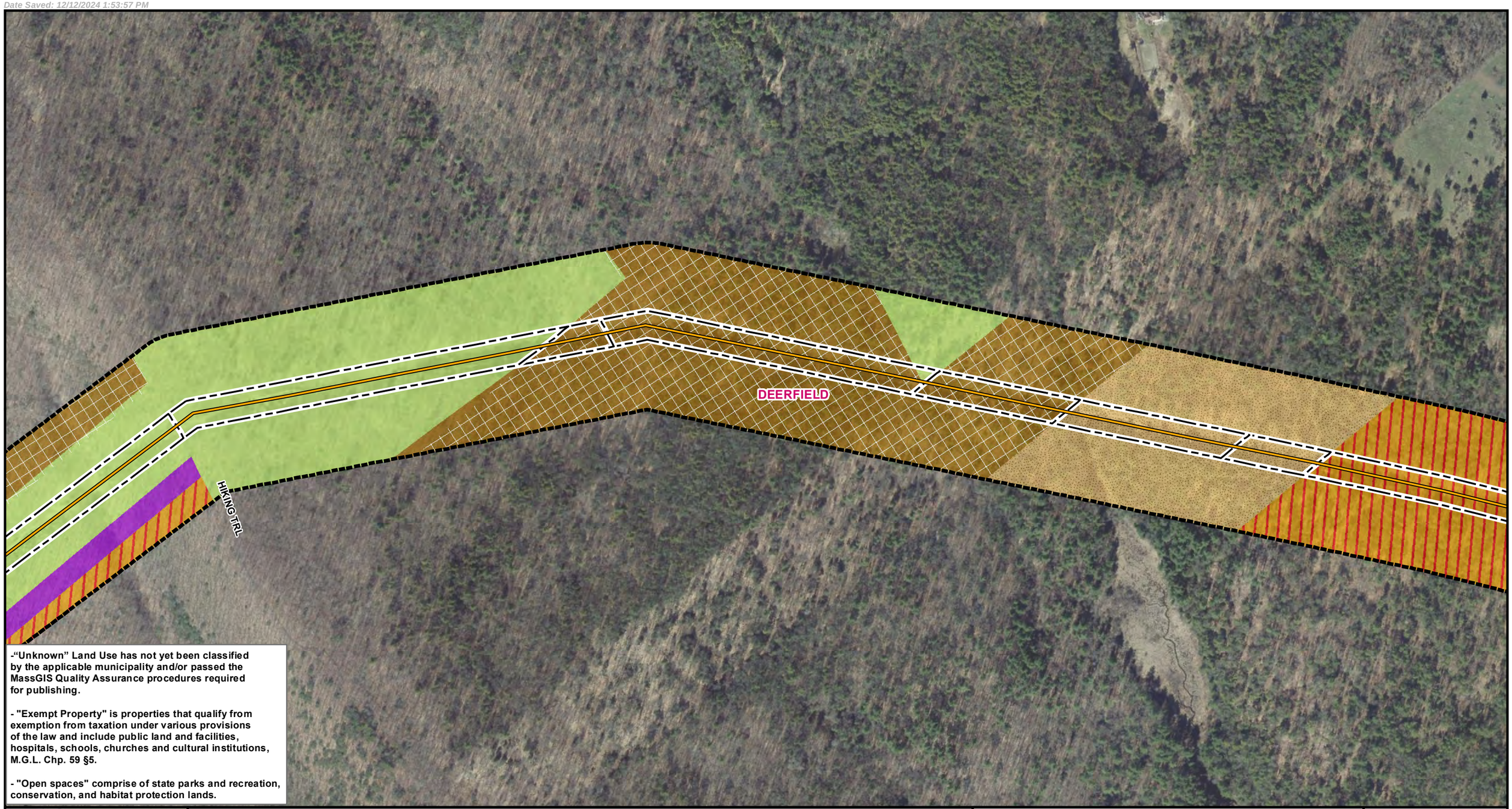

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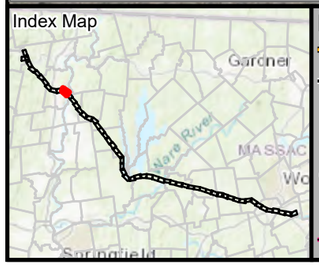

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Land Use Along the Project Route

Deerfield, MA

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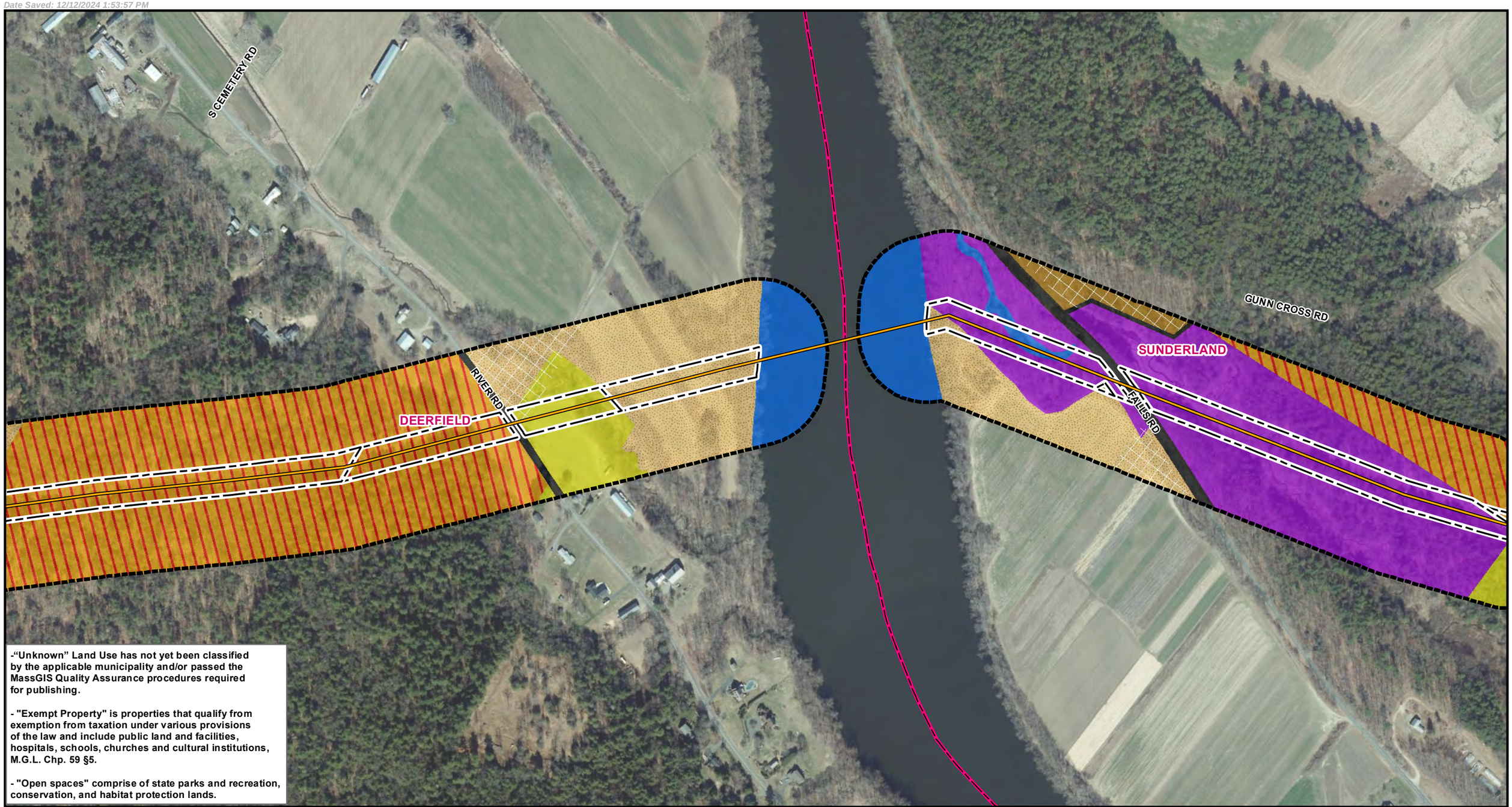

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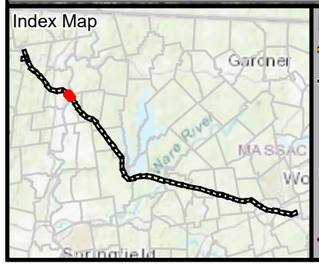

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Land Use Along the Project Route

Deerfield & Sunderland, MA

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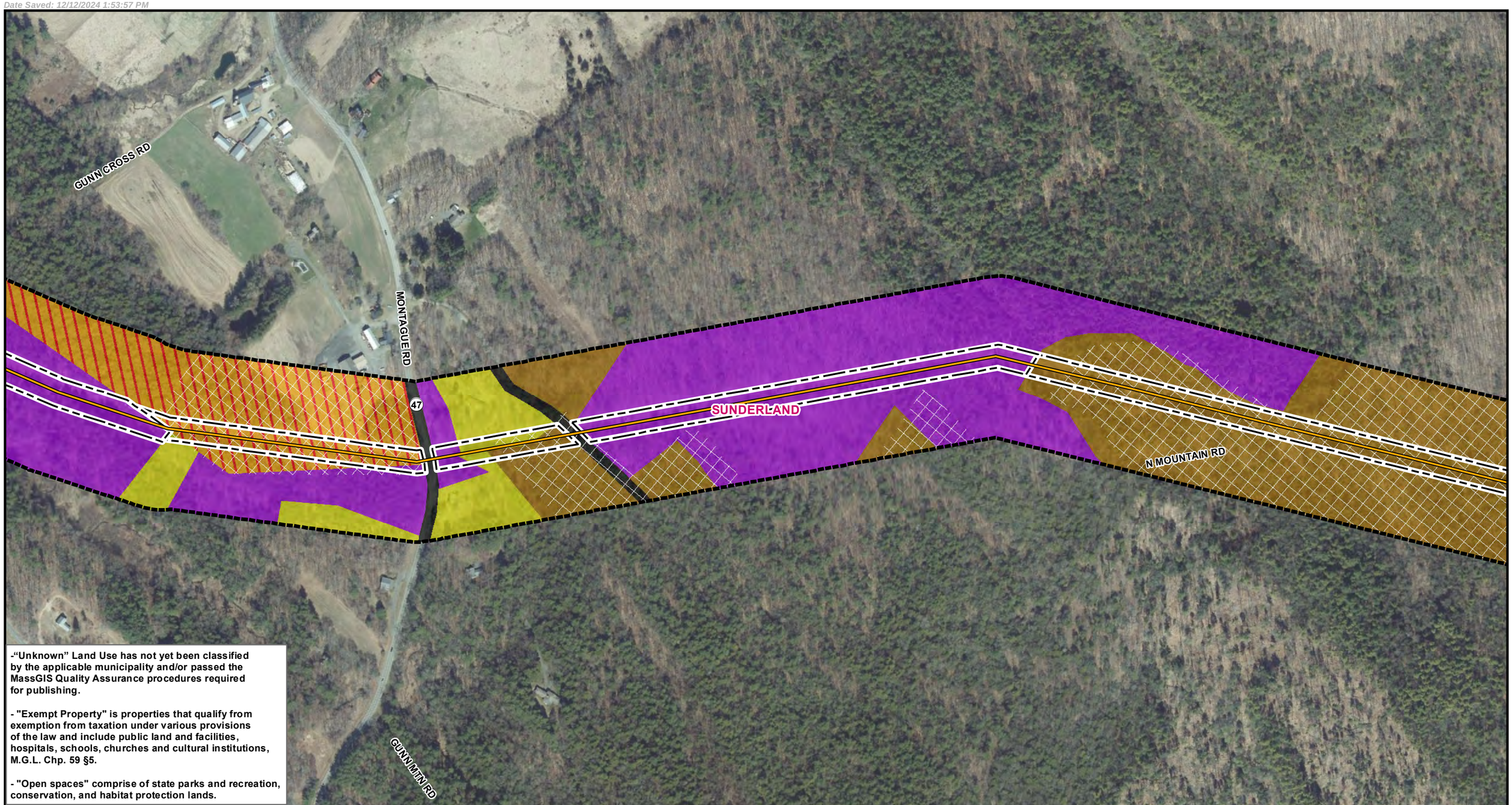

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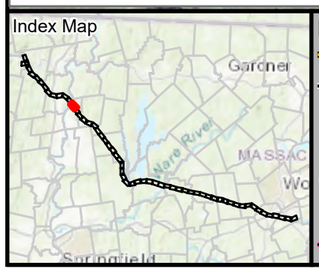

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Land Use Along the Project Route

Sunderland, MA

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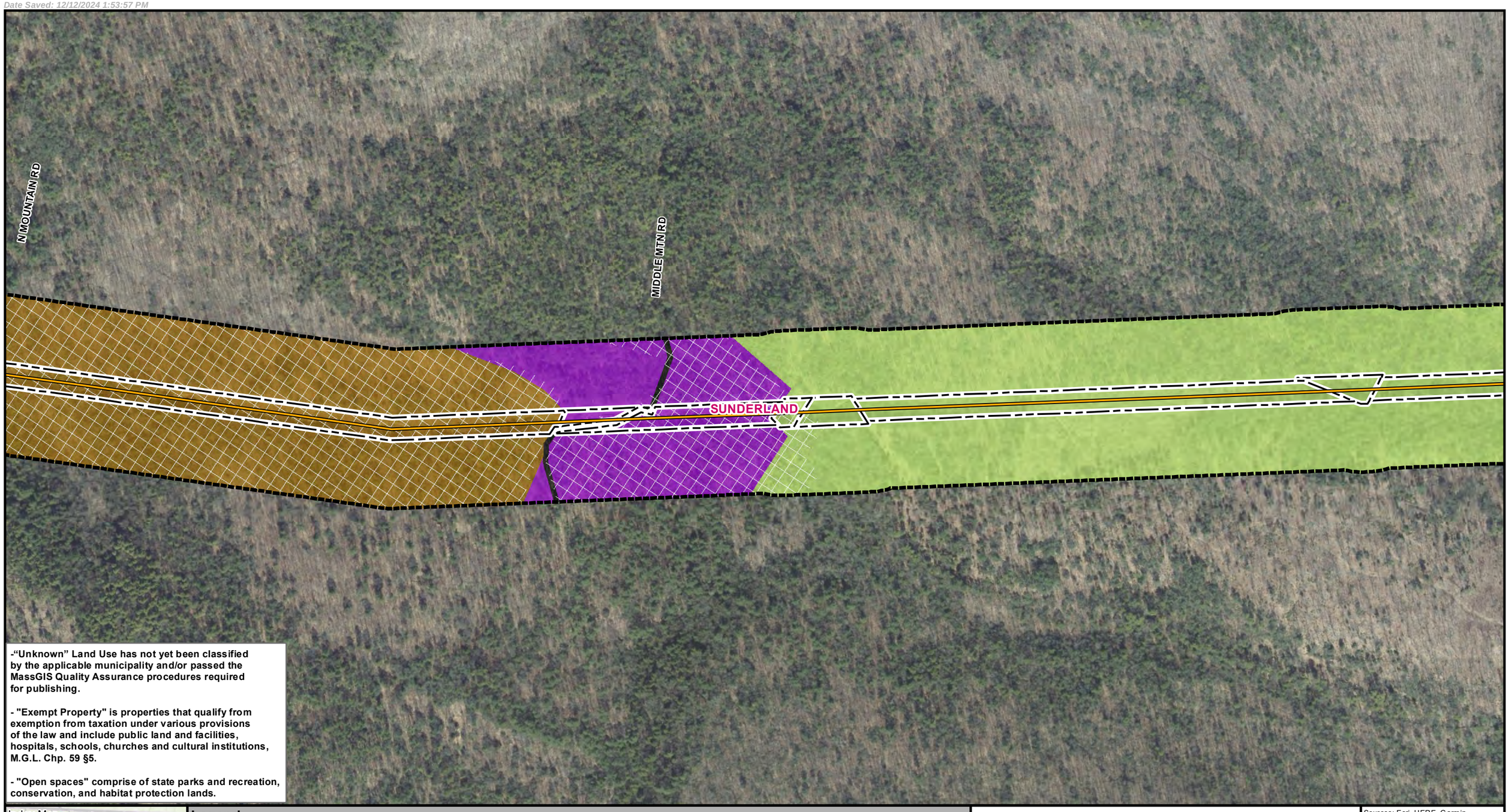

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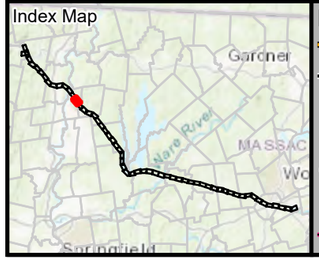

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Land Use Along the Project Route

Sunderland, MA

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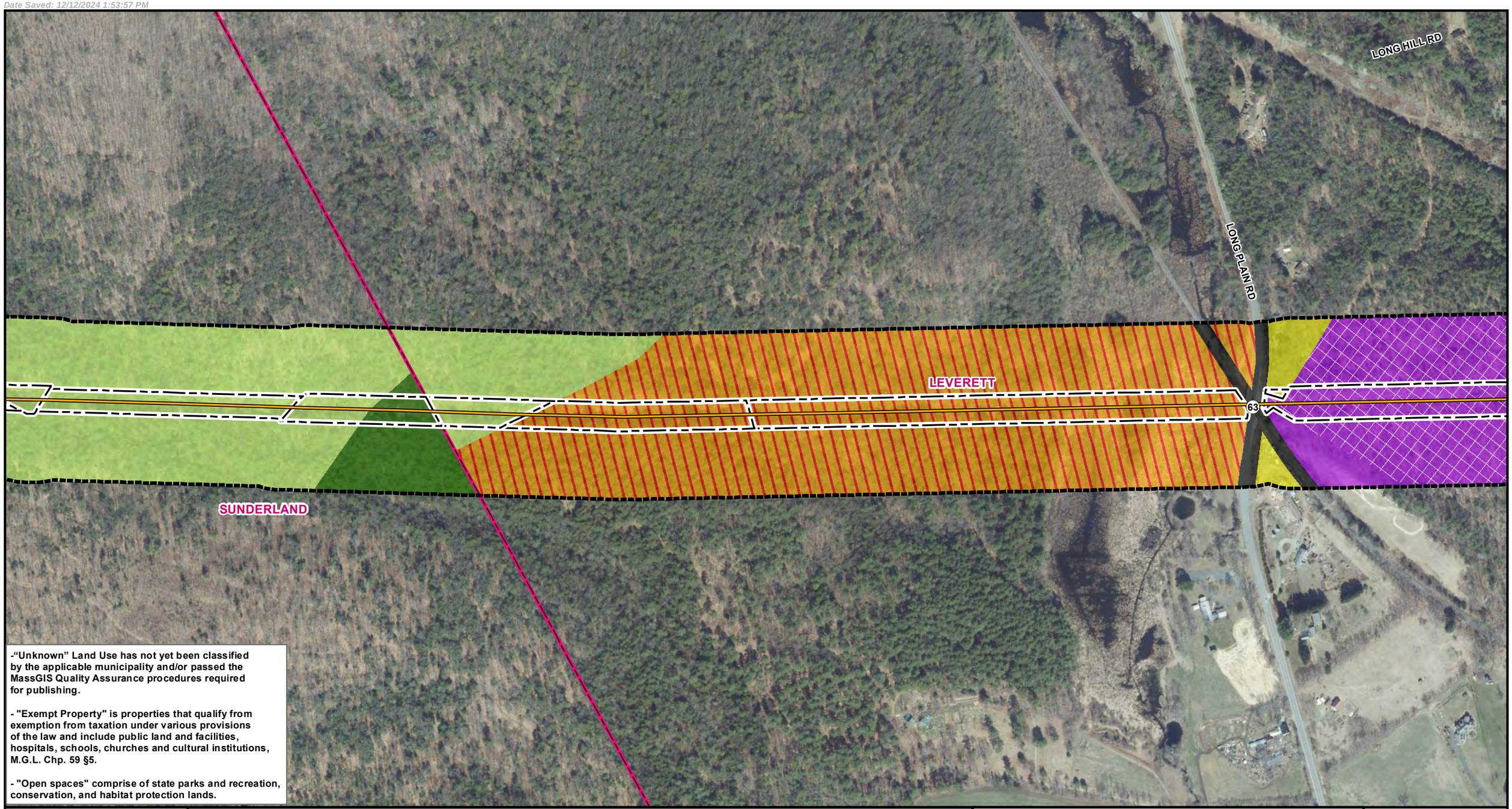

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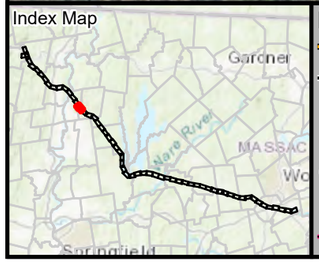
Index Map



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Land Use Along the Project Route

Sunderland & Leverett, MA

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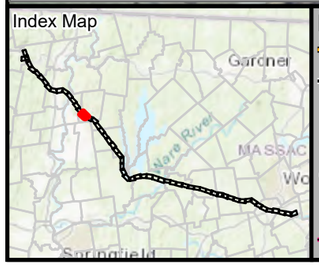

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Land Use Along the Project Route

Leverett, MA

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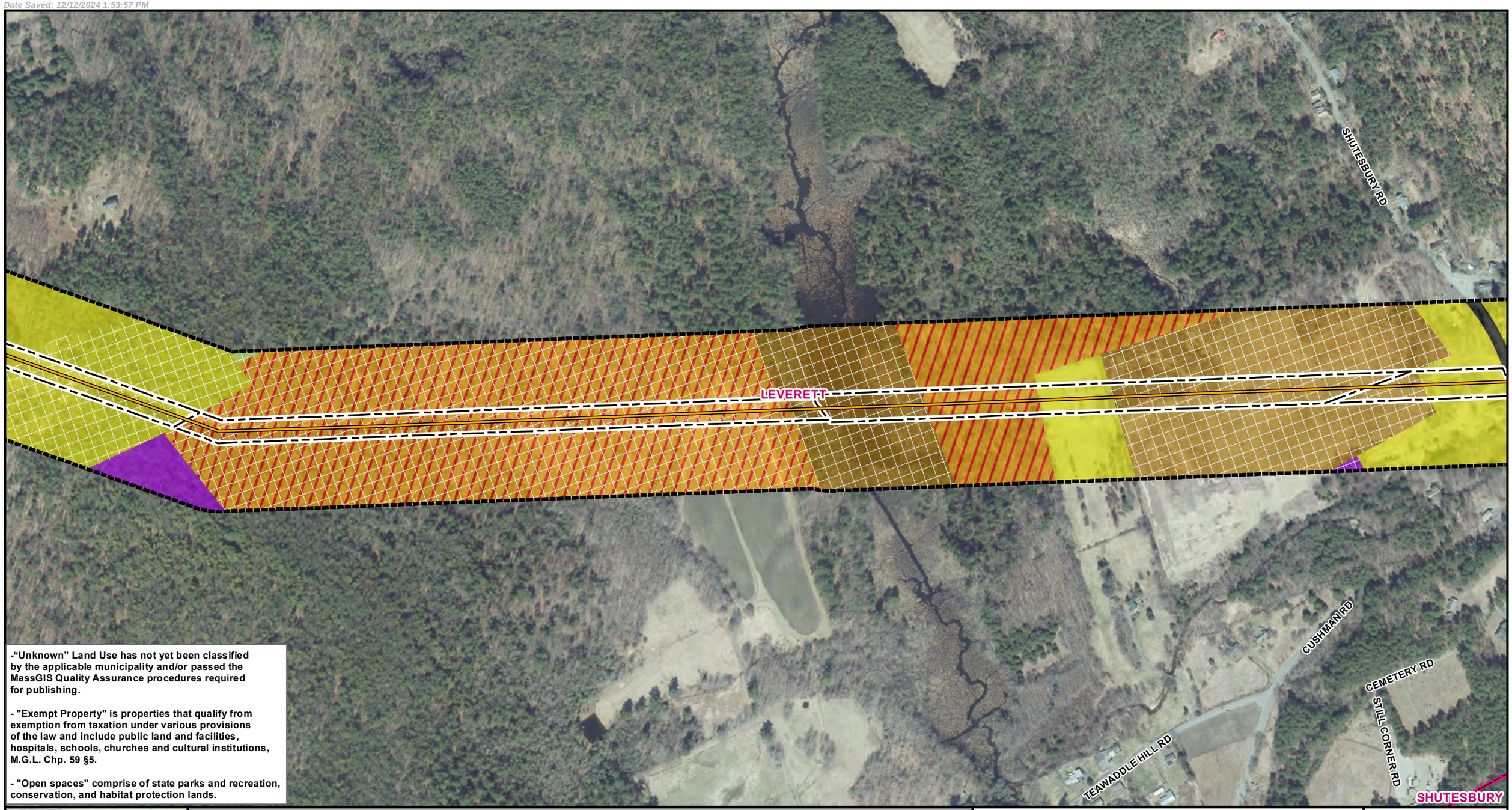

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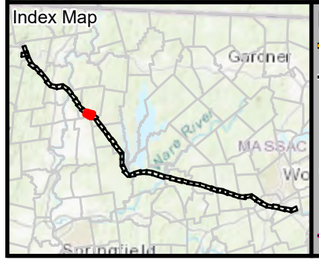

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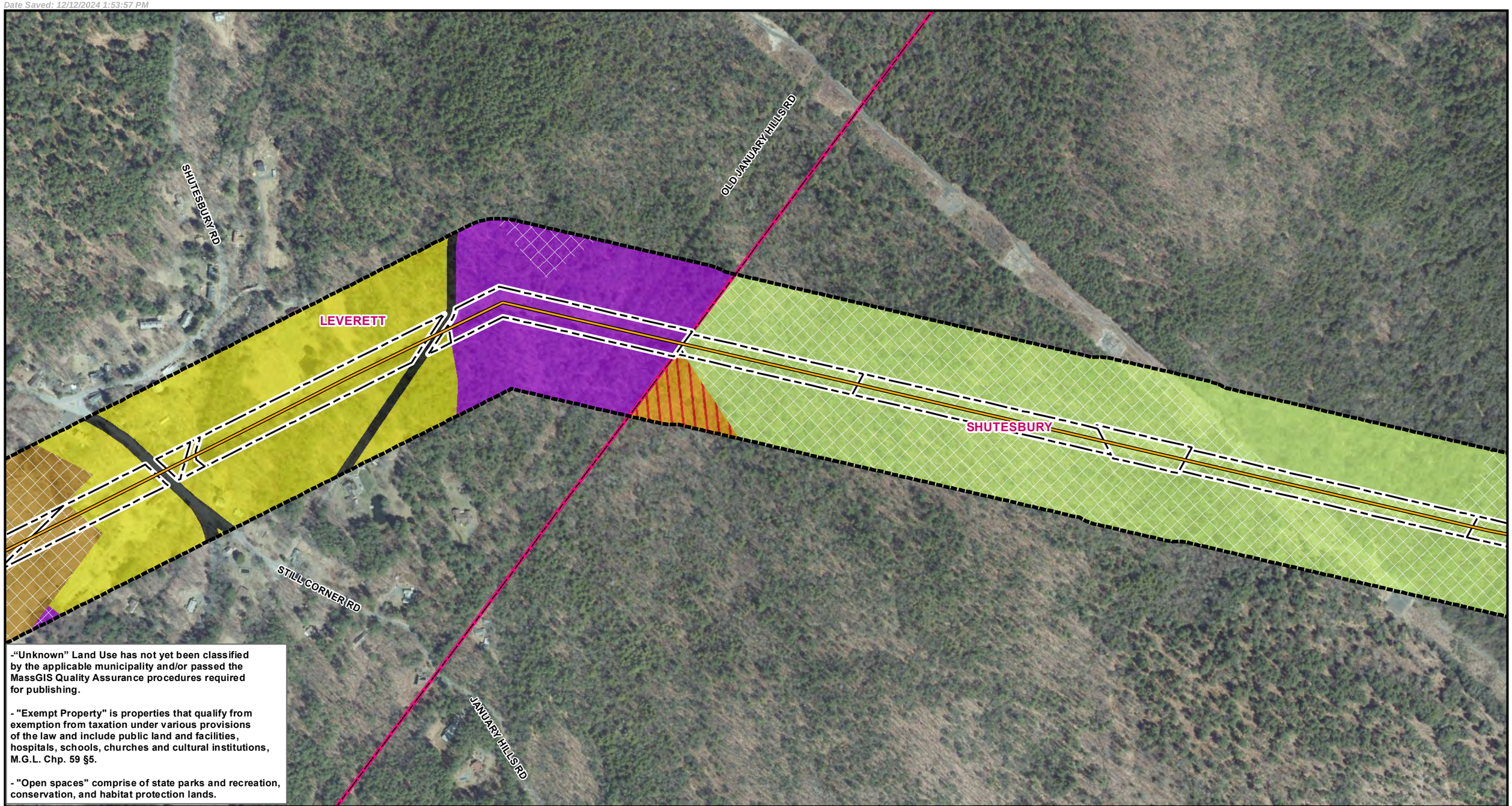

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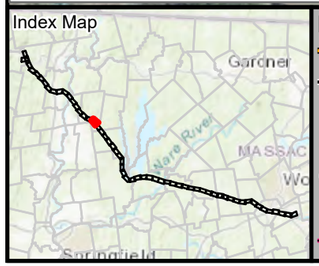

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Land Use Along the Project Route

Leverett & Shutesbury, MA

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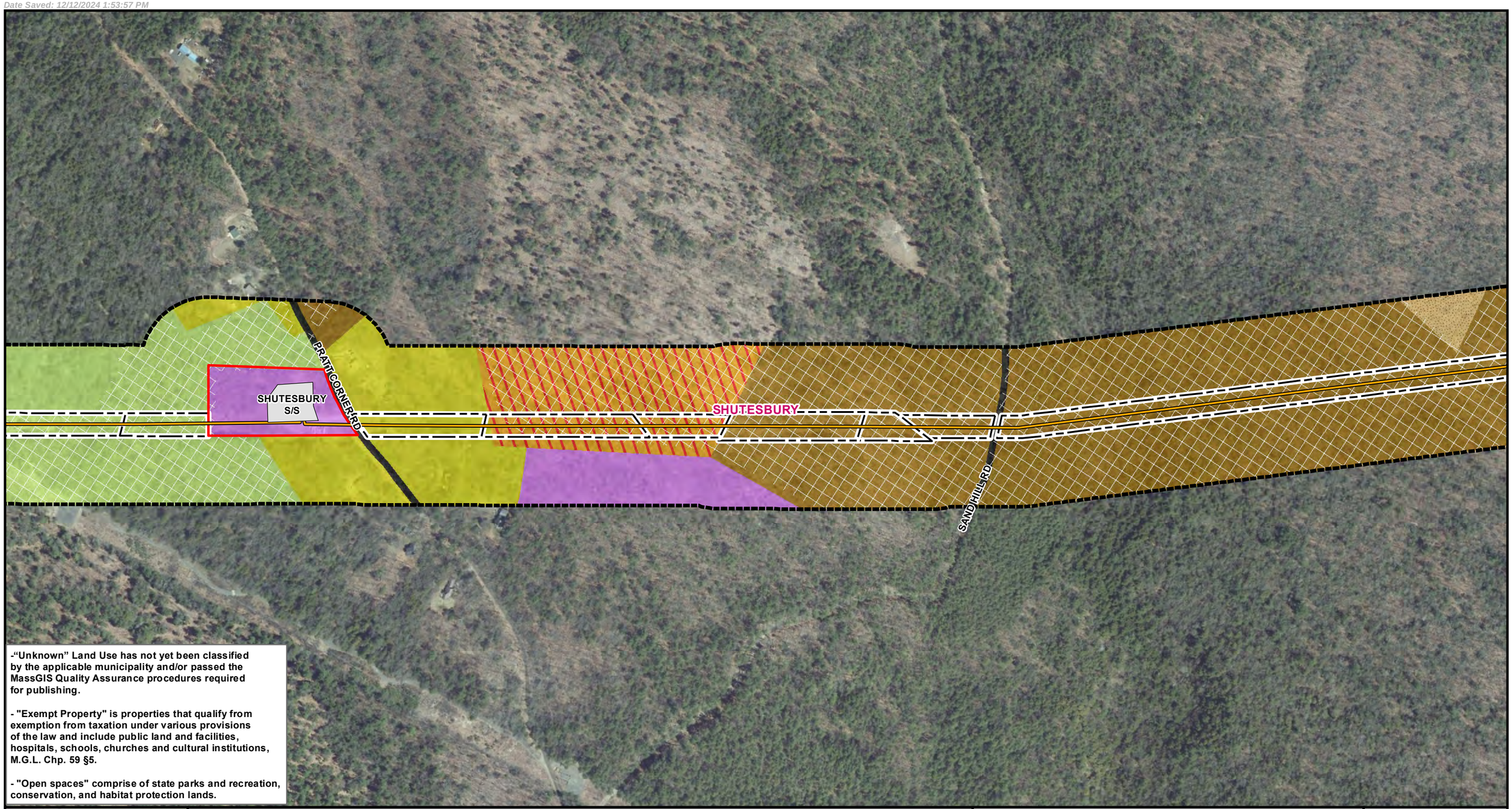

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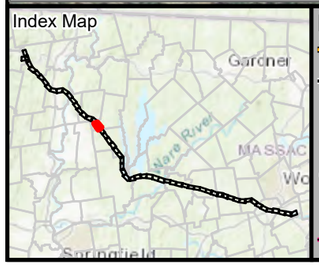

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Shutesbury, MA

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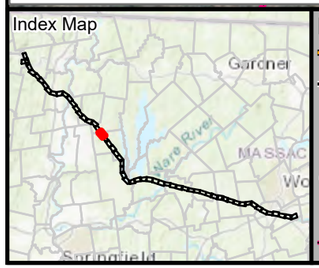

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Shutesbury & Pelham, MA

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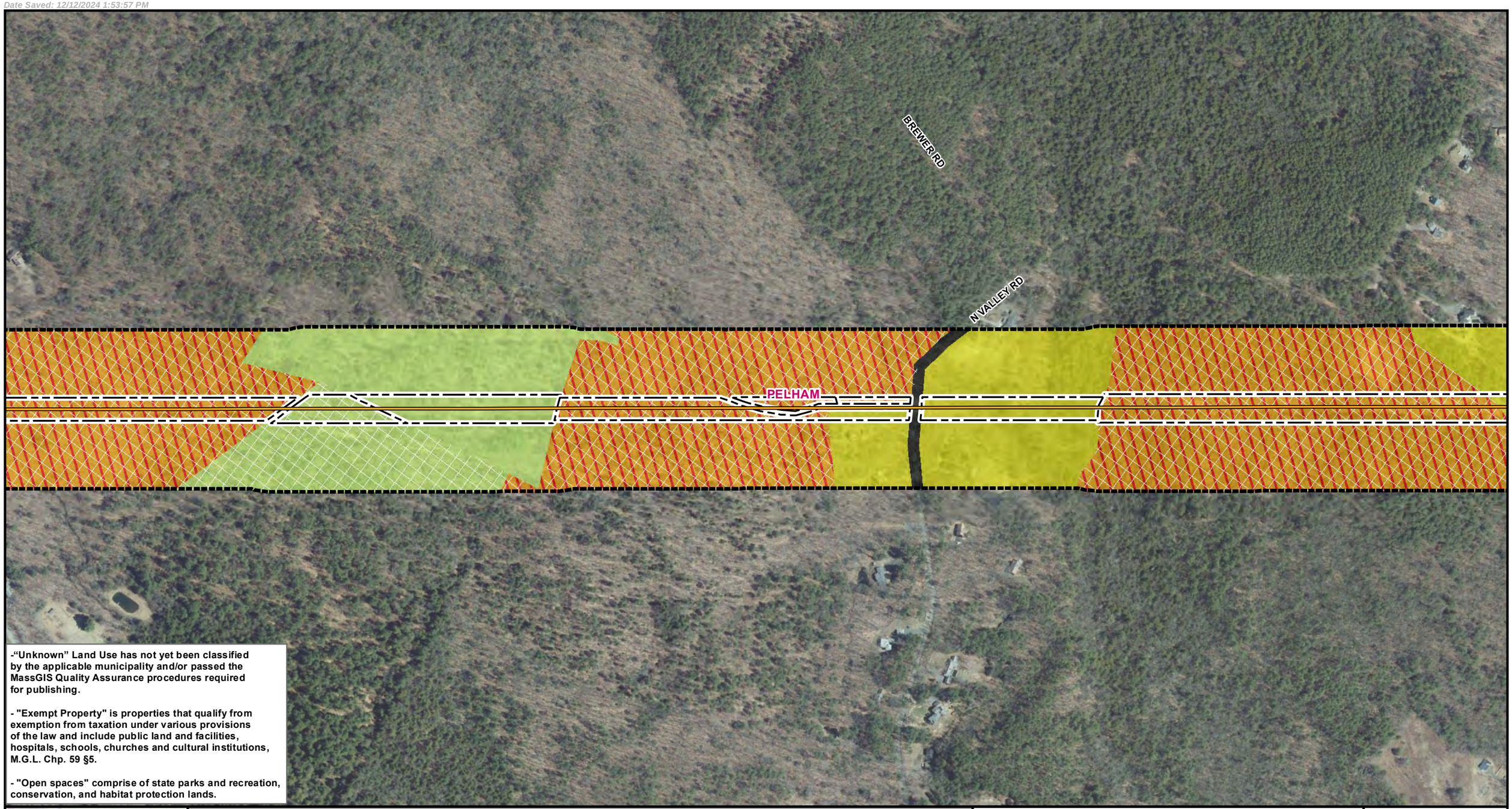

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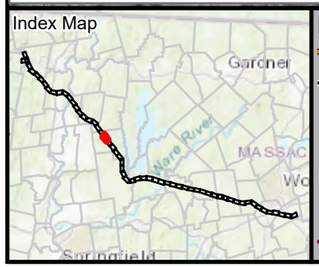

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Land Use Along the Project Route

Pelham, MA

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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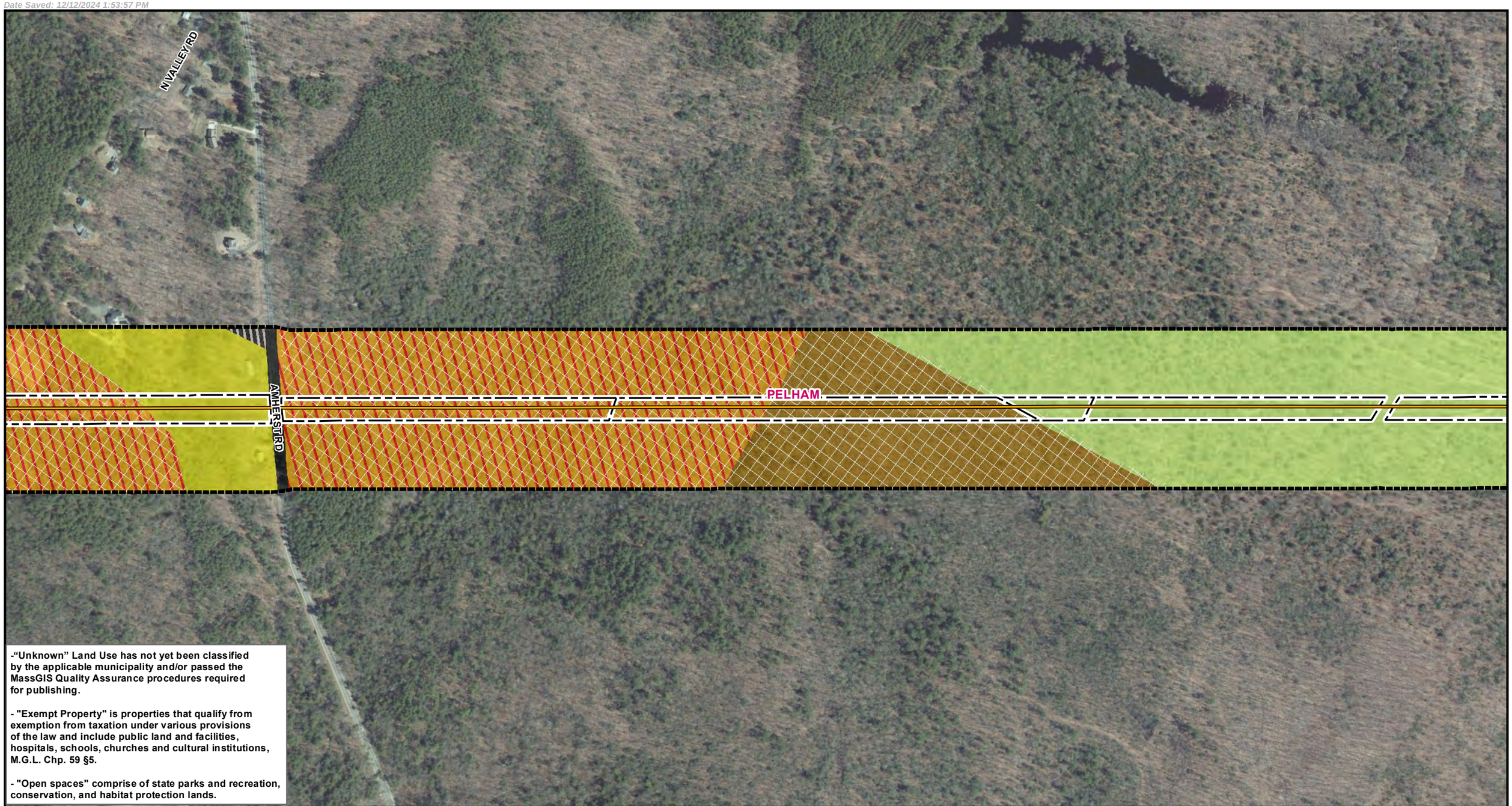

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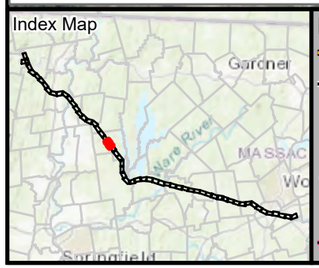

Legend

- Project Route
- Existing Right of Way
- Existing Substation
- National Grid Property
- 300ft Buffer to Existing ROWs
- Open Space
- Town Boundary

Land Use

- Agricultural/Horticultural
- Commercial
- Exempt Property
- Forest Property
- Industrial
- Mixed Use
- Recreational Property
- Residential
- Vacant
- Transportation
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1 inch = 400 feet
0 200 400
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Land Use Along the Project Route

Pelham, MA

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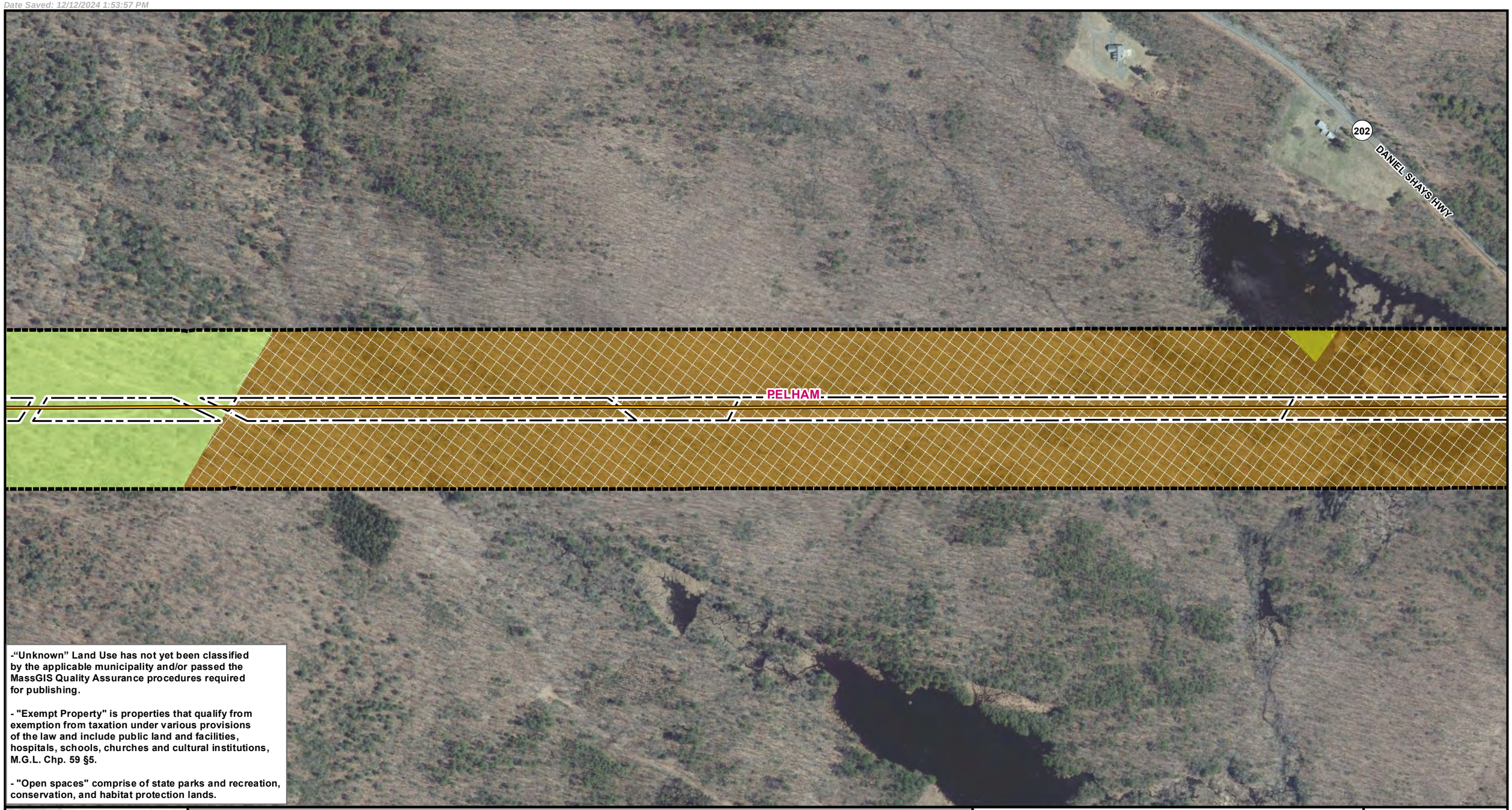

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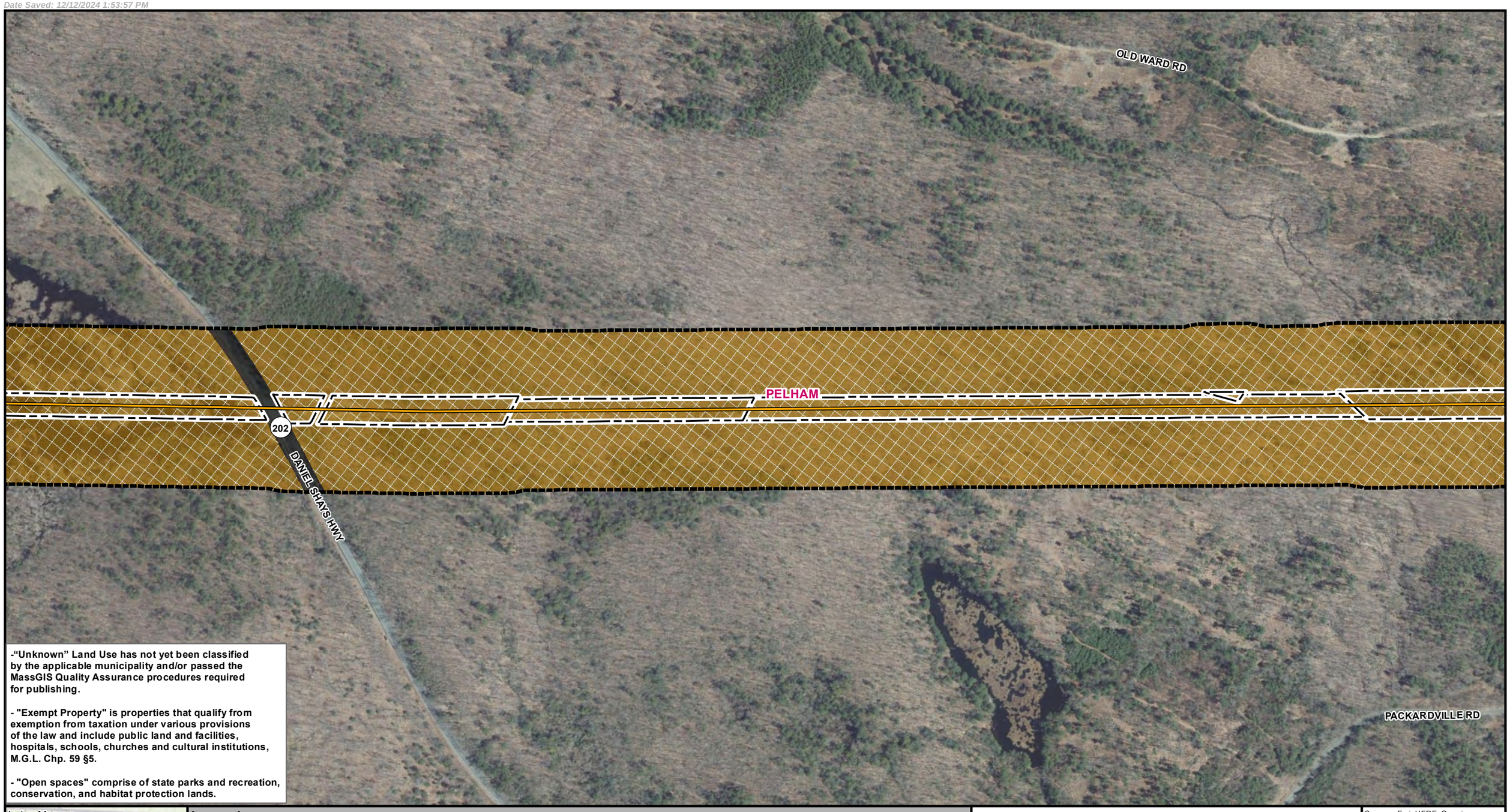

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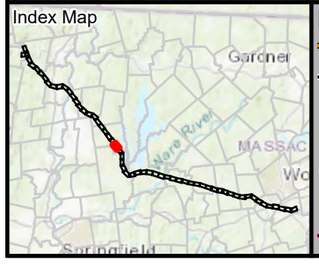

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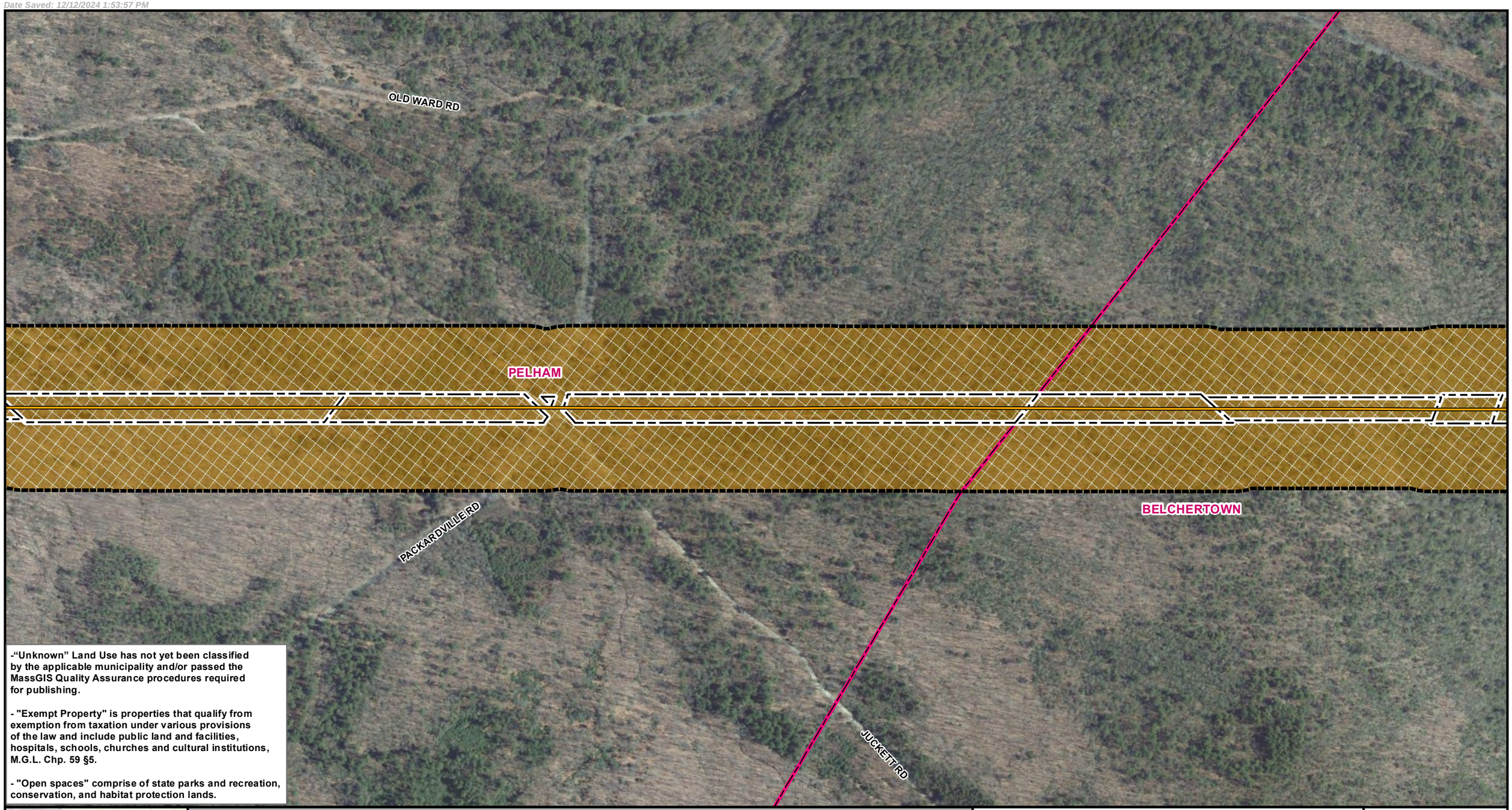

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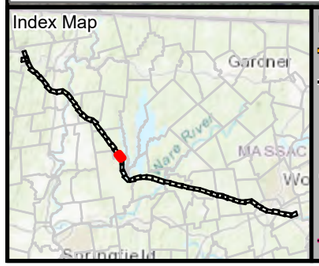

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Land Use Along the Project Route

Pelham & Belchertown, MA

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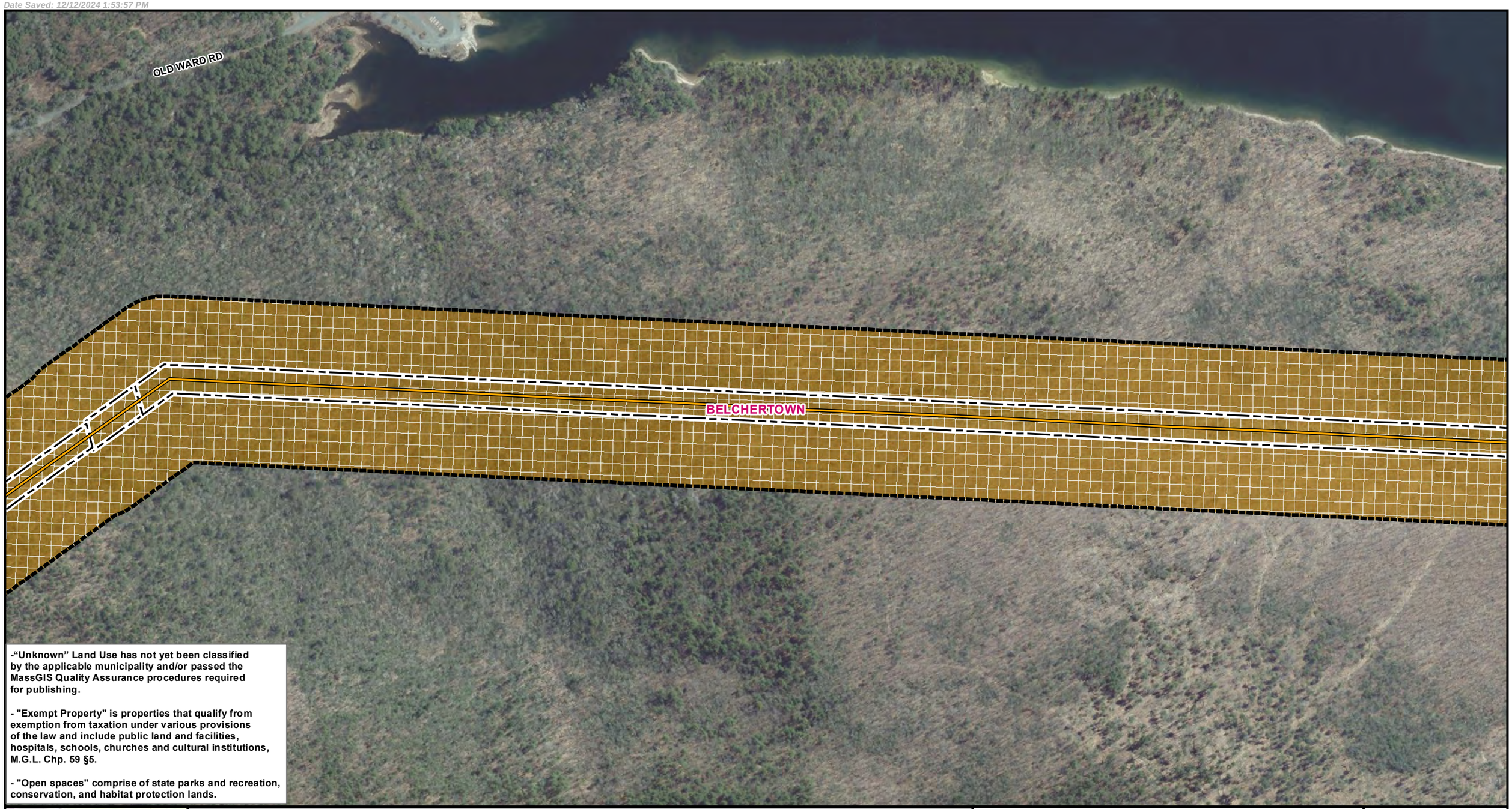

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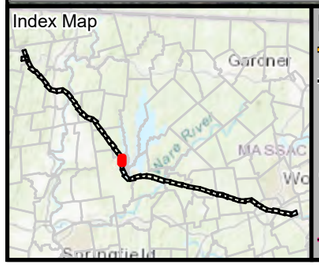

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Land Use Along the Project Route

Belchertown, MA

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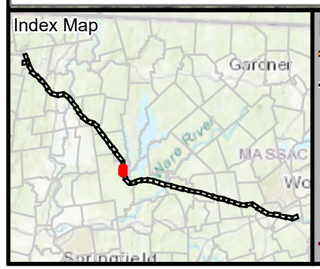

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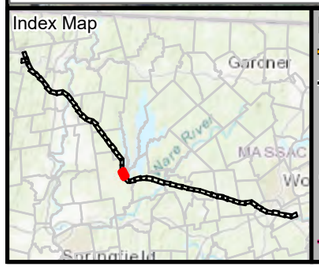

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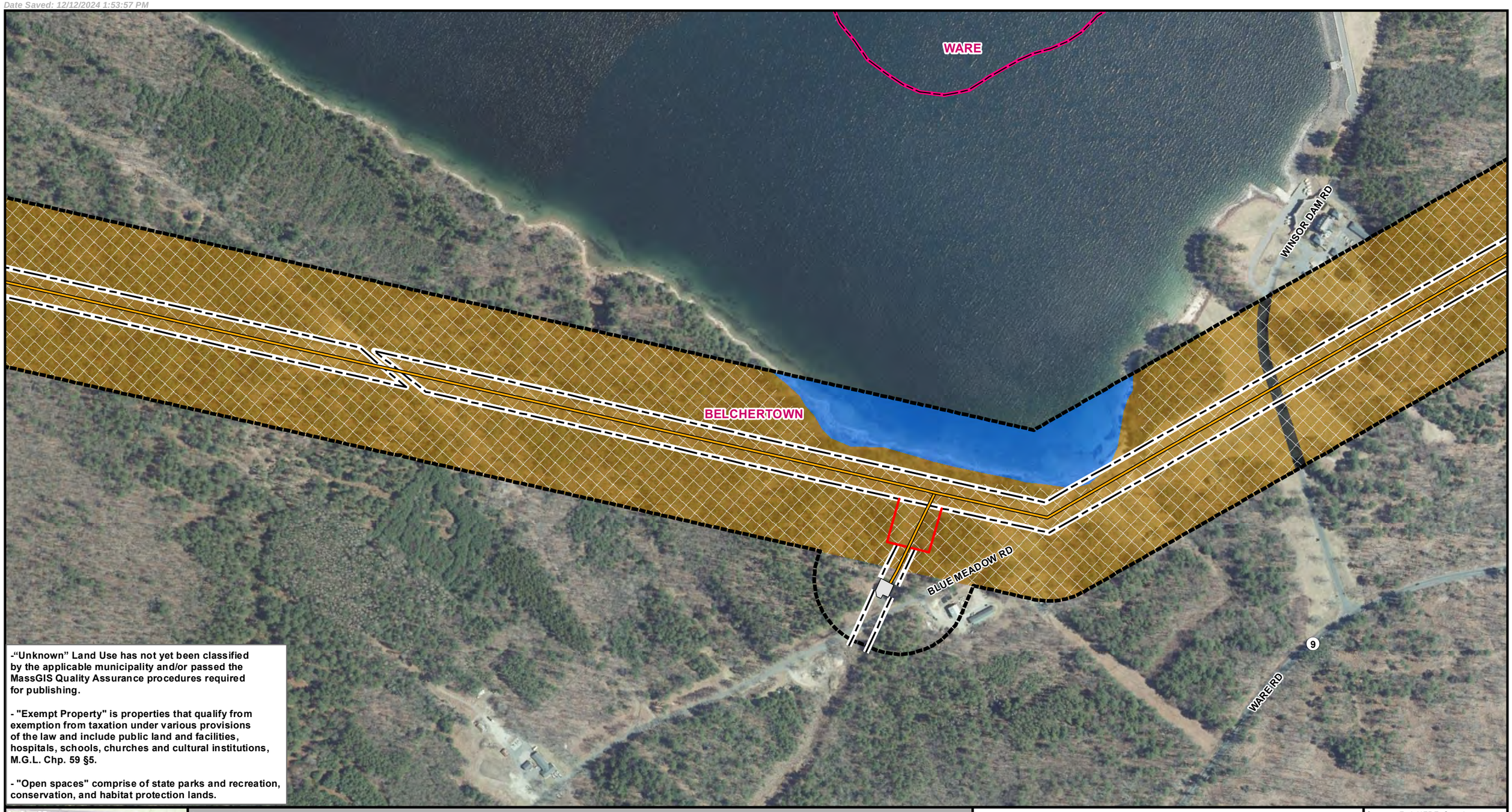

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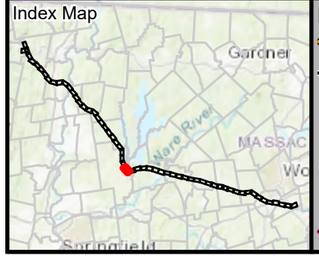

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Land Use Along the Project Route

Belchertown, MA

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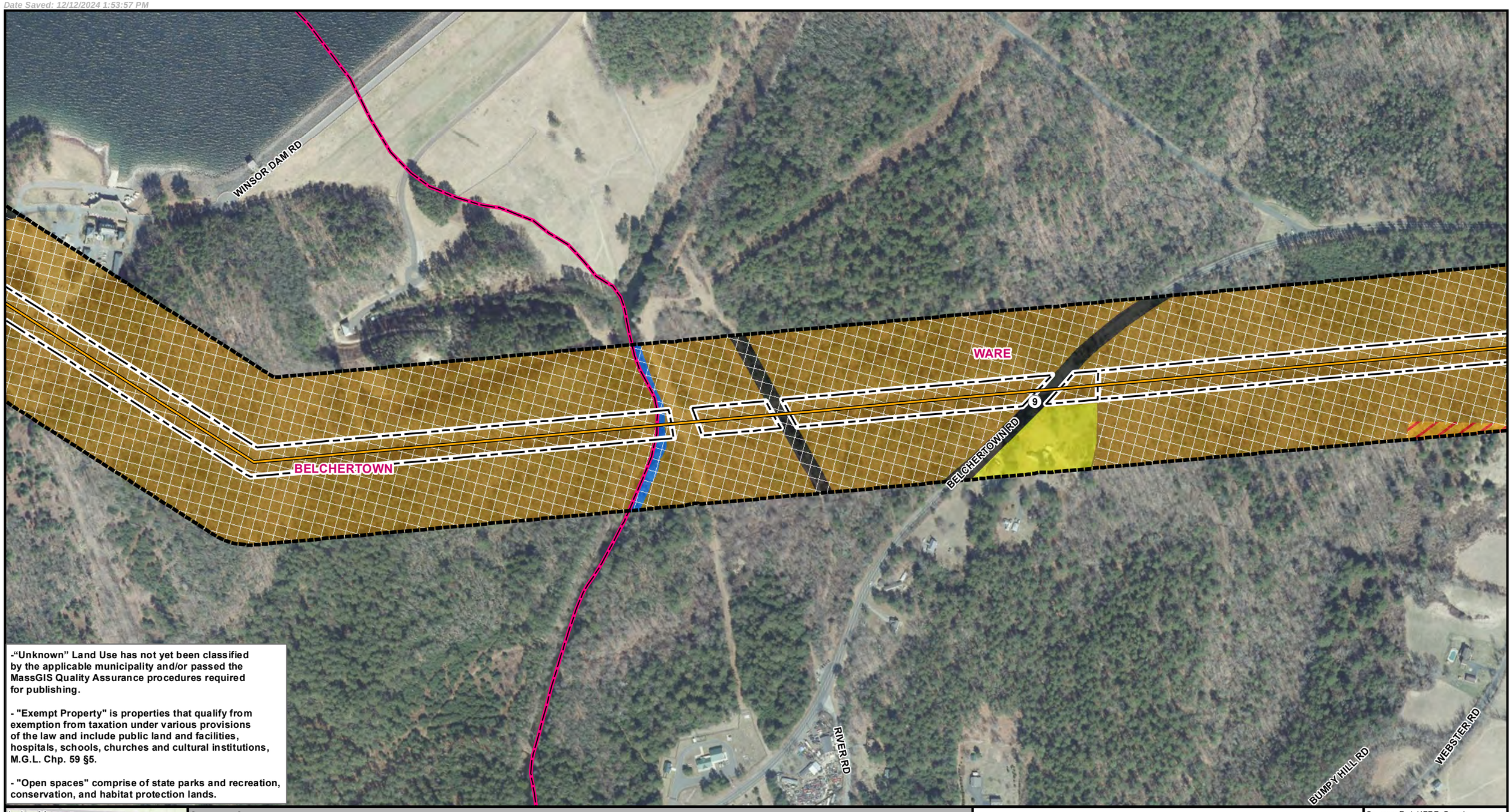

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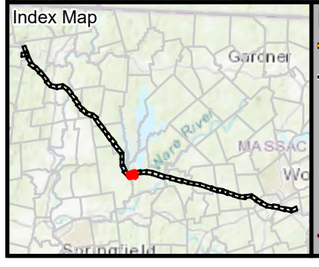

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Land Use Along the Project Route

Belchertown & Ware, MA

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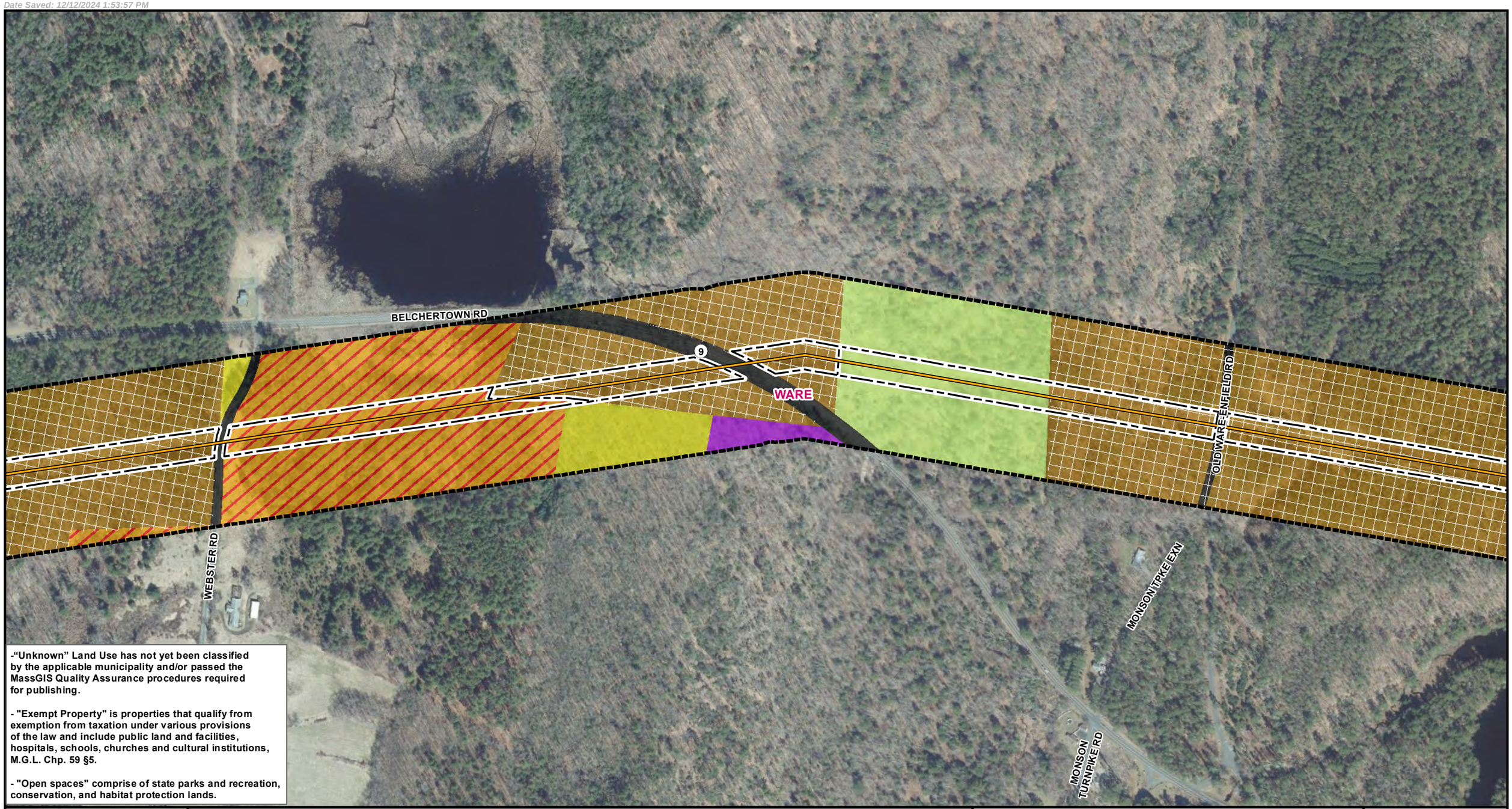

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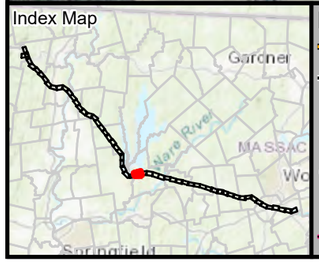

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Land Use Along the Project Route

Ware, MA

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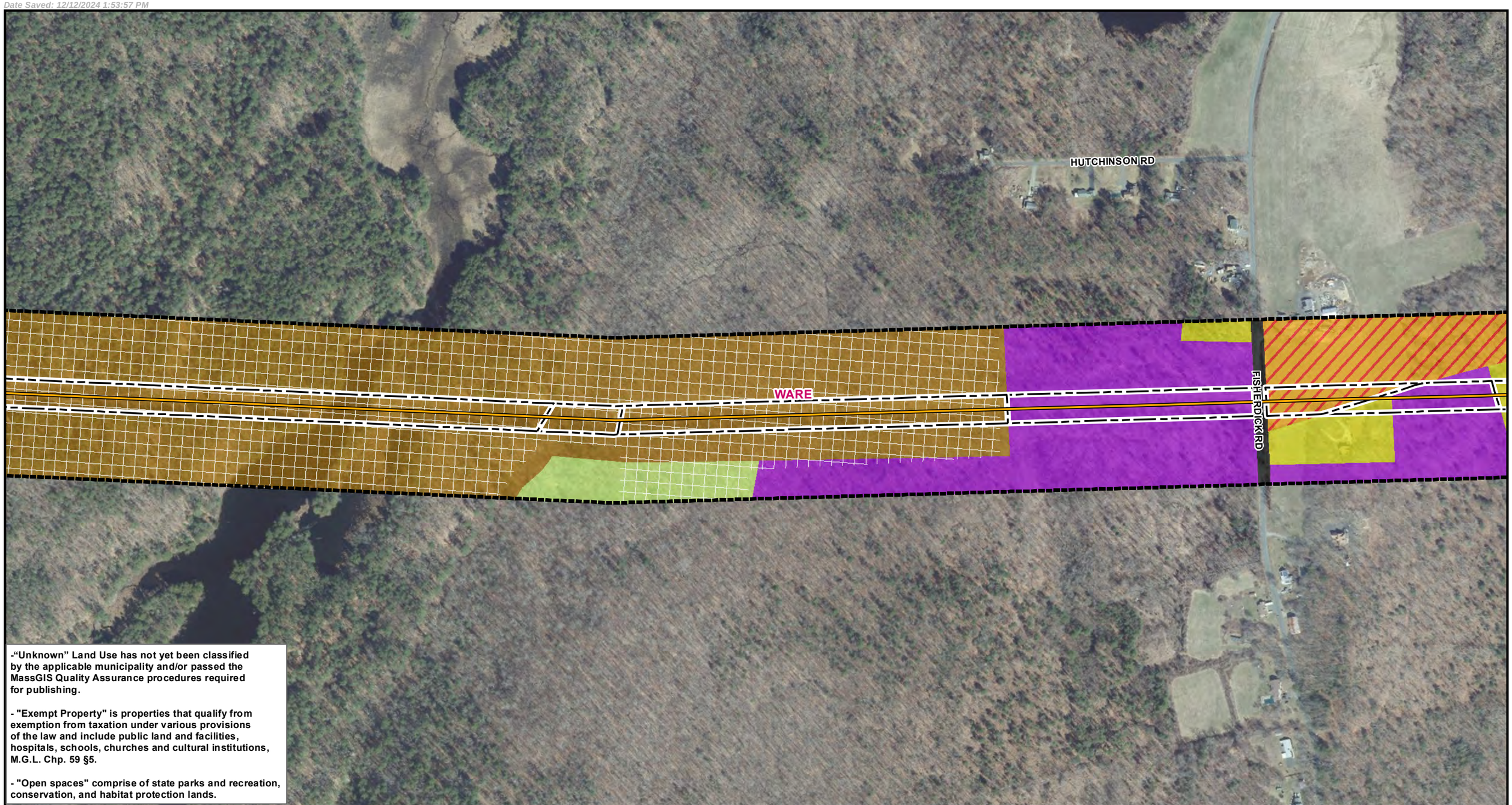

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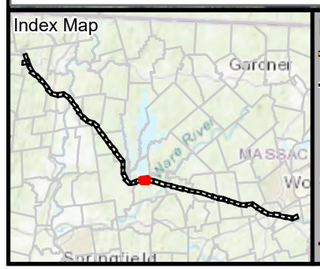

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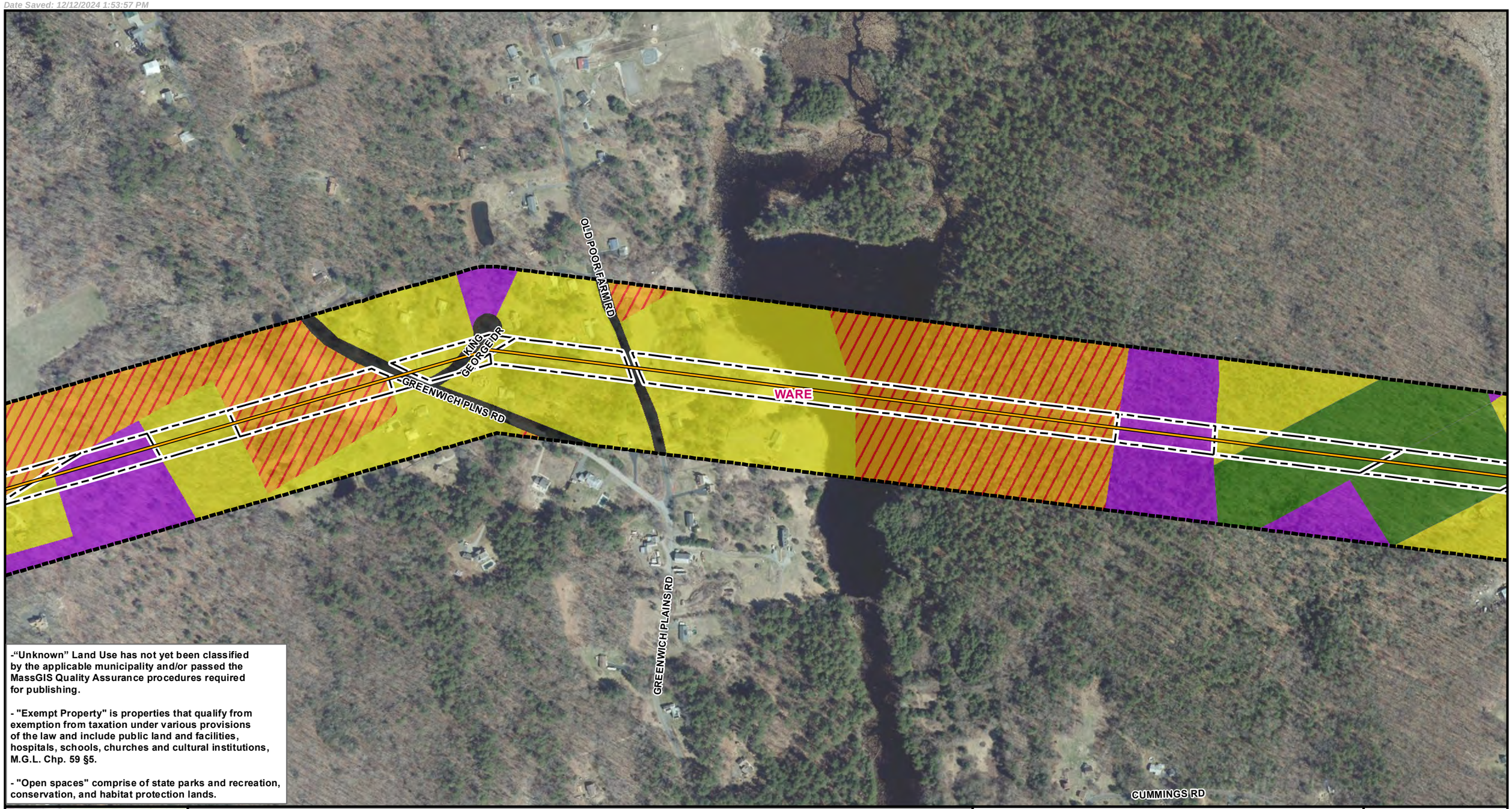

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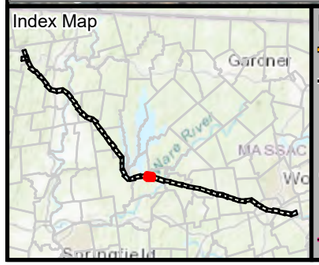

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1 inch = 400 feet
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Feet

Indicates Layers Set to Transparency

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Land Use Along the Project Route

Ware, MA

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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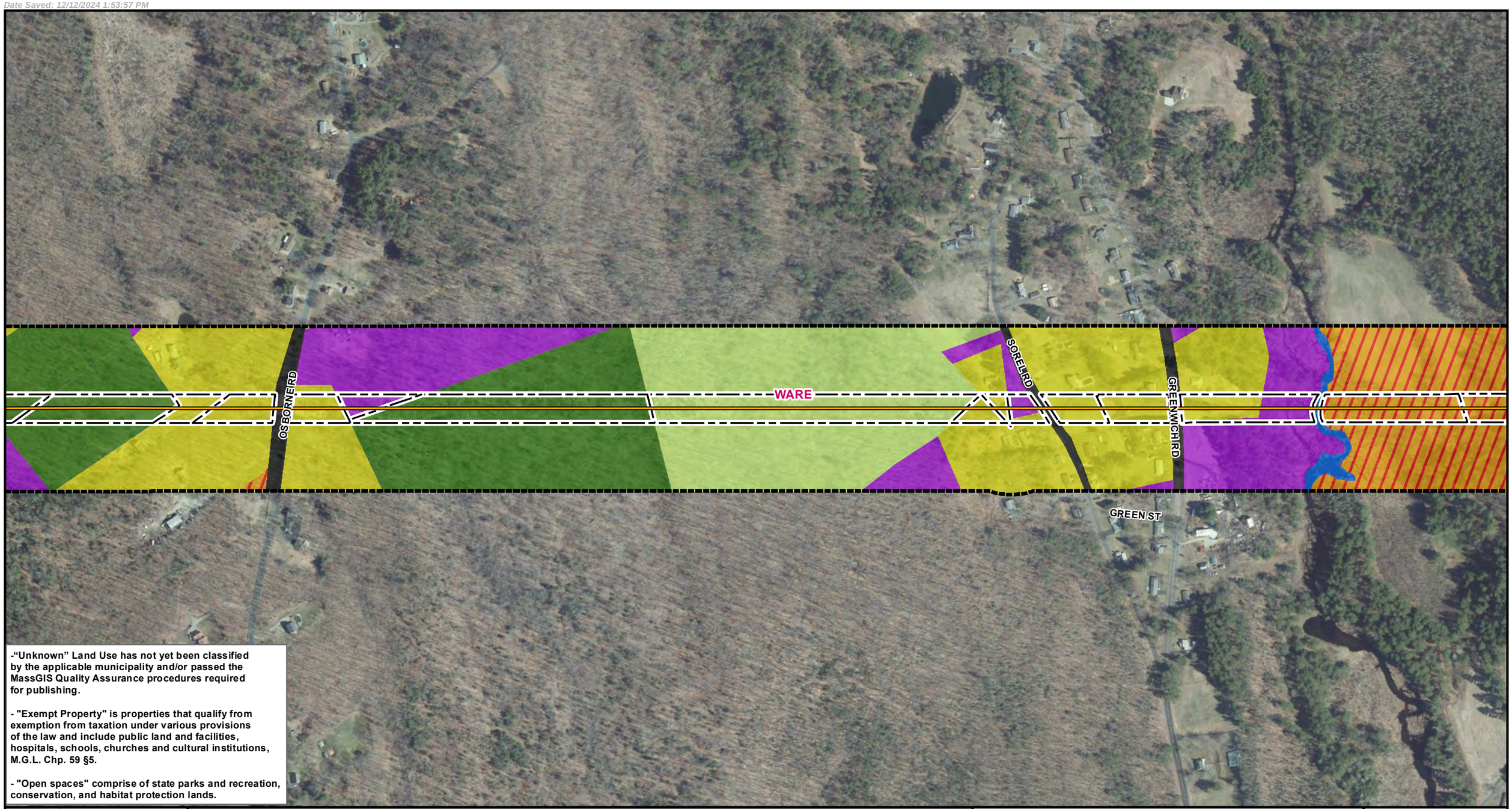

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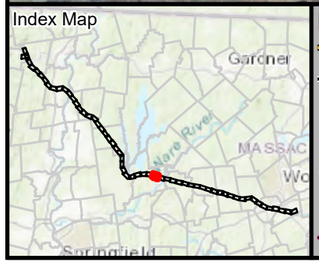
Index Map



Legend

- Project Route
- Existing Right of Way
- Existing Substation
- National Grid Property
- 300ft Buffer to Existing ROWs
- Open Space
- Town Boundary

Land Use

- Agricultural/Horticultural
- Commercial
- Exempt Property
- Forest Property
- Industrial
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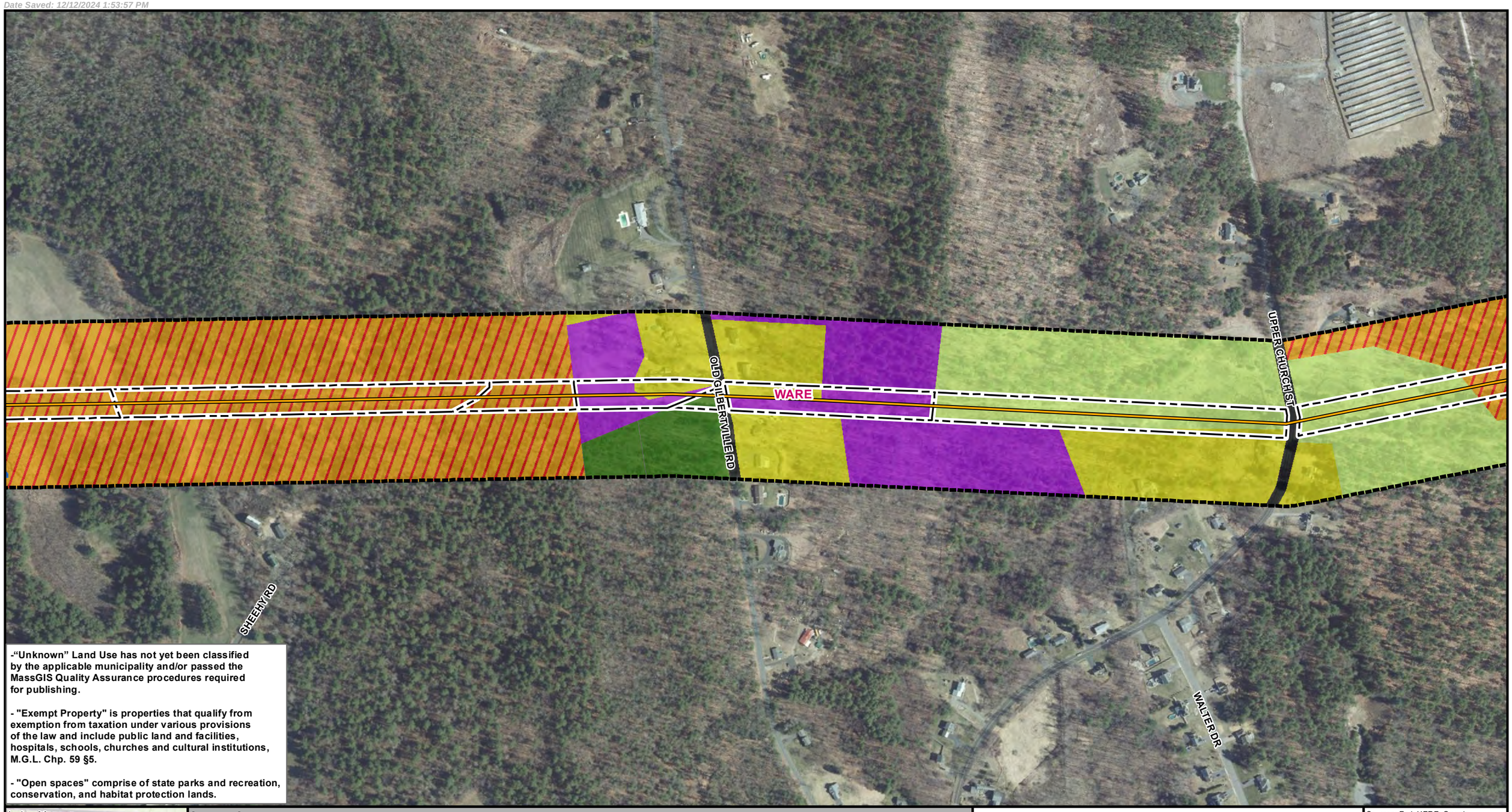

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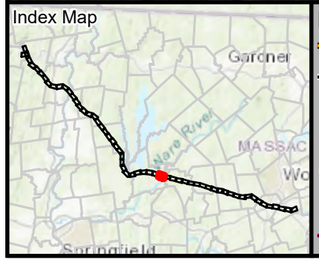

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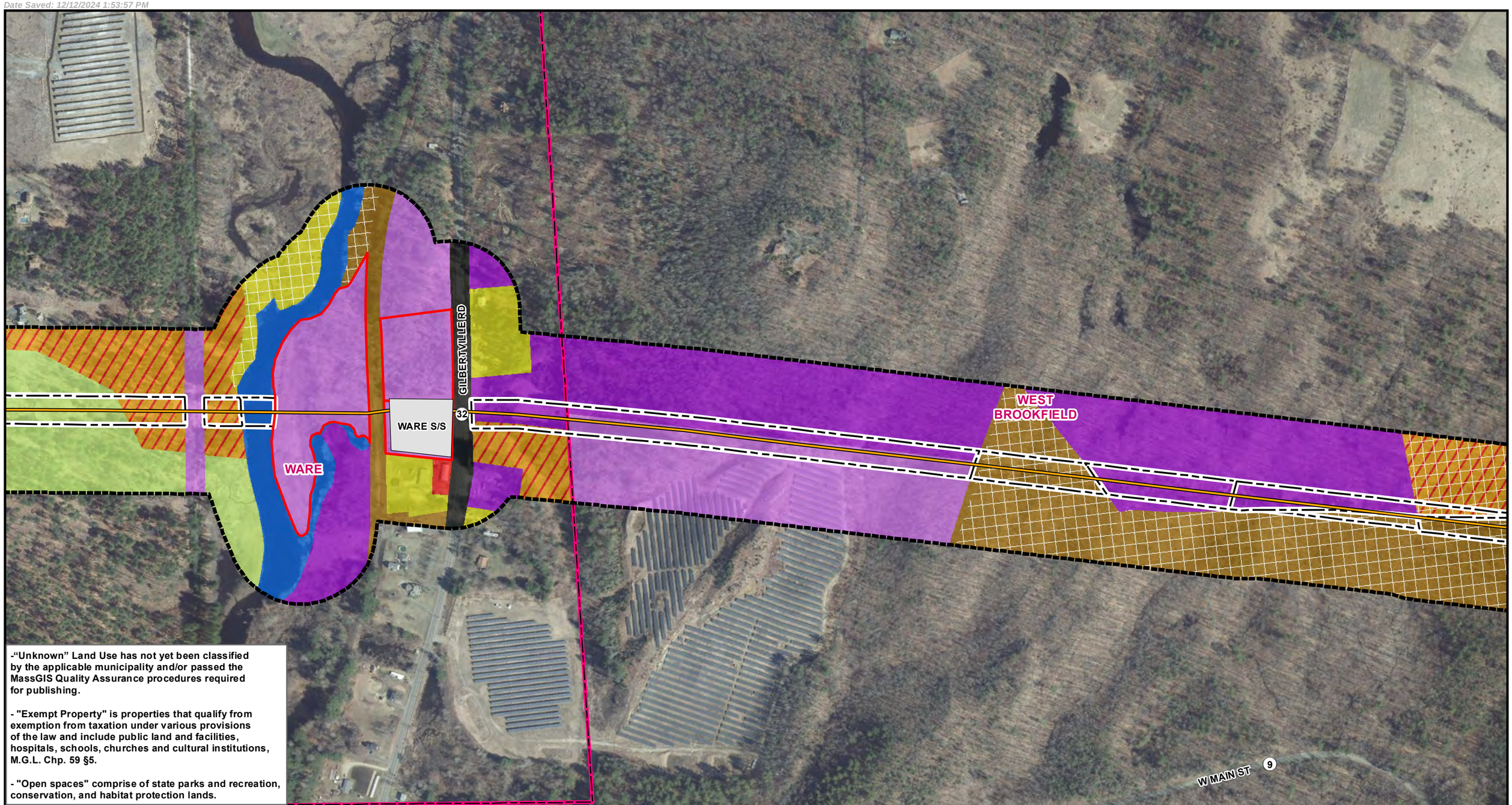

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Land Use Along the Project Route

Ware & West Brookfield, MA

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RAGGED HILL RD

WEST BROOKFIELD

PIERCE RD

CEDAR DR

WHISPERING PINE DR

FOREST DR

HILLTOP DR

WHITEBIRCH DR

JUNIPER ST

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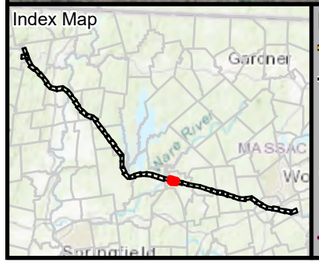

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West Brookfield, MA

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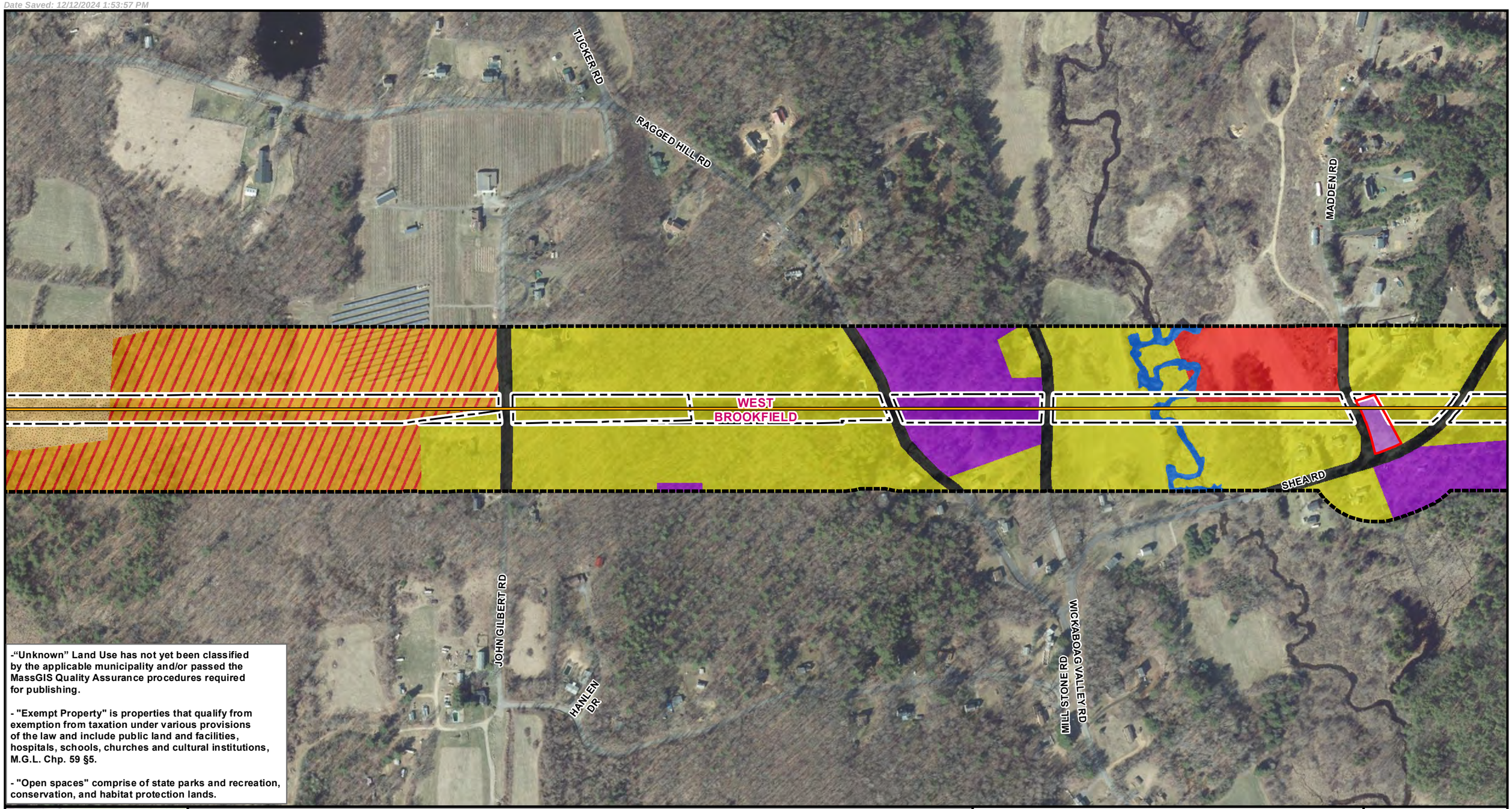

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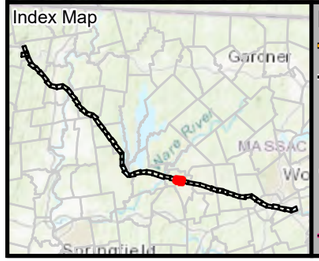

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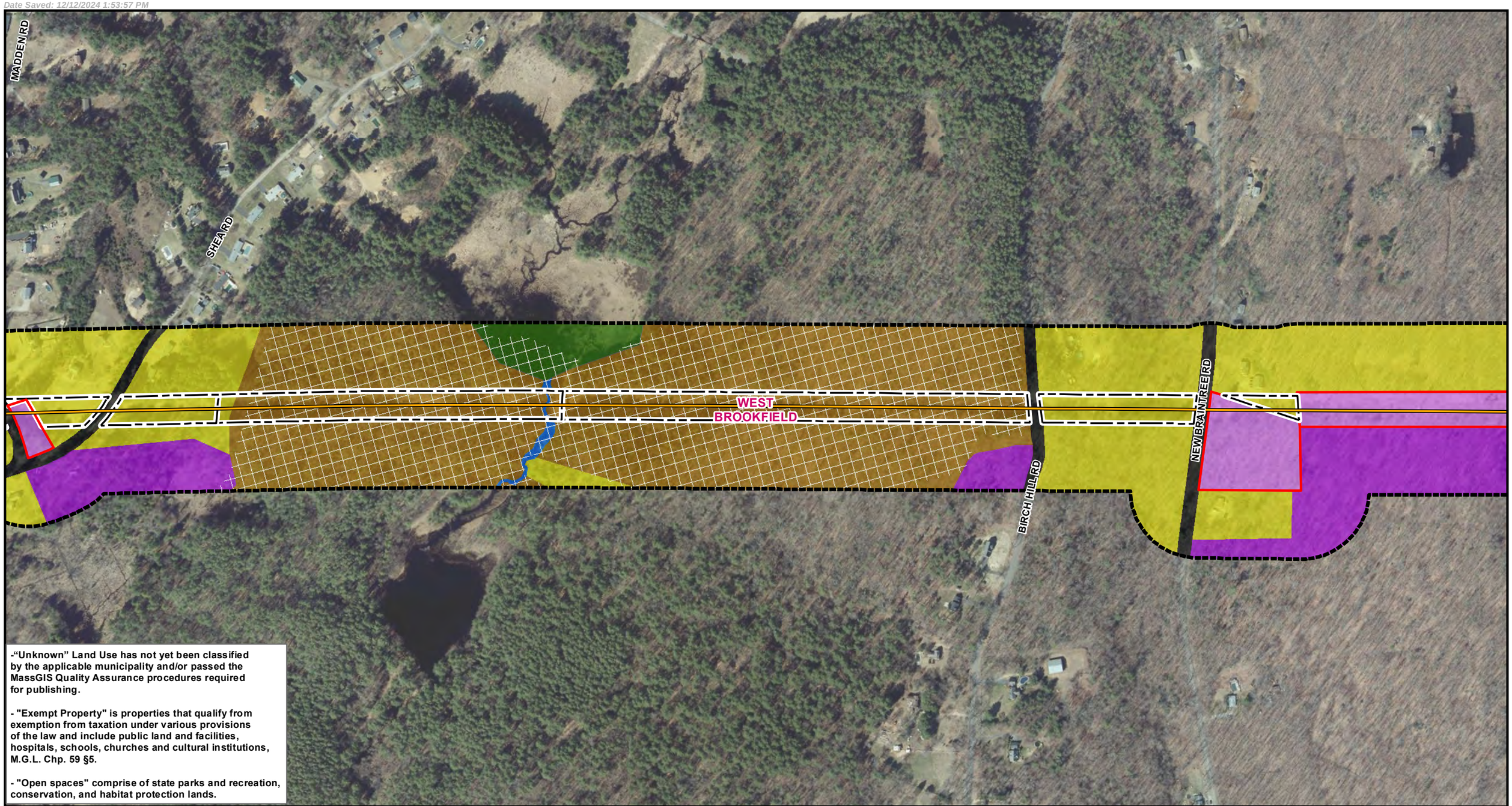

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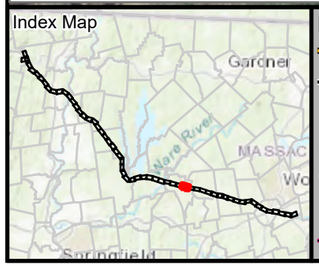

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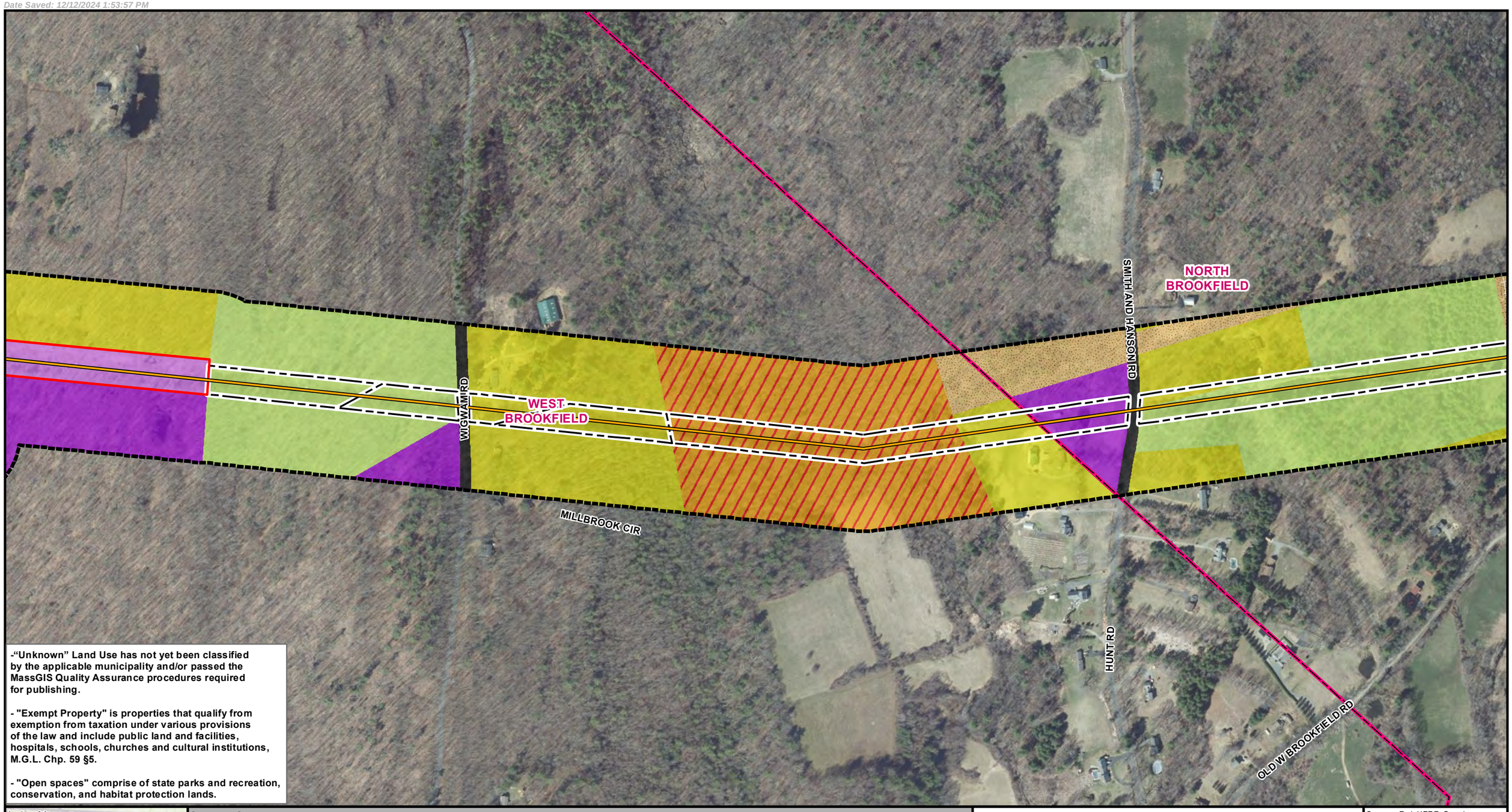

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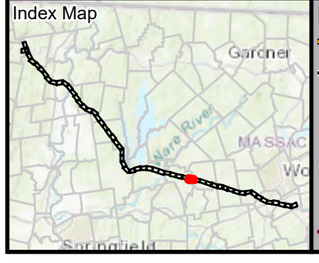

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Land Use Along the Project Route

West Brookfield & North Brookfield, MA

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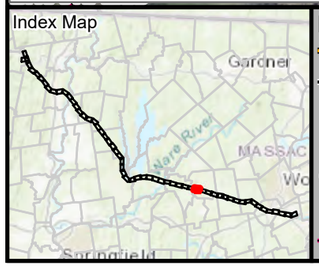

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Land Use Along the Project Route

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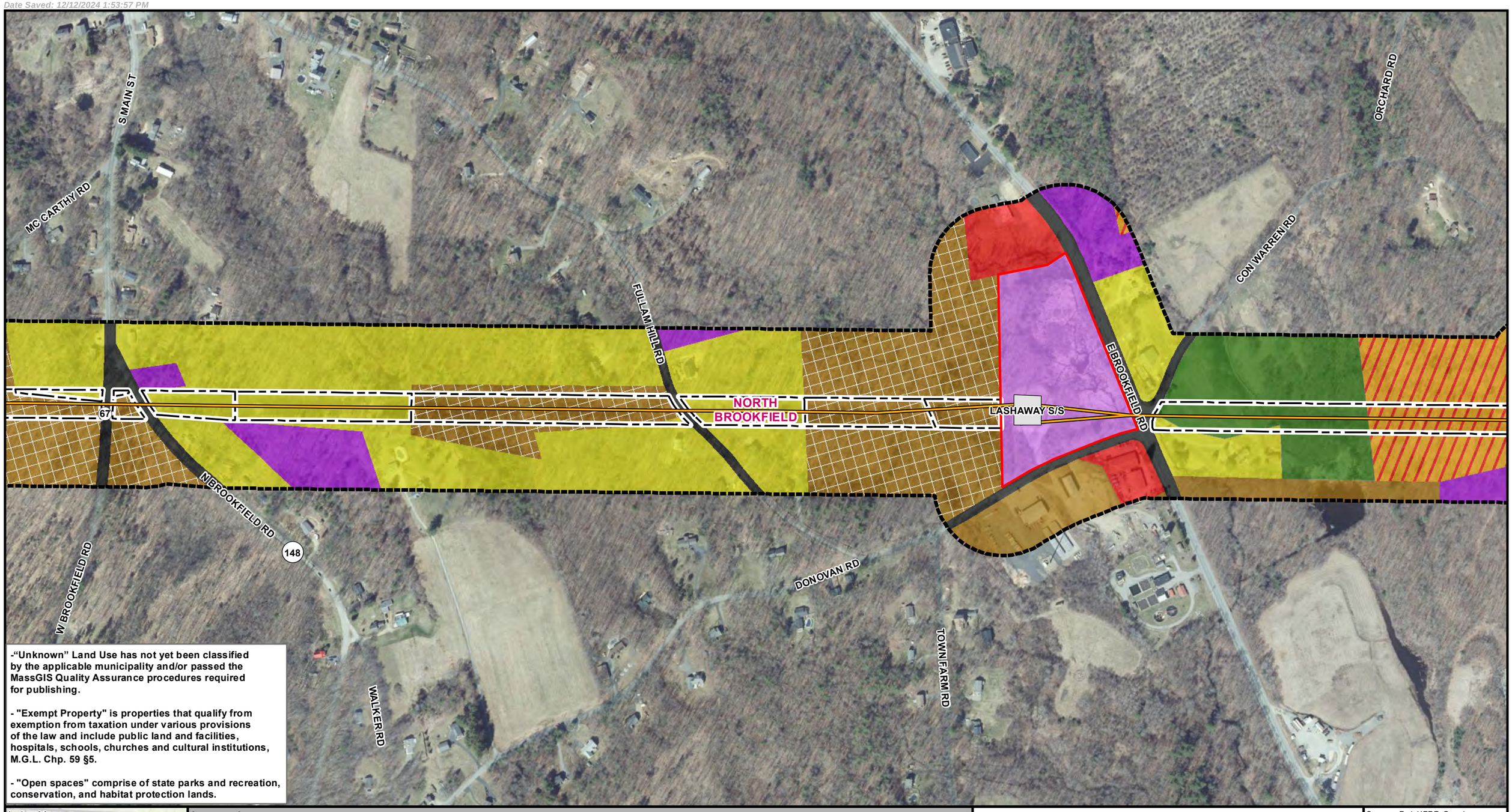

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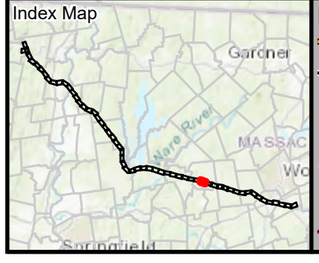

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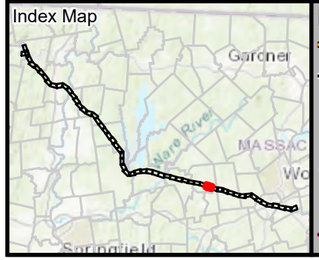

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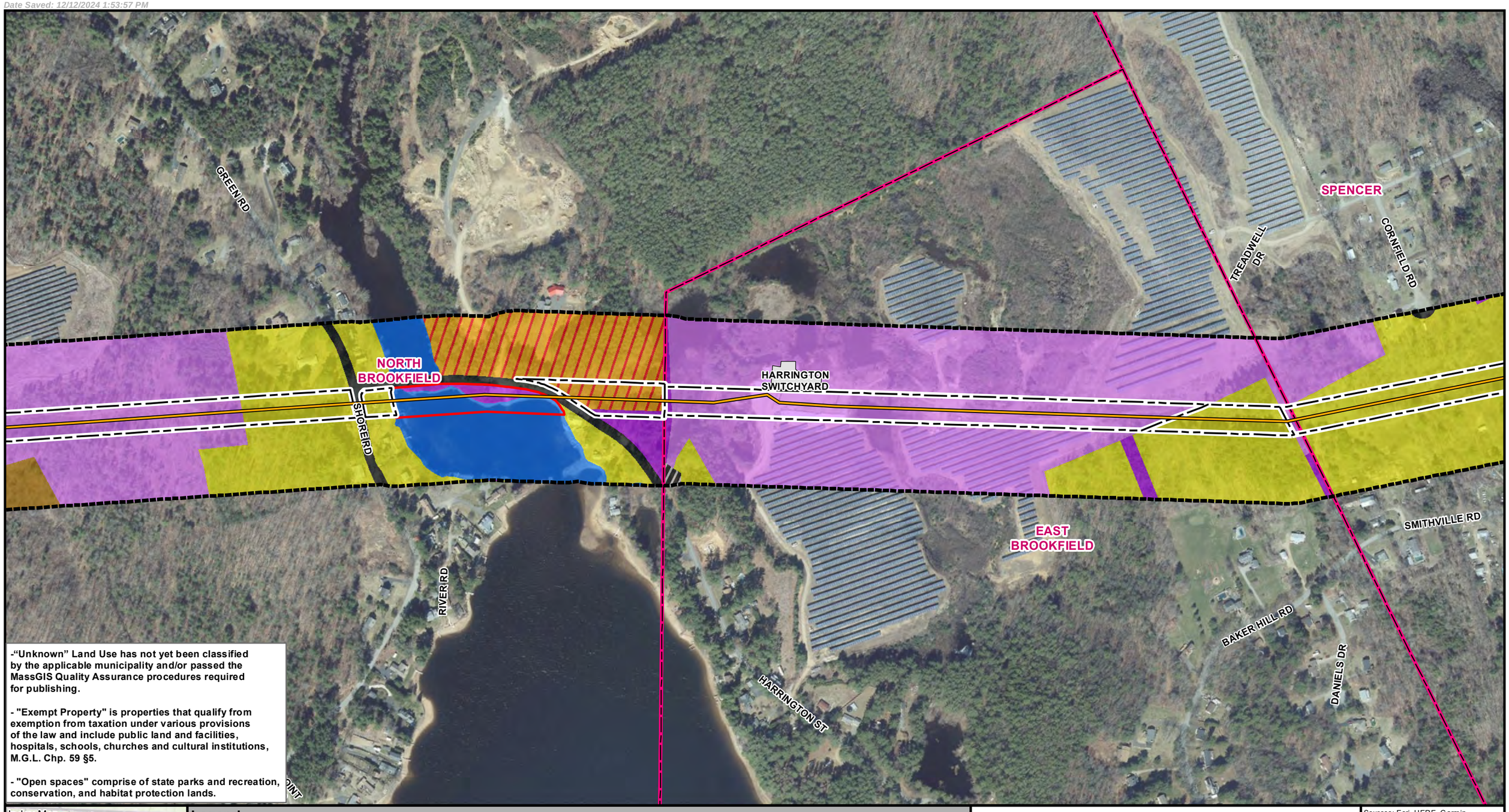

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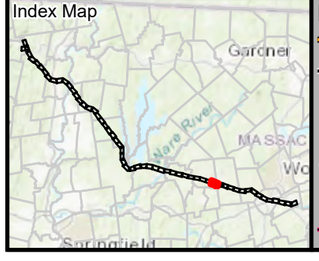

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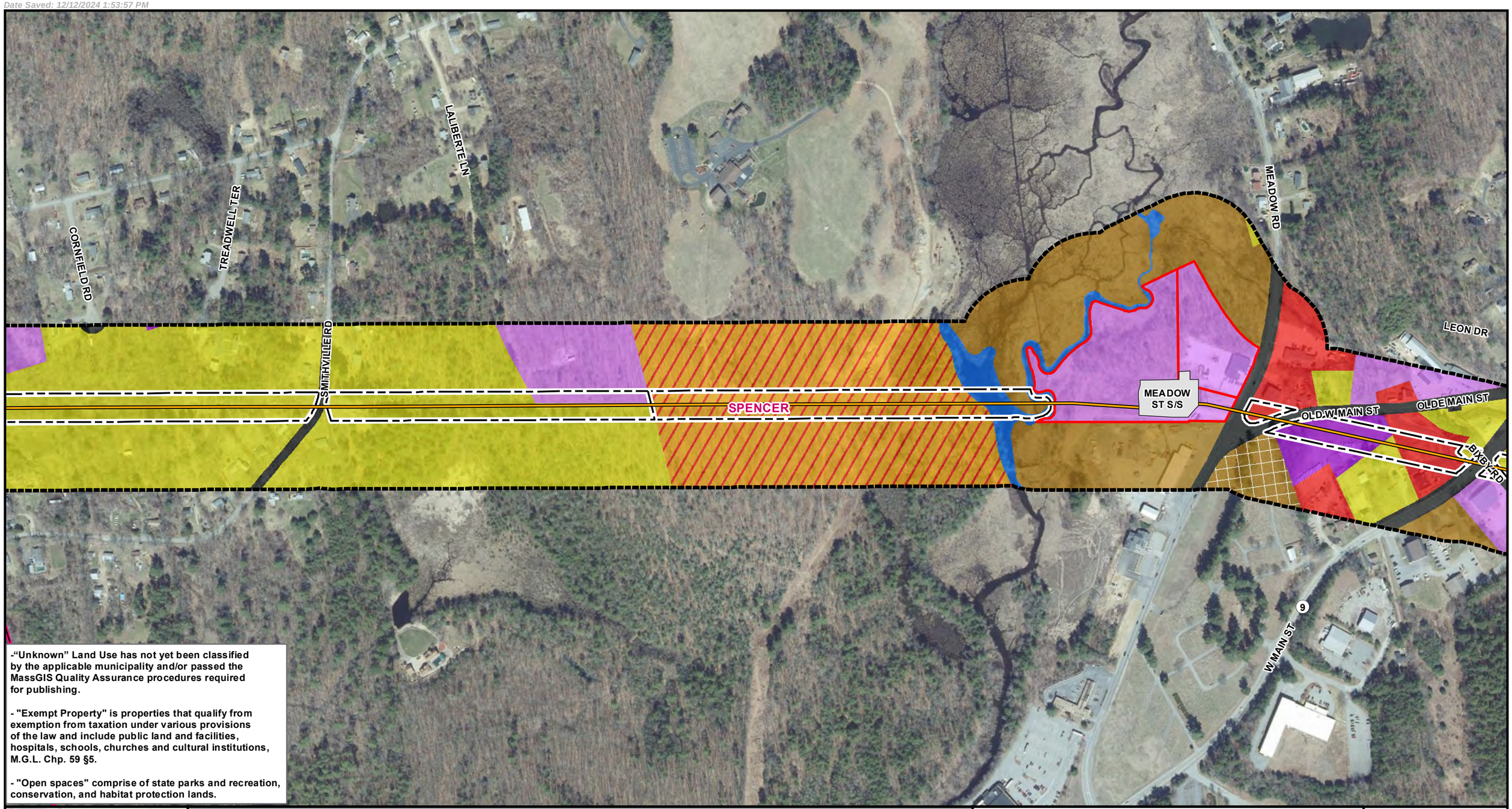

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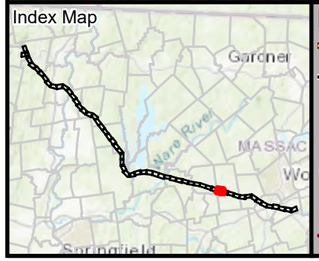

Legend

- Project Route
- Existing Right of Way
- Existing Substation
- National Grid Property
- 300ft Buffer to Existing ROWs
- Open Space
- Town Boundary

Land Use

- Agricultural/Horticultural
- Commercial
- Exempt Property
- Forest Property
- Industrial
- Mixed Use
- Recreational Property
- Residential
- Vacant
- Transportation
- Unknown
- Water

N

1 inch = 400 feet
0 200 400
Feet

Indicates Layers Set to Transparency

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Land Use Along the Project Route

Spencer, MA

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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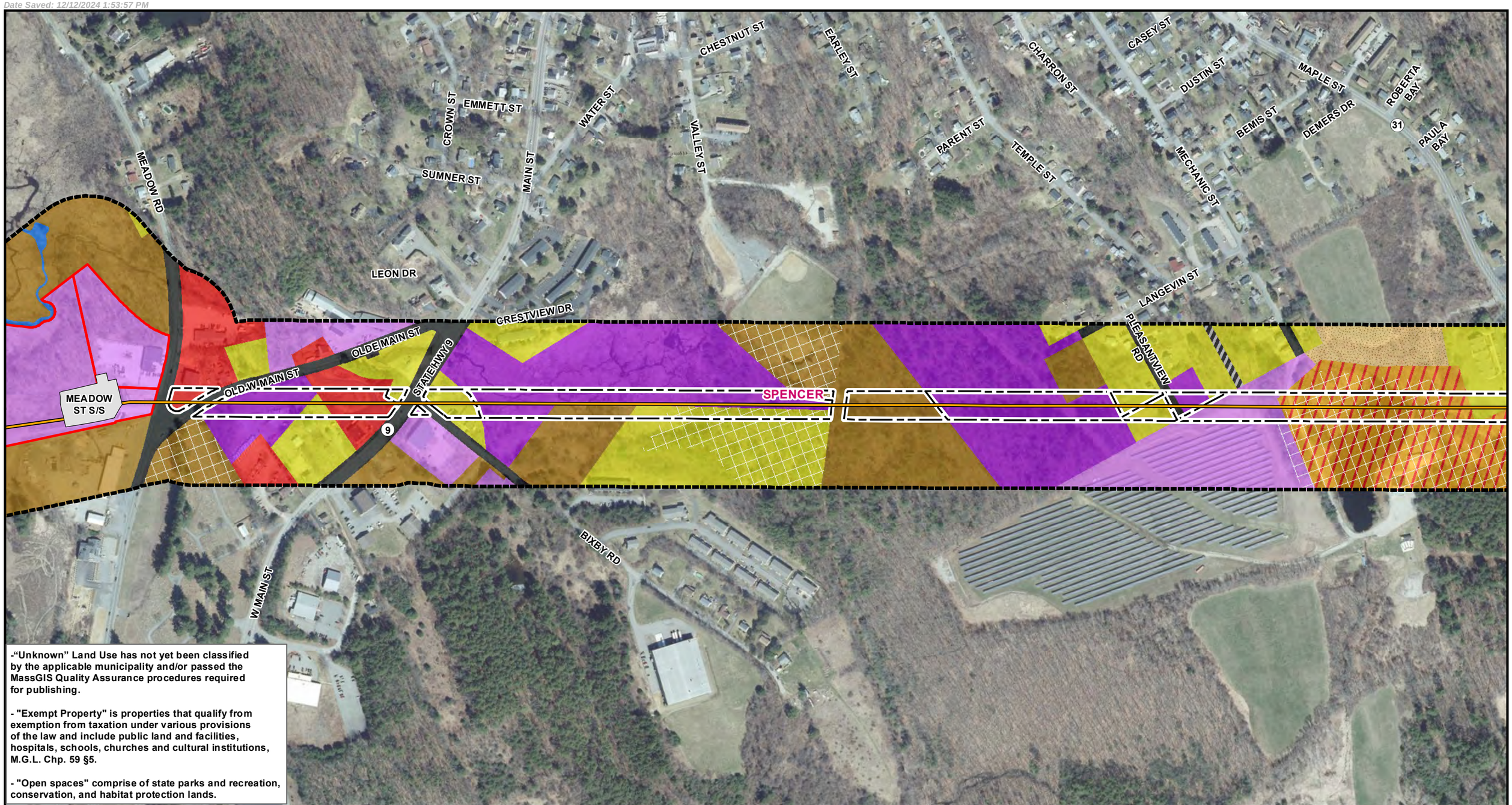

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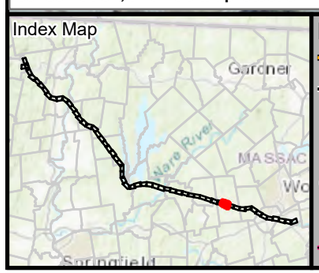

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Land Use Along the Project Route

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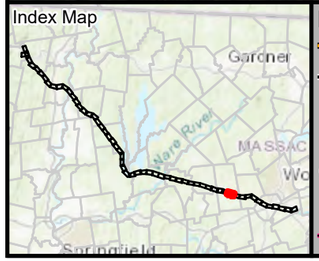

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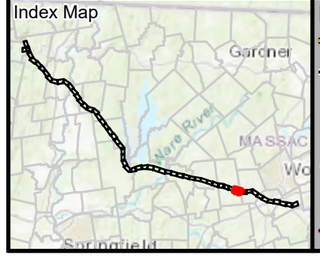

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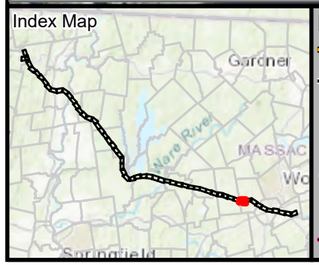

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Land Use Along the Project Route

Leicester, MA

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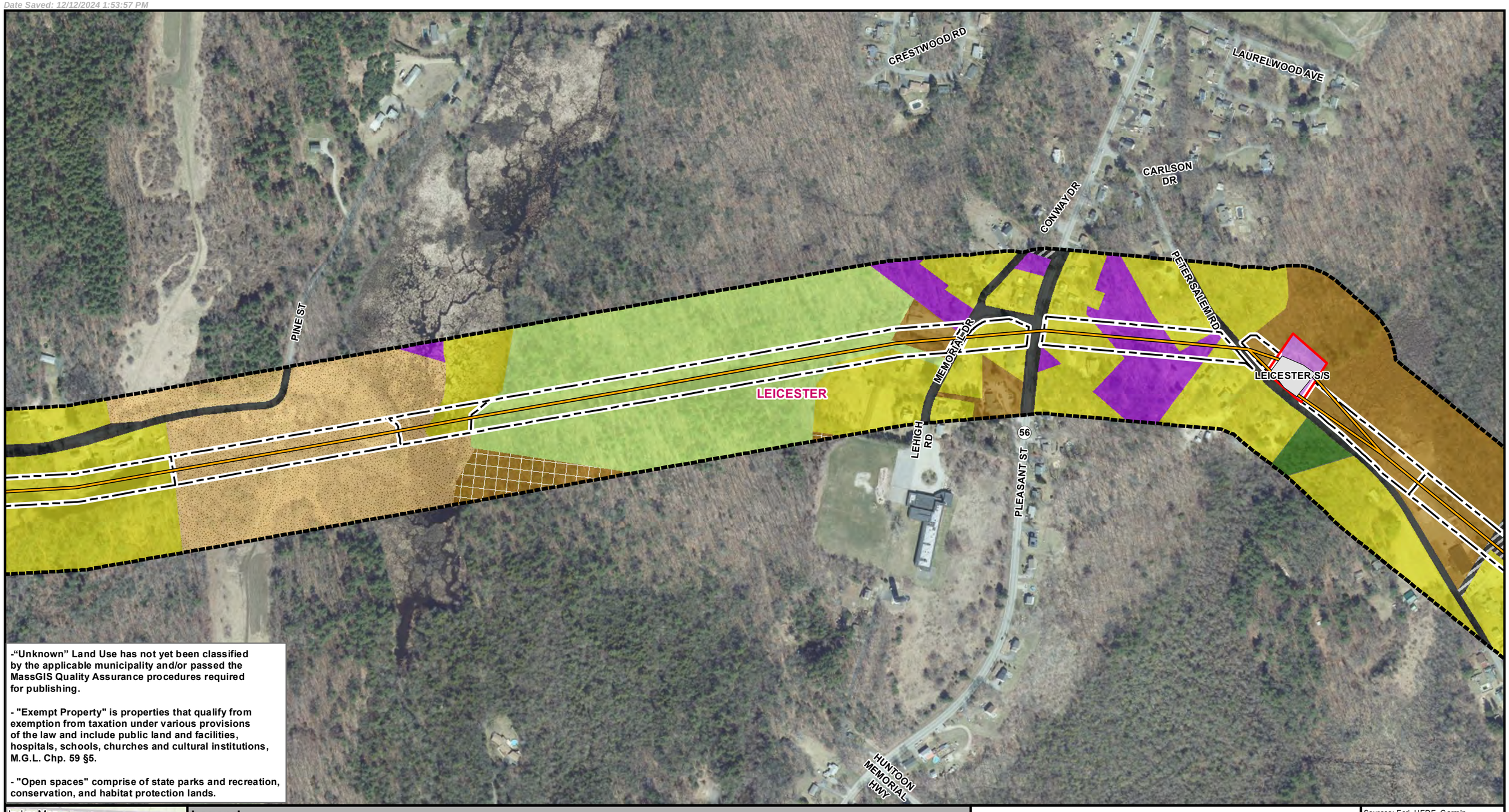

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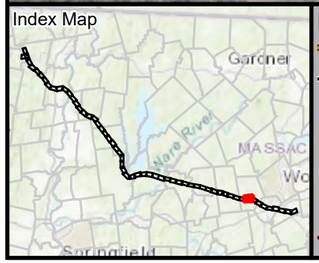

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Land Use Along the Project Route

Leicester, MA

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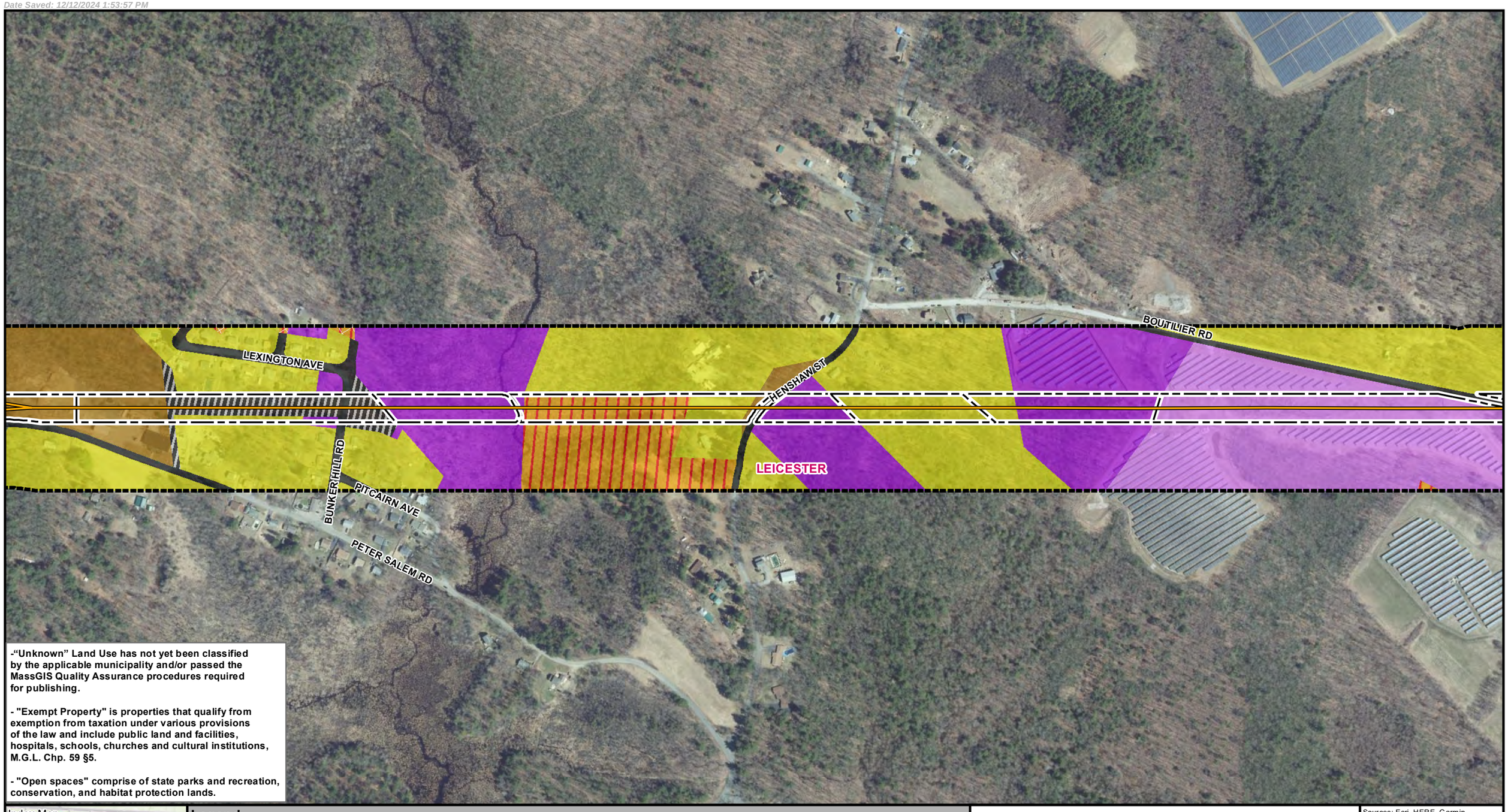

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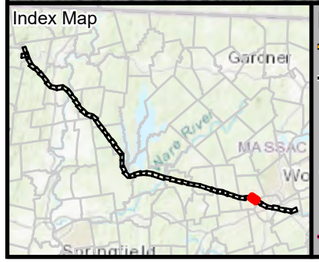

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Land Use Along the Project Route

Leicester, MA
Page 52 of 59

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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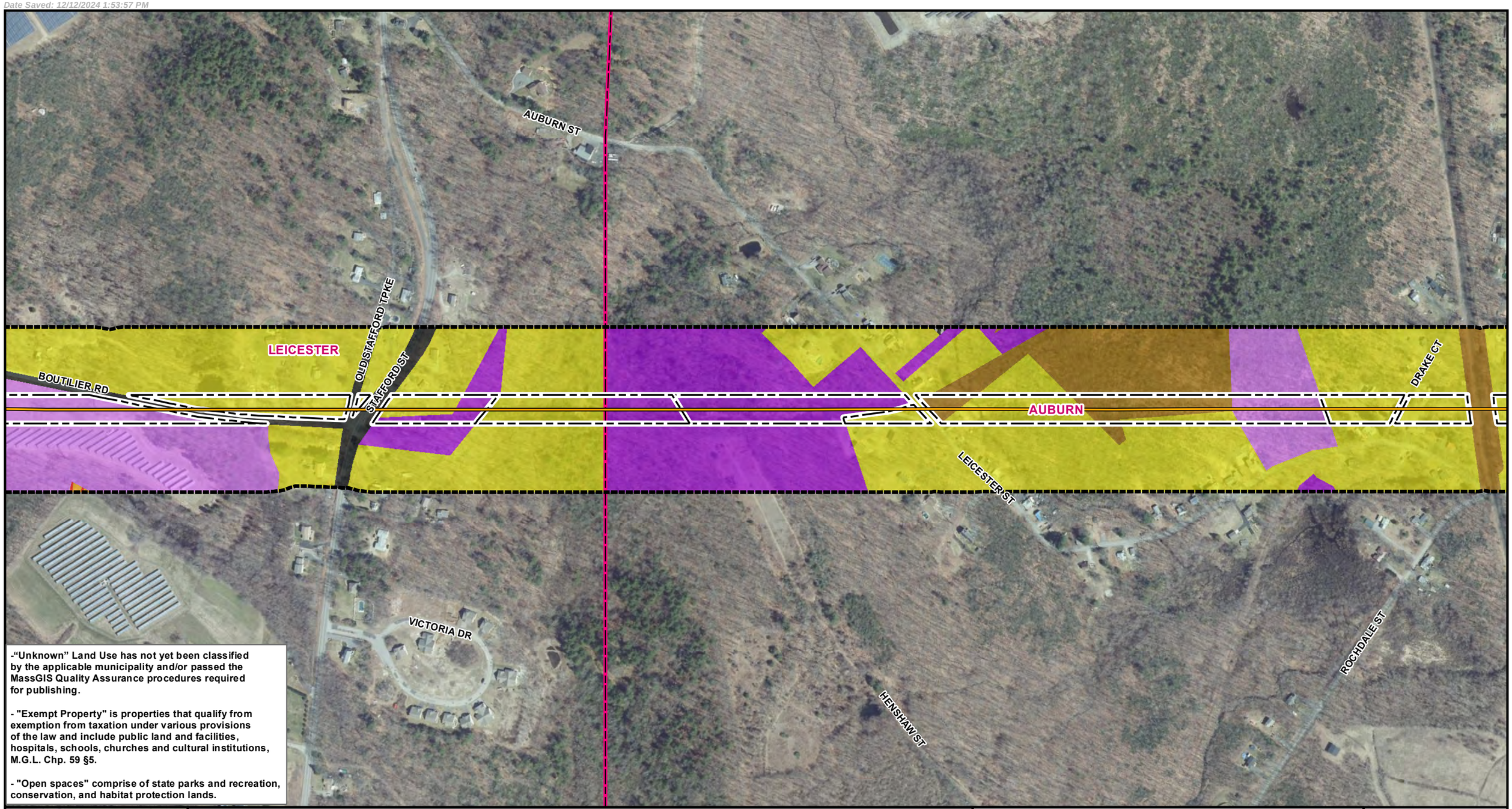

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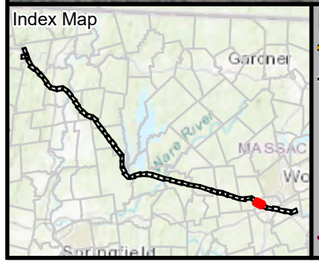

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Land Use Along the Project Route

Leicester and Auburn, MA

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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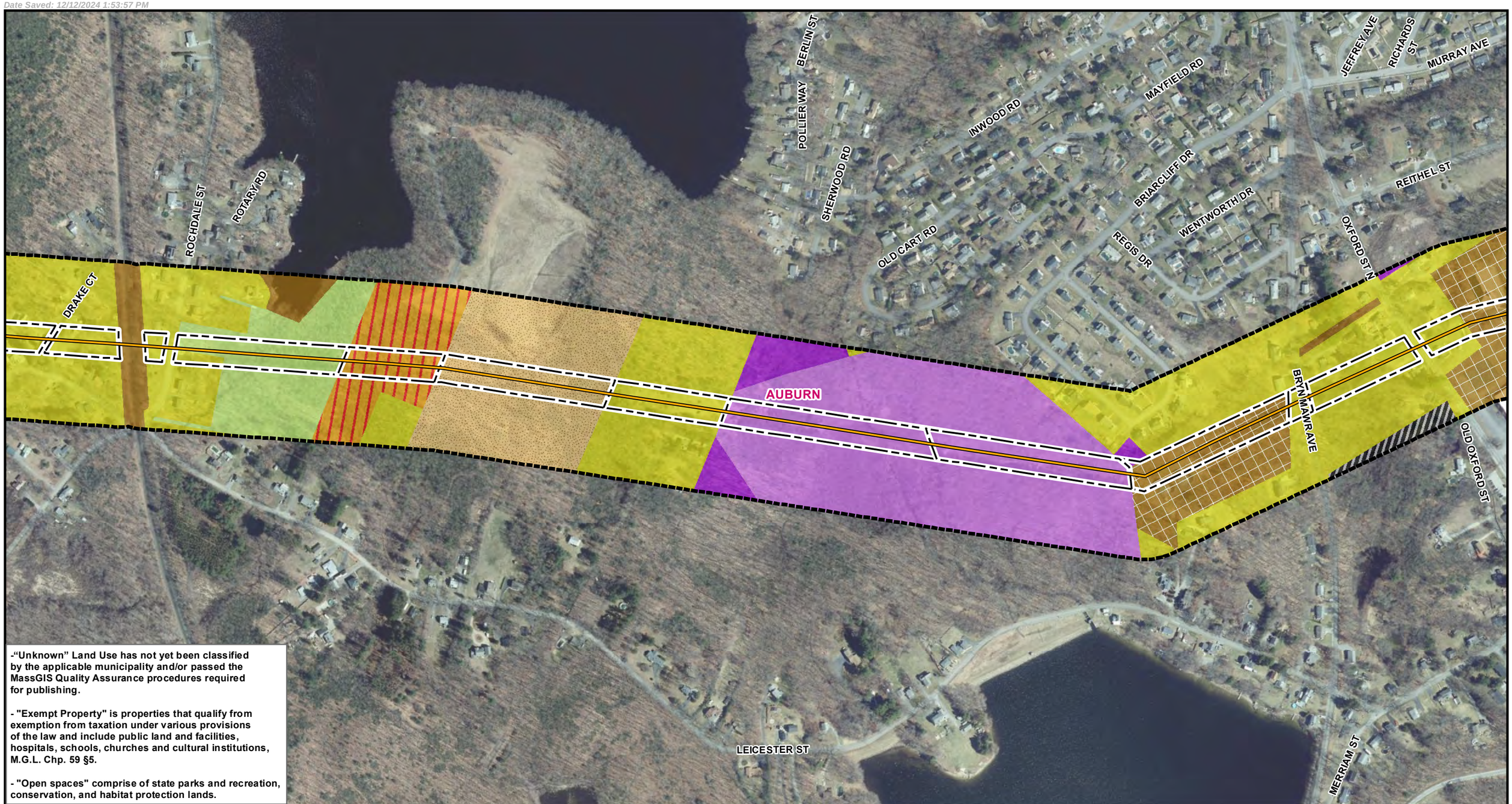

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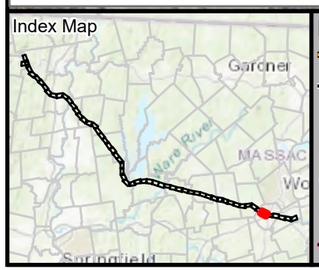

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Land Use Along the Project Route

Auburn, MA

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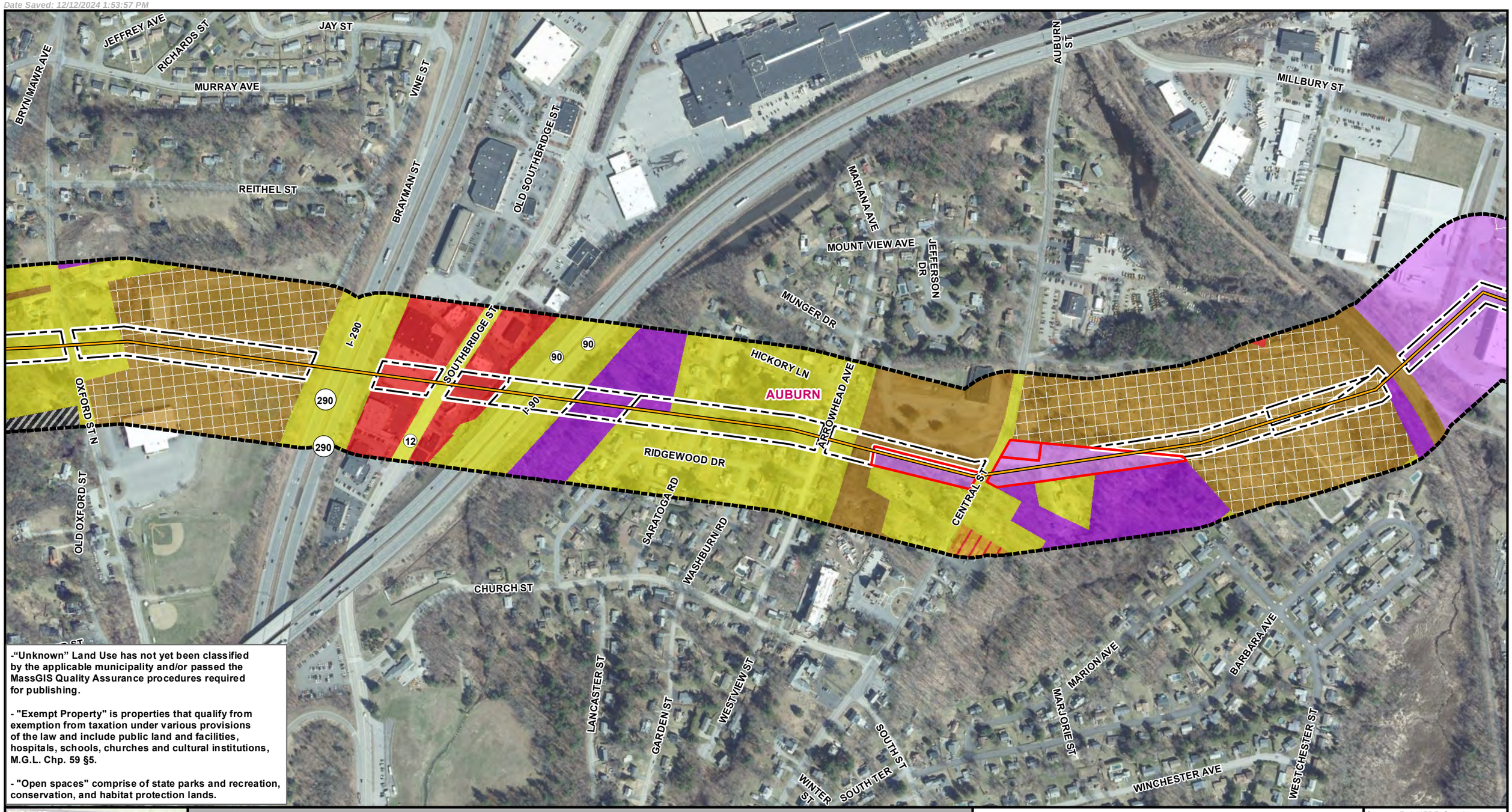

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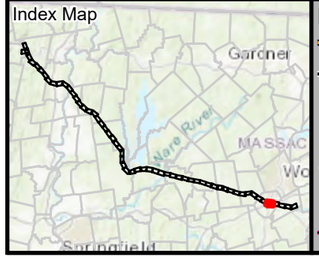
Index Map



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Land Use Along the Project Route

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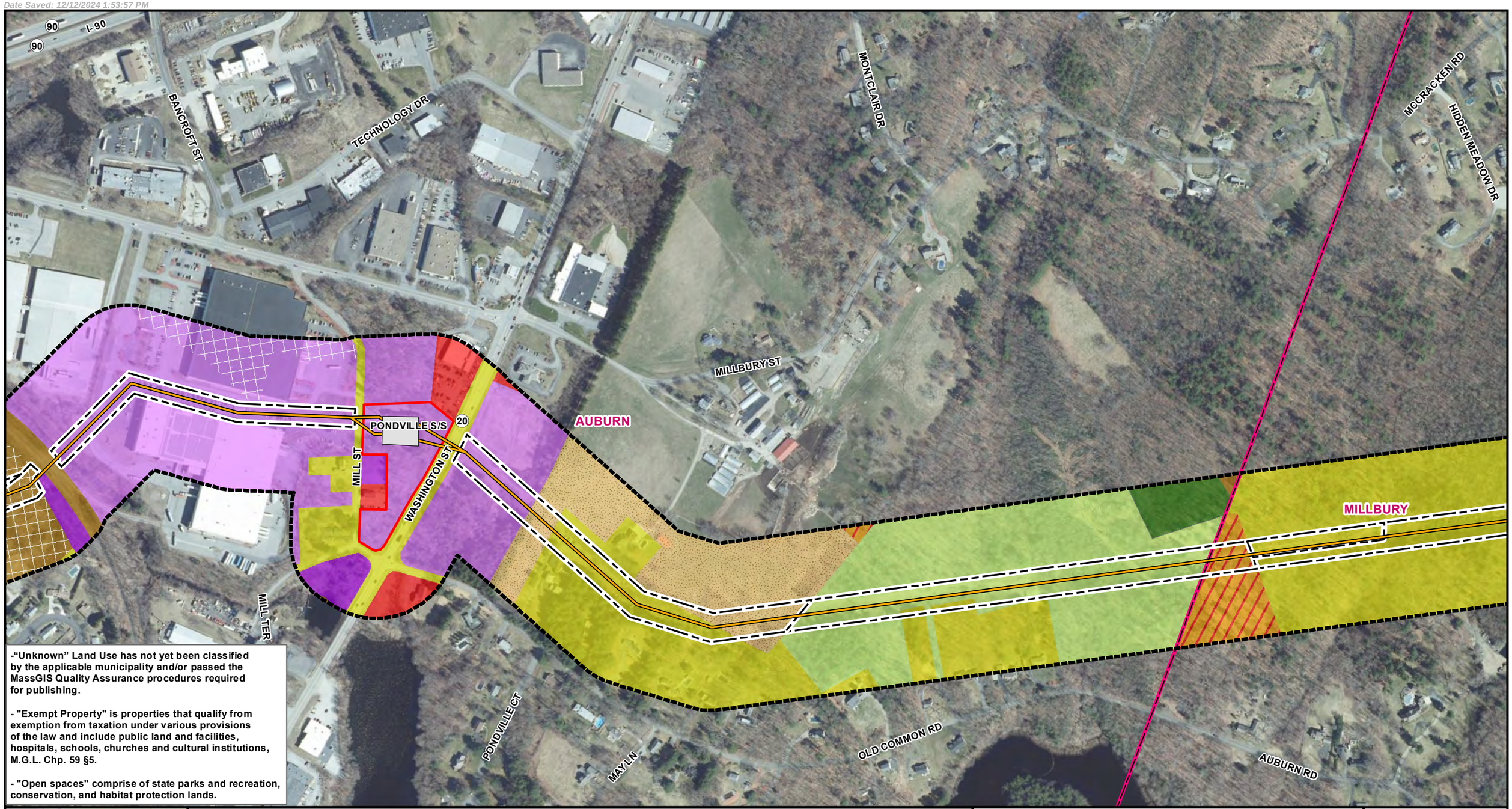

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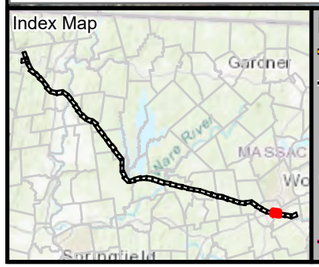

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Land Use Along the Project Route

Aurburn & Millbury, MA

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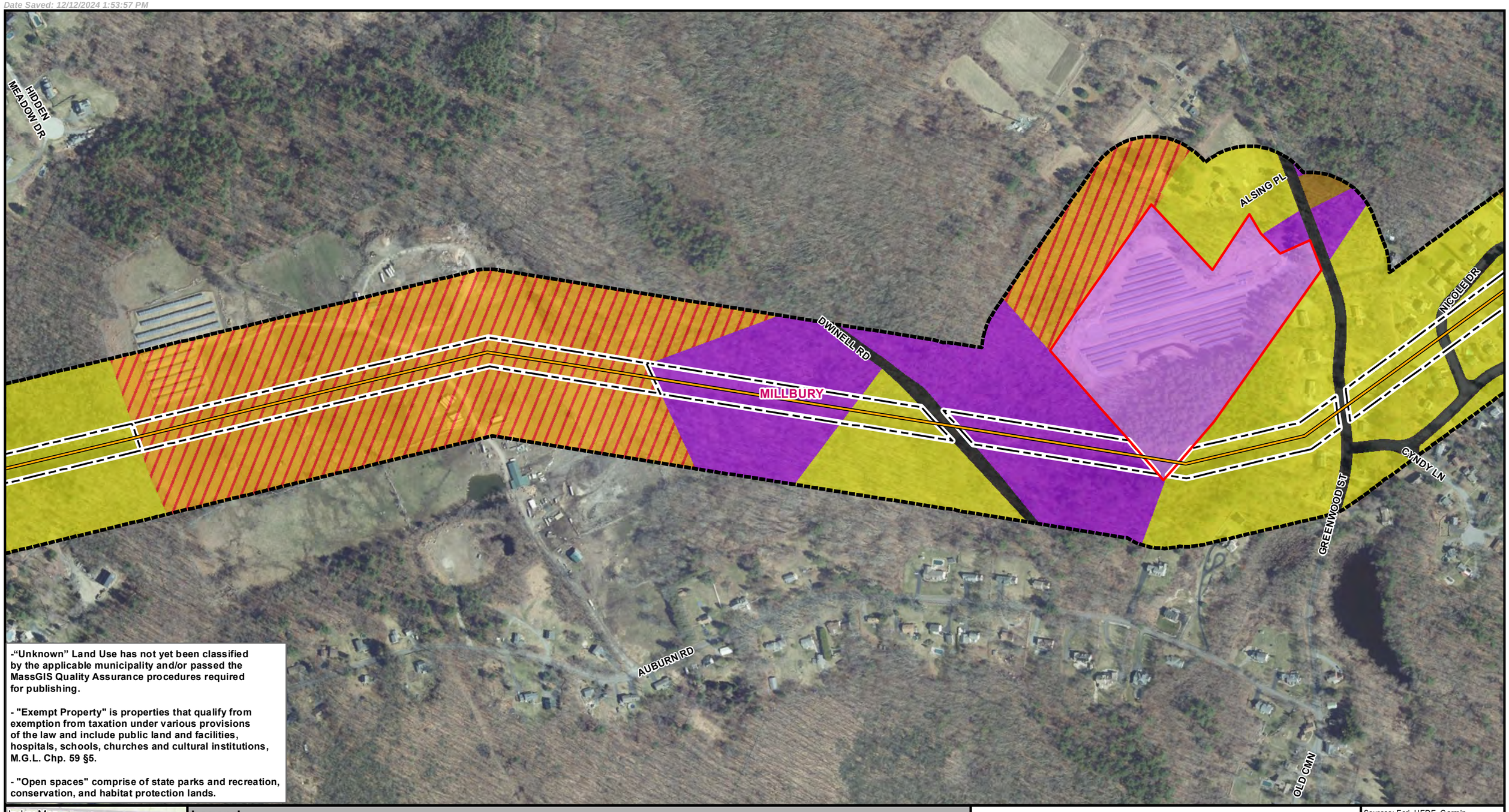

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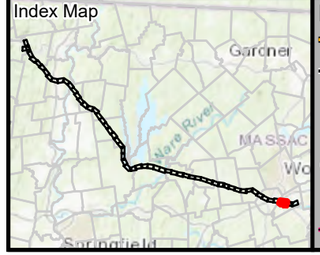

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Land Use Along the Project Route

Millbury, MA

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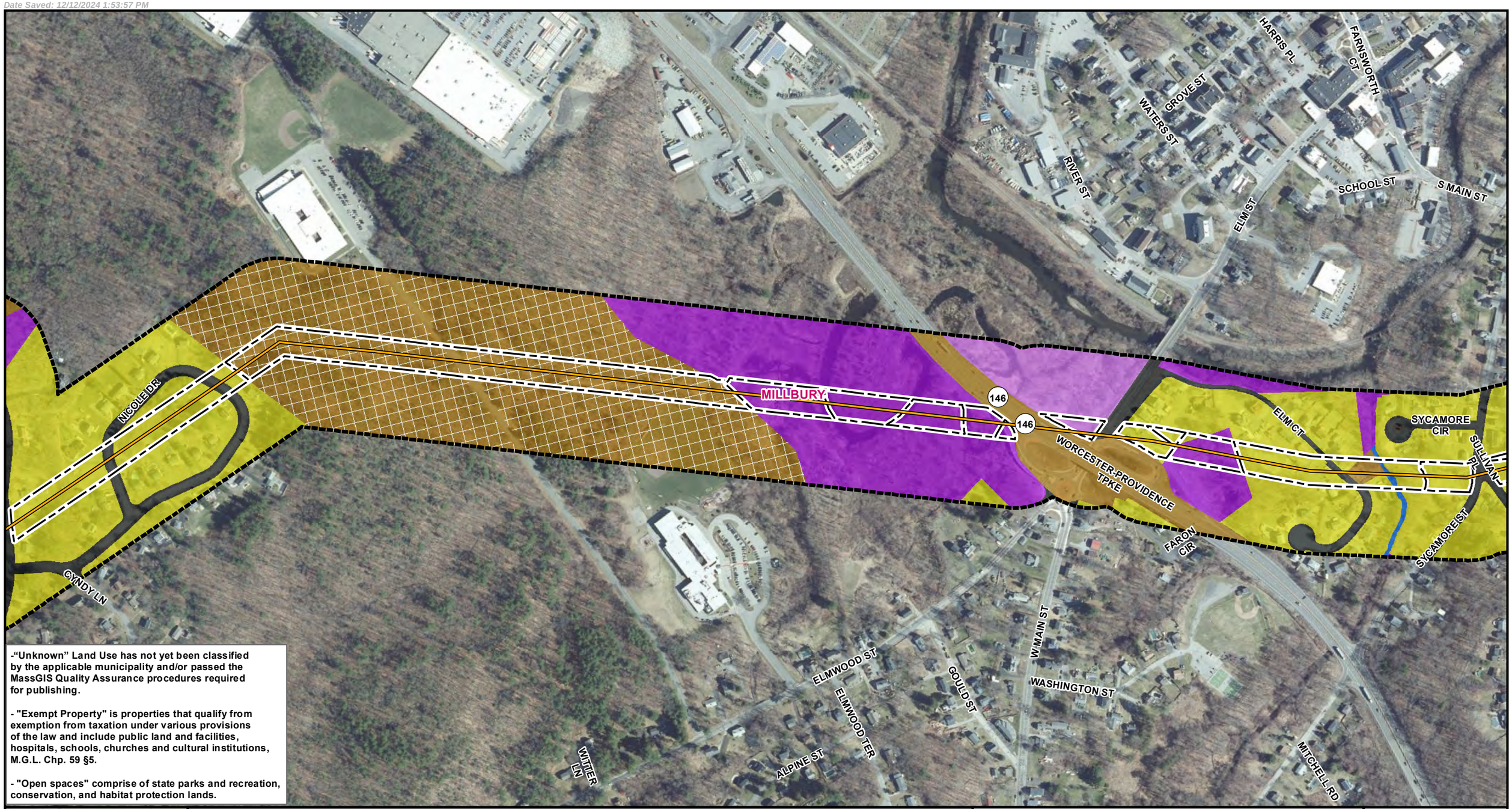
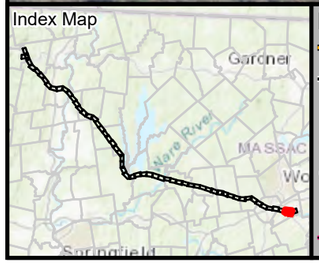


-"Unknown" Land Use has not yet been classified by the applicable municipality and/or passed the MassGIS Quality Assurance procedures required for publishing.

- "Exempt Property" is properties that qualify from exemption from taxation under various provisions of the law and include public land and facilities, hospitals, schools, churches and cultural institutions, M.G.L. Chp. 59 §5.

- "Open spaces" comprise of state parks and recreation, conservation, and habitat protection lands.



Legend

- Project Route
- Existing Right of Way
- Existing Substation
- National Grid Property
- 300ft Buffer to Existing ROWs
- Open Space
- Town Boundary

Land Use

- Agricultural/Horticultural
- Commercial
- Exempt Property
- Forest Property
- Industrial
- Mixed Use
- Recreational Property
- Residential
- Vacant
- Transportation
- Unknown
- Water

N

1 inch = 400 feet
0 200 400
Feet

**Indicates Layers Set to Transparency*

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Land Use Along the Project Route

Millbury, MA

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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ELM ST
SCHOOL ST
MAPLE ST
CORAL ST
CANAL ST
RIVERLIN ST
BELLVILLE LN
CAROUSEL DR
MEMORIAL DR
GRANITE ST
PEARL ST
CURVE ST
JACKIE DR
GRAFTON ST
ELM CT
SYCAMORE CIR
SYCAMORE ST
COLONIAL DR
FONTAINE ST
PROVIDENCE ST
MILLBURY
122A
MILLBURY #4 S/S
MILLBURY #2 S/S
MILLBURY #305 S/S
MILLBURY #305 S/S
MILLBURY #1 S/S
S MAIN ST
SULLIVAN PL
LESLIE LN
WOODLAND ST
RICE RD
ALDRICH AVE
PETER SIMPSON RD
THOMAS HILL RD
FOREST DR
PHILLIP DR
CAPT PETER SIMPSON RD
CROSS ST
MILLBURY #3 S/S

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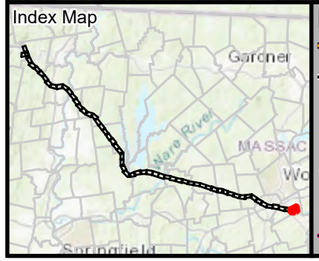
- "Open spaces" comprise of state parks and recreation, conservation, and habitat protection lands.

Index Map



Legend

- Project Route
- Existing Right of Way
- Existing Substation
- National Grid Property
- 300ft Buffer to Existing ROWs
- Open Space
- Town Boundary

Land Use

- Agricultural/Horticultural
- Commercial
- Exempt Property
- Forest Property
- Industrial
- Mixed Use
- Recreational Property
- Residential
- Vacant
- Transportation
- Unknown
- Water

1 inch = 400 feet
0 200 400
Feet
Indicates Layers Set to Transparency

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Land Use Along the Project Route

Millbury, MA

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, Maxar, Earthstar Geographics, and the GIS User

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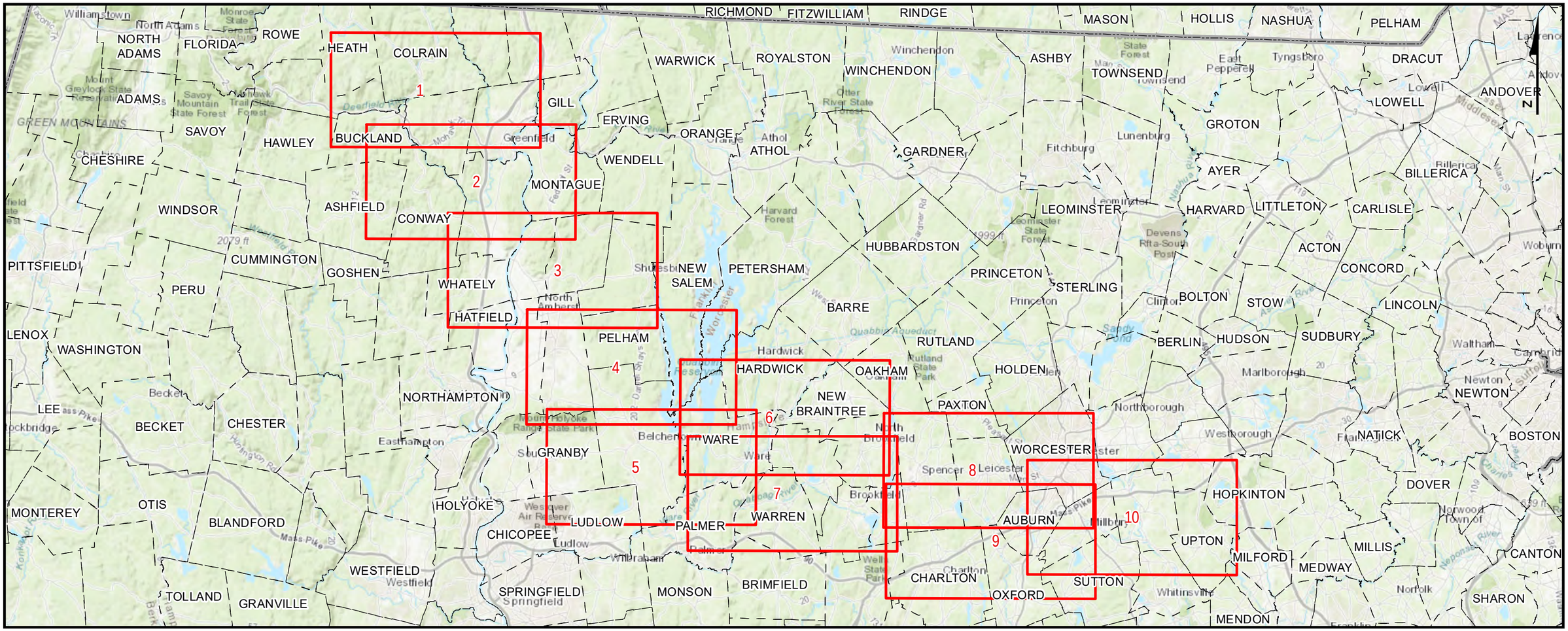
BSC Project Number: 100181.00

Central to Western Massachusetts Energy Improvement Project

Environmental Justice Populations Site Location Map

Shelburne, Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn & Millbury, MA

December 12, 2024



PREPARED FOR:

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170 Data Drive
Waltham, MA 02451

INDEX OF FIGURES

T1 - TITLE SHEET
S1 - SITE LOCATION MAP
1 - 10 - MAP SHEETS

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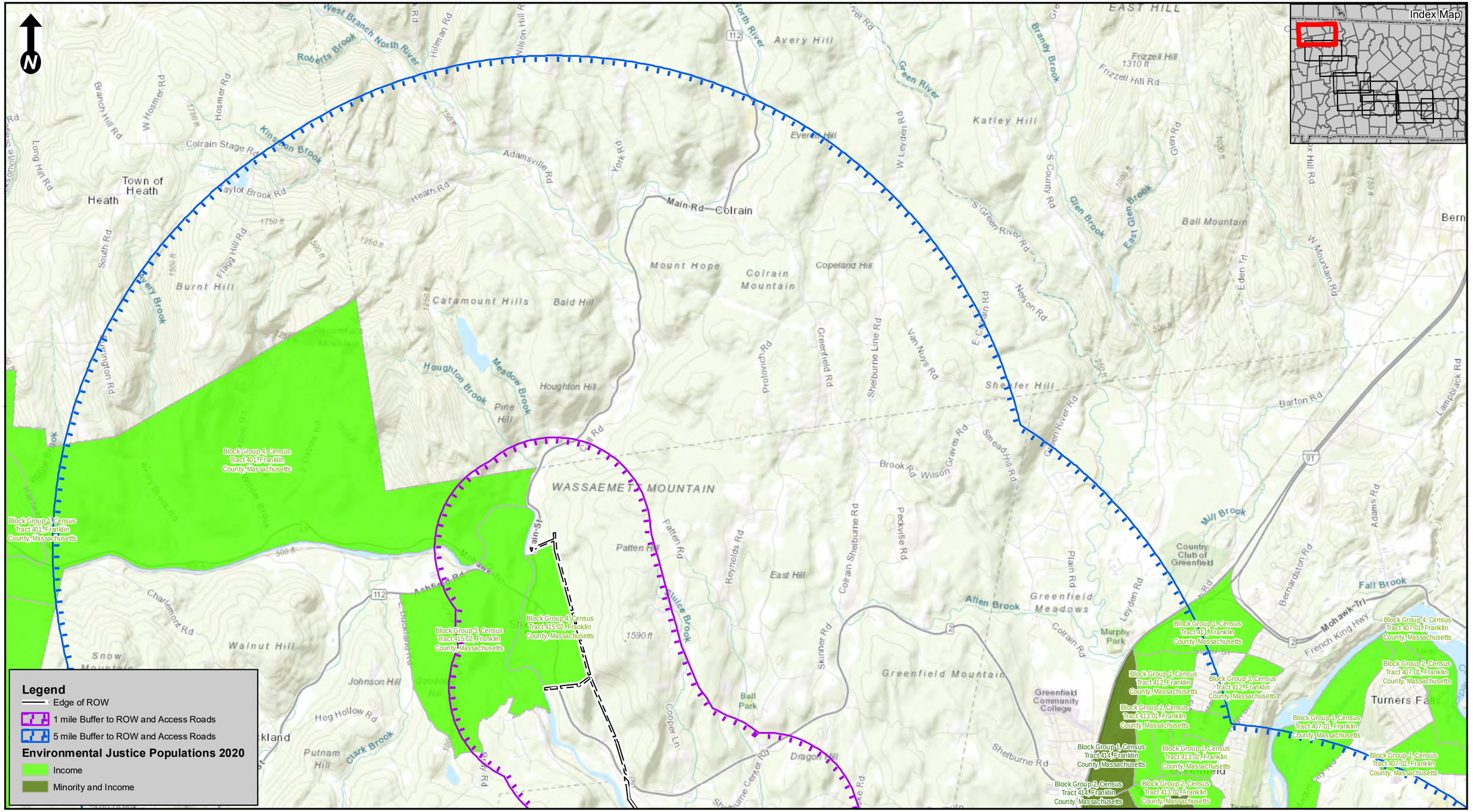
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Index Map
Legend
Edge of ROW
1 mile Buffer to ROW and Access Roads
5 mile Buffer to ROW and Access Roads
Environmental Justice Populations 2020
Income
Minority and Income
Block Group 4, Census Tract 401, Franklin County, Massachusetts
Block Group 1, Census Tract 401, Franklin County, Massachusetts
Block Group 3, Census Tract 415.02, Franklin County, Massachusetts
Block Group 4, Census Tract 415.02, Franklin County, Massachusetts
Block Group 1, Census Tract 412, Franklin County, Massachusetts
Block Group 3, Census Tract 412, Franklin County, Massachusetts
Block Group 2, Census Tract 413.01, Franklin County, Massachusetts
Block Group 1, Census Tract 414, Franklin County, Massachusetts
Block Group 1, Census Tract 413.02, Franklin County, Massachusetts
Block Group 2, Census Tract 414, Franklin County, Massachusetts
Block Group 2, Census Tract 413.02, Franklin County, Massachusetts
Block Group 1, Census Tract 411, Franklin County, Massachusetts
Block Group 4, Census Tract 407.01, Franklin County, Massachusetts
Block Group 2, Census Tract 407.01, Franklin County, Massachusetts
Block Group 1, Census Tract 407.01, Franklin County, Massachusetts
Block Group 1, Census Tract 407.02, Franklin County, Massachusetts
Town of Heath
Main Rd—Colrain
Avery Hill
Everett Hill
Katley Hill
Frizzell Hill
1310 ft
Frizzell Hill Rd
Ball Mountain
Burnt Hill
Mount Hope
Colrain Mountain
Copeland Hill
Catamount Hills
Bald Hill
Houghton Hill
Pine Hill
Patten Hill
East Hill
Greenfield Meadows
Greenfield Mountain
Greenfield Community College
Country Club of Greenfield
Murphy Park
Ball Park
Walnut Hill
Johnson Hill
Snow Mountain
Putnam Hill
Dragon Hill
Turners Falls
WASSAEMETT MOUNTAIN
Roberts Brook
West Branch North River
Kinsman Brook
Adamsville Rd
Heath Rd
Colrain Stage Rd
Taylor Brook Rd
Flagg Hill Rd
Hosmer Rd
W Hosmer Rd
Branch Hill Rd
Long Hill Rd
South Rd
Hillman Rd
Wilson Hill Rd
York Rd
North River
Green River
W Leyden Rd
Brandy Brook
S County Rd
S Green River Rd
Glen Rd
Glen Brook
East Glen Brook
Eden Trl
W Mountain Rd
Nelson Rd
Barton Rd
Lampblack Rd
Meadow Brook
Houghton Brook
Prolovich Rd
Greenfield Rd
Shelburne Line Rd
Van Nuys Rd
Sheafer Hill
Brook Rd
Wilson Graves Rd
Smead Hill Rd
Sluice Brook
Patten Rd
Reynolds Rd
Colrain Shelburne Rd
Peckville Rd
Skinner Rd
Cooper Ln
Shelburne Center Rd
Shelburne Rd
Plain Rd
Leyden Rd
Colrain Rd
Allen Brook
Mill Brook
Fall Brook
Bernardston Rd
Adams Rd
Mohawk Trl
French King Hwy
Charlemont Rd
Hog Hollow Rd
Clark Brook
Avery Brook Rd
Miller Brook
Millers River Rd
Chickley River Rd
Ashfield Rd
Doubleday Rd
Pudding Hill Rd
Mohawk Trail
Old Stage Rd
Old Colrain Rd
Old Shelburne Rd
Old Greenfield Rd
Old Main St
Old Bernardston Rd
Old Adams Rd
Old Mill Rd
Old Wilson Rd
Old Sheafer Hill Rd
Old Barton Rd
Old Lampblack Rd
Old Mohawk Trl
Old Fall Brook Rd
Old Meadow Brook Rd
Old Houghton Brook Rd
Old Prolovich Rd
Old Greenfield Rd
Old Shelburne Line Rd
Old Van Nuys Rd
Old Nelson Rd
Old Eden Trl
Old W Mountain Rd
Old Glen Brook Rd
Old Glen Rd
Old Brandy Brook Rd
Old Frizzell Hill Rd
Old Avery Hill Rd
Old Everett Hill Rd
Old Katley Hill Rd
Old Green River Rd
Old W Leyden Rd
Old S County Rd
Old S Green River Rd
Old Nelson Rd
Old Eden Trl
Old W Mountain Rd
Old Barton Rd
Old Lampblack Rd
Old Fall Brook Rd
Old Mohawk Trl
Old French King Hwy
Old Bernardston Rd
Old Adams Rd
Old Mill Rd
Old Wilson Rd
Old Sheafer Hill Rd
Old Shelburne Rd
Old Plain Rd
Old Leyden Rd
Old Colrain Rd
Old Allen Brook Rd
Old Greenfield Rd
Old Shelburne Line Rd
Old Van Nuys Rd
Old Prolovich Rd
Old Meadow Brook Rd
Old Houghton Brook Rd
Old Sluice Brook Rd
Old Patten Rd
Old Reynolds Rd
Old Colrain Shelburne Rd
Old Peckville Rd
Old Skinner Rd
Old Cooper Ln
Old Shelburne Center Rd
Old Dragon Hill Rd
Old Greenfield Mountain Rd
Old Ball Park Rd
Old Murphy Park Rd
Old Greenfield Meadows Rd
Old Country Club of Greenfield Rd
Old Turners Falls Rd
Old Temple Rd
Old Walnut Hill Rd
Old Johnson Hill Rd
Old Snow Mountain Rd
Old Putnam Hill Rd
Old Clark Brook Rd
Old Hog Hollow Rd
Old Charlemont Rd
Old Ashfield Rd
Old Doubleday Rd
Old Pudding Hill Rd
Old Mohawk Trail
Old Stage Rd
Old Colrain Rd
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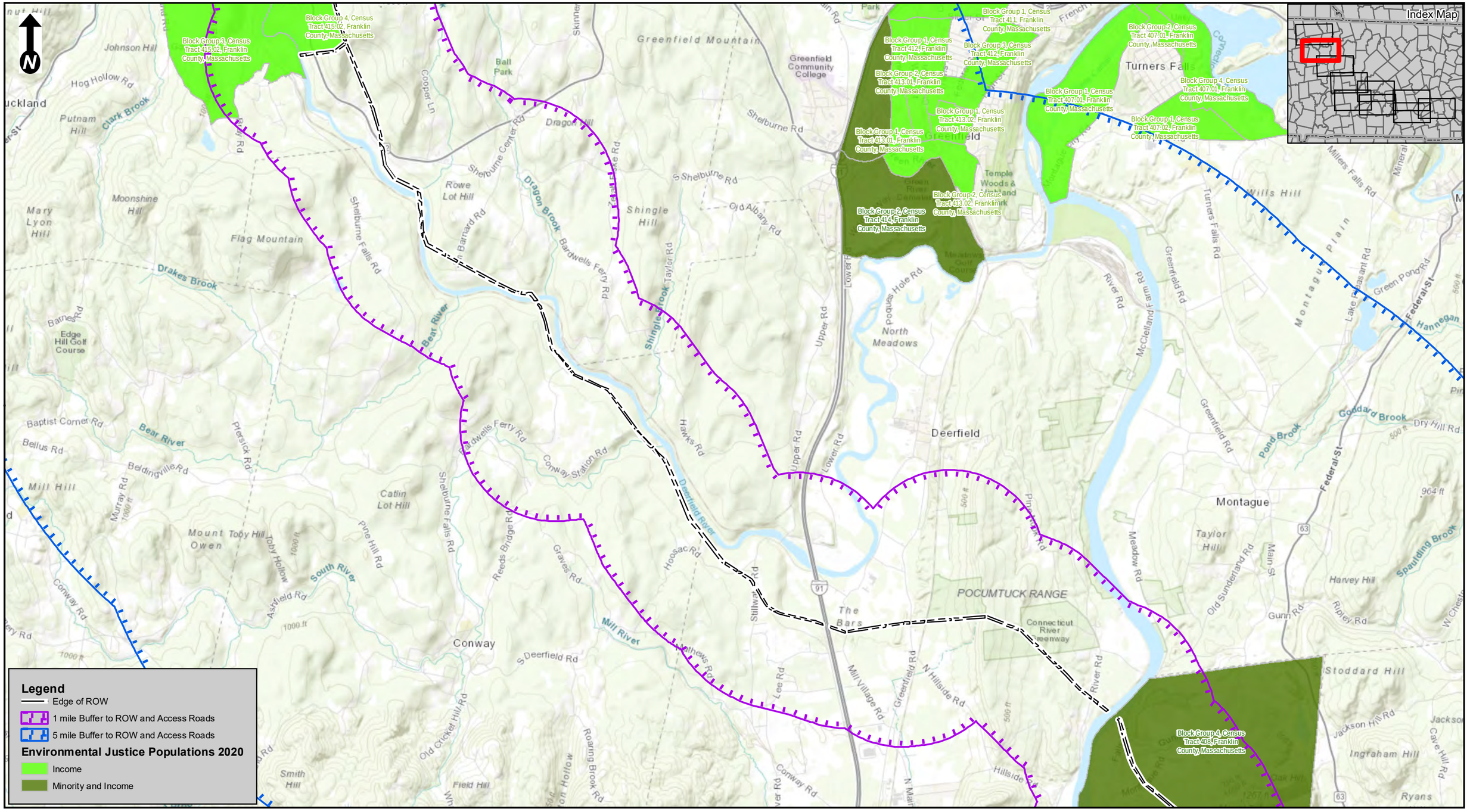
Old Mohawk Trl
Old French King Hwy



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Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT
Environmental Justice Populations Site Location Map
Shelburne, Conway, Deerfield & Sunderland, MA
Page 2 of 10

Source: 2013 National Geographic Society, i-cubed

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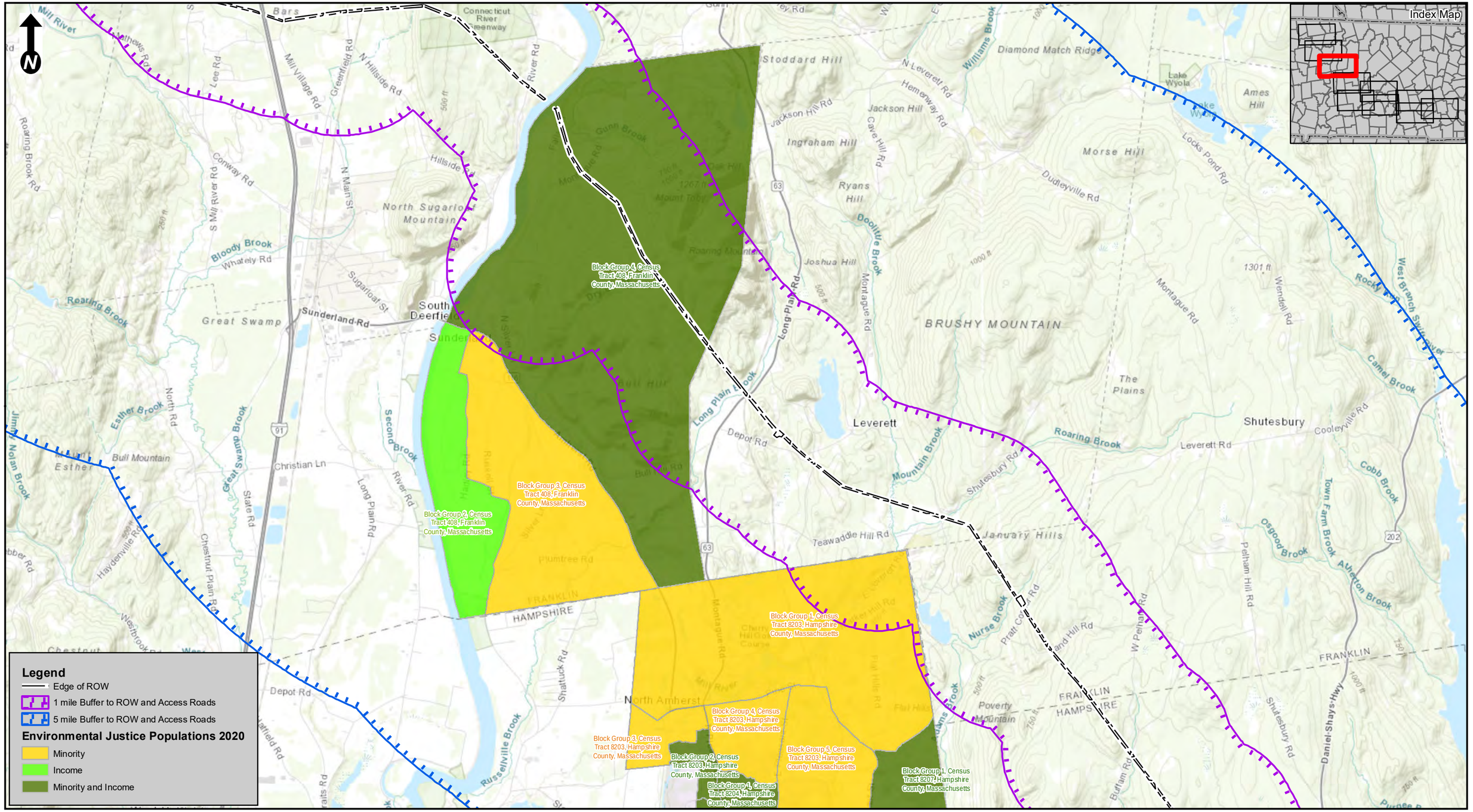
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Block Group 3, Census Tract 408, Franklin County, Massachusetts
Block Group 2, Census Tract 408, Franklin County, Massachusetts
Block Group 1, Census Tract 8203, Hampshire County, Massachusetts
Block Group 4, Census Tract 8203, Hampshire County, Massachusetts
Block Group 3, Census Tract 8203, Hampshire County, Massachusetts
Block Group 2, Census Tract 8203, Hampshire County, Massachusetts
Block Group 5, Census Tract 8203, Hampshire County, Massachusetts
Block Group 4, Census Tract 8204, Hampshire County, Massachusetts
Block Group 1, Census Tract 8207, Hampshire County, Massachusetts
Legend
Edge of ROW
1 mile Buffer to ROW and Access Roads
5 mile Buffer to ROW and Access Roads
Environmental Justice Populations 2020
Minority
Income
Minority and Income
BRUSHY MOUNTAIN
Leverett
Shutesbury
North Amherst
South Deerfield
Sunderland
Stoddard Hill
Ingraham Hill
Jackson Hill
Ryans Hill
Joshua Hill
Morse Hill
Ames Hill
Diamond Match Ridge
North Sugarloaf Mountain
Bull Mountain
January Hills
Poverty Mountain
The Plains
Great Swamp
Connecticut River Greenway
Mill River
Roaring Brook
Bloody Brook
Esther Brook
Second Brook
Great Swamp Brook
Long Plain Brook
Mountain Brook
Nurse Brook
Gunn Brook
Doolittle Brook
Montague Rd
Sunderland Rd
Whately Rd
Depot Rd
Teawaddle Hill Rd
Dudleyville Rd
Locks Pond Rd
Leverett Rd
Shutesbury Rd
Cooleyville Rd
Pelham Hill Rd
Daniel Shays Hwy
Osgood Brook
Cobb Brook
Camel Brook
Rocky Hill
West Branch Swift River
Wendell Rd
Lake Wyola
Williams Brook
Russellville Brook
Nolan Brook
Christian Ln
Chestnut Plain Rd
Haydenville Rd
Westbrook Rd
Shattuck Rd
Buffam Rd
Pratt Corner Rd
Sugarloaf St
Hillside Rd
Greenfield Rd
Mill Village Rd
Lee Rd
Conway Rd
Roaring Brook Rd
Matthews Rd
N Hillside Rd
N Main St
S Mill River Rd
River Rd
Long Plain Rd
Jackson Hill Rd
Hemenway Rd
N Leverett Rd
Cave Hill Rd
Flat Hills Rd
Bull Hill Rd
Plumtree Rd
Depot Rd
Shutesbury Rd
Teawaddle Hill Rd
Leverett Rd
Cooleyville Rd
Wendell Rd
Montague Rd
Long Plain Rd
Doolittle Brook
Gunn Brook
Mountain Brook
Roaring Brook
Esther Brook
Second Brook
Great Swamp Brook
Russellville Brook
Nurse Brook
Cobb Brook
Camel Brook
Rocky Hill
West Branch Swift River
Osgood Brook
Town Farm Brook
Atherton Brook
Daniel Shays Hwy
Pelham Hill Rd
W Pelham

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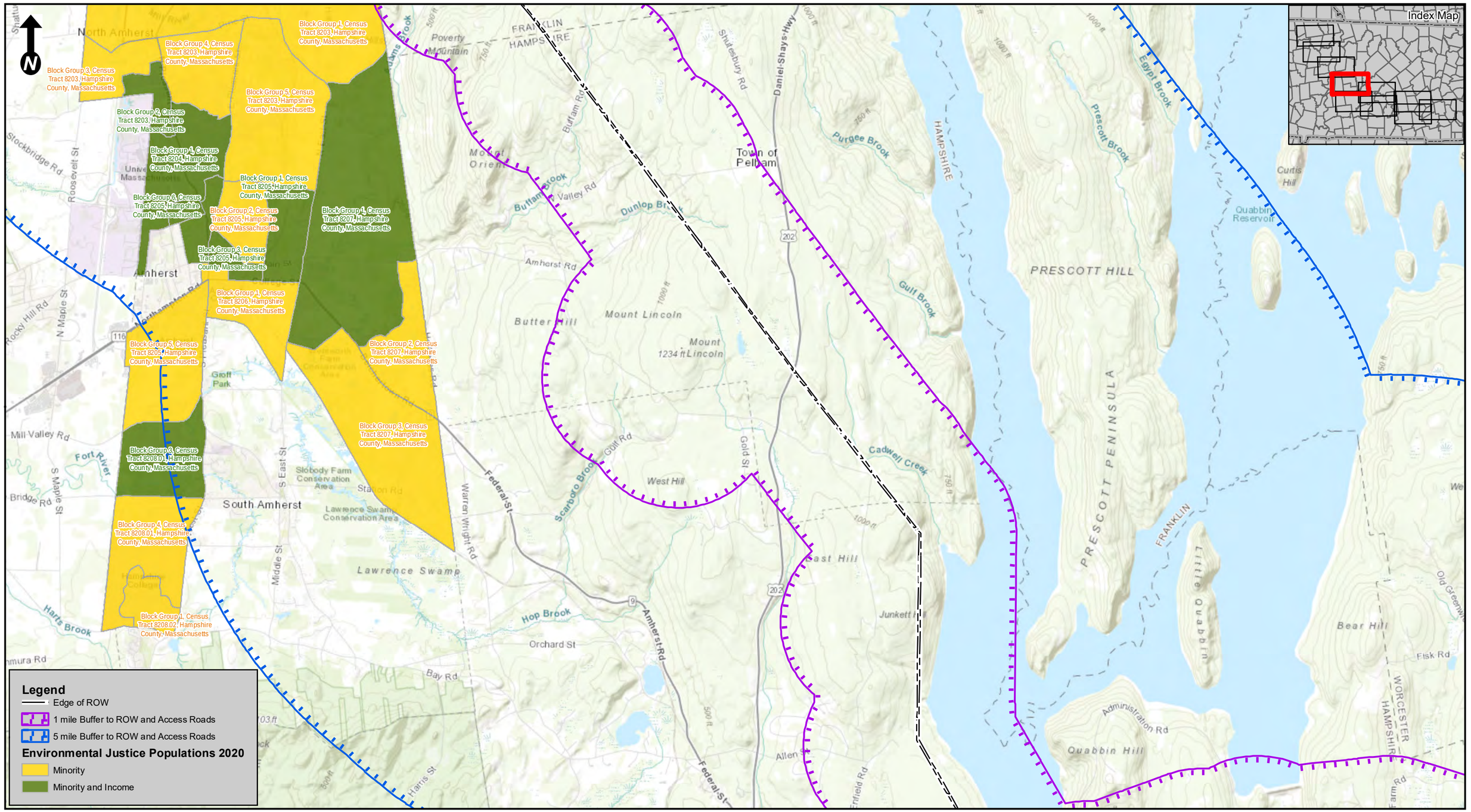

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT
Environmental Justice Populations Site Location Map
Shutesbury, Pelham & Belchertown, MA
Page 4 of 10

Source: 2013 National Geographic Society, i-cubed

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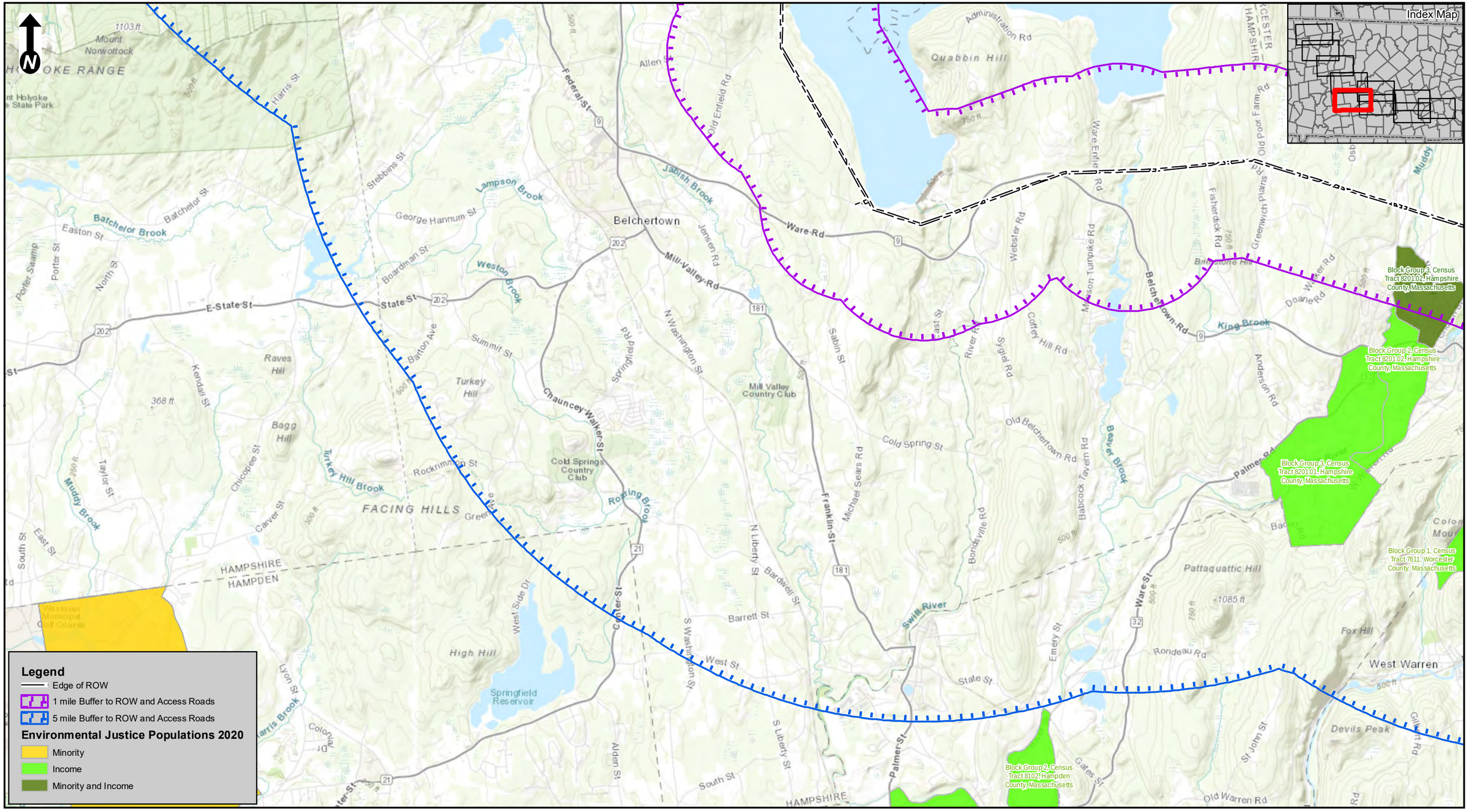

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT
Environmental Justice Populations Site Location Map
Belchertown & Ware, MA
Page 5 of 10

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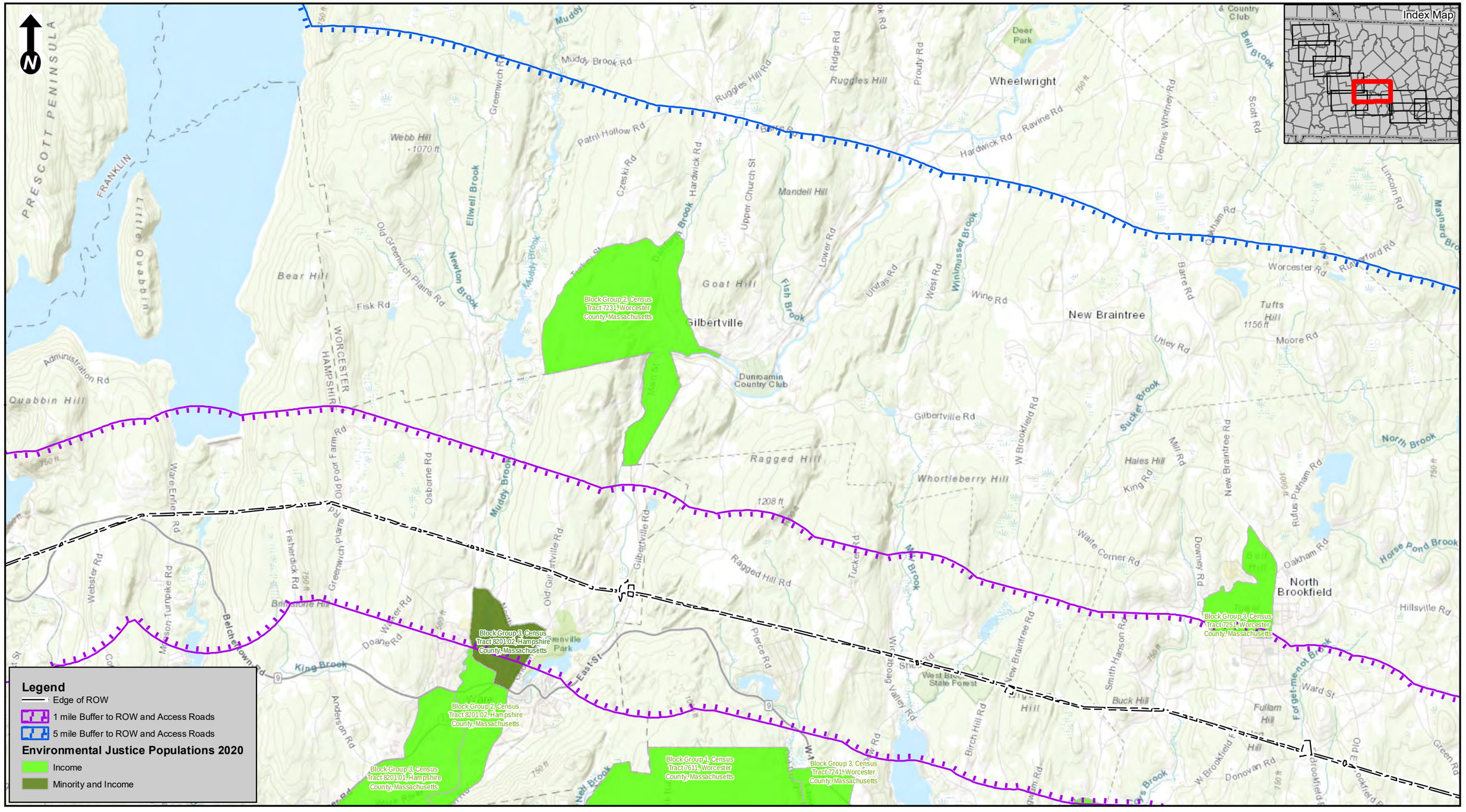

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT
Environmental Justice Populations Site Location Map
Ware, West Brookfield & North Brookfield, MA
Page 6 of 10

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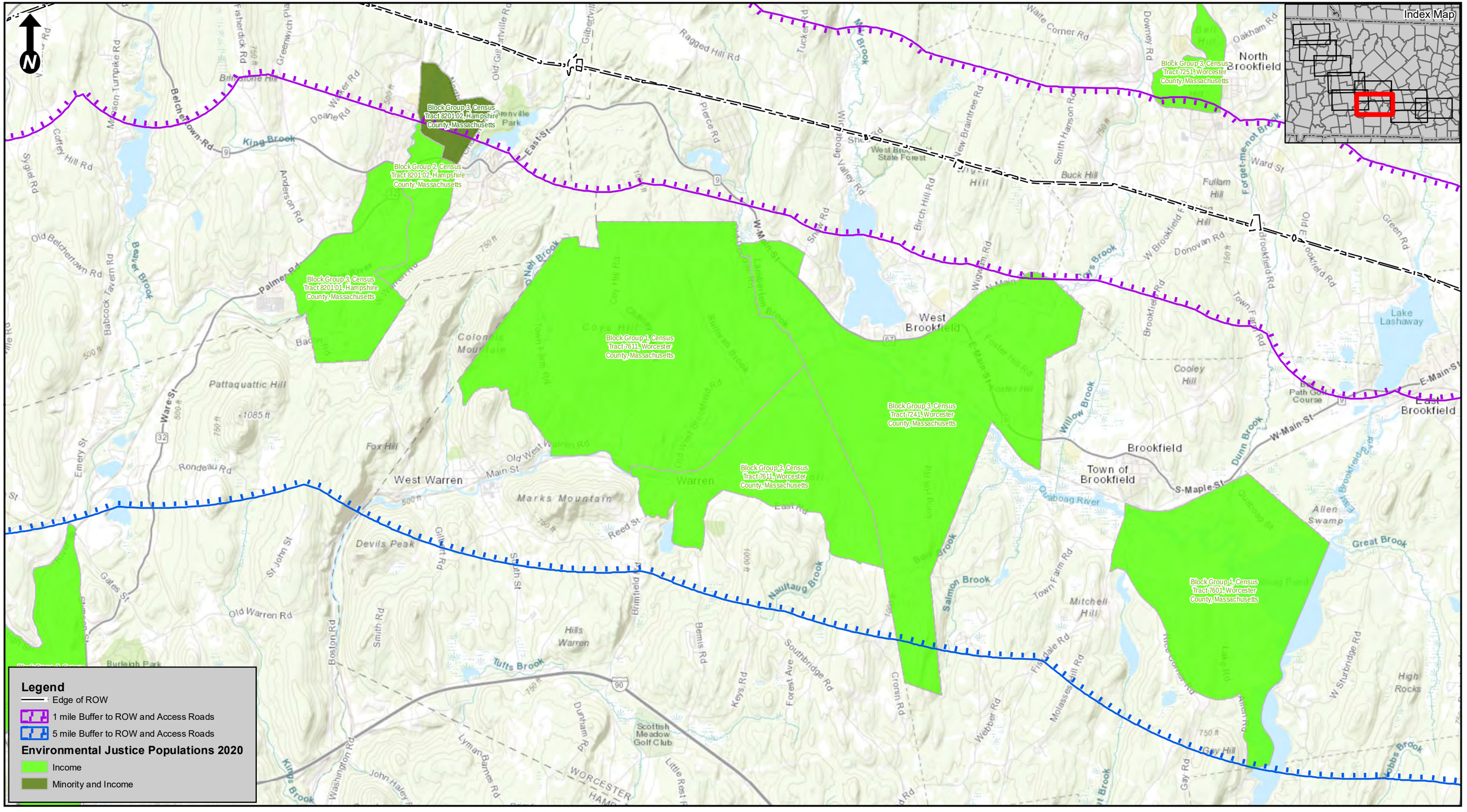
Index Map
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Block Group 2, Census Tract 8201.02, Hampshire County, Massachusetts
Block Group 3, Census Tract 8201.01, Hampshire County, Massachusetts
Block Group 1, Census Tract 7611, Worcester County, Massachusetts
Block Group 3, Census Tract 7241, Worcester County, Massachusetts
Block Group 3, Census Tract 7611, Worcester County, Massachusetts
Block Group 3, Census Tract 7251, Worcester County, Massachusetts
Block Group 1, Census Tract 7601, Worcester County, Massachusetts
Legend
Edge of ROW
1 mile Buffer to ROW and Access Roads
5 mile Buffer to ROW and Access Roads
Environmental Justice Populations 2020
Income
Minority and Income
West Brookfield
North Brookfield
East Brookfield
Brookfield
Town of Brookfield
West Warren
Warren
Pattaquattic Hill
Colonels Mountain
Fox Hill
Marks Mountain
Devils Peak
Hills Warren
Cole Hill
Buck Hill
Fullam Hill
Cooley Hill
Mitchell Hill
Gay Hill
Lake Lashaway
Allen Swamp
High Rocks
Scottish Meadow Golf Club
Quaboag River
King Brook
Beaver Brook
Naultaug Brook
Tufts Brook
Great Brook
Dunn Brook
Willow Brook
Salmon Brook
Sullivan Brook
Cole Hill Rd
Belchertown Rd
East St
W Main St
E Main St
W Brookfield Rd
Ware St
Rondeau Rd
Old West Warren Rd
Old Belchertown Rd
Palmer Rd
Ragged Hill Rd
Pierce Rd
Donovan Rd
Ward St
Green Rd
Old E Brookfield Rd
Brookfield Rd
Town Farm Rd
Waite Corner Rd
Oakham Rd
Downey Rd
Smith Hanson Rd
Buck Hill Rd
Birch Hill Rd
Wigwam Rd
Fiske Hill Rd
Molasses Hill Rd
Webber Rd
Gay Rd
Keys Rd
Forest Ave
Southbridge Rd
Cronin Rd
Bemis Rd
Brimfield Rd
Boston Rd
Smith Rd
St John St
Gilbert Rd
Reed St
Durham Rd
Lyman Barnes Rd
Washington Rd
Old Warren Rd
Gates St
Emery St
Babcock Tavern Rd
Coffey Hill Rd
Sigiel Rd
Anderson Rd
Doane Rd
Webster Rd
Fisherdick Rd
Greenwich Plain Rd
Mattawan Turnpike Rd
Old Gilbertville Rd
Tucker Rd
Mill Brook
Lovell Hill Rd
Fiske Rd
Brookfield Rd
Path Golf Course
Burleigh Park
Greenville Park
West Brookfield State Forest
Lovell Hill
Fisher Hill Rd
Lake Rd
W Sturbridge Rd
Hobbs Brook
Little Rest Brook
Mill Brook
Old Brookfield Rd
Fiske Hill Rd
Town Farm Rd
Mitchell Hill
Gay Hill
Allen Swamp
Great Brook
Quaboag River
Dunn Brook
Willow Brook
Salmon Brook
Naultaug Brook
Tufts Brook
King Brook
Beaver

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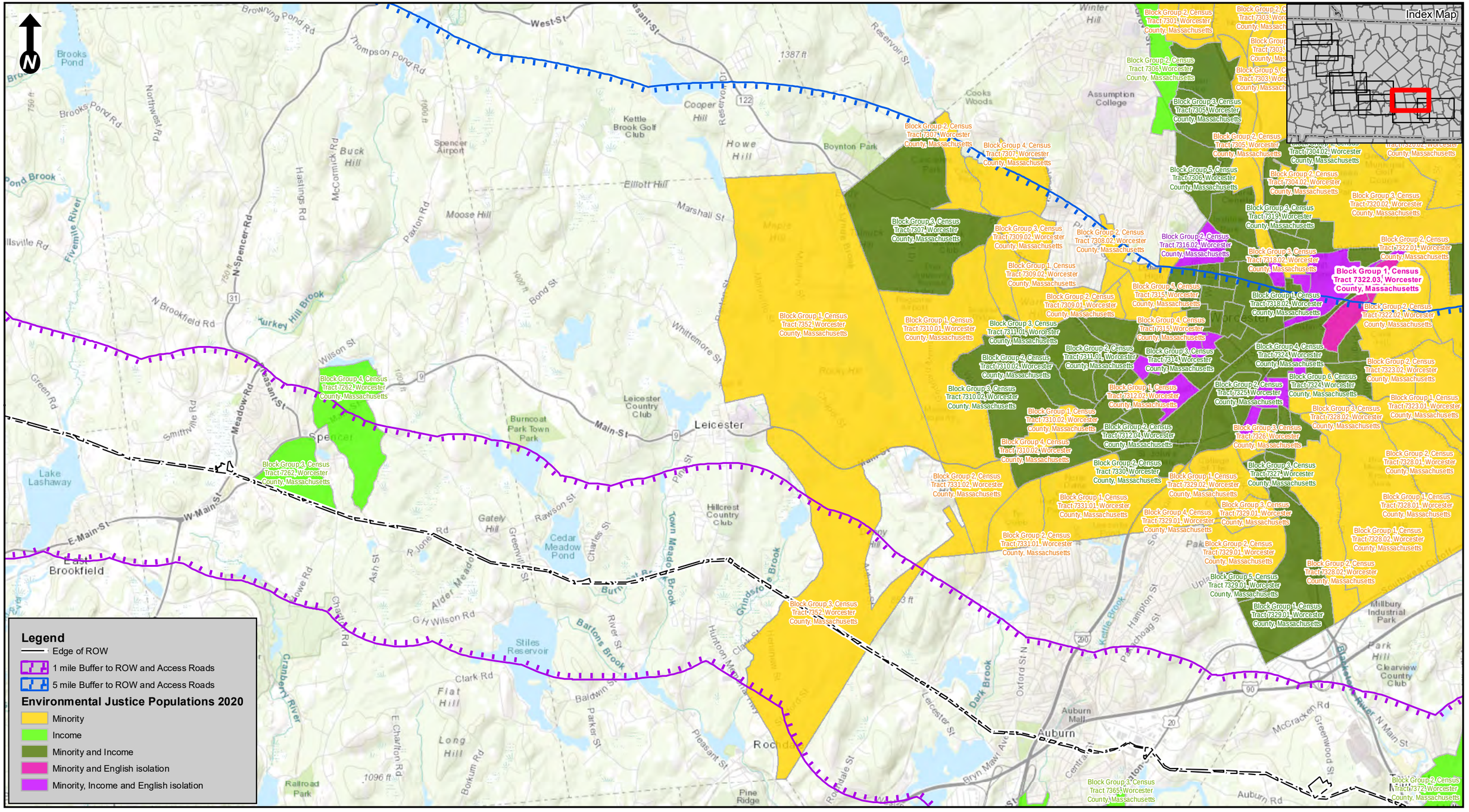

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT
Environmental Justice Populations Site Location Map
North Brookfield, East Brookfield, Spencer, Leicester, Auburn & Millbury, MA

Source: 2013 National Geographic Society, i-cubed

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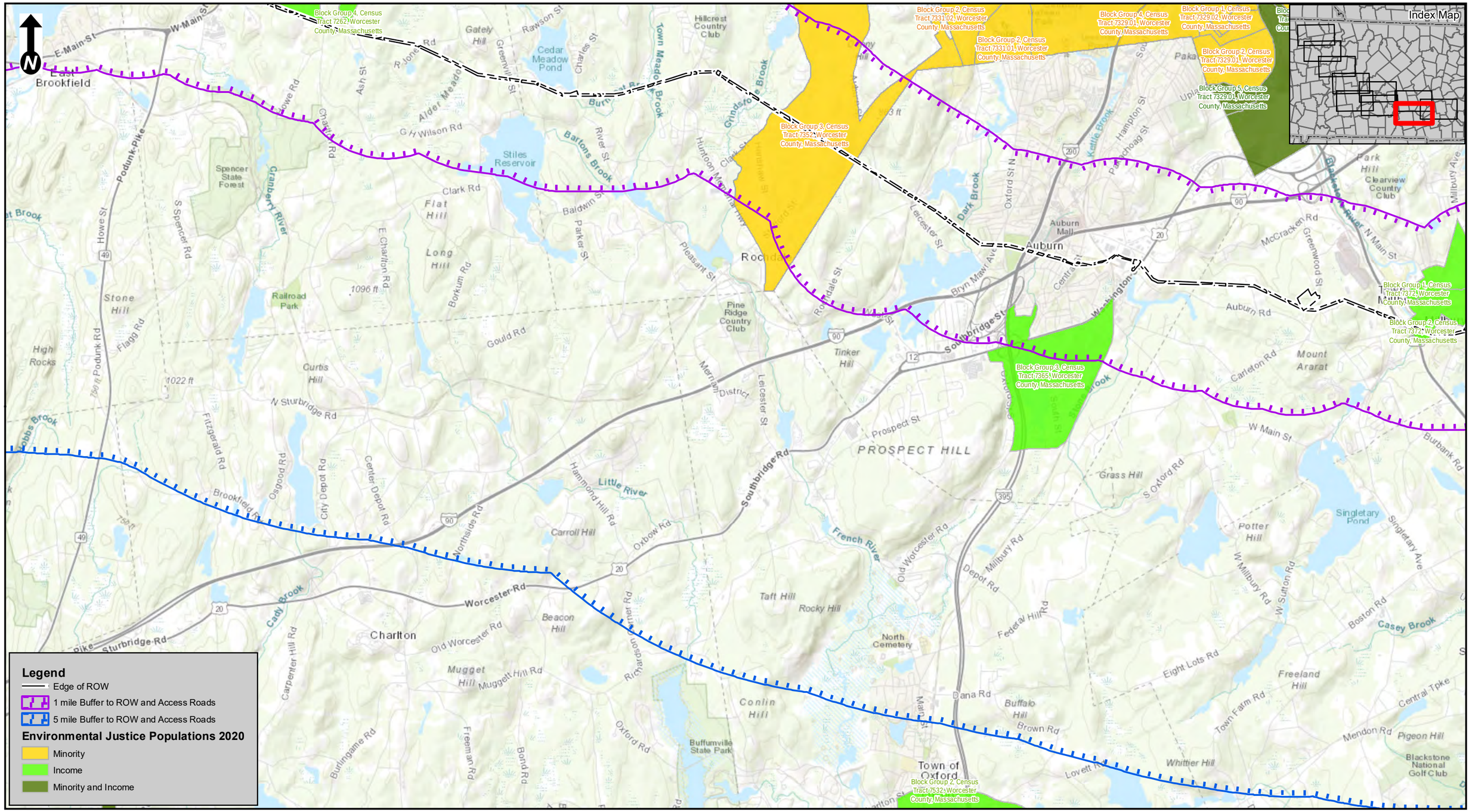

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT
Environmental Justice Populations Site Location Map
Spencer, Leicester, Auburn & Millbury, MA
Page 9 of 10

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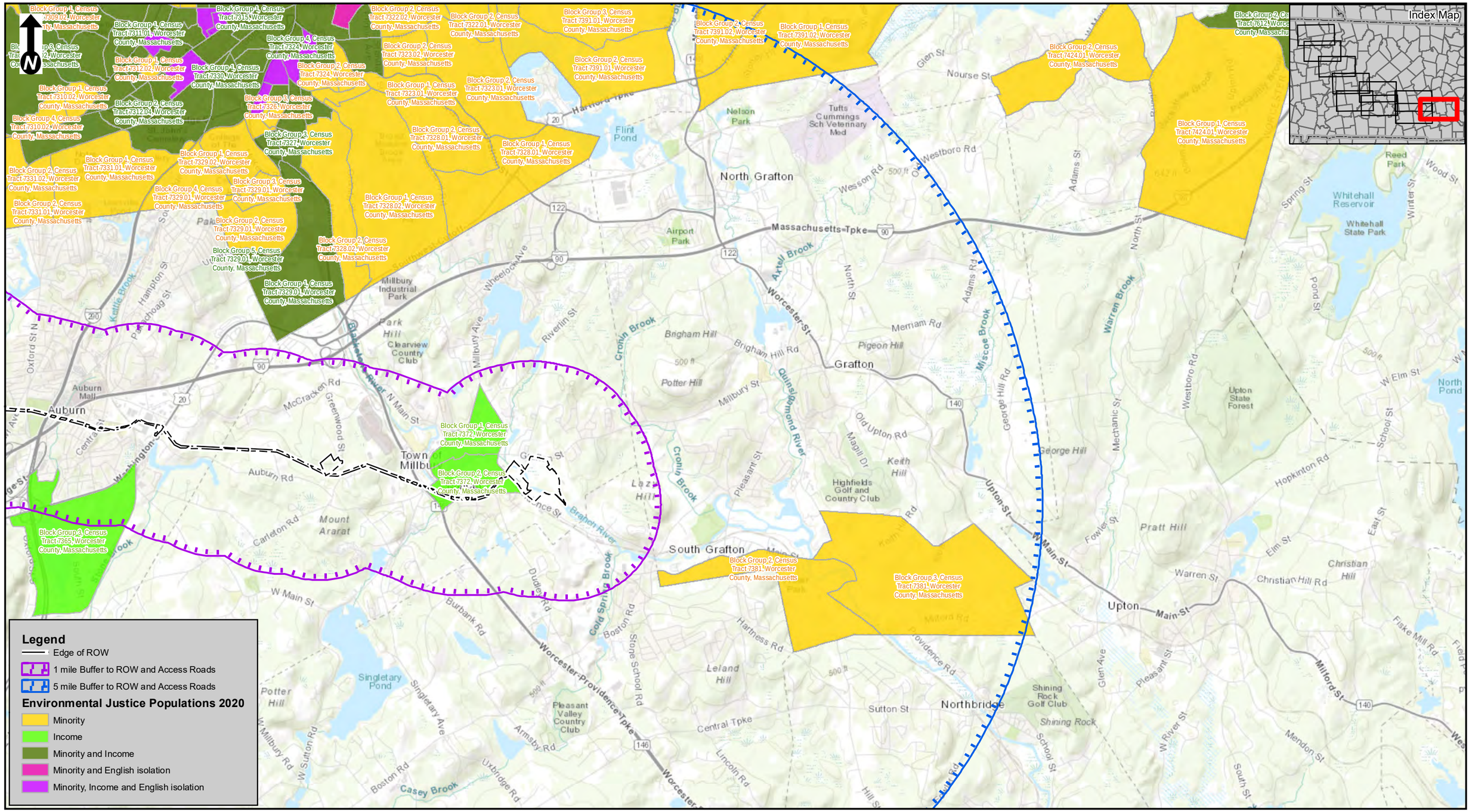

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT
Environmental Justice Populations Site Location Map
Auburn & Millbury, MA
Page 10 of 10

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Appendix 5-2: National Grid's ROW Access, Maintenance and Construction Best Management Practices ("EG-303NE")

PURPOSE/OBJECTIVE:

This document provides National Grid personnel, consultants and contractors with Best Management Practices (BMPs) for conducting work on electric and natural gas transmission and distribution rights-of-ways (ROWs) and substations in New England.

WHO:

These BMPs are to be followed by all personnel conducting work on Company electric and gas ROWs and substations in New England. These BMPs do not apply to Company employees and contractors performing routine vegetation management activities that are not a part of construction or re-construction projects. Employees and contractors maintaining vegetation on Company ROWs and substations must follow the National Grid ROW Vegetation and Substation Vegetation Management Plans.

DEFINITIONS:

Refer to **Glossary** in **Appendix 1** and **Acronyms** in **Appendix 2**.

WHAT TO DO:

1.0 Project Planning

Prior to the start of any project (proposed new facilities or maintenance of existing facilities), the Project Engineer or other project planner shall determine whether any environmental permits or approvals are required, per the state-specific EG-301 environmental checklists. Any questions regarding which activities may be conducted in regulated areas or within environmentally sensitive areas shall be referred to the National Grid Environmental Scientist or Project Environmental Consultant.

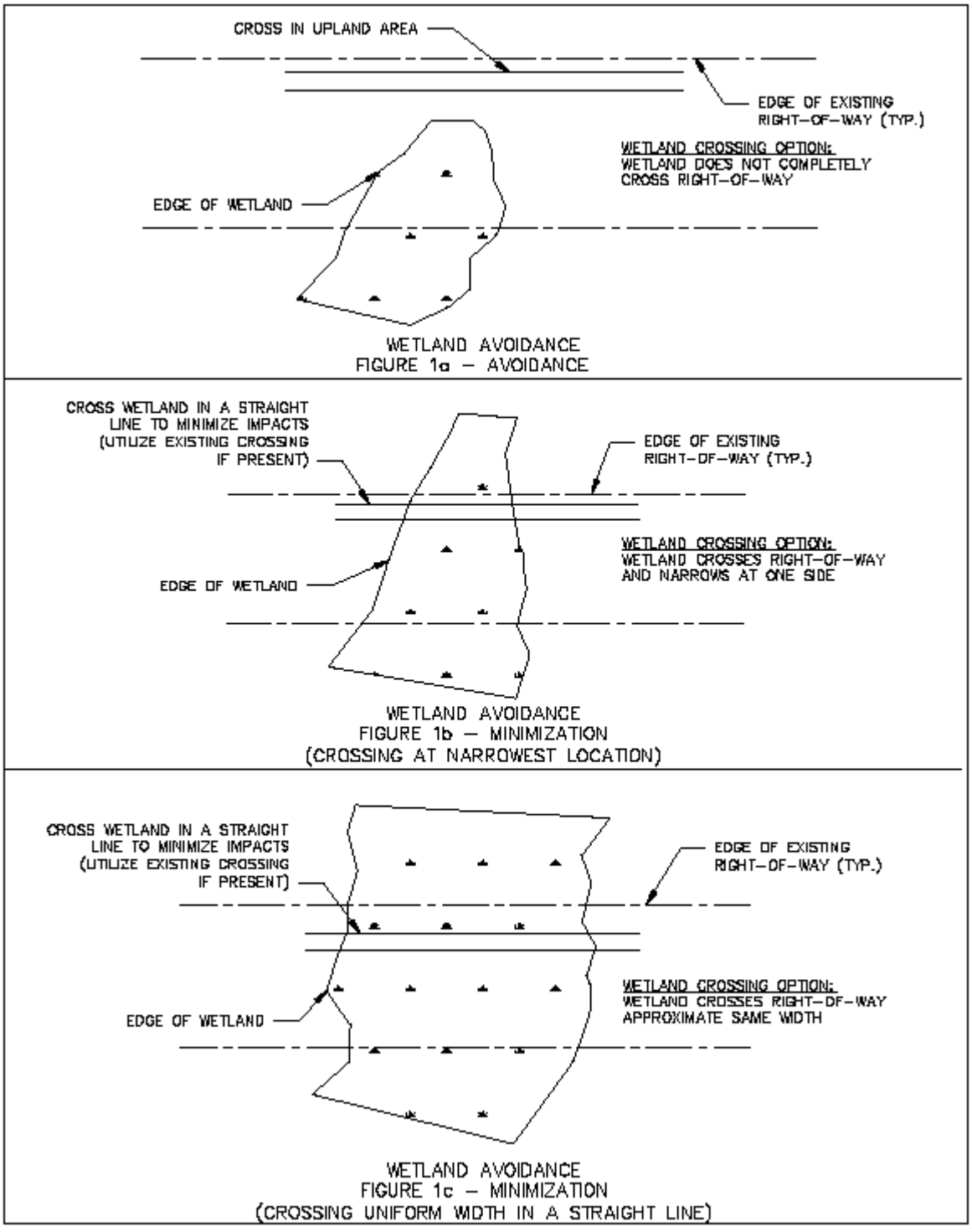
All new construction and maintenance projects shall follow clear and enforceable environmental performance standards, which is the purpose for which these BMPs have been compiled.

1.1 Avoidance and Minimization

Measures shall always be taken to avoid impacts to wetlands, waterways, rare species habitats, known below and above ground historical/archeological resources and other environmentally sensitive areas. If avoidance is not possible, then measures shall be taken to minimize the extent of impacts. Alternate access routes or staging areas shall always be considered. Below is a list of methods that shall be considered where impacts are unavoidable:

- Use existing ROW access where available. Keep to approved routes and roads without deviating from them or making them wider.
- Off-ROW access shall never be assumed and shall be coordinated through National Grid Real Estate before being implemented.
- Where no existing ROW access is present, avoid wetlands and if a wetland crossing is necessary, cross wetlands at the most narrow point possible or at the location of a previously used crossing (if evident). Figure 1 below illustrates this minimization technique.

- Avoid and minimize stream crossings.
- Minimize the width of typical access roads through wetlands to a maximum width of 16 feet.
- Conduct work manually (without using motorized equipment) in wetlands, wherever possible.
- Use construction mats in wetlands to minimize soil disturbance and rutting when crossing or working within wetlands. When not using mats for access, standard vehicles shall not be allowed to drive across wetlands without the prior approval of the National Grid Environmental Scientist. Use of a low ground pressure (LGP) vehicle may be a feasible alternative to mats provided that such LGP vehicle use has been reviewed and approved by the National Grid Environmental Scientist. See Section 7.0.
- Coordinate the timing of work to cause the least impacts during the regulatory low-flow period under normal conditions, when water/ground is frozen, after the spring songbird nesting season, and, outside of the anticipated amphibian migration window (mid-February to mid-June). Refer to the United States Army Corps of Engineers (USACE) state-specific General Permit for the definition of the low-flow period in each state at: http://www.nae.usace.army.mil/Missions/Regulatory/State-General-Permits/. A summary table is provided in Section 7.0.
- Seek alternative routes or work methods to minimize impact.


CROSS IN UPLAND AREA
EDGE OF EXISTING RIGHT-OF-WAY (TYP.)
WETLAND CROSSING OPTION:
WETLAND DOES NOT COMPLETELY CROSS RIGHT-OF-WAY
EDGE OF WETLAND
WETLAND AVOIDANCE
FIGURE 1a – AVOIDANCE
CROSS WETLAND IN A STRAIGHT LINE TO MINIMIZE IMPACTS (UTILIZE EXISTING CROSSING IF PRESENT)
EDGE OF EXISTING RIGHT-OF-WAY (TYP.)
WETLAND CROSSING OPTION:
WETLAND CROSSES RIGHT-OF-WAY AND NARROWS AT ONE SIDE
EDGE OF WETLAND
WETLAND AVOIDANCE
FIGURE 1b – MINIMIZATION
(CROSSING AT NARROWEST LOCATION)
CROSS WETLAND IN A STRAIGHT LINE TO MINIMIZE IMPACTS (UTILIZE EXISTING CROSSING IF PRESENT)
EDGE OF EXISTING RIGHT-OF-WAY (TYP.)
WETLAND CROSSING OPTION:
WETLAND CROSSES RIGHT-OF-WAY APPROXIMATE SAME WIDTH
EDGE OF WETLAND
WETLAND AVOIDANCE
FIGURE 1c – MINIMIZATION
(CROSSING UNIFORM WIDTH IN A STRAIGHT LINE)

Appı

1.2 Historically Significant Areas

Areas that have been identified as historically and/or culturally significant shall be avoided in accordance with site-specific avoidance plans, as applicable. Refer to the project-specific Environmental Field Issue (EFI) for any applicable avoidance plans or consult with the National Grid Environmental Scientist. Demarcation of these areas to be avoided shall use staked orange snow fencing or an equivalent physical barrier (not just ribbon flagging) and signage. Refer to Section 14.0 for signage guidance.

1.3 Rare Species Habitat

Work within areas that have been identified as mapped rare species habitat shall follow site-specific requirements, as applicable. In Massachusetts, maintenance activities within mapped habitat (known as Priority Habitat of Rare Species) shall follow the BMPs outlined in the Natural Heritage Endangered Species Program (NHESP)-approved National Grid Operation and Maintenance Plan. Work in mapped rare species habitat may require, at a minimum, turtle training for crews and sweeps of work areas for turtles, botanist identification of rare plant locations and avoidance of these locations, and protection of vernal pools, all prior to the start of work. Demarcation of these areas to be avoided (e.g., rare plant populations, overwintering turtles, nests) shall use staked orange snow fencing or an equivalent physical barrier (not just ribbon flagging) and signage. Refer to Section 14.0 for signage guidance.

Where new substations are being constructed or existing substations are undergoing a rebuild or expansion, and the substations are located in mapped rare turtle habitat, project team members should consider fenceline improvements or measures needed to prevent/eliminate turtle entrance into the substation or allow multiple points for easy egress such that turtles are not trapped within the substation fenceline.

Other requirements may apply in NH, VT and RI. Refer to the project-specific EFI for any applicable measures or consult with the National Grid Environmental Scientist.

1.4 Meetings

Pre-permitting meetings shall take place early in the project development process to determine what permits are triggered by the proposed work and the timeline required for permitting. During these meetings, the team shall develop access plans and BMPs to be used during construction of the project.

Field / Constructability review meetings shall take place on-site to evaluate construction site access and job site set-up, to ensure that the project can proceed as permitted. It is at this point in time where work areas, pulling locations, laydown areas, parking areas, and equipment storage areas are evaluated and located. Off-ROW areas under consideration should be included in this discussion.

Prior to submitting permit plans to regulatory authorities, the construction group (contractor or National Grid) shall review the plans for final sign off.

Pre-construction meetings are typically held prior to the commencement of all work to appoint responsible parties, discuss timing of work, and further consider options to avoid and/or minimize impacts to sensitive areas. These meetings can occur on- or off-site and shall include all the willing and available stakeholders (i.e., utility employees, contractors, consultants, inspectors, and/or monitors, and regulatory personnel). Training of crews and supervisors of the EFI, Stormwater Pollution Prevention Plan (SWPPP), rare species, and other permit requirements shall be conducted at a pre-construction meeting.

Pre-job briefings shall be conducted daily or otherwise routinely scheduled meetings shall be conducted on-site with the work crew throughout the duration of the work. These meetings are a way of keeping everyone up to date, confirming there is consensus on work methods and responsibilities, and ensuring that tasks are being fulfilled with as little impact to the environment as possible.

The Project Environmental Scientist/Monitor and Construction Project Manager shall communicate regularly (e.g. weekly or bi-weekly meetings or phone conversations) to discuss the work completed since last communication (i.e. work locations, wetland impacts, equipment used, and unexpected delays or work conditions). These meetings or calls shall include the expected schedule of construction for the upcoming week, the long term construction plans, and planned methods for working near/in wetlands. Both the Project Environmental Scientist/Monitor and Construction Project Manager shall work together so the Project complies with all environmental permits and regulations. When changes to the Project scope or agreed work plan are proposed they shall be done so with the final approval of the National Grid Environmental Scientist.

1.5 Communication of Project Specific Environmental Requirements

Project specific environmental concerns, to include sensitive resources, permits, approved access and time-of-year or other restrictions, shall be communicated to the project team and be included as part of the Pre-Bid and Pre-Construction Meetings. Project specific requirements shall be communicated to the project manager/construction manager/engineering group using the following guidelines:

Environmental Field Issue – The EFI will be a full document consisting of narrative, project permits, access and matting plans. A table summarizing pertinent (but not all) permit conditions and the responsible party for those conditions shall be included in the EFI. Copies of all permits should be included as attachments. This will be prepared for most projects with multiple permits or large, complex projects (siting board, Section 404, 401 WQC, SWPPP). There shall be EFI training at the pre-construction meeting. The National Grid EFI template is located in **EI-303NE**.

Simplified Environmental Field Issue – The Simplified EFI is a memorandum containing environmental resources present, project permit(s), access and matting plans and a table summarizing relevant permit conditions and responsible party for those conditions. Copies of all permits should be included as attachments. The Simplified EFI will be prepared for most projects with 1 or 2 permits (Order of Conditions, S404 Cat 1). The Simplified EFI should also be provided for projects that have environmental resources present, but the scope of the project does not trigger environmental permitting (e.g., the scope of work qualifies for maintenance exemption(s)). The resources present

shall be discussed at the Pre-Bid and Pre-Construction meetings and any changes in scope will require additional review by the National Grid project team.

E-mail delivery of Permit and any Sediment/Erosion control or BMP plan – For those projects with only one permit (eg., MA Order of Conditions, RI DEM permit, RI CRMC permit, NH Utility Notification) or projects with a sediment & erosion control plan (local town requirement or for exempt maintenance work), a copy of the permit and any applicable plan will be emailed to the Project Manager (and the project team where deemed necessary) to be incorporated into the Construction Field Issue.

STORMS work management system input – For STORMS work, no EFI is prepared unless multiple permits are required for the project (see guidance above). If only a MA Order of Conditions, MA Determination of Applicability, RI DEM permit, RI CRMC permit, RI SESC Approval, or NH Utility Notification is required, then the permit is attached in the Documents tab and conditions noted in Remarks/Comments section. Standard STORMS boilerplate language is located in **EI-303NE**.

1.6 Timing of Work

Regulatory authorities may place seasonal or time-of-year restrictions on project construction elements. These time-of-year restrictions may be state or permit-specific, and shall be adhered to.

Work during frozen conditions. Activities conducted once wetland areas are frozen sufficient to minimize rutting and other impacts to the surrounding environment may be authorized by the National Grid Environmental Scientist. Work during this time also generally reduces disturbance of aquatic and terrestrial wildlife movement by avoiding sensitive breeding and nesting seasons. When not using mats for access, vehicles shall not be allowed to drive across wetlands without the prior approval of the National Grid Environmental Scientist.

Work during the regulatory low-flow period. Conducting work during the low-flow period can reduce impacts to surface water and generally avoids spawning and breeding seasons of aquatic organisms. If the water is above normal seasonal levels, adjustments to work activities and methods are required.

1.7 Alternate Access

1.7.1 Manual Access

In some cases such as for smaller projects, work areas can be accessed manually. This includes access on foot through upland and shallow wetland areas, access by boat through open water or ponded areas, and climbing of structures where possible. Smaller projects, such as repair of individual structures, or parts of structures, that do not categorically require the use of heavy machinery, shall be accessed manually to the greatest extent practicable.

1.7.2 Use of Overhead/Aerial Access

Using helicopters can be expensive and is not always feasible, but it may be appropriate in some situations in order to get workers and equipment to a site that otherwise may be very difficult to access. The use of overhead and/or aerial equipment may be beneficial for work in areas where larger water bodies, deep crevices, or mountainous areas hinder ground access. The landing area for

helicopters shall be reviewed for environmentally sensitive resources. Use of helicopters requires Project Manager and Senior Management approval.

2.0 Inspection, Monitoring and Maintenance

All construction practices and controls shall be inspected on a regular basis and in accordance with all applicable permits and local, state, and federal regulations to avoid and correct ANY damage to sensitive areas.

The construction crews shall be responsible for completing daily inspections, and IMMEDIATELY bring any **damage or observed erosion, or failed erosion controls** to the attention of the Person-In-Charge and the National Grid Environmental Scientist. Where applicable and/or as directed by environmental permits issued for the project, the Project Environmental Consultant shall conduct weekly (at a minimum) inspections of the project work areas and shall document their inspection using the Stormwater, Wetlands & Priority Habitat Environmental Compliance Site Inspection / Monitoring Report form found in **Appendix 3** and issue the report within 24 hours. The Person-in-Charge shall work with the National Grid Environmental Scientist and the Project Environmental Consultant to determine when and how the repairs shall be made.

Project-specific Action Logs and Long-Term Restoration Logs are prepared as needed by the National Grid Environmental Scientist or the Project Environmental Consultant to track issues and/or repairs and assign responsible parties.

3.0 Best Management Practices

The BMP sections presented in this EG address access, construction, snow and ice management, structures in wetlands, access road maintenance and repair, clean-up and restoration standards, ROW gates, field refueling and maintenance operations, management of spills/releases, and a summary of key construction BMPs.

Note that BMPs shown on any permit drawings for a specific project may need to be revised and or supplemented during the execution of a project based on unforeseen or unexpected factors such as extreme weather or unknown subsurface conditions. It is the responsibility of the Contractor to work with the National Grid Environmental Scientist and/or the Project Environmental Consultant to identify necessary changes and to ensure that construction-related impacts to wetlands, water bodies and other environmentally sensitive areas are avoided.

Any deviation from the approved BMPs shown in the EFI and/or SWPPP plans shall be communicated immediately to the National Grid Environmental Scientist as it may require additional permitting or could result in a permit violation.

3.1 Wetland Boundary Demarcation

Prior to the start of any activity conducted under an environmental permit, wetland boundaries shall be reviewed. Flagging for wetland boundaries, stream banks and other resource areas shall be

refreshed as needed. This may become particularly important when the original flagging was placed in previous seasons and now may have become obscured.

3.2 Sedimentation and Erosion Controls

Appropriate sedimentation and erosion control devices shall be installed at work sites, in accordance with permit conditions and/or regulatory approvals, and as needed to prevent adverse impacts to water resources and adjacent properties.

The overall purpose of such controls is to prevent and control the movement of disturbed soil and sediment from work sites to adjacent, undisturbed areas, and particularly to water resources, public roads and adjacent properties. All proprietary controls shall be installed per manufacturer's recommendations and specifications.

Appropriate sedimentation and erosion control devices include but are not limited to: silt fencing, straw bales, wood chip bags, straw wattles, compost socks, erosion control blankets, mulch, slope interruption practices, flocculent powder/blocks and storm drain/catch basin inlet protection. Such controls shall be installed between the work area and environmentally sensitive areas such as wetlands, streams, drainage courses, roads and adjacent property when work activities shall disturb soils and result in a potential for causing sedimentation and erosion.

In Massachusetts, use of monofilament-encased wattles shall be avoided in mapped Priority Habitat for snakes and amphibians. For projects with work within mapped Priority Habitat for snakes and amphibians, wattles that are encased in a sock, hemp, fiber, or movable jute netting are required to prevent entrapment. Also, "wildlife gaps" should occur every 50 feet, if possible, given wetland permit conditions. This spacing of the wattles allows snakes and amphibians to move across the ROW. Refer to the Amphibian and Reptile BMPs in **Appendix 4**.

Staked straw bales often serve as the demarcation of the limits of work and/or sensitive areas to be avoided. Work shall never be conducted outside the limit of erosion controls without prior approval from the National Grid Environmental Scientist.

Project plans depict proposed erosion controls, however field conditions may warrant additional practices be implemented (e.g., wet conditions, frozen conditions, poorly drained soils, steep slopes, materials used for work pads, transition areas to construction mats, number of trips across work areas, etc.).

Any deviation from the approved erosion controls shown in the EFI and/or SWPPP plans needs to be communicated immediately to the National Grid Environmental Scientist as it may require additional permitting or result in a permit violation.

Appendix 4 provides typical sketches of common sedimentation and erosion controls. If a SWPPP is required for the project, maintenance and inspection of erosion controls shall follow the SWPPP requirements. Sedimentation and erosion controls shall be properly maintained and inspected on a

periodic basis, until work sites are properly stabilized and restored. Inspections shall be documented using the Inspection Form "Storm Water, Wetlands & Priority Habitat Environmental Compliance Site Inspection/Monitoring Report" (**Appendix 3**).

The sequence and timing of the installation of sedimentation and erosion control measures is critical to their success. Sedimentation and erosion controls shall be installed prior to commencing construction activities that may result in any soil disturbance or cause otherwise polluted site runoff. Inspection of these devices may be required by the National Grid Environmental Scientist or by regulators prior to the start of work. The installation of water bars and other erosion control measures shall be installed shortly thereafter.

3.3 Concrete Wash Outs

Concrete wash outs shall be used for management of concrete waste. Concrete and concrete washout water shall not be deposited or discharged directly on the ground, in wetlands or waterbodies, or in catch basins or other drainage structures. Where possible, concrete washouts shall be located away from wetlands or other sensitive areas. Consult the National Grid Environmental Scientist on proposed concrete wash out locations prior to their use. Following the completion of concrete pouring operations, the wash outs shall be disposed of off-site with other construction debris. Refer to BMPs in **Appendix 4**.

3.4 Construction Activities in Standing Water

The use of silt curtains or turbidity barriers may be required when working in or adjacent to standing water such as ponds, reservoirs, low flowing rivers/streams, or coastal areas. Silt curtains and turbidity barriers prevent sediment from migrating beyond the immediate work area into the resource areas.

Coffer dams constructed using sheet piling or large sandbags (Trade names such as "the Big Bag" or "DamItDams") may be used to temporarily isolate and contain a work area in standing water.

When working in standing water, an oil absorbent boom, in addition to a silt curtain or other temporary barrier, shall be placed around the work area for spill prevention.

Work in drinking water reservoirs or other waters may require extensive regulatory agency review, even for maintenance work, which could result in additional time required for permitting, review and material procurement prior to the start of work.

3.5 Dewatering

Where excavations require the need for dewatering of groundwater or accumulated stormwater, the water shall be treated before discharge. Appropriate controls include dewatering basins, flocculent blocks, filter bags, filter socks, or weir tanks. Schematics of these BMPs are included in **Appendix 4**. Water trucks or fractionation tanks may be utilized if watertight containers are desired for controlled on-site discharge or for off-site discharge into an approved dewatering area when site restrictions make it difficult to utilize other dewatering methods on-site. Dewatering discharge water shall never be directed into wetlands, streams/rivers, other sensitive resource areas, catch basins, other

stormwater devices, or substation Trenwa trenches. Dewatering flow shall be controlled so that it does not cause scouring or erosion through the use of a dewatering basin, filter sock, or equivalent. If it is determined that the chosen controls are not appropriately filtering the fine sediment from the dewatering pumpate then the National Grid Environmental Scientist shall be notified immediately and the controls shall be revised or supplemented.

When establishing a dewatering basin, consideration should be given to the anticipated volume of water and rate of pumping in determining the size of the dewatering basin. Dewatering basins shall be constructed on level ground. Once pumping commences, the basin shall be monitored frequently to assure that the rate of water delivery to the structure is low enough to prevent water from flowing, unfiltered, over the top of the basin walls. The basin shall be monitored throughout the dewatering process because the rate of filtration shall decrease as sediment clogs the filter fabric. If the basin is not appropriately filtering the fine sediment from the dewatering pumpate then the basin may need to be supplemented with a flocculent block. Field conditions shall dictate how often the basin should be inspected.

Distance to sensitive areas, direction of flow (toward or away from protected, or sensitive areas, such as wetlands, ponds, or streams), amount of vegetative ground cover between the basin and nearby sensitive areas, ground conditions (ledge, frozen, etc.), volume of water being pumped, and pump-rate, are some of the factors to be considered when determining an inspection frequency. Clogged filter fabric shall be replaced and accumulated sediment shall be removed as necessary from the basins to maintain efficacy.

Any new dewatering location (not previously reviewed and approved by the National Grid Environmental Scientist during project planning or permitting) shall be reviewed and the discharge location approved by the National Grid Environmental Scientist before use.

Complex projects that require large scale dewatering shall require individual review by the National Grid Environmental Scientist and may trigger additional permitting.

Dewatering in areas of known chemical contamination may require a separate NPDES permit, or other approval, and treatment or containment system. Consult with the National Grid Environmental Scientist.

3.5.1 Overnight Dewatering

Some projects may necessitate 24-hour dewatering for on-site construction activities. Overnight dewatering will be evaluated on a case-by-case basis by the National Grid Environmental Department.

If it is necessary to conduct overnight dewatering on a project, a dewatering plan must be submitted to the Environmental Department for review and approval **5 business days prior to beginning dewatering activities**. Sufficient knowledge of flow, discharge, and re-infiltration rate of water must be obtained and submitted for review. The Environmental Department

may require monitored dewatering for a period of time in order to provide this data in support of a request for 24-hour dewatering. The dewatering plan must include at a minimum:

1. Location of dewatering system, system components (basin, frac tank, etc), and materials.
2. Location of discharge and distance from closest wetland.
3. Location of erosion controls. A secondary perimeter of erosion controls will be required around the dewatering system for overnight dewatering.
4. Peak flow, discharge rate and re-infiltration rates.
5. Visual monitoring plan for discharge. Expected duration of dewatering.
6. Emergency provisions if overnight, unattended dewatering is proposed.

3.5.2 Dewatering Clean Up/Restoration

Basins shall be cleaned and removed as soon as dewatering is complete. Sediment removed from the dewatering basin shall be allowed to dry before being disposed of by evenly spreading it over unvegetated upland areas where erosion is not a concern if clean or removing it from the site for proper disposal. Off-site trucking of wet soils is prohibited. The sediment disposal area shall be approved by the National Grid Environmental Scientist or the Project Environmental Consultant prior to use. Stabilization measures shall also need to implemented and approved by the National Grid Environmental Scientist or the Project Environmental Consultant. Soils/sediments shall be dewatered and dried to the point practicable for either on-Site reuse or off-Site transport.

3.6 Check Dams

Check dams are a porous physical barrier installed perpendicular to concentrated storm water flow. They are used to reduce erosion in a swale by reducing runoff energy (velocity), while filtering storm water, thereby aiding in the removal of suspended solids.

Check dams should only be used in small drainage swales that shall not be overtopped by flow once the dams are constructed. These dams should not be placed in streams. Check dams are typically installed in ROWs or on other construction sites prior to the start of soil disturbing work. Per the Rhode Island Soil Erosion and Sediment Control Handbook, no formal design is required for a check dam if the contributing drainage area is 2 acres or less and its intended use is shorter than 6 months; however, the following criteria should be adhered to when specifying check dams.

- The drainage area of the ditch or swale being protected should not exceed 10 acres.
- The maximum height of the check dam should be 2 feet.
- The center of the check dam must be at least 6 inches lower than the outer edges.
- The maximum spacing between the dams should be such that the toe at the upstream dam is at the same elevation as the top of the downstream dam.

Per the NHDES stormwater manual, the use of check dams should be limited to swales with longitudinal slopes that range between 2 to 5 percent that convey drainage from an area less than 1 acre. Existing conditions that exceed these limitations should be assessed in the field and discussed

with the National Grid Environmental Scientist to determine the viability of this BMP for the specific application. Check dams are often comprised of stone, straw bales, sand bags, or compost/silt socks. Use of check dams should be coordinated with the National Grid Environmental Scientist to ensure that the material selection, spacing and construction method are appropriate for the site. Check dams composed of biodegradable materials (e.g. straw bales or wattles, wood chip bags) may require periodic replacement for continued proper functioning[1]. Refer to BMPs in **Appendix 4**.

3.7 Water Bars

Water bars should be used on sloping ROWs to divert storm water runoff from unstabilized or active access roads when needed to prevent erosion. Surface disturbance and tire compaction promote gully formation by increasing the concentration and velocity of runoff. Water bars are constructed by forming a ridge or ridge and channel diagonally across the sloping ROW. Each outlet should be stable. The height and side slopes of the ridge and channel are designed to divert water and to allow vehicles to cross. When siting water bars, consideration shall be given to the sensitivity of the area receiving the diverted runoff. For example, runoff should not be directed into a wetland, waterbody, other environmentally sensitive areas, or to private property or public roadways. Refer to BMPs in **Appendix 4**.

3.8 Retaining Walls

In some situations, retaining walls comprised of concrete blocks, gabions, boulders or other comparable materials may be required to stabilize the shoulder of existing access roads and/or supplement required erosion controls. Installation of such measures shall not be allowed as a maintenance activity. Should these controls be considered for a project, it shall be reviewed by the National Grid Environmental Scientist, as design and additional permitting may be required.

3.9 Slope Stabilization

Temporary slope stabilization practices help to keep exposed, erodible soils stabilized while vegetation is becoming established. Acceptable temporary slope stabilization practices may include the use of erosion control blankets, or hydraulic erosion control. Erosion control blankets, often comprised of natural fibers (e.g., jute, straw, coconut, or other degradable materials) are a useful slope stabilization, erosion control and vegetation establishment practice for ditches or steep slopes. Blankets are typically installed after final grading and seeding for temporary or permanent seeding applications. Hydraulic erosion control practices, including Bonded Fiber Matrix or hydroseed with a soil stabilizer (e.g., tackifier and/or mulch) may be an acceptable or desirable alternative form of temporary slope stabilization. For all practices, manufacturer's specifications should be followed for installation depending on slope and other field conditions. Consult the National Grid Environmental Scientist prior to selecting and installing any slope stabilization practices. Refer to BMPs in **Appendix 4**.

[1] Grass growth on a biodegradable type check dam is evidence that the material is decomposing. While this doesn't mean it is no longer functioning, it means it may be in a weakened condition and could potentially fail under high flow velocity. It is acceptable for grass to be growing on a stone check dam.

3.10 Maintenance of Sedimentation and Erosion Controls

Sedimentation and erosion controls shall be maintained in good operational condition during the course of the work. This includes, but is not limited to, replacing straw bales that are no longer in good condition, re-staking straw bales, replacing or re-staking silt fence, and removing accumulated sediment. Remove sediment before it has accumulated to one half the height of any exposed silt fence fabric, straw bales, other filter berm, check dams or water bars. Accumulated sediment shall be removed from sedimentation basins to maintain their efficacy. Manage the removed sediment by evenly spreading it over unvegetated upland areas where erosion is not a concern, by stockpiling and stabilizing, or by disposing of off-site. Stabilization measures shall also need to be implemented and approved by the National Grid Environmental Scientist or the Project Environmental Consultant. Where a SWPPP has been prepared for a specific site, the guidelines documented therein shall govern the management of sediment.

4.0 Right-of-Way (ROW) Access

Whenever possible, access shall be gained along existing access routes or roads within the ROW. However, in some cases there is no existing access. In many cases, temporary access can be utilized. The following practices provide general guidance on accessing a ROW. Check with a National Grid Environmental Scientist to determine if any environmental permitting is required before utilizing a temporary access.

Note that the building of new roads or enlargement of existing roads is **prohibited** unless this activity is allowed by a project-specific permit, and the new roads appear on the Site Plans that were authorized in the regulatory approvals.

4.1 Off-ROW Access

Off-ROW access shall be evaluated for wetlands, rare species, cultural resources and other potential sensitive receptors, as applicable. National Grid Real Estate and Stakeholder Relations shall also be contacted as soon as possible once off-ROW access is determined to be needed.

4.2 Stabilized Construction Entrance/Exit for Access to ROWs from Public or Private Roads

A suitable (minimum 15-foot wide by 50-foot long) construction entrance/exit shall be installed at the intersection of the ROW access road/route with public/private paved roads, or other such locations where equipment could track mud or soil onto paved roads. The construction entrance/exit should be comprised of clean stone installed over a geotextile fabric. Geotextile fabric may be omitted for permanent construction entrances/exits on a case-by-case basis with the approval of the National Grid Environmental Scientist. Refer to BMPs in **Appendix 4**.

Construction entrance areas shall be monitored and maintained to ensure that stone or other material is not deposited onto the roadway, causing a safety concern. Where track-out of sediment has occurred onto a roadway, it shall be swept off the road by the end of that same work day.

If a construction entrance/exit is clogged with sediment and no longer functions, the sediment and stone may require removal and replacement with additional clean stone (clean stone refreshment) to ensure this tracking pad is performing its intended function adequately. Heavier traffic use may require this clean stone refreshment multiple times throughout a project. Reinforcement of these stabilized construction entrance/exits with asphalt binder or asphalt millings is not likely to be considered "maintenance" and may trigger additional permitting requirements[2]. In some cases, heavily used construction entrances/exits may benefit from the installation of a 5-15 foot strip of asphalt binder or asphalt millings closest to the paved roadway to capture any stone that is tracked from the stone apron. Such cases shall be evaluated on an individual basis with the National Grid Environmental Scientist.

Once work is complete, the construction entrance/exit shall either be removed or retained, depending upon future maintenance-related access needs, property ownership, and/or project-specific approvals. If removed, the area shall be graded, seeded (if adequate root and seed stock are absent) and mulched. Proper approvals for leaving access roads in place shall be obtained; contact the National Grid Environmental Scientist and Property Legal.

4.3 Maintenance of Existing Access Roads

In many cases, the existing access road may need to be maintained to allow passage of the heavy equipment required for scheduled maintenance work. Access roads cannot deviate from the approved and permitted access plans. Maintenance of these roads may include adding clean gravel or clean crushed stone to fill depressions and eroded areas. This activity shall be conducted only within the width of the existing access road footprint and does not include widening existing access roads

If gravel begins to migrate onto the existing vegetated road shoulder, this gravel shall be removed during the project and/or after the completion of use of the road to ensure the road fill is not spreading into adjacent resource areas, or resulting in the road becoming much wider than its pre-existing or permitted condition. In some areas of mapped rare species habitat or other sensitive areas where project-specific permit conditions require the prevention of the migration of sediments into adjacent resources, an engineered stabilization system (e.g., GeoWeb or similar) may be suitable to prevent sedimentation while allowing for unrestricted wildlife migration.

In Massachusetts, any proposed widening of access roads in turtle Priority Habitat would require individual consultation with NHESP and, depending on the level of impact proposed, may require a Project Review filing. The limited filling of ruts or potholes is compatible with the National Grid Operation and Maintenance Plan approved by NHESP under the Massachusetts Endangered Species Act, however, severely rutted access roads in turtle Priority Habitat that require extensive linear feet of stone for safe passage will require individual consultation with NHESP.

[2] Depending on the road, use of an asphalt binder or asphalt millings as a construction entrance/exit may trigger state or local permit requirements.

Major reconstruction projects may require multiple permits. In all cases, the fill to be used for existing access roads shall be clean and free of construction debris, trash or woody debris. Use of processed gravel may be approved by the Person-In-Charge and the National Grid Environmental Scientist, on a case-by-case basis. If clean stone is used then addition of more erosion controls may not be necessary.

4.5 Maintenance of Existing Culverts

Damaged culverts may not be repaired or replaced without consulting with the National Grid Environmental Scientist to determine if a permit is required. For functioning culverts, care shall be taken to protect adjacent wetlands and watercourses by installing appropriate sedimentation and erosion controls around the downstream end of the culvert. Culverts shall be repaired/replaced in kind and shall not be changed in size unless approval has been obtained from the National Grid Environmental Scientist. In-kind replacement is replacement using the same material, functional inverts, diameter and length as the existing culvert. Changes to any of these characteristics shall require permitting. Installation of any **new** culvert is not allowed without obtaining all necessary permits first. Refer to BMPs in **Appendix 4**.

If, at the time of anticipated replacement, there is heavy flow through the culvert, the Person-In-Charge shall consult with the National Grid Environmental Scientist, to verify whether the culvert shall be replaced at that time. Water may need to be temporarily diverted during culvert repair/replacement. There typically are seasonal restrictions limiting both the replacement of existing culverts as well as installation of new culverts to the low-flow period. The low-flow period can vary from state to state. If any unexpected conditions are encountered during culvert replacement, the National Grid Environmental Scientist shall be contacted immediately prior to the work being completed for additional consultation.

4.6 Temporary Construction Access over Drainage Ditch or Swale

In some situations, construction access from paved roads onto ROWs may require the crossing of drainage ditches or swales along the road shoulder. In these situations, the installation of construction mats, mat bridges or temporary culverts may facilitate construction access over the ditches or swales. These culverts shall be temporary only, sized for peak flow, and shall be removed after construction is complete. Consult with the National Grid Environmental Scientist prior to installation. In addition, if access over existing culverts may require extending the culvert, consult with the National Grid Environmental Scientist. Refer to BMPs in **Appendix 4**.

4.7 Construction Material along ROW

After preparing a site by clearing and/or installing any necessary erosion and sediment controls and prior to the start of construction, material such as poles, cross-arms, cable, insulators, stone and other engineered backfill materials may be placed along the ROW, as part of the project. The stockpiling of stone and other unconsolidated material on construction mats shall be avoided, if determined necessary due to access and work pad constraints, the material must be placed on a geotextile fabric and be properly contained with a sedimentation barrier such as straw wattle. No construction material shall be placed in wetlands or other sensitive resource areas unless authorized by the National Grid Environmental Scientist or Project Environmental Consultant.

5.0 Winter Conditions

5.1 Snow Management

Refer to **Appendix 6** for the current Snow Disposal Guidelines.

5.2 De-Icing

Where allowed, calcium chloride is preferred as a de-icing agent when applied according to manufacturer's guidelines in upland areas. Sand shall be used on construction mats through wetland areas.

Consult with the National Grid Environmental Scientist on de-icing agents when working in a facility or substation close to resource areas. Many municipalities have specific requirements for de-icing agents allowed within 100 feet of wetland resources and other sensitive areas.

5.3 Snow and Ice Management on Construction Mats

Proper snow removal on construction mats shall avoid the formation of ice. To avoid the formation of ice, snow shall be removed from construction mats before applying sand. Prior to their removal from wetlands, sand shall be collected from the construction mats and disposed of in an upland area. A round street sweeping brush mounted on the front of a truck may be an effective way to remove snow from construction mats. Propane heaters may also be suitable solutions for snow removal and/or de-icing of construction mats.

Once construction mats are removed, wetlands shall be inspected for build up of sand that may have fallen through construction mats. Care shall be taken to inspect wetland crossings as each mat is removed to ensure sand is properly removed and disposed of off-site.

6.0 Construction Mats

The use of construction mats allows for heavy equipment access within wetland areas. The use of construction mats minimizes the need to remove vegetation beneath the access way and helps to reduce the degree of soil disturbance and rutting in soft wetland soils. Construction mats most often used by National Grid are wooden timbers bolted together typically into 4-ft by 16-ft sections, wooden lattice mats, or composite mats. In some cases, construction mats or other mats are used for staging or access in upland areas based on site conditions (e.g., agricultural field access). Refer to BMPs in **Appendix 4**.

Typically construction mats may be installed on top of the existing vegetation, however in some instances cutting large woody vegetation may be required. Check with National Grid Environmental Scientist prior to cutting or clearing vegetation for construction mat placement.

Where an extended period of time has lapsed since wetland delineation and start of construction, and new vegetative growth has concealed wetland flagging or flagging is simply no longer obviously visible, wetland boundaries should be re-flagged where necessary prior to the installation of matting.

Follow the approved plans in the EFI for construction mat installation and do not deviate from the plans. **Any deviation from the approved plans needs to be communicated immediately to the National Grid Environmental Scientist as it may require additional permitting, require stopping the project or result in a permit violation or revocation.**

6.1 Construction Mats and Mowing

Close coordination with the mowing contractor shall be required to ensure that access plans are followed, and construction mats are utilized when necessary. Sometimes mowing contractors may have to work off the leading edge of a construction mat to mow in order to lay the next construction mat and continue further into the wetland. Under no circumstances shall trees or shrubs be allowed to be pulled out of the wetland by the root ball. The root ball of trees and shrubs shall remain intact. Chipping debris and excessive amounts of slash shall not be placed in wetlands or other resource areas. In some instances, it may be beneficial to pile a reasonable amount of slash within a nearby upland area to create habitat for wildlife. This activity shall be approved by the National Grid Environmental Scientist.

6.2 Stream Crossings and Stream Bank Stabilization

Stream crossings shall be bridged with construction mats or other temporary minimally-intrusive measures unless fording is acceptable for the site and is authorized by the National Grid Environmental Scientist. Care shall be taken when installing a construction mat bridge to insure that the stream bed and banks are not damaged during installation and removal and that stream flow is not unduly restricted. Where stream width allows, construction mats shall be installed to span the watercourse in its entirety without stringer placement in the water or any restriction of stream flow. Environmental permits may be required to cross or disturb protected waters, depending upon state-specific regulatory requirements. Refer to BMPs in **Appendix 4**. Immediately following construction mat removal, all stream banks shall be stabilized and restored to prevent sedimentation and erosion.

6.3 Cleaning of Construction Mats

Mats shall be certified clean by the vendor prior to installation. The vendor shall use the certification form provided as **Appendix 5** to document compliance. Clean is defined as being free of plant matter (stems, flowers, roots, etc), soil, or other deleterious materials prior to being brought to the project site. Any equipment or timber mats that have been placed or used within areas containing invasive species within the project site shall be cleaned of plant matter (stems, flowers, roots, etc), soil, or other deleterious materials at the site of the invasive species prior to being moved to other areas on the project site to prevent the spread of invasive species from one area to another[3]. **Mats shall be cleaned prior to being removed at the completion of the project: exceptions to this requirement**

[3] On ROW projects where multiple wetlands may be dominated by the same invasive species, cleaning may not be required for movement along the ROW. Check with the National Grid Environmental scientist for guidance.

may be made on a case-by-case basis. Consult with the National Grid Environmental Scientist prior to discharging or disposing of any waste water or waste material from the cleaning of construction mats.

6.4 Stone Removal for Construction Mat Placement

For situations where the matting contractor determines that stones or boulders must be removed or relocated within wetland areas in order to install safe and level structure work pads or access roads the boulders shall be moved in a manner which does not result in significant soil disturbance (i.e., pushing with a bull dozer is not allowed). The boulders shall not be placed on any existing vegetated areas within wetlands or within vernal pools. When numerous boulders shall be removed from a wetland area, they shall be deposited in an upland area outside of the flagged wetland limits, outside of any cultural resource areas and outside of any RTE species populations. Any boulders that shall be placed within buffers (In MA, the 100-foot buffer zone, and in RI, the 50-foot Perimeter Wetland, 100-foot or 200-foot Riverbank Wetlands) shall be placed to avoid causing soil disturbance and they shall be within an approved limit of work. When there is a significant number of boulders that need to be removed, the National Grid Environmental Scientist shall be consulted for guidance.

6.5 Transition onto Mats

Erosion controls and stone or wood chip ramps shall be installed to promote a smooth transition to and minimize sediment tracking onto construction mats. Geotextile may be added beneath stone or wood chip transitions to facilitate removal, as necessitated by site or permit conditions. Mat transitions shall be removed once construction mats have been removed and during restoration. Refer to BMPs in **Appendix 4**.

6.6 Construction Material on Mats

The stockpiling of stone, drill spoils and other unconsolidated material on construction mats shall be avoided unless determined necessary due to access and work pad constraints. Additional controls, such as watertight mud boxes and geotextile/filter fabric over or between construction mats shall be considered for stockpile management. If material is placed on construction mats and falls through into wetlands, the material must be removed by hand. Saturated soils shall be allowed to dewater prior to off-site transport for sufficient time to ensure that water/sediment is not deposited onto construction mats or public roads during transport. Heavy machinery shall not be left overnight on mats located within floodplain unless approved by the National Grid Environmental Scientist, the machinery is still in use, and removal of the equipment requires the use of additional equipment to move it and would increase vehicle trips in/ou of wetlands. In these situations and when approved by the National Grid Environmental Scientist, the equipment shall be secured against vandalism and secondary containment measures shall be employed where feasible. Mat anchoring shall be evaluated, see below.

6.7 Mat Anchoring

The National Grid Environmental Scientist and Project environmental consultant shall indicate to the project team when mat anchoring may or shall be necessary. The matting contractor will propose the method of mat anchoring, which will be approved by the National Grid Environmental Scientist and the

National Grid Construction Supervisor. The need for anchoring should be noted in the project EFI, on the project access and matting plans, and in the scope of the bid document (if externally sourced).

Anchoring of construction mats should be considered when any of the following conditions are presented at a project work location:

Location	Considerations
Stream crossings Shorelines of Ponds/Lakes Wetlands Floodplains	When located in a mapped flood area (A). When mapped 100-year flood elevations (AE) are greater than 2 ft above existing grades. Where past flash flood events have occurred. Where steep terrain is present or surrounds the project location. When mats will be in place during hurricane season for greater than 2 weeks.
Tidal areas	When located in a Velocity (V or VE) Zone. When mats will be in place during a moon tide cycle. When mats will be in place during hurricane season for greater than 2 weeks.

Examples of mat anchoring are provided below, but the implementation methods for anchoring mats are not limited to these examples. Where anchoring is determined to be necessary, the matting contractor should propose a method suitable based on field conditions and that takes crew safety, slip/trip/fall hazards, size of matting footprint, and other project and site-specific factors into consideration. Refer to BMPs in **Appendix 4**.

Limited sets of mats

- Cable or rope in chain pockets and run linearly, or
- Linear ropes anchored using helical screws, manta ray anchors, or posts.

Larger sets of mats or those without chain pockets

- Chain link fence posts or other posts driven in along mat edge every 3-4 feet and ropes then laced across mats between opposing posts before storm event, or
- Anchor bolts added to mats, then cable is laced between bolts and tied to helical or manta ray anchor.

6.8 Corduroy Roads

Corduroy roads are a wetland crossing method where logs are cut from the immediate area and used as a road bed to prevent rutting from equipment crossing. This technique is designed to be used in areas of wetland crossings where there is no defined channel or stream flow and should never be used in streams. Corduroy logs shall be placed in the narrowest area practicable for crossing with the logs

placed perpendicular to the direction of travel across wet area. The use of corduroy logs shall only be in emergencies when approved by the National Grid Environmental Scientist or when they have been specifically permitted as part of a project. Refer to BMPs in **Appendix 4**.

6.9 Construction Mat Removal

Once construction mats are removed, wetlands shall be inspected for build up of sand or other materials that may have fallen through construction mats. Care shall be taken to inspect wetland crossings as each mat is removed to ensure any materials are properly removed and disposed of off-site.

6.10 Utility Air Bridging

In ROWs where other utility facilities (including but not limited to gas, oil, fiber optic, electric, water, and sewer) are co-located within the transmission ROW, bridging may be required to cross those facilities. The project team shall coordinate with the respective utility company prior to determining if bridging or permanent crossings are required.

7.0 LGP Equipment Use

Only when approved by the National Grid Environmental Scientist on a case-by-case basis shall equipment with a LGP **psi that meets the state-specific USACE General Permit requirement when loaded** be allowed to access through wetlands. Refer to the state-specific General Permit for the definition of LGP in each state at: http://www.nae.usace.army.mil/Missions/Regulatory/State-General-Permits/, or to the summary table provided below. The National Grid Environmental Scientist's approval of the use of LGP equipment through wetlands depends on several criteria including:

- Time of year. LGP equipment use may be allowed if weather and field conditions at the time of construction are suitable to eliminate/minimize the concern of rutting or other impacts. Frozen, frozen snow pack, low flow, drought conditions, or unsaturated surface soil conditions are typically acceptable conditions. Spring and fall construction, due to the typical higher precipitation, are not suitable times of year for LGP equipment use.
- Number of trips. Multiple trips through a wetland have shown to increase the potential for damage and require matting. LGP equipment use shall likely only be approved if trips are limited to one trip in and one trip out.
- Type of wetland system. Some wetlands have harder soils/substrate, and may be passable without causing significant damage. Some of the wetlands along National Grid ROWs have existing hard bottom roads that have been vegetated over time and may be traversed with LGP equipment without construction mats.
- Emergencies. LGP equipment use may be allowed during emergency or storm conditions for outage restoration.
- State-specific USACE General Permit Performance Standards. The standard is for no impact to the wetland, which may be obtained by using LGP equipment **when loaded**). "*Where construction requires heavy equipment operation in wetlands, the equipment shall either have low ground*

pressure (as specified in the USACE GP), or shall not be located directly on wetland soils and vegetation; it shall be placed on construction mats that are adequate to support the equipment in such a way as to minimize disturbance of wetland soil and vegetation."

- Local bylaws. Municipal wetland bylaws, where applicable, shall be reviewed for prohibitive conditions or applicable performance standards.

LGP equipment is prohibited in the following resources areas:

- Stream crossings
- State listed-species habitat
- Outstanding Resource Waters (ORWs)
- Vernal pools
- Archaeological sensitive areas

Where LGP equipment use is desired in lieu of construction mats, the construction supervisor should identify these areas on marked-up access plans. A site visit with the Project Environmental Monitor should be scheduled to assess if the proposed locations are potential candidates. The Project Environmental Monitor will document potentially suitable locations and dismiss others as unsuitable.

ACOE New England District General Permit Requirements

State	Restrictions	Maximum PSI (when loaded) for Use without Mats	Reference
MA	*One of the following must apply:* Equipment operated within wetlands shall: a) Have low ground pressure; b) Be placed on timber mats that are adequate to support the equipment in such a way as to minimize disturbance of wetland soil and vegetation; or c) Equipment must be operated on adequately dry or frozen conditions such that shear pressure does not cause subsidence of the wetlands immediately beneath equipment and upheaval of adjacent wetlands.	3 psi	MA General Permit, General Condition 13
NH	*One of the following must apply:* Equipment operated within wetlands shall: a) Have low ground pressure; b) Be placed on timber mats that are adequate to support the equipment in such a way as to minimize disturbance of wetland soil and vegetation; or c) Be operated on frozen wetlands.	4 psi	NH General Permit, General Condition 17
VT	*One of the following must apply:* Equipment operated within wetlands shall: a) Have low ground pressure; b) Be placed on timber mats that are adequate to support the equipment in such a way as to minimize disturbance of wetland soil and vegetation; or c) Be operated on frozen wetlands such that shear pressure does not cause subsidence of the wetlands immediately beneath equipment and upheaval of adjacent wetlands. Note: Written authorization from the Corps required to waive the use of mats during frozen or dry conditions.	3 psi	Vermont General Permit, General Condition 14
RI	*One of the following must apply:* Equipment operated within wetlands shall: a) Have low ground pressure; b) Be placed on timber mats that are adequate to support the equipment in such a way as to minimize disturbance of wetland soil and vegetation; or c) Be operated on frozen wetlands such that shear pressure does not cause subsidence of the wetlands immediately beneath equipment and upheaval of adjacent wetlands.	6 psi	Rhode Island General Permit, General Condition 15

State	Restrictions	Maximum PSI (when loaded) for Use without Mats	Reference
	Note: Written authorization from the Corps required to waive the use of mats during frozen or dry conditions.		

Due to the fact that ground conditions may change between the time of the evaluation and construction, LGP equipment approval is required **at the time of construction for each wetland crossing** and shall be dependent upon the above conditions. In addition, LGP equipment use and approval shall be assessed by the National Grid Environmental Scientist or Project Environmental Monitor during construction on a continuing basis

Once a location is approved for the use of LGP equipment:

- The Construction Supervisor must check-in with the Project Environmental Monitor at least two weeks before construction begins to ensure conditions remain suitable for LGP equipment use, and weather conditions are favorable.
- The Project Environmental Monitor must observe the equipment when in use.
- LGP equipment use shall cease immediately if field conditions are found to be unsuitable (i.e. soil rutting greater than six inches or the destruction of vegetation root systems beyond the capacity of natural revegetation).
- **If wetlands damage occurs, the use of the LGP equipment shall be suspended, and the wetlands be restored.**
- Any LGP equipment used within areas containing invasive species within the project site shall be cleaned of plant matter (stems, flowers, roots, etc), soil, or other deleterious materials at the site of the invasive species prior to being moved to other areas on the project site to prevent the spread of invasive species from one area to another.

8.0 Soil Disturbing Activities

8.1 Dust Control

Cutting activities shall be conducted to minimize the impacts of dust on the surrounding areas. Dust suppression is an important consideration. Water or other National Grid approved equivalent in accordance with the manufacturer's guidelines may be used for dust control along ROWs in upland areas. During application of water for dust control, care shall be taken to ensure that water does not create run-off or erosion issues. Refer to BMPs in **Appendix 4.**

8.2 Clearing

Clearing is not allowed without specific permission as it constitutes soil disturbance under several regulatory programs and may trigger permitting by increasing the project's footprint of disturbance. If clearing is required for a project, the limit of clearing shall be established with flagging or construction

fencing and/or erosion controls. Clearing shall be done in accordance with project specific permits. Following the completion of clearing, the limits of work shall be re-established. Refer to BMPs in **Appendix 4**.

8.3 Grubbing

Grubbing is not allowed without specific permission as it constitutes soil disturbance under several regulatory programs and likely triggers permitting by increasing the project's footprint of disturbance. If grubbing is required for a project, the limit of grubbing shall be re-established after clearing has been completed. The area of grubbing shall be identified with flagging or construction fencing and/or erosion controls. Grubbing shall be conducted in accordance with project-specific permits.

8.4 Blasting, Noise and Vibration Control

If blasting is anticipated, the project team, including the National Grid Environmental Scientist, shall be consulted. If possible, plan work in residential areas to avoid noisy activities at night, weekends or during evenings. Emergency work in residential areas should be carried out in such a way as to keep noise to a minimum at night and weekends. Equipment should be maintained as per the manufacturer's guidance to minimize noise and vibration.

Work plans must consider local noise ordinances and provide specific controls to ensure noise levels are maintained within specified limitations.

8.5 Site Grading

The work site shall not be graded other than in accordance with project permits. Any proposed grading shall be reviewed by the National Grid Environmental Scientist for wetlands, rare species habitat, areas of cultural and historical significance, and other environmentally sensitive areas prior to start of work. In some cases, additional testing for cultural or historical resources may be triggered by proposed grading; alternatives to grading may be sought due to protracted time frame of obtaining the permit associated with testing and performing the testing. Grading outside of a regulated area shall be kept to the minimum extent necessary for safe and efficient operations and shall comply with the project permit plans.

Grading shall be performed in a manner which does not increase the erosion potential at the Site (e.g., terraces or slope interruptions shall be utilized). Graded sites shall be promptly stabilized by applying a National Grid approved seed mix (if adequate root and seed stock are absent), and mulching with hay, straw or cellulose (use straw or cellulose hydromulch where the potential introduction of invasive plant species is of concern) to reduce erosion and visual impact, as soon as possible following completion of work at the site. Grading within a regulated area shall be subject to the review and approval of the National Grid Environmental Scientist.

In some municipalities, site grading activities require the prior approval of the Town Engineer, Building and Zoning Official, or Public Works Director. Local ordinances or bylaws should be reviewed for applicable restrictions and permitting thresholds

8.6 Grounding Wells

The installation of grounding wells shall require erosion controls and proper soil management. Due to the typical depth required for grounding wells (typically 50 to 200 feet or more), erosion controls shall be installed around the proposed well location when working in buffer zone, in proximity to sensitive resources or near slopes. Also, dewatering basins may be required for the proper management of groundwater. The National Grid Environmental Scientist shall be consulted for the disposal of any excess soil.

8.7 Counterpoise and Cathodic Protection

The installation of counterpoise or cathodic protection shall require erosion controls and proper soil management. The National Grid Environmental Scientist shall be consulted for the disposal of any excess soil.

8.8 Work Pads

When work pads are being constructed, only clean material shall be used in their construction. Work pads shall only be constructed in areas approved by the National Grid Environmental Scientist and shown on the approved permit access plans.

8.9 Site Staging and Parking

During the project planning and permitting process, locations shall be identified for designated crew parking areas, material storage, and staging areas. Where possible, these areas should be located outside of buffer zones, watershed protection areas, and other environmentally sensitive areas. Any proposed locations shall be evaluated for all sensitive receptors and for new projects requiring permitting, shall be incorporated onto permitting and access plans.

8.10 Soil Stockpiling

Soil stockpiles shall be located in upland areas and, if in close proximity to wetlands and wetland buffers, shall be enclosed by staked straw bales or another erosion control barrier. The stockpiling of stone, drill spoils and other unconsolidated material on construction mats shall be avoided unless determined necessary due to access and work pad constraints. Additional controls, such as watertight mud boxes and geotextile/filter fabric over or between construction mats shall be considered for stockpile management. If material is placed on construction mats and falls through into wetlands, the material must be removed by hand. Saturated soils shall be allowed to dewater prior to off-site transport for sufficient time to ensure that water/sediment is not deposited onto construction mats or public roads during transport.

8.11 Top Soil/High Organic Content Soil

When the work site requires excavation and grading, the top soil shall be stockpiled separately from the material excavated. This top soil shall be spread as a top dressing over the disturbed area during restoration of the site.

In some instances where work is occurring within wetlands, high organic content soil may be displaced. Such high organic content soil shall be segregated from other excavated materials and stockpiled for

use in wetland restoration areas. Care shall be taken to minimize the handling of high organic content soil. Preferably, the soil shall be stockpiled in one location until it is moved to the restoration area.

9.0 Stone Wall Dismantling and Re-building

Removal or alteration of stonewalls shall be avoided, whenever possible. As appropriate, some stonewalls removed or breached by construction activities shall be repaired or rebuilt. Rebuilt stone walls shall be placed on the same alignment that existed prior to temporary removal, to the extent that it shall not interfere with operations. The removal and rebuilding of stone walls requires approval from the National Grid Environmental Scientist and Property Legal, and may require several weeks lead time for coordination. Note that not all states allow this technique and that dismantling may not be allowed at all due to quality or significance of the wall. Once a stone wall has been identified as requiring dismantling, the following procedures shall be followed:

- Identify stone wall that is required to be temporarily dismantled and notify project team that a site visit is warranted to review the stone wall.
- The National Grid Environmental Scientist, with support from Property Legal and/or cultural/historical consultant, shall determine if permitting or additional permissions are required prior to dismantling stone wall.
- Once permit or permissions have been received, full documentation of wall dimensions (measurements and photographs) shall be submitted to the National Grid Environmental Scientist. Documentation of the wall dimensions shall be marked onto a copy of the applicable EFI access plan (or equivalent plan) with a useful reference for future locating such as GPS coordinates and/or measurement from a permanent reference point (closest structure location or closest cross street, etc.). The wall shall be photographed from all sides with a written description of the photograph (i.e. southern side of wall looking north). In addition, documentation of the length of wall to be dismantled shall be recorded. Take special care to note if granite property bounds (or other marker) are located within the wall so additional survey can be accomplished prior to dismantling in cases where the stone wall represents a property boundary. Site visits by project team (which shall include the National Grid Environmental Scientist) are a mandatory requirement prior to dismantling.
- No dismantling shall take place until documentation has been submitted to the National Grid Environmental Scientist and approved as sufficient documentation.
- Stones from the wall shall be removed from the work area and temporarily stored in nearby location, away from wetlands; buffer zones; rare species habitat and other historical/archeological concerns.
- Avoid dismantling via the “bulldozer” method when possible as this method makes it nearly impossible to rebuild the wall in the same alignment due to its uncontrolled nature. Dismantling shall be conducted either by hand, with stones stacked as they are removed, or on less “sensitive” walls to use an excavator with a thumb to grab each stone and build a stockpile. Significant ground disturbance below the wall shall be avoided.

- Once construction and access in the area has been completed, the wall shall be rebuilt to pre-dismantled conditions or better. If rebuilding a stone wall can not be placed on the same alignment that existed prior to temporary removal, approval from the National Grid Environmental Scientist and Property Legal is required. **Note that if the wall represents a legal property boundary or is historically or culturally significant (or was previously determined to be in a very high quality condition), a professional stone masonry company may be required to document wall alignment, and conduct the dismantling and rebuilding.**

10.0 Avian Nest Removal

Avian nest removal shall be done in accordance with EG-304. Consult the National Grid Environmental Scientist prior to removing any nests. There are seasonal restrictions of the removal of avian nests and federal or state permits may be necessary prior to removal.

11.0 Drilling Fluids and Additives

When installing subsurface structures, there may be a need to utilize drilling aids such as slurries, borehole sealants, and other additives. All necessary steps shall be taken by National Grid personnel and contractors to prevent potential adverse effects on drinking water aquifers, groundwater quality, and wetlands when utilizing drilling aids. Efforts should be made to utilize natural bentonite clay-type materials, in place of polymer-based drilling aids. Regardless of the specific product type, the following requirements shall be met:

- Drilling aids must be NSF certified and manufactured to NSF-ANSI 60 standards. https://www.nsf.org/newsroom_pdf/NSF-ANSI_60_watemarked.pdf
- Product use must be in accordance with manufacturer's specifications and instructions.
- National Grid personnel or their contractor shall provide all the necessary information regarding the proposed product to be used to National Grid's Environmental Sustainability, Compliance and Licensing & Permitting Department as early as possible in the project planning phase. If the work is being performed by a contractor, this information must be included as part of their initial bid package.
- If polymer-based products are proposed for use, product information shall be included in all related environmental regulatory filings and frac-out plans, if possible.
- A qualified individual shall be designated who will confirm/verify and document the specific use of a drilling aid at each location. This will include add-mix ratios, surface area treated, volume of water within excavation, volumes/weight of additives used, and any other measurements specified by the manufacturer. No mixing will be allowed in the drilled shaft excavation.
- The Contractor or National Grid crew performing the work is responsible for neutralizing all drilling products, as applicable, in accordance with the manufacturer's specifications. This shall be performed following removal from the excavation and while held in holding tanks. A

qualified person shall be designated by the Contractor who will confirm/verify and document the appropriate neutralization activity at each location, as necessary.

- Waste drilling aids (neutralized or not) or soils that may have come into contact with drilling aids will not be disposed of on National Grid properties, discharged to any ground surface or subsurface, waterbodies, wetlands or placed on 3rd party properties.
- All product use must be completed in strict adherence with the management, storage, mixing, transporting, disposing and any other requirements of state and federal regulatory approvals and permits, as applicable.
- Relevant documentation shall be maintained by the Contractor or National Grid crew performing the work, and shall include volume of material treated and disposed and the location/facility at which it was disposed.
- National Grid will not be identified as the disposal generator for any polymer based slurry waste or additives generated by Contractor activities.
- The Contractor or National Grid crew performing the work assumes full responsibility for the safe storage of all polymers and additives during use and also assumes full responsibility for improper use and application of said polymers and additives that are deemed to have contravened aquifer and/or groundwater quality.
- National Grid reserves the right to refuse and terminate the use of any specific drilling aid at any time.

Regardless of the type of drilling aid utilized, the Contractor or National Grid crew performing the work is responsible for properly treating, containerizing, testing, transporting and disposing of any/all fluids and solids generated during their activities. All wastes must be disposed of in accordance with federal and state regulations. Relevant documentation shall be maintained and shall include volume of material treated and disposed and the location/facility at which it was disposed.

12.0 Water Withdrawal for Geotechnical Investigations

The use of water during geotechnical drilling operations may be required, and is most common during the “drive and wash” drilling technique, where 4- or 6-inch diameter casing is driven into the ground, and the soil inside the casing is washed out using a pump and hollow rods. Soil samples are generally collected at periodic intervals using a split spoon sampler (e.g., every 5 vertical feet).

The National Grid Environmental Scientist and/or Project Environmental Monitor may approve withdrawals from wetlands and waterways on a case-by-case basis should the geotechnical team advise no other options are available. Generally, the amount of water required for withdrawal is between 100 and 200 gallons, and the water is then recycled continuously in the drilling process. Certain scenarios may require additional water usage if water is lost down the boring (e.g., lost due to bedrock fractures during rock coring). The following general guidance should be adhered to when determining whether water withdrawals may be allowed during geotechnical investigations on the ROW. Approval from the National Grid Environmental Scientist and/or Project Environmental Monitor is required prior to initiating water withdrawals during geotechnical investigations.

- Withdrawals from perennial streams, ponds, lakes and large wetlands systems are preferred over small isolated wetlands to ensure the water level, water table, and hydroperiod are not affected. Prior to start of work, the Contractor shall identify which water source they prefer to withdraw from. The National Grid Environmental Scientist and/or the Project Environmental Monitor will confirm whether these sources are appropriate.
- Care should be taken to avoid alteration of wetlands or the beds and banks of surface waters. Examples of alterations include, but are not limited to, the following:

  (a) the changing of pre-existing drainage characteristics, flushing characteristics, salinity distribution, sedimentation patterns, flow patterns and flood retention areas;

  (b) the lowering of the water level or water table;

  (c) the destruction of vegetation; and

  (d) the changing of water temperature, biochemical oxygen demand (BOD), and other physical, biological or chemical characteristics of receiving waters.
- Wetlands and waterways providing habitat for rare species should be avoided unless all other options are exhausted. Under no circumstances should water be withdrawn from a Vernal Pool.
- Withdrawal pipes or stingers should be elevated off the bottom of wetlands and streams during the duration of pumping. Additionally, fabric or screening should be covering the withdrawal pipes to eliminate inadvertent harm to wildlife.
- Withdrawals should be performed in a manner that does not damage vegetation, disturb sediment, or result in the release of temporary or permanent fill material (e.g., sediment, spoils, or turbid water) into the wetland/waterway. Additional detail from geotechnical experts may be required to solidify BMP recommendations.
- Any water used for geotechnical drilling operations (including water withdrawn from surface water, brought on-site, or from other sources) shall be discharged into the open borehole or to an upland area such that the water infiltrates to the ground and is not discharged to a wetland or surface water resource area. Consultation with the National Grid Environmental Scientist and/or the Project Environmental Monitor is required if this is not feasible. At no time should water withdrawals result in a temporary or permanent fill/discharge of material (e.g. sediment, spoils, or turbid water) into the wetland or waterway.
- If water sourcing options is not determined prior to mobilization, necessary water shall be brought in by tank truck. Should withdrawal from surface water sources become necessary during soil boring work, the National Grid Environmental Scientist and/or the Project Environmental Monitor shall be notified prior to beginning withdrawal. If initial withdrawal from surface water is approved by the National Grid Environmental Scientist and/or the Project Environmental Monitor, the driller may withdraw from the surface water, as long as the above criteria are met.
- If excessive water withdrawal is necessary, the National Grid Environmental Scientist and/or the Project Environmental Monitor shall be consulted to determine whether the water source is appropriate for withdrawal.
- In New Hampshire, withdrawals made from state-owned property require written permission from

the agency with primary responsibility for monitoring and/or maintaining the site.

13.0 Gates

When not in use, gates shall be locked with a company-approved lock or double locked with the property owner's lock. New gates may be installed during a project, however, installation of a gate requires permission from the property owner, and may require environmental permitting. Consult with National Grid Real Estate and the National Grid Environmental Scientist prior to installing a new gate, as well as with the appropriate engineering department for the current company gate specifications. Refer to BMPs in **Appendix 4**. Installation of ROW access restrictions (e.g., stone, bollards, other) at road crossings also require consultation with the National Grid Environmental Scientist and Property Legal.

14.0 Signage

Specific signage may be required by permits or be specified in the EFI to limit access in certain sensitive areas. Signs shall be used to clarify allowed access and sensitive areas, such as:

- "No snow stockpiling beyond this point";
- "Approved access (to structures A-F)";
- "Do not cross this area until construction mats are in place";
- "No vehicle crossing";
- "Areas to avoid"; and
- "Environmentally Sensitive Area – Keep Out."

Signs shall be used in conjunction with snow fencing or other physical barriers as demarcation for sensitive areas (e.g., rare species areas, sensitive archeological locations, etc.) that need to be protected and avoided by construction activities. In addition, permit signs required by the regulatory agencies shall be present (i.e. MADEP, RIDEM, EPA (SWPPP), ACOE, etc) at construction sites and/or ROW access points. Construction signage shall be installed and maintained by the contractor performing the work during the project. Absence of signage does not eliminate the need to comply with access plans, permit conditions, and other regulatory requirements. Refer to BMPs in **Appendix 4**.

15.0 Refueling and Maintenance Operations

15.1 Spill Prevention and Response Plan

Spill controls shall be provided on every field vehicle. Bulk storage of fuels (55 gallons or greater) shall be approved by the National Grid Environmental Scientist prior to being brought on site. The need for a field spill plan shall be evaluated specific to the project for regulatory requirements under SPCC regulations or local ordinances. A field spill plan would include information on fuels and oils being used, approximate amounts in each container or type of equipment, location, fueling location, secondary containment, response and notification procedures, including contact phone numbers, etc. All

personnel shall be briefed on spill prevention and response prior to the commencement of construction. The state-specific EI-501 and EG-502 shall be followed in the event of a spill.

Typical construction activities do not require the use or storage of large quantities of oil or hazardous materials (i.e., greater than 55 gallons). However, oil and/or hazardous materials (OHM) may be required in limited quantities to support construction or vehicle operations. Best practices shall be followed in the use and storage of OHM which include but are not limited to: storage and refueling greater than 100 feet from resource areas; maintenance of spill response equipment at work locations sufficient to handle incidental releases from operating equipment; general training for on-site personnel for spill clean up response for incidental releases of OHM; and contracting with an on-call spill response contractor that is capable of managing incidental and significant releases of OHM. There may situations that additional precautions shall be required for the storage or use of OHM (i.e., within wellhead protection areas, GA/GAA areas, Zone IIs). Storage of OHM shall be done in accordance with any applicable regulatory requirements.

15.2 Field Refueling

Small equipment such as pumps and generators shall be placed in small swimming pools or on absorbent blankets/pads, to contain any accidental fuel spills. Small swimming pools with absorbent blankets/pads, and/or other secondary containment, shall be used for refueling of fixed equipment in wetlands and should be maintained to prevent accumulation of precipitation.

15.3 Grease, Oil, and Filter Changes

Routine vehicle maintenance shall not be conducted on project sites.

15.4 Other Field Maintenance Operations

When other vehicle or equipment maintenance operations (such as emergency repairs) occur, company personnel or contractors at field locations shall bring vehicles or equipment to an access location a minimum of 100 feet away from environmentally sensitive areas (e.g., wetlands or drinking water sources). A paved area, such as a parking lot or roadway, is a preferred field maintenance location to minimize the possibility of spills or releases to the environment.

Crews shall take all usual and reasonable environmental precautions during repair or maintenance operations. Occasionally, it is infeasible to move the affected vehicle or equipment from an environmentally sensitive area to a suitable access area. When this situation occurs, precautions shall be taken to prevent oil or hazardous material release to the environment. These precautions include (but are not limited to) deployment of portable basins or similar secondary containment devices, use of ground covers, such as plastic tarpaulins, and precautionary placement of floating booms on nearby surface water bodies.

15.5 Tools and Equipment

Cleaning of tools and equipment shall be conducted away from environmentally sensitive areas (such as wetlands, buffer zones or drinking water sources) to the maximum extent possible. A paved area such

as a parking lot or roadway is preferred, to minimize the possibility of spill or release to the environment. Crews shall wipe up all minor drips or spills of grease and oil at field locations.

16.0 Stabilization Deadlines for Projects Subject to EPA Construction General Permit

16.1 Deadlines to Initiate Stabilization Activities (Permanent and Temporary)

Soil stabilization measures shall be implemented immediately whenever earth-disturbing activities have permanently or temporarily ceased on any portion of the project. The following are some examples of activities that constitute initiation of stabilization:

- Preparing the soil for vegetative or non-vegetative stabilization;
- Applying mulch or other non-vegetative product to the exposed area;
- Seeding or planting the exposed area;
- Finalizing the arrangements to have stabilization product fully installed in compliance with the deadlines to complete stabilization in Section 15.2 below.

16.2 Deadlines to Complete Stabilization Activities (Permanent and Temporary)

As soon as practicable, but no later than 14 calendar days or 7 calendar days (for areas discharging to a sensitive water) after the initiation of soil stabilization measures commence the following should be completed:

- For vegetative stabilization, all activities necessary to initially seed or plant the area to be stabilized; and
- For non-vegetative stabilization, the installation or application of all such non-vegetative measures.

16.3 Vegetative Stabilization (all except for arid, semi-arid, or on agricultural lands)

- Provide established uniform vegetation (e.g., evenly distributed without large bare areas), which provides 70% or more of the density of coverage that was provided by vegetation prior to commencing earth-disturbing activities. Avoid the use of invasive species as cover.
- For final stabilization, vegetative cover must be perennial; and
- Immediately after seeding or planting a disturbed area to be vegetatively stabilized, a non-vegetative erosion control must be implemented to the area while the vegetation is becoming established. Examples include; mulch and rolled erosion control products.

16.4 Vegetative Stabilization (Agricultural Lands)

- Disturbed areas on land used for agricultural purposes that are restored to their pre-construction agricultural use are not subject to vegetative stabilization standards.

16.5 Non-Vegetative Stabilization

If using non-vegetative controls to stabilize exposed portions of your site, or if you are using such controls to temporarily protect areas that are being vegetatively stabilized, you must provide effective

non-vegetative cover to stabilize any such exposed portions of the site. Examples of non-vegetative stabilization techniques include, but are not limited to, rip-rap, gabions, and geotextiles.

17.0 Clean-up and Restoration Standards

The following steps shall be taken once construction has been completed at each location along the ROW or within the project site. The following are minimum guidelines for clean-up and stabilization standards. Please refer to permit conditions for project-specific related standards. Refer to the EFI for applicable permit requirements and to determine if the site needs to be reviewed and approved by the permitting authorities prior to removal of erosion controls.

17.1 Removal of Sedimentation and Erosion Controls

After all work has been satisfactorily completed and vegetation has been re-established to a minimum of 75% cover, and upon approval by the National Grid Environmental Scientist, all non-biodegradable materials (e.g., siltation fencing, straw bale strings, stakes, straw wattle mesh casing, etc.) shall be disposed of properly off-site.

Dependent on permit requirements, sedimentation and erosion controls may not be allowed to be removed until after inspection and approval by one or more permitting authority. In most cases, removed straw bales may be used to mulch disturbed areas. Remaining straw bales that do not block the flow of water may be left in place unless they are required to be removed pursuant to permit conditions. Straw bales that block the flow of water shall be removed.

Prior to project construction being completed, the project team will develop post-construction inspection intervals to ensure timely removal of temporary BMPs. BMPs will be removed when the area is stabilized, which typically occurs when the area has either naturally stabilized (75% cover), or seed and mulch that was installed has achieved 75% cover.

17.2 In-Situ Restoration

Unless otherwise specified in permits or prescribed by the National Grid Environmental Scientist or the Project Environmental Consultant, all disturbed areas, including stream banks, wetlands and access routes, shall be restored following the completion of work. When the work is completed and construction mats have been removed, the National Grid Environmental Scientist or Project Environmental Consultant shall conduct an inspection. Wetlands shall be inspected for build up of sand or other materials that may have fallen through construction mats. Care shall be taken to inspect wetland crossings carefully after construction mat removal to ensure any materials are properly removed and disposed of off-site.

Restoration of Soil Compaction. If rutting or soil compaction following construction mat removal is observed, the area shall be returned to pre-existing conditions, and comparable to the surrounding area, by light hand raking or by back-blading with machinery. Restoration shall be overseen by the Project Environmental Consultant or National Grid Environmental Scientist. Deep ruts (>12”) shall be filled in using available, loose soil from the work area.

Seeding and Mulching. If adequate root and seed stock are absent and have been stripped from the area, graded sites shall be promptly stabilized by applying an approved seed mix and mulching with straw to reduce erosion and visual impact. Seeding and mulching shall be completed as soon as possible following completion of work at the site. For some wetland areas, natural re-vegetation may be more appropriate than seeding disturbed sites. Wetland areas where adequate root and seed stock are absent will be seeded using an approved wetland native seed mix. For some wetland areas, natural re-vegetation may be more appropriate than seeding disturbed sites. Refer to BMPs in **Appendix 4** for seed mix tables and mulch ratio tables.

If needed, the import of quality topsoil onto the ROW will be required. Topsoil should be tested, and approved by the Project Environmental Consultant or National Grid Environmental Scientist to determine its suitability for site conditions. Fertilizers will be approved on a case-by-case basis.

For upland areas, the disturbed vegetation and soil shall be restored and stabilized[4] by regrading the area to pre-existing conditions, if needed, seeding (if adequate root and seed stock are absent) and mulching the exposed soil, and removing strings and stakes from straw bales and using broken up straw bales for the mulch. Siltation fencing, strings and stakes shall be removed for disposal as ordinary waste. Refer to BMPs in **Appendix 4** for seed mix tables and mulch ratio tables.

For sites with excess boulders, additional boulders could be used at proposed and existing gate locations to use on either side of the gates as a deterrent for unauthorized vehicle access or be placed along the edges of work pads where steep slopes are present for safety purposes. The final placement of boulders should be reviewed prior to installation with Real Estate and the National Grid Environmental Scientist or Project Environmental Consultant.

Unless otherwise specified in Project-specific permit conditions, the National Grid Environmental Scientist or Project Environmental Consultant shall develop an inspection frequency to monitor restored areas for stabilization, germination and successful revegetation.

17.3 Invasive Species

All equipment shall be certified clean[5] utilizing the attached form (**Appendix 5**) or equivalent as approved by the vendor prior to mobilization to the work site. The vendor shall use the certification from provided as **Appendix 5** to document compliance with invasive species management BMPs. Clean is defined as being free of plant matter (stems, flowers, roots, etc), soil, or other deleterious materials prior to being brought to the project site. Any equipment that has been placed or used within areas containing invasive species within the project site shall be cleaned of plant matter (stems, flowers, roots, etc), soil, or other deleterious materials at the site of the invasive species prior to being moved to other areas on the project

[4] For projects subject to the 2012 CGP, stabilization is required within 14 days, or within 7 days for sensitive areas.

[5] The **Appendix 5** certification form (or equivalent as approved by National Grid Environmental Scientist) shall be used to document the clean certification

site to prevent the spread of invasive species from one area to another[6]. **Equipment shall be cleaned prior to being removed at the completion of the project: exceptions to this requirement shall be determined on a case-by-case basis.** Consult with the National Grid Environmental Scientist prior to discharging or disposing of any waste water or waste material from the cleaning of equipment.

17.4 Cleaning of Equipment

At the completion of the project, equipment shall be cleaned prior to being de-mobilized to prevent tracking of material onto roads and causing safety issues. Consult with the National Grid Environmental Scientist prior to discharging or disposing of any waste water or waste material from the cleaning of equipment.

17.5 Access Roads

Constructed gravel roads shall be left in place following project completion unless permit conditions require their removal. Refer to the specific permit conditions for these provisions. If the road is to be removed, the crushed stone and geotextile fabric shall be removed from the work site. Seeding and/or mulching of gravel roads is generally not required, unless necessary to prevent erosion. Pre-existing sandy soils within mapped rare turtle habitat shall not be seeded unless directed by the National Grid Environmental Scientist so as to not alter nesting habitat.

17.6 Stone Work Pads

Unless permit conditions or property owner's require the removal of constructed stone work pads following project completion, constructed work pads shall be left in place. Refer to the specific permit conditions for these provisions.

17.7 Construction Materials on ROWs

As soon as the structure work has been completed, all used parts and trash are to be picked up and removed from the project site. Retired poles shall be removed in accordance with National Grid Engineering Standard SP.06.01.301. In some cases, the used material from structure work may be temporarily stored at the work area by placing it out of the wetlands or other sensitive resource area until work in the adjacent areas has been completed. However, treated wood poles shall never be stored in standing water or in wetlands. If the project is cancelled, all material shall be removed from the project site. Excess material brought to the project site shall be removed upon project completion. Consult with the National Grid Environmental Scientist on whether the work site shall be restored in addition to the measures outlined above

17.8 Improved Areas

Yards, lawns, agricultural areas, and other improved areas shall be returned to a condition at least equal to that which existed at the start of the project. Off-ROW access shall never be assumed and shall be coordinated through Real Estate before being implemented. Depending on the access point, construction matting or other BMPs may be required to prevent ruts, lawn damage, or other property damage.

[6] On ROW projects where multiple wetlands may be dominated by the same invasive species, cleaning may not be required for movement along the ROW. Check with the National Grid Environmental Scientist for guidance.

Restoration following the completion of work and any use of improved areas shall be conducted in accordance with the measures outlined above.

17.9 Property Damage

All damage to property occurring as a result of a project shall be immediately repaired or replaced. In some locations, it may be desirable to document pre-existing damage prior to work commencing in that area in order to demonstrate afterwards that the damage did not result from the project. Work crews, the Project Environmental Consultant or the National Grid Environmental Scientist shall document repairs that were performed in response to damage from unauthorized vehicle use.

17.10 Overall Work Site

Upon satisfactory completion of work, the construction personnel shall remove all work-related trailers, buildings, rubbish, waste soil, temporary structures, and unused materials belonging to them or used under their direction during construction, or waste materials from previous construction and maintenance operations. All areas shall be left clean, without any litter or equipment (wire, pole butts, anchors, insulators, cross-arms, cardboard, coffee cups, water bottles, etc.) and restored to a stable condition and as near as possible to its original condition, where feasible. Debris and spent equipment shall be returned to the operating facility or contractor staging area for disposal or recycling (cardboard) as appropriate in accordance with EI-111.

17.11 Material Storage/Staging and Parking Areas

Upon completion of all work, all material storage yards, staging areas, and parking areas shall be completely cleared of all waste and debris. Unless otherwise directed or unless other arrangements have been made with an off ROW or off-property owner, material storage yards and staging areas shall be returned to the condition that existed prior to the installation of the material storage yard or staging area. Regardless of arrangements made with a landowner, all areas shall be restored to their pre-construction condition or better. Also any temporary structures erected by the construction personnel, including fences, shall be removed by the construction personnel and the area restored as near as possible to its original condition, including seeding and mulching as needed.

18.0 Notification of Emergency Work

Because it is sometimes difficult to identify wetlands and other sensitive environmental areas, the National Grid Environmental Scientist shall be notified within 24 hours or by the next working day whenever emergency off-road repair work takes place. Although the routine maintenance and emergency repair work is generally allowed, due to site conditions or the scope of the project, notification to the regulating agencies may be required.

19.0 Appendices

APPENDIX 1: Glossary
APPENDIX 2: Acronyms

APPENDIX 3:	Storm Water, Wetlands & Priority Habitat Environmental Compliance Site Inspection / Monitoring Report Form
APPENDIX 4:	BMP Drawings and Guidelines
APPENDIX 5:	Certification Sheet for Invasive Species Control
APPENDIX 6:	Snow Disposal Guidelines

Appendix 1 – Glossary

Access Road – An existing, periodically maintained road often consisting of gravel and/or exposed soils or vegetated with grasses but devoid of woody vegetation, that is visible on aerial photography and shown on ROW T-sheets. May include newly permitted permanent roads (i.e., roads to be constructed in accordance with a project-specific permit).

Access Route - A pathway previously used or proposed to be used by crews for access along the ROW. Routes may be shown on ROW T-sheets or previous project access plans but are not improved as maintained gravel/exposed soil roads. Access routes may be mown and can consist of trails utilized by recreational vehicles.

Action Logs – Project-specific log used to document action items required for permit compliance. The log identifies timeframes for completion and responsible parties. The log is typically updated by the Project Environmental Consultant or the National Grid Environment Scientist and circulated to the project team on a weekly, or more frequent, basis.

Bank – The transitional slope immediately adjacent to the edge of a surface water body, the upper limit of which is usually defined by a break in slope, or, for a wetland, where a line delineated in accordance with applicable state and federal regulations that indicates a change from wetland to upland.

BMP – Best Management Practice. Individual engineered constructions or operating procedures intended to minimize and mitigate soil disturbance, erosion, sedimentation, turbid discharges, and/or impacts to sensitive receptors.

Clean - Free of plant matter (stems, flowers, roots, etc), soil, or other deleterious materials prior to being brought to the project site.

Clean Gravel – Gravel is a type of coarse-grained soil that consists of small stones and other mineral particles. Clean Gravel shall meet the requirements in accordance with National Grid Standard Construction Specification for Electric Stations (Engineering Standard SP.08.00.001) Clean Gravel will not have fine materials that could lead to a turbid discharge.

Clean Stone (Crushed Stone) – Clean Stone (Crushed Stone) shall meet the requirements in accordance with National Grid Standard Construction Specification for Electric Stations (Engineering Standard SP.08.00.001). Clean Stone will not have fine materials that could lead to a turbid discharge.

Clearing – The cutting of trees and large bushes by hand and/or mechanical means.

Compost Socks – Tubular devices comprised of non-degradable, photodegradable, or biodegradable mesh tubing containing organic compost matrix. Compost socks are effective for intercepting site runoff, trapping

sediment, and treating for soluble pollutants by filtering stormwater runoff. . Compost socks are a useful sedimentation control device along construction site perimeters, as check dams in drainage channels, as a slope interruption practice on long and/or steep slopes, and around drain or street curb inlets.

Construction Mats - **C**onstruction, swamp, and timber mats ("construction mats") are generic terms used to describe structures that distribute equipment weight to minimize disturbance to wetland soil and vegetation while facilitating passage and providing work platforms for workers and equipment. They are comprised of sheets or mats made from a variety of materials in various sizes.

Corduroy Road – Corduroy roads are cut trees and/or saplings with the crowns and branches removed, and the trunks lined up next to one another.

Dewatering Basin – An established containment area for saturated materials and pumped discharges. This measure is used for the purpose of de-watering soils prior to transport off site or for use in another location on site, and for allowing suspended sediment to settle out of pumped discharges.

Detention/Retention Basin – A detention/retention basin is designed for the purpose of detaining or retaining water. A dewatering basin is a form of detention basin

Dewatering – Use of a system of pumps, pipes and temporary holding dams to drain or divert waterways or wetlands, or lower the groundwater table before and during excavation activities.

Drainage Ditch or Swale – A clearly noticeable channel that is typically dry, except after precipitation events. Intermittent and perennial streams and rivers are not included in this definition.

Dredge – To dig, excavate, or otherwise disturb the contour or integrity of sediments in the bank or bed of a wetland, a surface water body, or other area within the regulating bodies' jurisdiction.

Dredge Spoils – Material removed as the result of dredging.

Embankment – A protective bank constructed of mounded earth or fill materials located between a roadway (or rail bed) and a seasonal stream or other wetland.

Environmental Field Issue – Document that contains copies of all project-specific environmental permits and summarizes all environmental permit conditions. The EFI is prepared by the Project Environmental Consultant or the National Grid Environment Scientist and copies are provided to the Project Manager, Construction Supervisor(s), and other team members as appropriate.

Environmental Monitoring Records – Examples of checklists and/or monitoring reports suggested for use by the Company Environmental Engineer to document conformance of the project with this Environmental Guidance and or project specific permit/license conditions.

Environmental Scientist – Formerly Environmental Engineer. The National Grid Environmental Department representative for the project or the territory where the work is located. For a map of Environmental Department staff territories, refer to the Environmental page of the National Grid infonet.

Environmentally Sensitive Areas – Examples of environmentally sensitive areas that may be found on National Grid properties are rivers, streams, ponds, lakes, wetlands, bogs, swamps, salt marshes, rare species habitat, wellhead protection areas, cultural sites, parks, preserves, schools and as otherwise defined by Federal, State or local regulations. Refer to EG-301.

Erosion Controls – The utilization of methods to prevent soil detachment and minimize displacement or washing down slopes by rainfall or run-off. Common practices include, but are not limited to:

(a) Temporary and Permanent Seeding.

(b) Mulching, Soil Binders, Tackifiers.

(c) Erosion Control Blankets.

(d) Hydraulic Erosion Control.

Excavate/Excavation – To dig, remove, or form a cavity or a hole in an area within the department's jurisdiction.

Fill (n.) – Any rock, soil, gravel, sand or other such material that has been deposited or caused to be deposited by human activity.

Fill (v.) – To place or deposit materials in or on a wetland, surface water body, bank or otherwise in or on an area within the jurisdiction of the department.

Flats – Relatively level landforms composed of unconsolidated mineral and organic sediments usually mud or sand, that are alternately flooded and exposed by the tides and that usually are continuous with the shore.

Frozen Condition – Field conditions when the upper portion of the ground surface freezes or when areas of standing water freeze solid such that vehicle passage over these areas is supported without any resulting soil disturbance. The frozen conditions must have been affected by severe cold (maximum daily temperatures less than 32 degrees F) for a continuous 2-week period.

GAA – Rhode Island groundwater classification, groundwater resources that are known, or presumed to be suitable for drinking water use without treatment, and are located in one of the three areas described below.

a) The state's major stratified drift aquifers that are capable of serving as a significant source for a public water supply ("groundwater reservoirs") and the critical portion of their recharge area as delineated by DEM;

b) The wellhead protection area for each public water system community water supply well. Community water supply wells are those that serve resident populations and have at least 15 service

connections or serve at least 25 individuals, e. g. municipal wells and wells serving nursing homes, condominiums, mobile home parks, etc.; and

c) Groundwater dependent areas that are physically isolated from reasonable alternative water supplies and where existing groundwater warrants the highest level of protection. At present only Block Island has been designated as meeting this criterion.

GA – Rhode Island groundwater classification, groundwater resources that are known, or presumed to be suitable for drinking water use without treatment. However, groundwater classified by GA does not fall within any of the three priority areas described under the GAA classification.

Grade/Grading – The movement of soil and fill material to change the elevation of the land. The term refers to the combined actions of excavating and filling to change elevation or shape.

Grubbing – The removal of stumps/roots by mechanical means during site preparation activities.

Immediately - As soon as practicable, but no later than the end of the next work day, following the day when the earth-disturbing activities have temporarily or permanently ceased.

In-kind Replacement - Replacement using the same material, functional inverts, diameter and length as the existing item. In-kind replacement includes the substitution of a structure with a similar structure in approximately the same location as is practicable, and is approximately the same in design. The design may be altered to meet applicable utility standards, and may include alternate materials designed to prolong the life of that service.

Intermittent Stream – A stream that flows for sufficient time to develop and maintain a defined channel, but which might not flow during dry portions of the year.

In the Dry – Work done either during periods of low water or behind temporary diversions, such as Earth Dike / Drainage Swale and Lined Ditches designed and installed in accordance with best management practices.

Limit of Work/Disturbance – The approved project limits within regulated areas. All project related activities in regulated areas must be conducted within the approved limit of work/disturbance. The limit of work/disturbance shall be depicted on the approved permit site plans and in the EFI plans. Where it is warranted National Grid may require that these limits be identified in the field by flagging, construction fencing, and/or perimeter erosion controls.

Long-Term Restoration Logs - Project-specific log used to document restoration required following the completion of construction or as areas of the project have been completed (i.e., segments of ROW for a multi-mile project). The log is typically updated by the Project Environmental Consultant or the National Grid Environment Scientist and circulated to the project team on a weekly basis.

Low Flow Conditions – Low water flow that generally occurs during the summer, as a result of decreased precipitation and the removal of water by increased evaporation and evapotranspiration by vegetation. Work done under low-flow conditions minimizes the potential for environmental damage. The USACE defines the calendar dates for low flow conditions in its New England state-specific Programmatic General Permits.

Low Ground Pressure – Equipment that meets the USACE GP state-specific defined Pounds per Square Inch (PSI) ground pressure when loaded. Use of LGP equipment ***requires approval*** from the National Grid Environmental Scientist.

Marsh – A wetland:

a) That is distinguished by the absence of trees and shrubs;

b) Dominated by soft-stemmed herbaceous plants such as grasses, reeds, and sedges; and

c) Where the water table is at or above the surface throughout the year, but can fluctuate seasonally.

Methods – Are the construction practices and procedures that take place through choosing the proper equipment, trucks and labor to execute the earth moving activities based on the existing conditions and implementing creative and sensitive scheduling for the daily activities.

NHESP - Natural Heritage Endangered Species Program; a department within the Massachusetts Division of Fisheries and Wildlife that is responsible for protecting the 176 species of vertebrate and invertebrate animals and 259 species of native plants that are officially listed as Endangered, Threatened or of Special Concern in Massachusetts.

Perennial – A stream that contains water at all times except during extreme drought.

Permanently Ceased – Is applicable to earth disturbance activities when clearing and excavation within any area of the Project that will not include permanent structures has been completed.

Person-in-Charge – A National Grid Project Engineer, Manager, Supervisor, Field Construction Coordinator or equivalent Contractor personnel assigned to oversee and coordinate work activities.

Processed Gravel – Processed Gravel shall meet the requirements in accordance with National Grid Standard Construction Specification for Electric Stations (Engineering Standard SP.08.00.001). Processed Gravel will not have fine materials that could lead to a turbid discharge. Gravel consisting of inert material that is hard, durable stone and is free from loam and clay, surface coatings and deleterious materials.

Regulating Body – Federal, State, or local authority that has jurisdiction over resource areas that may be impacted by company operations

Regulated Wetland Area – Those areas that are subject to federal, state or local wetland regulation, including certain buffer or adjacent areas.

Repair – The restoring of an existing legal structure by partial replacement of work, or broken, or unsound parts (Env-Wt 101.73).

Replacement – The substitution of a new structure for an existing legal structure with no change in size, dimensions, location, configuration, construction, or which conforms in all material aspects to the original structure

Right-of-Way – A corridor of land where National Grid has legal rights (either fee ownership, lease or easement) to construct, operate, and maintain an electric power line and/or natural gas pipeline and may include work on customer owned properties.

River – A watercourse that is larger than a perennial stream and flows all year long.

Routine Utility Rights-of-Way Maintenance Activity – Includes but is not limited to vegetation management and repair or replacement of existing utility structures.

Sedimentation Controls – Silt fences, straw bales, compost socks/berms and other barrier devices strategically placed to intercept and treat sediment-laden site runoff.

Sensitive Water - Includes any sediment or nutrient impaired water or a water that is identified by the state, tribe or EPA as Tier 2, 2.5 or Tier 3 for antidegradation purposes.

Siltation Curtain – An impervious barrier erected to prevent silt and sand and/or fines from being washed into a wetland, surface water body or other area of concern.

Surface Water Body or Surface Waters – Those portions of waters which have standing or flowing water at or on the surface of the ground.

Spill Prevention, Control and Countermeasure Plans – Required for site operations that involve the storage of 1,320 gallons or greater of fuel and oils, both in storage containers and stored in equipment. Response actions to spills and releases are specified in these plans.

Stormwater Pollution Prevention Plan – A site-specific, written document that, among other things: (1) identifies potential sources of stormwater pollution at a construction site; (2) describes stormwater control measures to reduce or eliminate pollutants in stormwater discharge from a construction site; and (3) identifies procedures the operator will implement to comply with the terms and conditions of EPA NPDES Construction General Permit (CGP). SWPPPs must be prepared, maintained on-site, and amended as necessary in order to obtain NPDES permit coverage for specific construction site stormwater discharges under the EPA NPDES CGP.

Temporarily Ceased - Is applicable when there are earth disturbance activities such as clearing, grading, and/or excavation that are not complete, but will be idle in one area for a period of up to 14 or more calendar days, and which will resume in the future. The 14 calendar day timeframe begins as soon as you now that construction work on a portion of the Project will be left incomplete and idle. In circumstances where there are unanticipated delays and you do not know at first how long the work stoppage will continue, the requirement to immediately initiate stabilization is triggered as soon as you know with reasonable certainty that work will be stopped for 14 or more additional calendar days.

Tidal Wetlands – A wetland whose vegetation, hydrology or soils are influenced by periodic inundation or tidal waters.

Topsoil – The uppermost part of the soil, ordinarily moved in tillage, or its equivalent in uncultivated soils and ranging in depth from 2 to 10 inches.

Turbidity – The condition in which solid particles suspended in water make the water cloudy or even opaque in extreme cases.

United States Geological Survey Topographic Map – A map that uses contour lines to represent the three-dimensional features of a landscape on a two-dimensional surface. These maps use a line and symbol representation of natural and artificially created features in an area.

Wetland – An area that is inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal conditions does support, a prevalence of vegetation (more than 50 percent) typically adapted for life in saturated soil conditions (hydric soils). Wetlands include but are not limited to swamps, marshes, bogs, and similar areas.

Work Site – An area where work is performed.

Worker – Company employee, contractor, consultant working on site.

Zone II - Massachusetts - That area of an aquifer which contributes water to a well under the most severe pumping and recharge conditions that can be realistically anticipated (180 days of pumping at safe yield, with no recharge from precipitation). It is bounded by the groundwater divides which result from pumping the well and by the contact of the aquifer with less permeable materials such as till or bedrock. In some cases, streams or lakes may act as recharge boundaries. In all cases, Zone IIs shall extend up gradient to its point of intersection with prevailing hydrogeologic boundaries (a groundwater flow divide, a contact with till or bedrock , or a recharge boundary).

Appendix 2 – Acronyms

ASTM	American Society for Testing and Materials
BMP	Best Management Practices
EFI	Environmental Field Issue
EG	Environmental Guidance
EPA	Environmental Protection Agency
GA/GAA	Rhode Island Groundwater Classifications – see glossary
LGP	Low Ground Pressure
MA	Massachusetts
MA DEP	Massachusetts Department of Environmental Protection
MassDOT	Massachusetts Department of Transportation
NE	New England
NH	New Hampshire
NH DES	New Hampshire Department of Environmental Services
NHESP	Natural Heritage Endangered Species Program
NPDES	National Pollutant Discharge Elimination System
OHM	Oil and/or Hazardous Materials
PSI	Pounds per square inch
RI	Rhode Island
RI DEM	Rhode Island Department of Environmental Management
RI CRMC	Rhode Island Coastal Resources Management Council
RI SESC	Rhode Island soil erosion and sediment control
ROW	Right-of-Way
RTE	Rare, Threatened or Endangered
SPCC	Spill Prevention, Control and Countermeasure
SWPPP	Storm Water Pollution Prevention Plan
TOY	Time-of-Year
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
VT	Vermont

VT DEC	Vermont Department of Environmental Conservation
Zone II	Massachusetts Groundwater Protection district – see glossary

Appendix 3

See EG303NE_Appendix3_Reporting Form published separately

Appendix 4 – BMPs

See EG303NE_Form1 for a list of BMPS

See EG303NE_Form2 for BMP details

APPENDIX 5
CERTIFICATION FORM FOR INVASIVE SPECIES CONTROL

Certain permit conditions, therefore a Condition of Contracts for the Prime Contractor, any Subcontractors, and any equipment or mat vendors for ***National Grid Projects*** shall be required to Certify their equipment[7] {each piece of equipment used on site} as 'clean'[8].

_____ (*name of firm*) hereby Certifies that

_____ (*make, model, and/or type*)

_____ (*equipment ID tag or #)* meets the following

1. before entry on to the job site, has been sufficiently cleaned to remove all accumulated mud, debris, plant fragments, and detritus that could harbor seeds, roots, or plant fragments of so-called invasive plant species; and

2. that the above piece of equipment has neither been off-loaded nor operated in the interval between cleaning and delivery to the jobsite.

3. that equipment deployed in areas of invasive species (as identified in project plans) shall be cleaned prior to redeployment.

_____ (*signed*) _____ (*dated*)

_____ (*printed name*) _____ (*title*)

_____ (*Firm*)

The signed original of this form {one for each piece of equipment (or lot[9] of mats)} is to be given to the NG Construction Supervisor assigned to the project.

---

7 Equipment may include, but is not limited to bulldozers, excavators, backhoes, bucket trucks (tracked or wheeled), pulling equipment, concrete trucks, compressors, drilling equipment, and mats (composite, wood, or other materials).

8 With regard to invasive species, the definition of clean means free of accumulated mud, debris, plant fragments, and detritus that could harbor seeds, roots, or plant fragments of so-called invasive plant species.

9 Lot of mats is the number of mats that may be transported by one forwarder/truck at a time.

Appendix 6 – Snow Disposal Guidelines

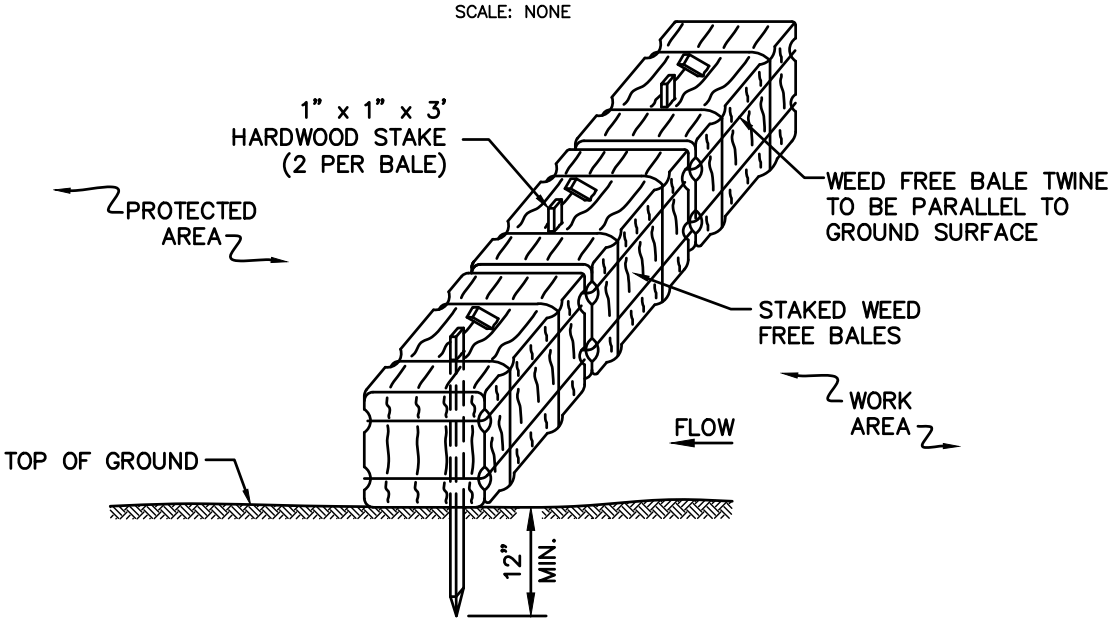
See EG303NE_App6 published separately

	BMP #	Measure
Sediment & Erosion Controls	SEC-1	Weed free bale barrier
	SEC-2	Sediment control fence
	SEC-3	Silt fence / weed free barrier
	SEC-4	Silt Soxx
	SEC-5	Straw Wattle
	SEC-6	Erosion Control Blanket - Ditch
	SEC-7	Erosion Control Blanket - Slope
	SEC-8	Hydroseeding with Tackifier (slope stabilization)
	SEC-9	Mulch materials, rates and uses (from NY)
	SEC-10	Seeding options - Upland Seed Mixes
	SEC-11	Seeding options - Wetland Seed Mix
	SEC-12	Distribution Pole Erosion Control
Crossing Measures	CM-1	Prefabricated mats
	CM-2	Construction mat bridge
	CM-3	Construction mat layout (with transition)
	CM-4	Construction mat layout (with transition & BMPs)
	CM-5	Construction mat - Air Bridge
	CM-6	Corduroy road
	CM-7	Rock Ford
	CM-8	Temporary construction entrance / exit
	CM-9	Temporary construction culvert
	CM-10	Access way stabilization
	CM-11	Construction signage
	CM-12	Construction Mat Anchoring
Advanced Applications	AA-1	Reinforced silt fence
	AA-2	Sediment filter
	AA-3	Stone check dams
	AA-4	Straw / haybale check dam
	AA-5	Waterbar
	AA-6	Sandbag check dam
	AA-7	Earth dike
	AA-8	Drainage swale and lined ditch
	AA-9	Sedimentation basin
	AA-10	Dewatering basin - Small scale
	AA-11	Dewatering basin - Large scale
	AA-12	Dirtbag
	AA-13	Concrete waste sump

	AA-14	Outpak concrete washout
Advanced Applications	AA-15	Barrier fence (construction fence)
	AA-16	ROW gates / fences
	AA-17	Bollard
	AA-18	Dust control
	AA-19	Catch Basin Inlet Protection
	AA-20	Silt Sack
	AA-21	Turbidity Curtain
	AA-22	Siltsoxx Amphibian & Reptile Crossing #1
	AA-23	Siltsoxx Amphibian & Reptile Crossing #2
	AA-24	Siltsoxx Amphibian & Reptile Crossing #3
	AA-25	Cultural Avoidance

BMP DETAIL

SCALE: NONE



NOTES:

1. THE GROUND SHALL BE PREPARED TO PROVIDE COMPLETE CONTACT WITH THE BALES.

BMP PICTURE



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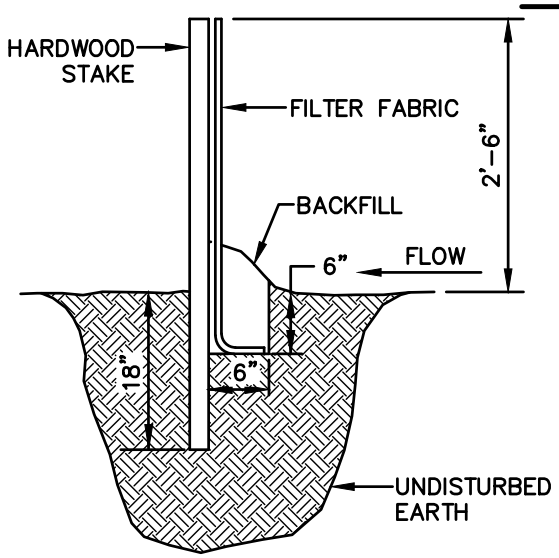
SEC-1
WEED FREE BALE BARRIER

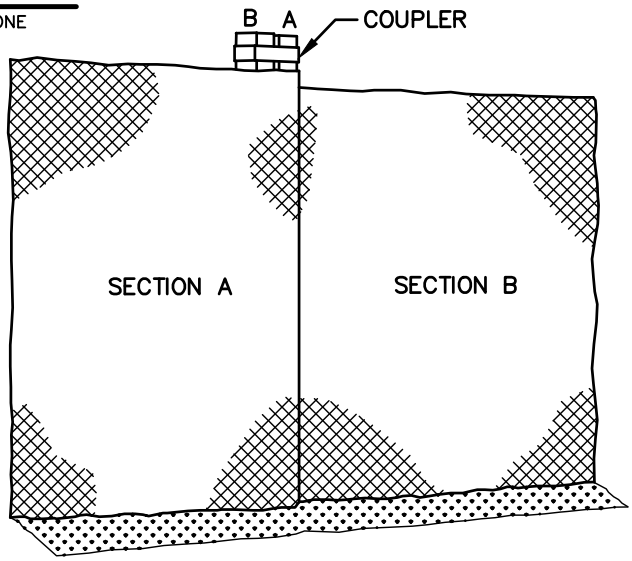
File: BALE_BARRIER.DWG

BMP DETAIL

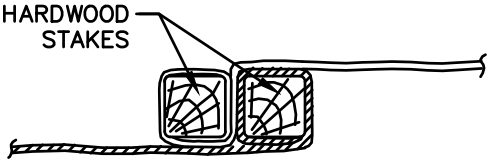
SCALE: NONE



PROFILE



SECTION



PLAN

BMP PICTURE

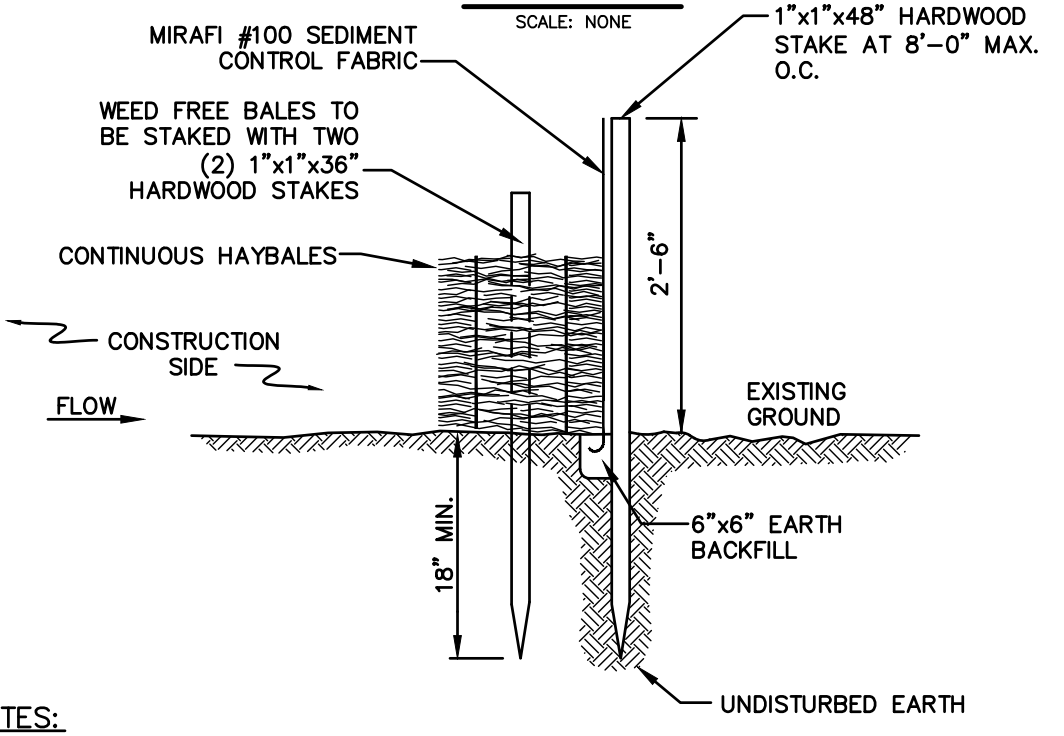


SEC-2
SEDIMENT CONTROL FENCE

File: Sediment_Fence.dwg

BMP DETAIL

SCALE: NONE



NOTES:

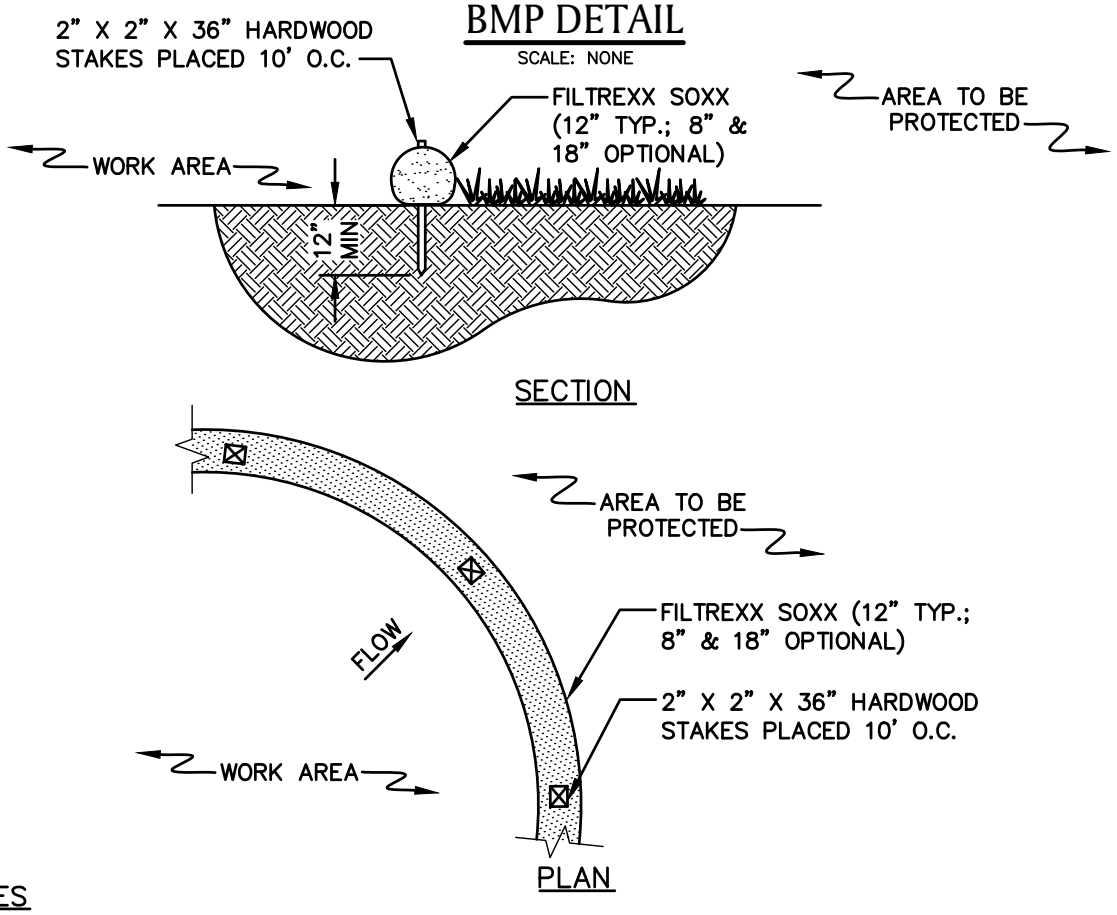
1. BALES SHALL BE PLACED IN A ROW WITH THE ENDS TIGHTLY ABUTTING THE ADJACENT BALES.
2. BALES SHALL BE SECURELY ANCHORED IN PLACE BY TWO (2) 1"X1"X36" HARDWOOD STAKES DRIVEN THROUGH THE BALES. THE FIRST STAKE IN EACH BALE SHALL BE ANGLED TOWARD PREVIOUSLY LAID BALE TO FORCE BALES TOGETHER.
3. INSPECTION SHALL BE FREQUENT AND REPAIR OR REPLACEMENT SHALL BE MADE PROMPTLY AS NEEDED.
4. BALES SHALL BE REMOVED AND REPLACED WHEN THEY BECOME FILLED WITH SEDIMENT AND BLOCK OR IMPEDE STORM FLOW OR DRAINAGE.
5. BALES SHALL BE REMOVED WHEN THE EMBANKMENTS STABILIZE.
6. BALES TO BE TWINE BOUND.

BMP PICTURE



BMP DETAIL

SCALE: NONE



NOTES

1. PRODUCT TO BE FILTREXX SILT SOXX OR APPROVED EQUAL BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. ALL MATERIAL TO MEET FILTREXX SPECIFICATIONS.
3. FILTER MEDIA FILL TO MEET APPLICATION REQUIREMENTS.
4. MESH CONTAINMENT MATERIAL SHOULD BE KNITTED PHOTODEGRADABLE OR BIODEGRADABLE MATERIAL, WITH OPENING SIZES BETWEEN 1/8" – 3/8".
5. COMPOST MEDIA SHOULD HAVE PARTICLE SIZE WHERE 99% < 2", 50% > 1/2".
6. COMPOST MATERIAL TO BE DISPERSED ON SITE, AS DETERMINED BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.

BMP PICTURE



*** PICTURE AND DETAIL PROVIDED BY FILTREXX LAND IMPROVEMENT SYSTEMS**

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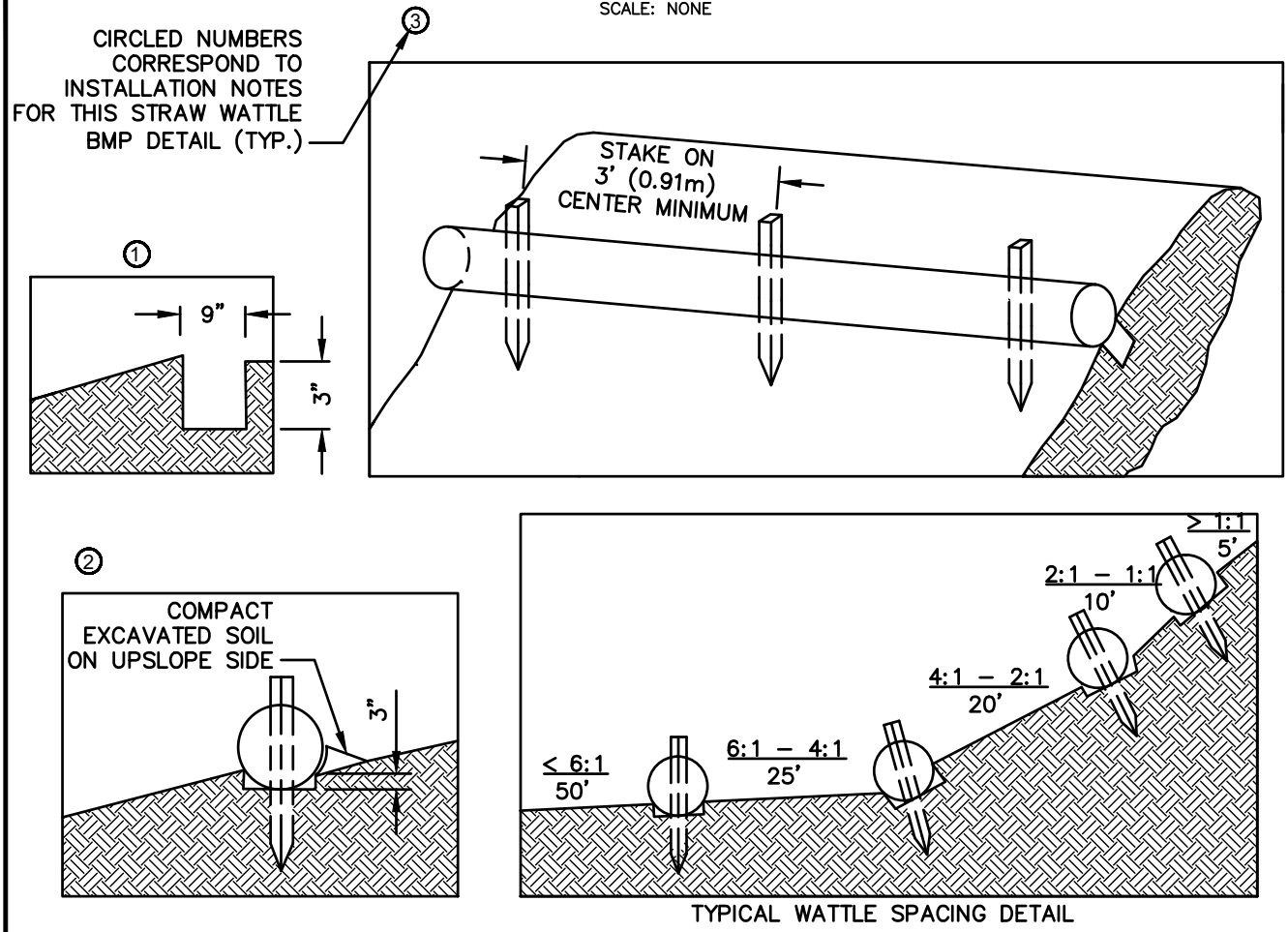
SEC-4
SILT SOXX *

File: SiltSOXX.dwg

BMP DETAIL

SCALE: NONE



TYPICAL WATTLE SPACING DETAIL

NOTES:

1. PRODUCT TO BE TENSAR NORTH AMERICAN GREEN STRAW WATTLE OR APPROVED EQUAL BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. TYPICAL WATTLE SPACING BASED ON SLOPE GRADIENT. COORDINATE SPACING AND LOCATION WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.
3. MINIMUM 12" DIAMETER WATTLES SHOULD BE USED FOR HIGHLY DISTURBED AREAS (I.E., HEAVILY USED ACCESS ROAD WITH ADJACENT WETLAND) AND MINIMUM 9–10" WATTLES SHOULD BE USED FOR LESS DISTURBED SOILS.

INSTALLATION NOTES:

1. BEGIN AT THE LOCATION WHERE THE WATTLE IS TO BE INSTALLED BY EXCAVATING A 2–3" DEEP X 9" WIDE TRENCH ALONG THE CONTOUR OF THE SLOPE. EXCAVATED SOIL SHOULD BE PLACED UPSLOPE FROM THE ANCHOR TRENCH.
2. PLACE THE WATTLE IN THE TRENCH SO THAT IT CONTOURS TO THE SOIL SURFACE. COMPACT SOIL FROM THE EXCAVATED TRENCH AGAINST THE WATTLE ON THE UPHILL SIDE. ADJACENT WATTLES SHOULD TIGHTLY ABUT.
3. SECURE THE WATTLE WITH 18–24" HARDWOOD STAKES EVERY 3–4' AND WITH A STAKE ON EACH END. STAKES SHOULD BE DRIVEN THROUGH THE MIDDLE OF THE WATTLE LEAVING AT LEAST 2–3" OF STAKE EXTENDING ABOVE THE WATTLE. STAKES SHOULD BE DRIVEN PERPENDICULAR TO THE SLOPE FACE.

*** DETAIL AND PICTURE PROVIDED BY TENSAR NORTH AMERICAN GREEN**
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SEC-5
STRAW WATTLE * (1 OF 2)

File: Straw_Wattle.dwg

BMP PICTURE



STRAW WATTLE – SHALLOW SLOPE (≤4:1)
(ALTERNATE STAKING)

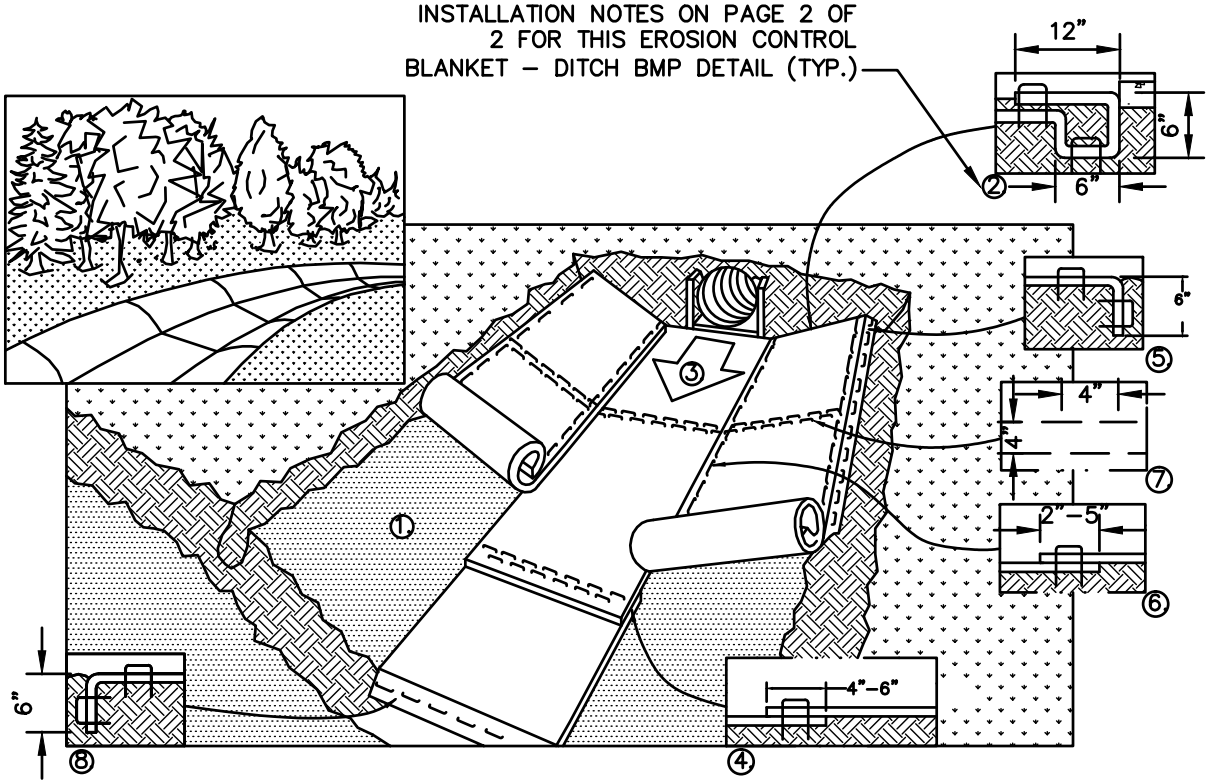
ALTERNATE STAKING INSTALLATION NOTES:

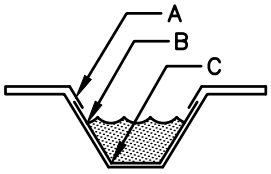
1. ON SHALLOW SLOPES (≤4:1), STRAW WATTLE MAY BE SECURED WITH 18–24" HARDWOOD STAKES DRIVEN AGAINST THE SIDES OF THE WATTLE INSTEAD OF THROUGH. STAKES SHALL ALTERNATE SIDES, AND BE SPACED 3–4' MAX.
2. TWINE SHALL BE TIED FROM STAKE TO STAKE, CRISS–CROSSING THE STRAW WATTLE. TIE TWINE TO STAKES BELOW THE HEIGHT OF THE WATTLE.

BMP DETAIL

SCALE: NONE

CIRCLED NUMBERS CORRESPOND TO INSTALLATION NOTES ON PAGE 2 OF 2 FOR THIS EROSION CONTROL BLANKET – DITCH BMP DETAIL (TYP.)





CRITICAL POINTS
A. OVERLAPS AND SEAMS
B. PROJECTED WATER LINE
C. CHANNEL BOTTOM/SIDE SLOPE VERTICES

NOTES:

1. PRODUCT TO BE NORTH AMERICAN GREEN EROSION CONTROL BLANKET OR APPROVED EQUAL BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. HORIZONTAL STAPLE SPACING SHOULD BE ALTERED IF NECESSARY TO ALLOW STAPLES TO SECURE THE CRITICAL POINTS ALONG THE CHANNEL SURFACE.
3. IN LOOSE SOIL CONDITIONS, THE USE OF STAPLE OR STAKE LENGTHS GREATER THAN 6" (15 CM) MAY BE NECESSARY TO PROPERLY ANCHOR THE ROLLED EROSION CONTROL PRODUCTS (RECP's).

BMP DETAIL

INSTALLATION NOTES:

1. PREPARE SOIL BEFORE INSTALLING ROLLED EROSION CONTROL PRODUCTS (RECP's), INCLUDING ANY NECESSARY APPLICATION OF LIME, FERTILIZER, AND SEED. NOTE: WHEN USING CELL-O-SEED DO NOT SEED PREPARED AREA. CELL-O-SEED MUST BE INSTALLED WITH PAPER SIDE DOWN.
2. BEGIN AT THE TOP OF THE CHANNEL BY ANCHORING THE RECP's IN A 6" (15 CM) DEEP X 6" (15 CM) WIDE TRENCH WITH APPROXIMATELY 12" (30 CM) OF RECP's EXTENDED BEYOND THE UP-SLOPE PORTION OF THE TRENCH. ANCHOR THE RECP's WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30 CM) APART IN THE BOTTOM OF THE TRENCH. BACKFILL AND COMAPCT THE TRENCH AFTER STAPLING. APPLY SEED TO COMPACTED SOIL AND FOLD REMAINING 12" (30 CM) PORTION OF RECP's BACK OVER SEED AND COMPACTED SOIL. SECURE RECP's OVER COMPACTED SOIL WITH A ROW OF STAPLES/STAKES SPACED APPROXIMATELY 12" (30 CM) ACROSS THE WIDTH OF THE RECP's.
3. ROLL CENTER RECP's IN DIRECTION OF WATER FLOW IN BOTTOM OF CHANNEL. RECP's WILL UNROLL WITH APPROPRIATE SIDE AGAINST THE SOIL SURFACE. ALL RECP's MUST BE SECURELY FASTENED TO SOIL SURFACE BY PLACING STAPLES/STAKES IN APPROPRIATE LOCATIONS AS SHOWN IN THE STAPLE PATTERN GUIDE. ™ WHEN USING THE DOT SYSTEM , STAPLES/STAKES SHOULD BE PLACED THROUGH EACH OF THE COLORED DOTS CORRESPONDING TO THE APPROPRIATE STAPLE PATTERN.
4. PLACE CONSECUTIVE RECP's END OVER END (SHINGLE STYLE) WITH A 4" – 6" (10 CM –15 CM) OVERLAP. USE A DOUBLE ROW OF STAPLES STAGGERED 4" (10 CM) APART AND 4" (10 CM) ON CENTER TO SECURE RECP's.
5. FULL LENGTH EDGE OF RECP's AT TOP OF SIDE SLOPES MUST BE ANCHORED WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30 CM) APART IN A 6" (15 CM) DEEP X 6" (15 CM) WIDE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.
6. ADJACENT RECP's MUST BE OVERLAPPED APPROXIMATELY 2" – 5" (5 CM –12.5 CM) (DEPENDING ON RECP's TYPE) AND STAPLED.
7. IN HIGH FLOW CHANNEL APPLICATIONS, A STAPLE CHECK SLOT IS RECOMMENDED AT 30 TO 40 FOOT (9 M – 12 M) INTERVALS. USE A DOUBLE ROW OF STAPLES STAGGERED 4" (10 CM) APART AND 4" (10 CM) ON CENTER OVER ENTIRE WIDTH OF THE CHANNEL.
8. THE TERMINAL END OF THE RECP's MUST BE ANCHORED WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30 CM) APART IN A 6" (15 CM) DEEP X 6" (15 CM) WIDE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.

BMP PICTURE



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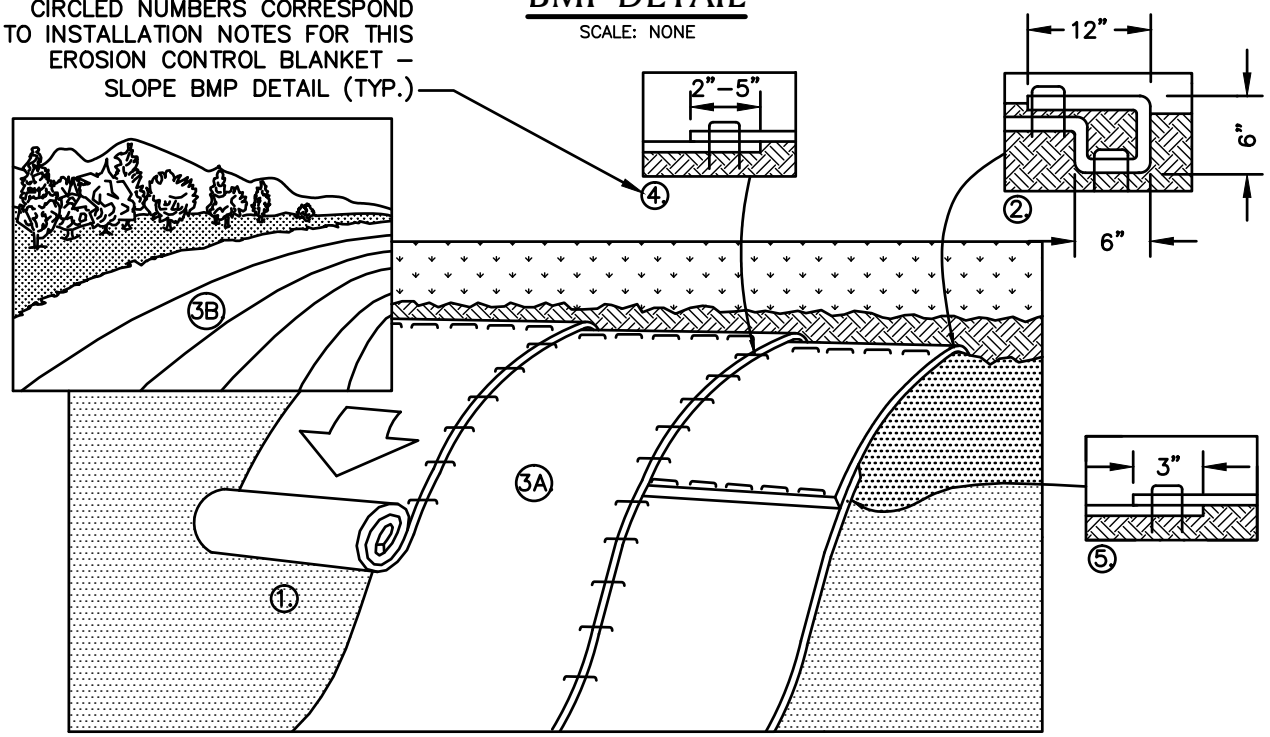
SEC-6
EROSION CONTROL BLANKET - DITCH * (2 OF 2)

File: Erosion_Blanket_Ditch.dwg

BMP DETAIL

SCALE: NONE



NOTES:

1. PRODUCT TO BE NORTH AMERICAN GREEN EROSION CONTROL BLANKET OR APPROVED EQUAL BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. IN LOOSE SOIL CONDITIONS, THE USE OF STAPLES OR STAKE LENGTHS GREATER THAN 6" (15 CM) MAY BE NECESSARY TO PROPERLY SECURE THE RECP's.

INSTALLATION NOTES:

1. PREPARE SOIL BEFORE INSTALLING ROLLED EROSION CONTROL PRODUCTS (RECP's), INCLUDING ANY NECESSARY APPLICATION OF LIME, FERTILIZER, AND SEED. NOTE: WHEN USING CELL–O–SEED DO NOT SEED PREPARED AREA. CELL–O–SEED MUST BE INSTALLED WITH PAPER SIDE DOWN.
2. BEGIN AT THE TOP OF THE SLOPE BY ANCHORING THE RECP's IN A 6" (15 CM) DEEP X 6" (15 CM) WIDE TRENCH WITH APPROXIMATELY 12" (30 CM) OF RECP's EXTENDED BEYOND THE UP–SLOPE PORTION OF THE TRENCH. ANCHOR THE RECP's WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30 CM) APART IN THE BOTTOM OF THE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING. APPLY SEED TO COMPACTED SOIL AND FOLD REMAINING 12" (30 CM) PORTION OF RECP's BACK OVER SEED AND COMPACTED SOIL. SECURE RECP's OVER COMPACTED SOIL WITH A ROW OF STAPLES/STAKES SPACED APPROXIMATELY 12" (30 CM) APART ACROSS THE WIDTH OF THE RECP's.
3. ROLL THE RECP's (A.) DOWN OR (B.) HORIZONTALLY ACROSS THE SLOPE. RECP's WILL UNROLL WITH APPROPRIATE SIDE AGAINST THE SOIL SURFACE. ALL RECP's MUST BE SECURELY FASTENED TO SOIL SURFACE BY PLACING STAPLES/STAKES IN APPROPRIATE LOCATIONS AS SHOWN IN THE STAPLE PATTERN GUIDE. WHEN USING THE DOT SYSTEM , STAPLES/STAKES SHOULD BE PLACED THROUGH EACH OF THE COLORED DOTS CORRESPONDING TO THE APPROPRIATE STAPLE PATTERN.
4. THE EDGES OF PARALLEL RECP's MUST BE STAPLED WITH APPROXIMATELY 2" – 5" (5 CM – 12.5 CM) OVERLAP DEPENDING ON RECP's TYPE.
5. CONSECUTIVE RECP's SPLICED DOWN THE SLOPE MUST BE PLACED END OVER END (SHINGLE STYLE) WITH AN APPROXIMATE 3" (7.5 CM) OVERLAP. STAPLE THROUGH OVERLAPPED AREA, APPROXIMATELY 12" (30 CM) APART ACROSS ENTIRE RECP's WIDTH.

*** PICTURE AND DETAIL PROVIDED BY TENSAR NORTH AMERICAN GREEN**

SEC-7
EROSION CONTROL BLANKET - SLOPE * (1 OF 2)

File: Erosion_Blanket_Slope.dwg

BMP PICTURE



File: Erosion_Blanket_Slope.dwg

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SEC-7
EROSION CONTROL BLANKET - SLOPE * (2 OF 2)

BMP PICTURE



NOTES:

1. COORDINATE MIXTURE TYPE AND APPLICATION AREAS WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST PRIOR TO CONSTRUCTION.
2. A MINIMUM OF 1500 LBS. PER ACRE OF A PAPER/CORN FIBER OR EQUIVALENT WITH NATURAL TACKIFIERS WILL BE USED ON SLOPES LESS THAN 3:1.
3. A BFM (BONDED FIBER MATRIX) WILL BE USED ON SLOPES GREATER THAN 2:1.
4. A FGM (FLEXIBLE GROWTH MATRIX) OR ESM (EXTREME SLOPE MATRIX) WILL BE USED ON SLOPES GREATER THAN 1:1.
5. REFER TO BMP #10 FOR SEED MIXTURE OPTIONS.

*** PICTURE PROVIDED BY TENSAR NORTH AMERICAN GREEN**
*** TACKIFIER INFORMATION PROVIDED BY FILTREXX LAND IMPROVEMENT SYSTEMS AND TENSAR NORTH AMERICAN GREEN**

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SEC-8
HYDROSEEDING WITH TACKIFIER
(SLOPE STABILIZATION) *

File: Hydroseeding.dwg

BMP

Definition

Applying coarse plant residue or chips, or other suitable materials, to cover the soil surface.

Purpose

The primary purpose is to provide initial erosion control while a seeding or shrub planting is establishing. Mulch will conserve moisture and modify the surface soil temperature and reduce fluctuation of both. Mulch will prevent soil surface crusting and aid in weed control. Mulch is also used alone for temporary stabilization in non-growing months.

Conditions Where Practice Applies

On soils subject to erosion and on new seedings and shrub plantings. Mulch is useful on soils with low infiltration rates by retarding runoff.

Criteria

Site preparation prior to mulching requires the installation of necessary erosion control or water management practices and drainage systems.

Slope, grade and smooth the site to fit needs of selected mulch products.

Remove all undesirable stones and other debris to meet the needs of the anticipated land use and maintenance required.

Apply mulch after soil amendments and planting is accomplished or simultaneously if hydroseeding is used.

Select appropriate mulch material and application rate or material needs. Determine local availability.

Select appropriate mulch anchoring material.

NOTE: The best combination for grass/legume establishment is straw (cereal grain) mulch applied at 2 ton/ acre (90 lbs./1000sq.ft.) and anchored with wood fiber mulch (hydromulch) at 500 – 750 lbs./acre (11 – 17 lbs./1000 sq. ft.). The wood fiber mulch must be applied through a hydroseeder immediately after mulching.



NOTE:

1. PICTURE DEPICTS STRAW MULCH APPLICATION (FROM MULCH SPREADER) ON STEEP SLOPE WITH AN IMPROVED DRAINAGE SWALE.
2. COORDINATE MULCH MATERIALS AND RATES WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.

* BMP INFORMATION FROM "NEW YORK STANDARDS AND SPECIFICATIONS FOR EROSION AND SEDIMENT CONTROL (AUGUST, 2005)." INFORMATION OBTAINED VIA WEBSITE: http://www.dec.ny.gov/chemical/29066.html

UPLAND ROW RESTORATION MIX – GENERAL

Species Composition Options:

- Andropogon gerardii; Niagra Big Bluestem
- Schizachyrium scoparium; Little Bluestem
- Elymus Canadensis; Canada Wild Rye
- Elymus virginicus; Virginia Wildrye
- Lolium multiflorum; Annual Ryegrass
- Sorghastrum nutans; Indiangrass
- Chamaecrista fasciculate; Partridge Pea
- Desmodium canadense; Showy Tick Trefoil
- Helioposis helianthoides; Ox–Eye Sunflower
- Panicum virgatum; Switchgrass
- Rudbeckia hirta; Black Eyed Susan
- Poa palustris; Fowl Bluegrass
- Agrostis perennans; Upland Bentgrass
- Agrostis alba; Redtop
- Festuca rubra; Red Fescue
- Lotus corniculatus; Birds–Foot Trefoil
- Chrysanthemum leucanthem; Ox–Eye Daisy
- Aster novae–angliae; New England Aster

Example Seed Mixes:

1. Native Upland wildlife forage and Cover Meadow Mix – Ernst Conservation Seeds (ERNMX–123)
2. Eastern Ecotype Native Grass Mix– Ernst Conservation Seeds (ERNMX–177)
3. New England Native Warm Season Grass Mix – New England Wetland Plants, Inc.
4. New England Logging Road Mix – New England Wetland Plants, Inc.
5. Northeast Upland Wildflower/Restoration Erosion Mix – Southern Tier Consulting (STCMX–2)

UPLAND ROW RESTORATION MIX – DRY/ROCKY SITES

Species Composition Options:

- Festuca rubra; Red Fescue
- Schizachyrium scoparium; Little Bluestem
- Elymus Canadensis; Canada Wild Rye
- Bouteloua gracillis; Blue Grama
- Lolium multiflorum; Annual Ryegrass
- Lolium perenne; Perennial Ryegrass
- Agrostics scabra; Rough Bentgrass
- Agrostis perennans; Upland Bentgrass
- Sorghastrum nutans; Indiangrass

Example Seed Mixes:

1. New England Erosion Control/ Restoration Mix for Dry Sites – New England Wetland Plants, Inc.
2. Ernst Conservation Seeds and similar companies can create a custom seed mix matching the composition above (with site specific additions if necessary).

WETLAND ROW RESTORATION MIX

Species Composition Options:

- Agrostis stolonifera; Creeping Bentgrass
- Poa trivialis; Rough Bluegrass
- Alopecurus arundinaceus; Creeping Meadow Foxtail
- Lolium multiflorum; Annual Ryegrass
- Festuca rubra; Creeping Red Fescue
- Elymus virginicus; Virginia Wildrye
- Schizachyrium scoparium; Little Bluestem
- Andropogon gerardii; Niagra Big Bluestem
- Carex vulpinoidea; Fox sedge
- Panicum virgatum; Switchgrass
- Agrostis scabra; Rough Bentgrass
- Aster novae–angliae; New England Aster
- Eupatorium perfoliatum; Boneset
- Euthamia graminifolia; Grass Leaved Goldenrod
- Scirpus atrovirens; Green Bulrush
- Verbene hastate; Blue Vervain
- Juncus effusus; Soft Rush
- Scirpus cyperinus; Wool Grass
- Panicum clandestinum; Deertongue

Example Seed Mixes

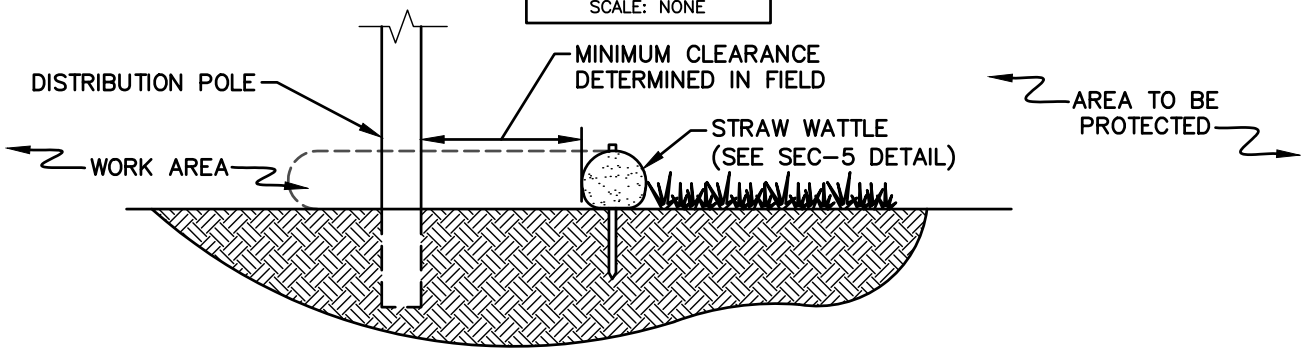
1. New England Erosion Control/Restoration Mix for Detention Basins and Moist Sites – New England Wetland Plants, Inc.
2. Northeast Wetland Grass Seed Mix – Southern Tier Consulting (STCMX–7)
3. Ernst Conservation Seeds and similar companies can create a custom seed mix matching the composition above (with site specific additions if necessary).

GERNERAL NOTES:

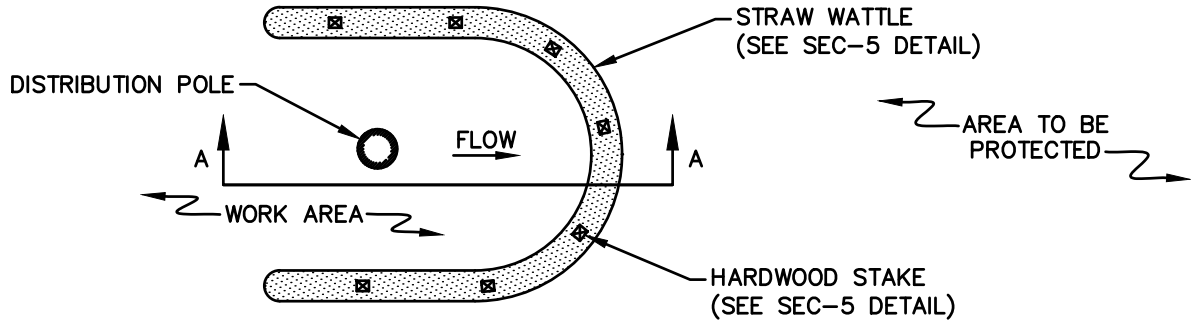
1. Seed mixes described herein are intended to cover a variety of typical new england landscapes. However, site specific seed mixes will need to be evaluated in coastal or mountainous regions.
2. Seed mixes described herein are intended for general ROW restoration. Site specific wetland seed mixes may be required by local, state and/or federal regulators for certain impacts to wetlands.
3. All seed mixes are to be approved by National Grid Environmental Scientist prior to construction and must conform with all project permits.
4. Seedbed preparation and maintenance as well as temporary erosion and sediment controls are crucial to the establishment of newly seeded areas. Coordinate with National Grid Environmental Scientist on seed bed preparation and maintenance as well as temporary erosion and sediment controls prior to construction.

BMP DETAIL

SCALE: NONE



SECTION A–A



PLAN

NOTES

1. PRODUCT TO BE STRAW WATTLE OR APPROVED EQUAL BY NATIONAL GRID ENVIRONMENTAL SCIENTIST (SEE SEC–5 BMP DETAIL).
2. STRAW BALE BARRIER PER SEC–1 BMP DETAIL TO BE AN AVAILABLE ALTERNATE DEPENDING ON SITE CONDITIONS AT THE DIRECTION OF NATIONAL GRID ENVIRONMENTAL SCIENTIST (SEE FIGURE 2).
3. MINIMUM CLEARANCE BETWEEN POLE AND EROSION CONTROL TO BE DETERMINED BY CONDITIONS OF POLE INSTALLATION/REPLACEMENT WORK AND ASSOCIATED DISTURBANCE.

BMP PICTURE



FIGURE 1: TYP. STRAW WATTLE APPLICATION



FIGURE 2: ALT. STRAW BALE APPLICATION

BMP PICTURE

SCALE: NONE

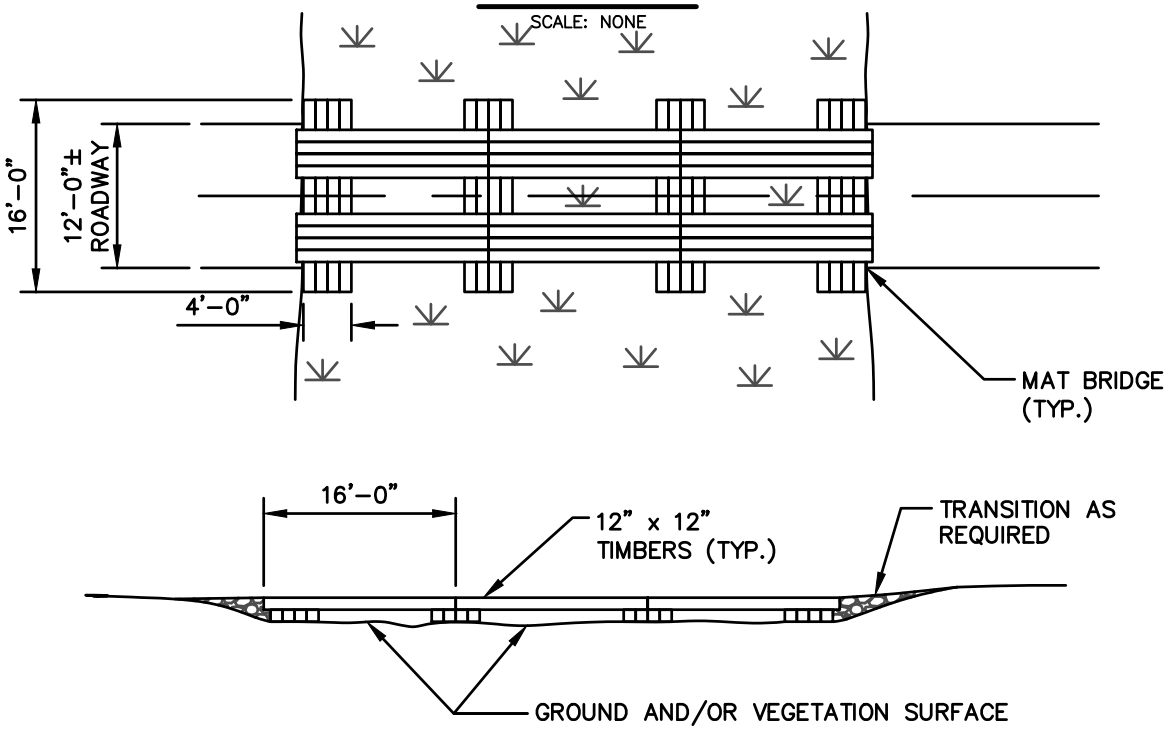


NOTES:

1. PRODUCT TO BE ALTURNAMATS' PREFABRICATED MATS OR APPROVED EQUAL BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. PRODUCT AVAILABLE IN 4X8' UNITS.
3. IF MATS ARE INSTALLED IN A WETLAND AREA, INSTALL EROSION CONTROLS TO CONTAIN MATERIAL UTILIZED IN THE MAT TRANSITIONS.

BMP DETAIL

SCALE: NONE



NOTES:

1. IF MATS ARE INSTALLED IN A WETLAND AREA, INSTALL EROSION CONTROLS TO CONTAIN MATERIAL UTILIZED IN THE MAT TRANSITIONS.

BMP PICTURE



CM-2
CONSTRUCTION MAT BRIDGE
(1 OF 2)

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File: Mat_Bridge.dwg

BMP PICTURE - SINGLE SPAN

SCALE: NONE





NOTES:

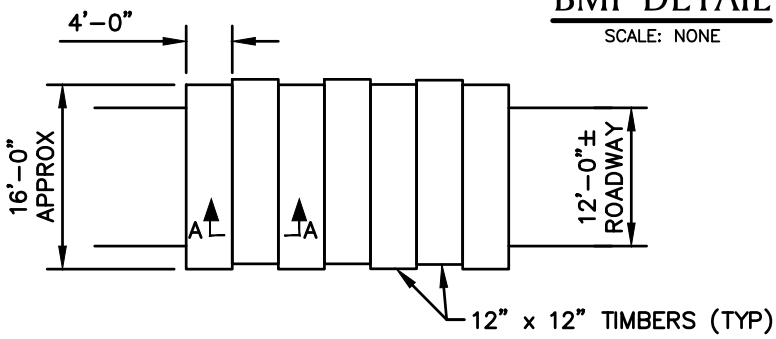
1. WHERE STREAM WIDTH ALLOWS, INSTALL CONSTRUCTION MATS TO SPAN THE WATERCOURSE IN ITS ENTIRETY WITHOUT STRINGER PLACEMENT IN THE WATER OR ANY RESTRICTION OF STREAM FLOW.

2. INSTALLATION OF THE CONSTRUCTION MAT BRIDGE SHALL NOT DAMAGE THE STREAM BED AND BANKS. WHERE POSSIBLE, FOOTERS SHALL BE PLACED PARALLEL TO THE TOP OF THE STREAM BANKS, WITH ACCESS MATTING PLACED ACROSS THE TOP OF THE STRINGERS DISTRIBUTING THE WEIGHT OF THE CONSTRUCTION EQUIPMENT.

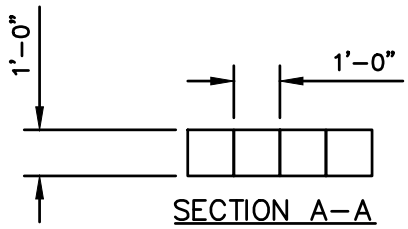
3. AT STREAM CROSSINGS THAT CANNOT BE SPANNED BY A SINGLE SECTION OF CONSTRUCTION MATTING, AND WHERE PERMITS ALLOW, STRINGERS SHALL BE PLACED ATOP THE STREAM BED PARALLEL TO THE FLOW OF WATER.

BMP DETAIL

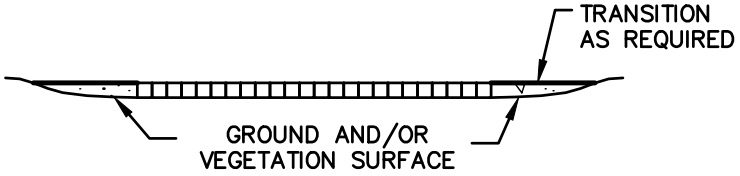
SCALE: NONE



TYPICAL PLAN VIEW



SECTION A–A
TYPICAL MAT SECTION
BOLTED TOGETHER



TYPICAL SECTION VIEW

NOTES:

1. TO BE INSTALLED IF NECESSARY TO PREVENT RUTTING, TO ACCESS STRUCTURES.
2. THIS DETAIL SHOWS TYPICAL DIMENSIONS. SOME CONTRACTOR'S CONSTRUCTION MATS ARE DIMENSIONALLY DIFFERENT FROM WHAT IS SHOWN HERE.
3. DEPENDENT ON SITE CONDITIONS, MULTIPLE LAYERS OF CONSTRUCTION MATS MAY BE INSTALLED.

BMP PICTURE



CM-3
CONSTRUCTION MAT LAYOUT
(WITH TRANSITION)

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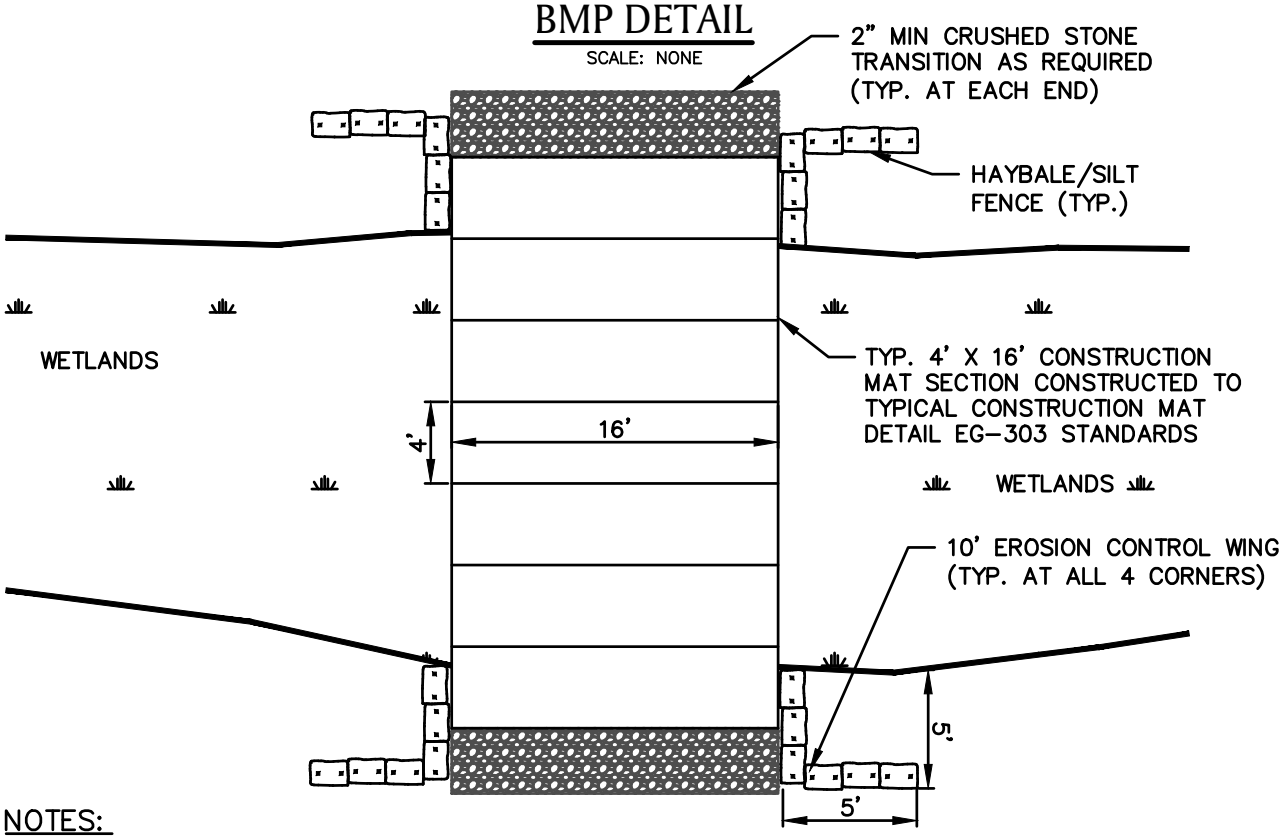
File: Swamp_Mat_Layout.dwg

BMP DETAIL

SCALE: NONE



NOTES:

1. ADD FILTER FABRIC AS NEEDED UNDER STONE TRANSITION RAMPS.
2. ALL MEASUREMENTS AND LOCATIONS ARE APPROXIMATE.

BMP PICTURE



CM-4
CONSTRUCTION MAT LAYOUT
(WITH TRANSITION AND BMPs)

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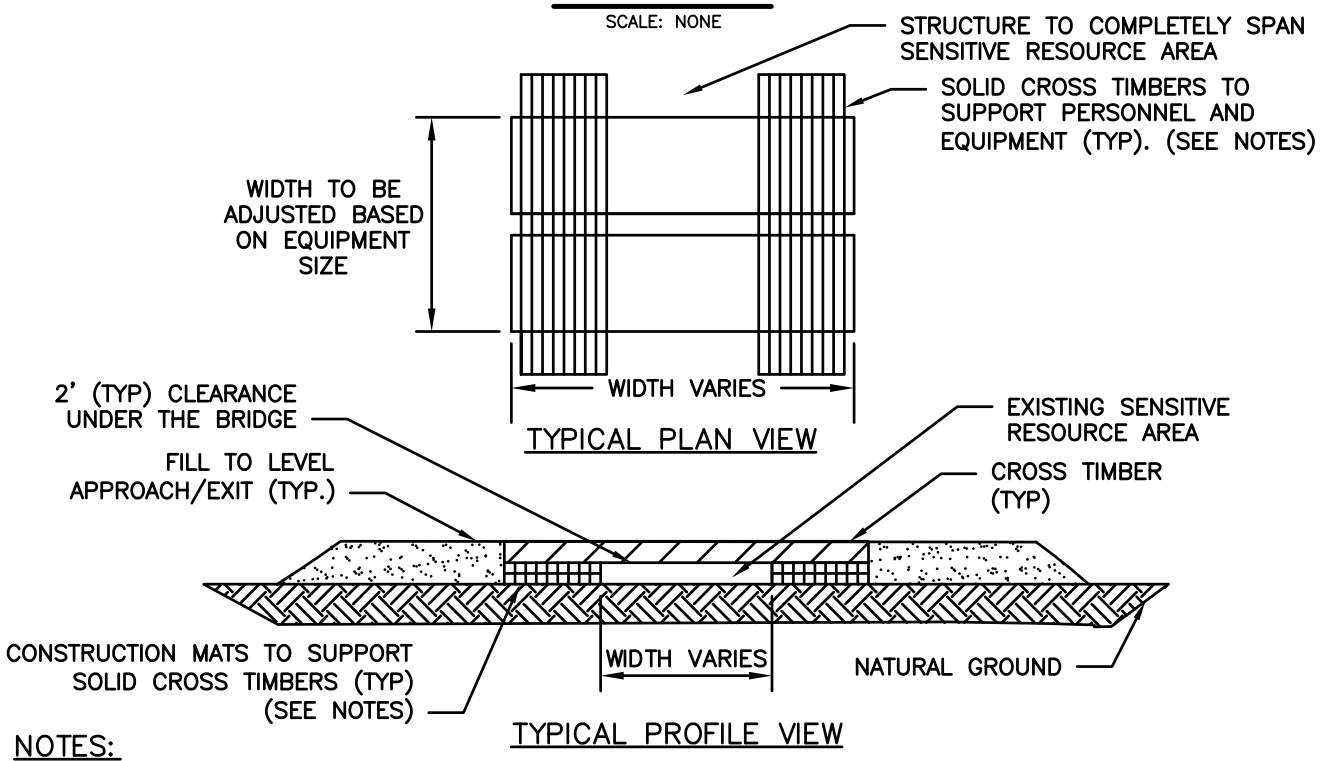
File: Swamp_Mat_Transition and BMPs.dwg

BMP DETAIL

SCALE: NONE



NOTES:

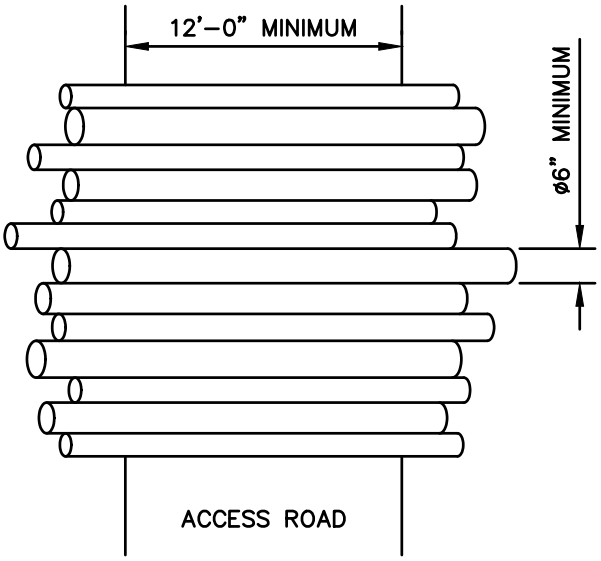
1. THE DETAIL SHOWN IS CONCEPTUAL. CONSTRUCTION MATS AND CROSS TIMBERS SHALL BE SIZED AND SELECTED BASED ON SPAN WIDTH, CROSSING EQUIPMENT AND FIELD CONDITIONS.
2. THE NUMBER OF CONSTRUCTION MATS MAY VARY DEPENDING ON THE CLEARANCE HEIGHT.
3. EQUIPMENT AND PERSONNEL LOAD SHALL BE DISTRIBUTED ON ALL TIMBERS.
4. EACH EQUIPMENT OPERATOR AND USER OF THE FIELD BRIDGE SHALL BE FAMILIAR WITH THE DESIGN AND THE MAXIMUM EQUIPMENT AND PERSONNEL LOADS.
5. THIS DETAIL MAY NOT BE APPLICABLE IN ALL FIELD CONDITIONS.
6. INSTALL EROSION CONTROLS ADJACENT TO THE CULVERT ENDS TO PROTECT THE WATERWAY FROM ROADWAY DEBRIS.

BMP PICTURE



BMP DETAIL

SCALE: NONE



RANDOM LENGTH AND DIAMETER LOGS PLACED ACROSS AN ACCESS ROAD

NOTE:

1. A SIMILAR BRUSH MAT INSTALLATION CONSISTING OF SMALLER DIAMETER STEMS AND LOGS CAN BE USED.
2. CORDUROY ROADS SHALL ONLY BE USED IN EMERGENCIES OR AFTER APPROVAL FROM THE PROJECT ENVIRONMENTAL CONSULTANT OR NATIONAL GRID ENVIRONMENTAL SCIENTIST.

BMP PICTURE

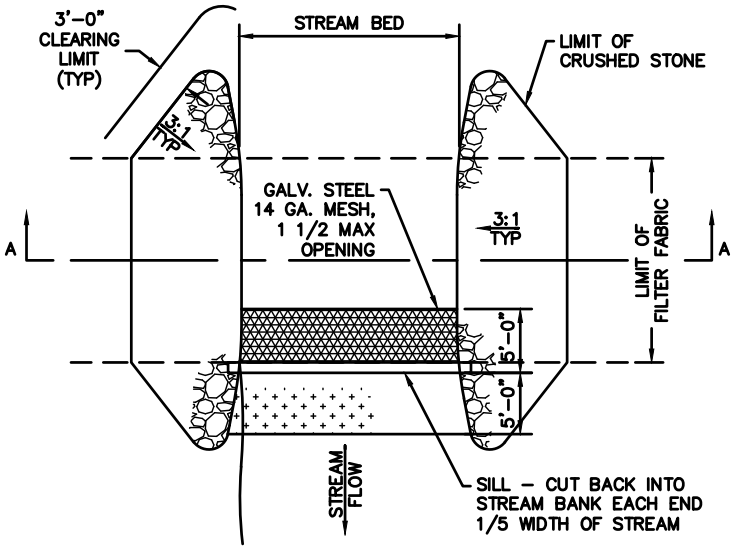


CM-6
CORDUROY ROAD

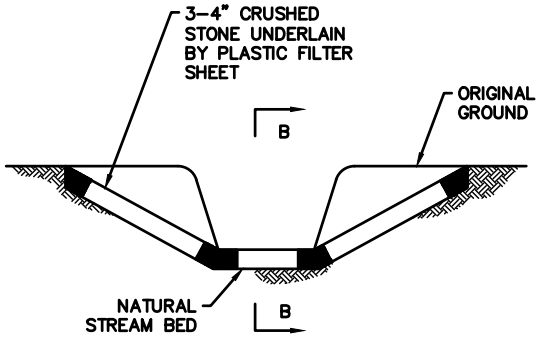
File: Corduroy_Road.dwg

BMP DETAIL

SCALE: NONE



PLAN VIEW



SECTION 'A-A'

BMP PICTURE





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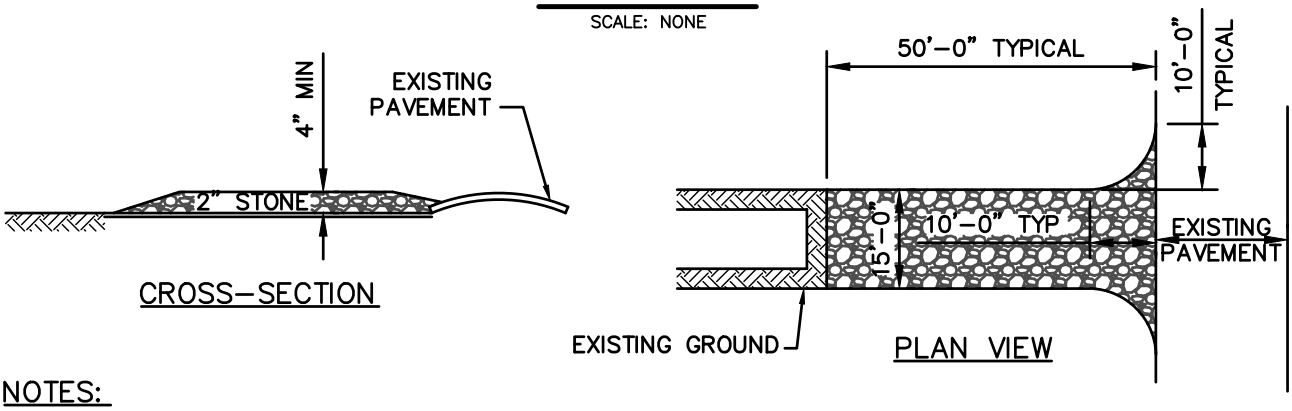
CM-7
ROCK FORD

File: Rock_Ford.dwg

BMP DETAIL

SCALE: NONE



NOTES:

1. STONE SIZE – USE 2" STONE (MINIMUM) TO 6" STONE (MAXIMUM)
2. LENGTH – GREATER THAN OR EQUAL TO 50 FEET
3. THICKNESS – 4"
4. WIDTH – FIFTEEN (15) FOOT TYP., BUT NOT LESS THAN FULL WIDTH AT POINTS WHERE INGRESS OR EGRESS OCCURS.
5. SURFACE WATER – ALL SURFACE WATER FLOWING OR DIVERTED TOWARD CONSTRUCTION ENTRANCES SHALL BE PIPED ACROSS ENTRANCE. IF PIPING IS IMPRACTICAL, MOUNTABLE BERM SHALL BE PERMITTED.
6. MAINTENANCE – THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION WHICH SHALL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHTS–OF–WAY. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL STONE AS CONDITIONS DEMAND AND REPAIR OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT. ALL SEDIMENT SPILLED, DROPPED, WASHED OR TRACKED ONTO PUBLIC RIGHTS–OF–WAY MUST BE REMOVED IMMEDIATELY.
7. PERIODIC INSPECTION AND NEEDED MAINTENANCE SHALL BE PROVIDED.
8. THE CLEAN STONE SHOULD BE INSTALLED OVER A GEOTEXTILE FABRIC. GEOTEXTILE FABRIC MAY BE OMITTED FOR PERMANENT CONSTRUCTION ENTRANCES/EXITS ON A CASE–BY–CASE BASIS WITH THE APPROVAL OF THE NATIONAL GRID ENVIRONMENTAL SCIENTIST.
9. FOLLOWING CONSTRUCTION, THE CONSTRUCTION ENTRANCE/EXIT SHALL BE REMOVED AND THE AREA GRADED, SEEDED, AND MULCHED AS NEEDED. ENTRANCE/EXITS MAY REMAIN DEPENDING UPON FUTURE ACCESS NEEDS AND/OR PROJECT–SPECIFIC APPROVALS BUT REQUIRES APPROVALS FROM THE NATIONAL GRID ENVIRONMENTAL SCIENTIST AND PROPERTY LEGAL.

BMP PICTURE

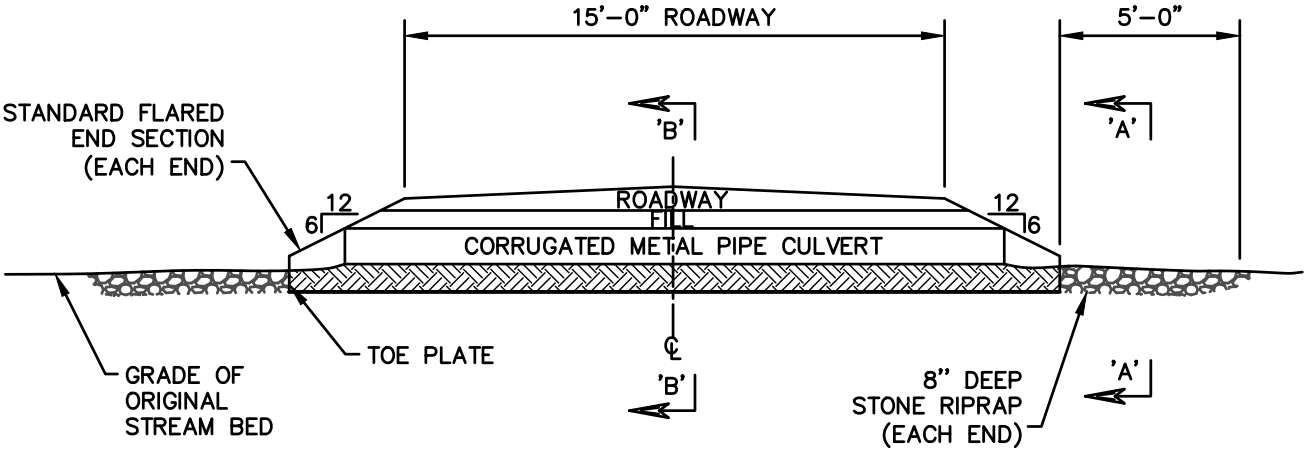


CM-8
TEMPORARY CONSTRUCTION ENTRANCE/ EXIT

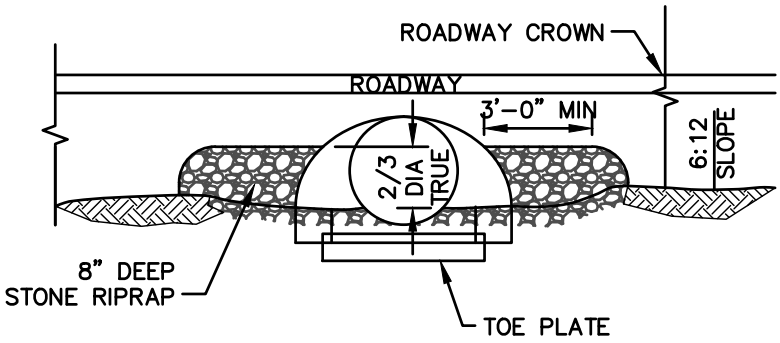
File: Temp_Construction_Ent.dwg

BMP DETAIL

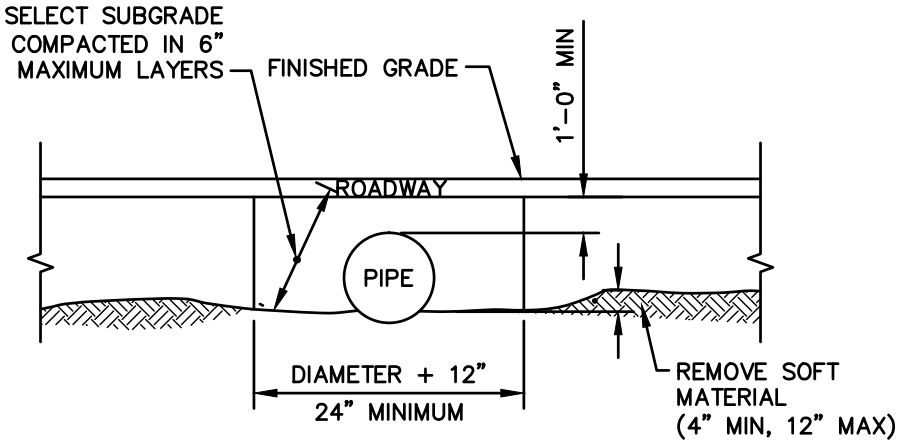
SCALE: NONE



CROSS SECTION



SECTION 'A–A'
(SAME BOTH ENDS)



SECTION 'B–B'

CM-9
TEMPORARY CONSTRUCTION
CULVERT (1 OF 2)

File: Temp_Constr_Culvert.dwg

BMP DETAIL

SCALE: NONE

NOTES:

1. CULVERT DESIGN AND LAYOUT SHALL BE COORDINATED WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST (NGES).
2. CROWN ROADWAY 1/2 INCH PER FOOT.
3. LAY THE CULVERT STRAIGHT AND AS NEARLY AS POSSIBLE ALONG THE EXISTING STREAM BED AND WITH THE INVERTS AT OR SLIGHTLY BELOW BED ELEVATION.
4. CORRUGATED METAL PIPE IS TO BE GALVANIZED STEEL, OR ALUMINIZED STEEL (TYPE 2), WITH BOLTED CONNECTORS.
5. DIAMETERS SHALL BE AS PER THE PROJECT DRAWINGS AND THE SPECIFICATION. THE PIPE GAGE SHALL BE AS FOLLOWS:

DIAMETER (INCHES)	GAGE
12" – 15"	.004"
18" – 24"	.079"
30" – 36"	.109"

6. INSTALLATION OF CULVERTS LARGER THAN 36 INCH DIAMETER SHALL REQUIRE SPECIAL ENGINEERING DESIGN.
7. SELECT SUBGRADE SHALL BE A GRANULAR MATERIAL AS DESCRIBED IN NYSDOT SPECIFICATION ITEM 203–2.02C, OR AS APPROVED BY A NGES.
8. STONE RIPRAP SHALL BE AS DESCRIBED IN NYSDOT SPECIFICATION ITEM 203–2.02D, WITH 8 INCH MAXIMUM SIZE, OR AS APPROVED BY A NGES. EXCEPT WHERE PROTECTED BY STONE, ALL EMBANKMENT SLOPES ARE TO BE STABILIZED, MULCHED AND SEEDED AS PER PROJECT SPECIFICATIONS.
9. OUTLET SHOULD BE CONFIGURED NOT TO CREATE HYDRAULIC JUMP OR PLUNGE POOL.
10. INSTALL EROSION CONTROLS ADJACENT TO THE CULVERT ENDS TO PROTECT THE WATERWAY FROM ROADWAY DEBRIS.

BMP PICTURE



BMP PICTURE



NOTE:

1. PICTURE SHOWS VIEW OF ACCESS WAY STABILIZATION ADJACENT TO A WETLAND.
2. COORDINATE STABILIZATION DESIGN AND PRODUCT WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.

BMP PICTURE




NO ACCESS – WETLAND/STREAM CROSSING MATS REQUIRED







NO ACCESS – A.) PROJECT LIMITS E.G. ROW LIMITS
B.) HISTORICAL/CULTURAL
C.) ENVIRONMENTALLY SENSITIVE E.G. THREATENED & ENDANGERED
D.) OTHER

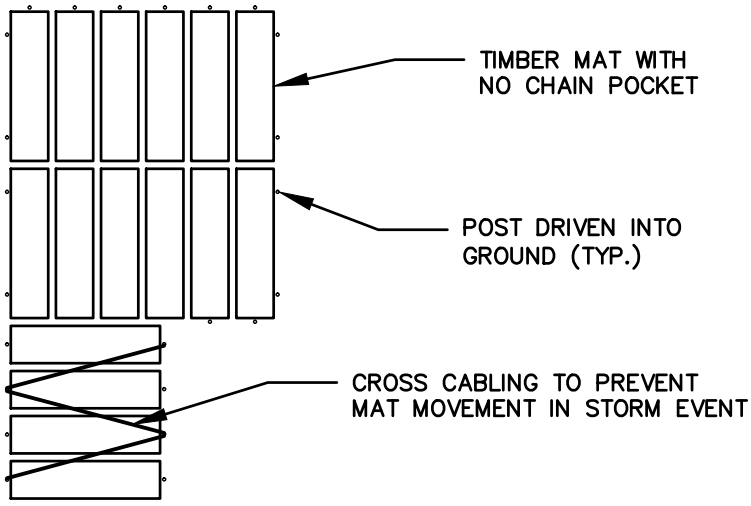




APPROVED ACCESS

BMP DETAIL 1

SCALE: NONE



TYPICAL PLAN VIEW

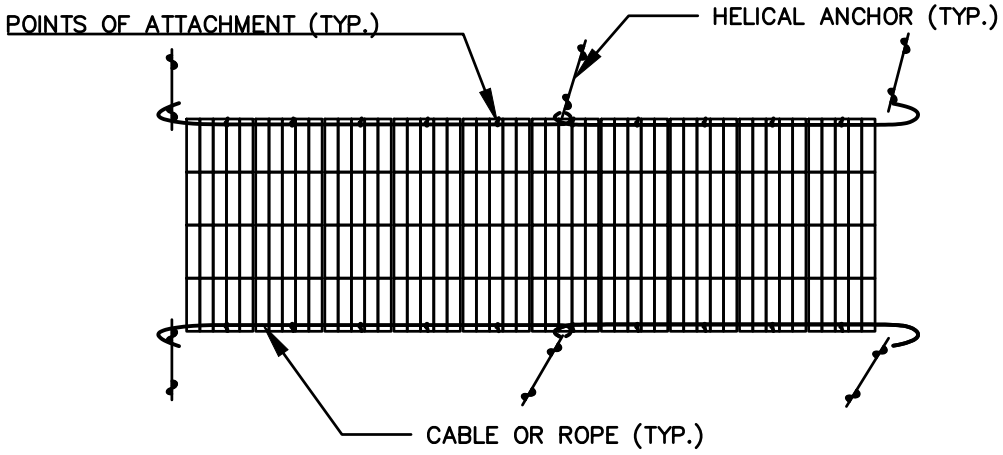
NOTES:

1. EXAMPLES OF ANCHORING ONLY. MATTING CONTRACTOR SHALL PROPOSE THE METHOD OF ANCHORING BASED ON FIELD CONDITIONS.
2. ANCHORING METHOD TO BE APPROVED BY THE NATIONAL GRID ENVIRONMENTAL SCIENTIST AND TRANSMISSION LINE CONSTRUCTION SUPERVISOR.

BMP DETAIL 2

NOTES:

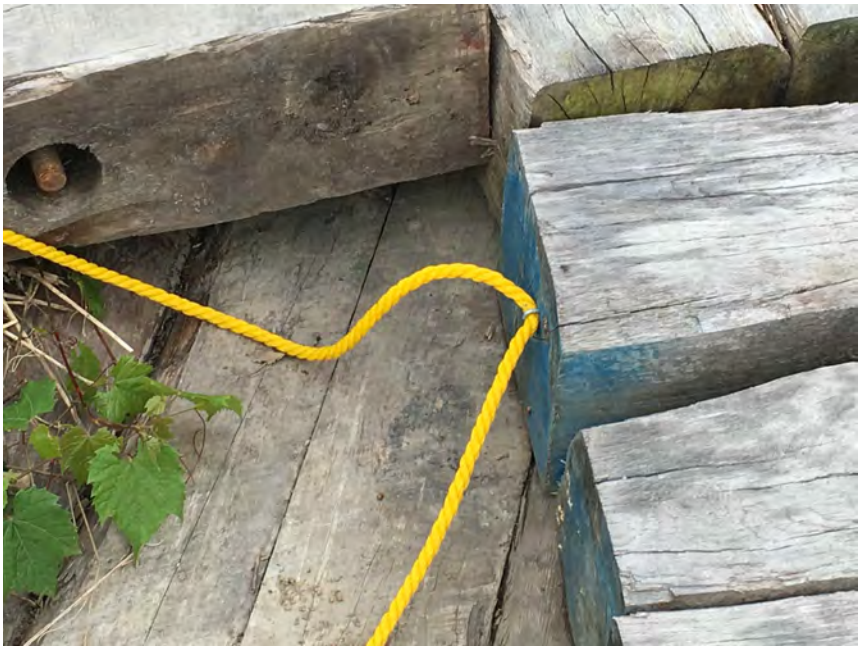
1. TYPICAL HELICAL ANCHOR AND CABLE CONFIGURATION FOR MAT CONTAINMENT IN FLOODPLAINS/LAND SUBJECT TO FLOODING.
2. TYPICAL POINTS OF ATTACHMENT HEAVY STAPLES, EYE BOLTS OR OTHER SUITABLE HARDWARE TO SECURE ATTACHMENT OF MAT TO LINEAR CABLE. IF CHAIN POCKETS ARE PRESENT IN THE MATS CABLE OR ROPE CAN BE LOOPED THROUGH RODS.



BMP PICTURE 1



BMP PICTURE 2



CM-12
EXAMPLE OF CONSTRUCTION MAT ANCHORING (2 OF 2)

File: Const_Mat_Anchoring.dwg

BMP DETAIL

SCALE: NONE

WIRE BACKED SILT FENCE



MUTUAL INDUSTRIES WIRE BACKED SILT FENCE
PART # 1776-14-24
36" X 100'
36" MISF 1776 FABRIC
24" 14GA WIRE MESH
OPENING OF MESH 2" X 4"
FABRIC HOG RINGED EVERY 12"-18" ALONG THE TOP OF THE FENCE

ROLL WEIGHT 40 LBS

32 ROLLS PER PALLET

NOTES:

1. PRODUCT TO BE MUTUAL INDUSTRIES' WIRE BACKED SILT FENCE OR APPROVED EQUAL BY NATIONAL ENVIRONMENTAL SCIENTIST.
2. COORDINATE INSTALLATION METHOD AND LOCATION WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.

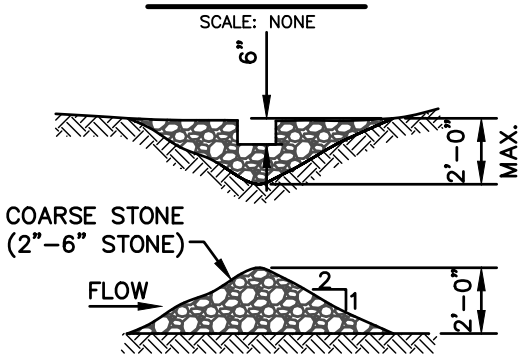
BMP PICTURE



NOTE:

1. PICTURE SHOWS SEDIMENT FILTER WITHIN A WETLAND.

BMP DETAIL



STONE CHECK DAM

NOTES:

1. USE CHECK DAMS TO SLOW WATER FLOWS AND AS SMALL SEDIMENT TRAPS IN DITCHES ALONG ACCESS ROADS.
2. CLEAN SEDIMENT AND REPLACE DAMS AS NECESSARY.
3. THE CENTER OF THE CHECK DAM MUST BE AT LEAST 6" LOWER THAN THE OUTER EDGES.
4. COORDINATE SPACING WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.
5. MAX. SPACING: TOE OF THE UPSTREAM DAM IS SAME ELEVATION AS TOP OF DOWNSTREAM DAM.
6. STONE SHALL BE FREE OF FINE PARTICLES TO PREVENT TURBID DISCHARGES.

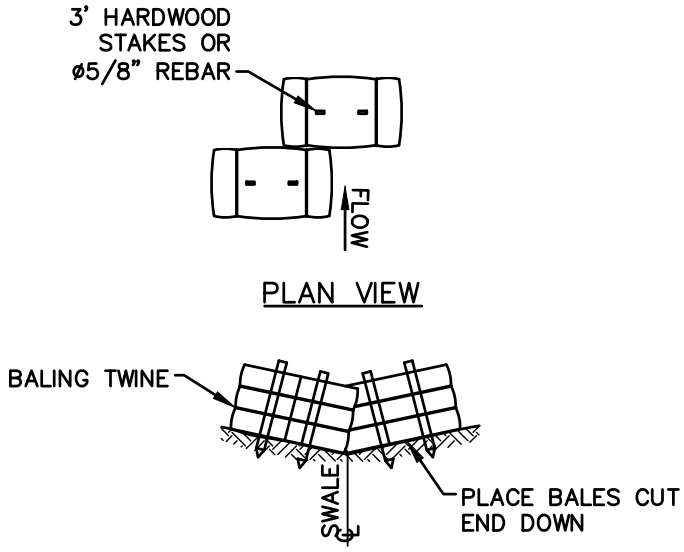
BMP PICTURE



NOTE: A SMALLER STONE SIZE IS SHOWN IN THIS PICTURE.

BMP DETAIL

SCALE: NONE



NOTES:

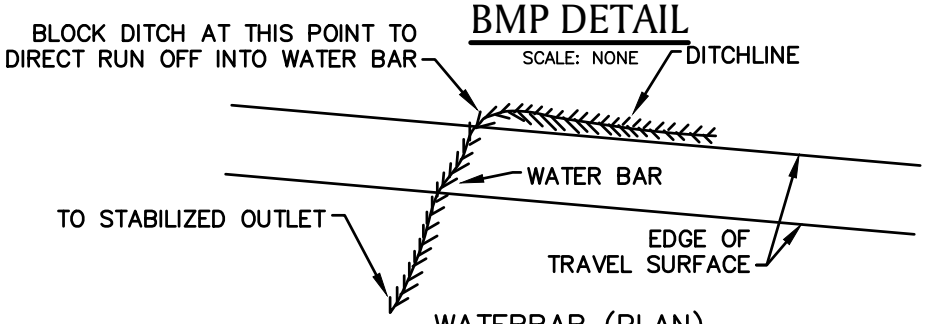
1. USE CHECK DAMS TO SLOW WATER FLOWS AND AS SMALL SEDIMENT TRAPS IN DITCHES ALONG ACCESS ROADS.
2. CLEAN SEDIMENT AND REPLACE DAMS AS NECESSARY.
3. COORDINATE SPACING WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.

BMP PICTURE

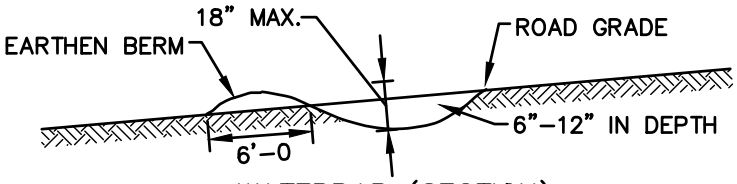


BMP DETAIL

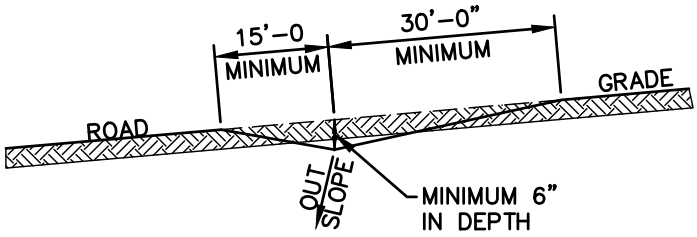
SCALE: NONE



WATERBAR (PLAN)



WATERBAR (SECTION)



DISCHARGE (SECTION)

NOTE:

1. LINE WITH 2"–6" STONE UNDERLAIN BY GEOTEXTILE FILTER FABRIC, KEYED INTO ROAD SURFACE AT LEAST 10 FEET EACH SIDE OF WATERBAR.
2. COORDINATE SPACING WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.

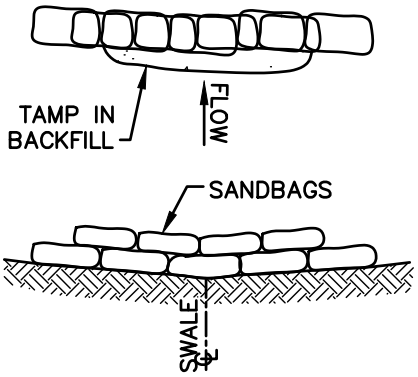
BMP PICTURE





BMP DETAIL

SCALE: NONE



SANDBAG
CHECK DAM

NOTES:

1. USE CHECK DAMS TO SLOW WATER FLOWS AND AS SMALL SEDIMENT TRAPS IN DITCHES ALONG ACCESS ROADS.
2. CLEAN SEDIMENT AND REPLACE DAMS AS NECESSARY.
3. COORDINATE SPACING WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.

BMP PICTURE



NOTE:

1. PICTURE DOES NOT DEPICT "TAMP IN BACKFILL"

BMP PICTURE

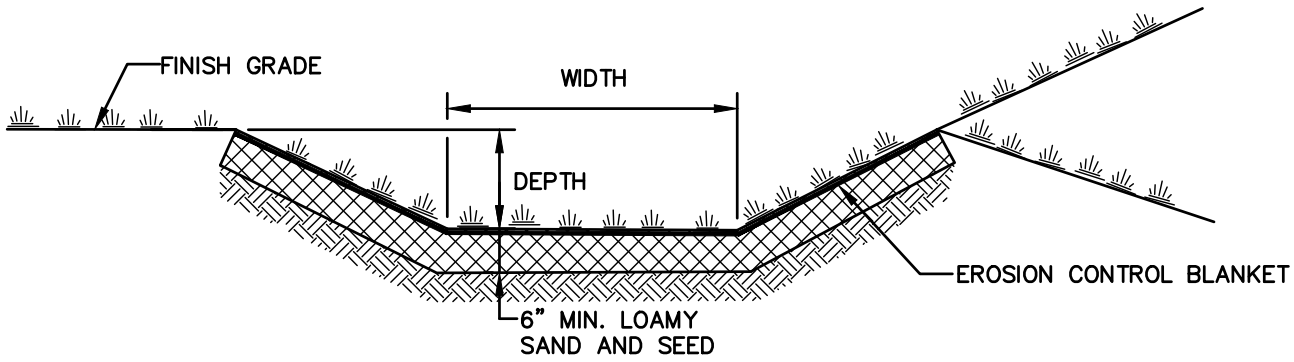


NOTE:

1. EXACT SIZE, LOCATION AND DESIGN IS DEPENDANT ON SITE CONDITIONS, AND LOCAL AND STATE REGULATIONS. COORDINATE THIS BMP WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST PRIOR TO CONSTRUCTION.

BMP DETAIL

SCALE: NONE



NOTES:

1. WIDTH AND DEPTH OF SWALE, AND EROSION CONTROL BLANKET TYPE TO BE COORDINATED WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. REFER TO DETAILS SEC–10 AND SEC–11 FOR SEED MIXTURE OPTIONS.

BMP PICTURE

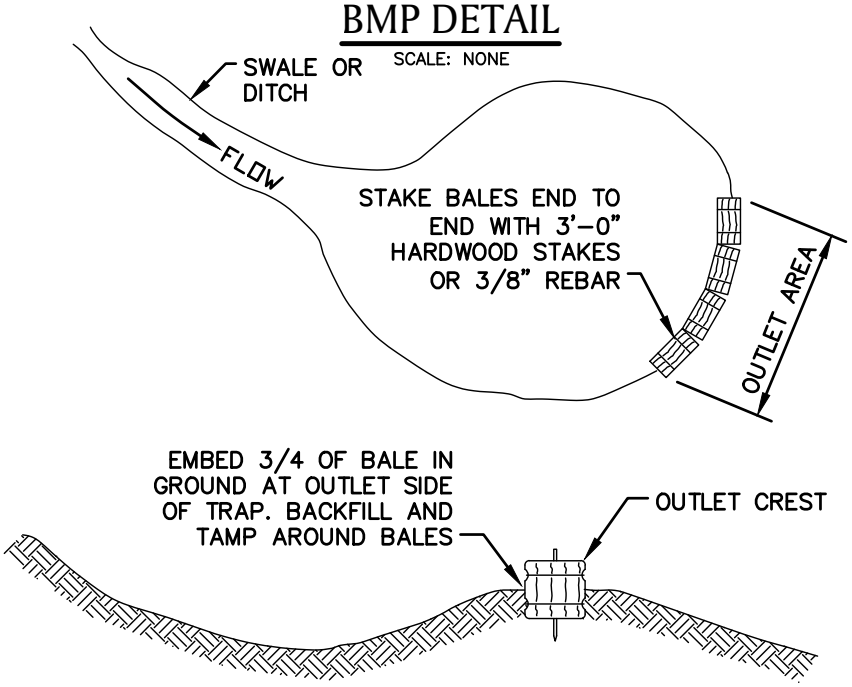


AA-8
DRAINAGE SWALE AND
LINED DITCH

File: Lined_Drainage_Swale.dwg

BMP DETAIL

SCALE: NONE



TYPICAL PROFILE

NOTES

1. SIZE, SHAPE AND PROFILE OF SEDIMENT WILL VARY ACCORDING TO ANTICIPATED FLOW VOLUME AND SURROUNDING TERRAIN AND SHALL BE COORDIANTED WITH THE NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. THE BASIN SHALL BE CUT BELOW THE GROUNDLINE. FILL SHALL NOT BE USED TO HOLD WATER UNLESS ROLLED AND COMPACTED.
3. OUTLET AREA IS TO REMAIN FREE OF EXCAVATION SPOILS.
4. OUTLET CREST ELEVATION SHALL BE LOWER THAN INLET ELEVATION AND AT LEAST 1'–0" BELOW THE TOP OF THE BASIN.ARMOUR SLOPES >8% IN OUTLET AREA WITH STONE OF APPROPRIATE SIZE TO PREVENT SCOUR.
5. ARMOUR SLOPES >8% IN OUTLET AREA WITH STONE OF APPROPRIATE SIZE TO PREVENT SCOUR.

BMP PICTURE

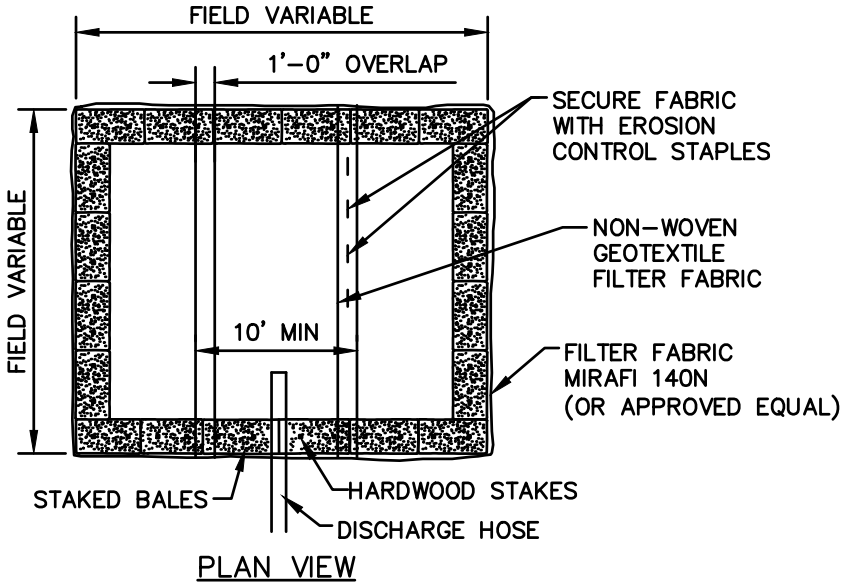


AA-9
SEDIMENTATION BASIN

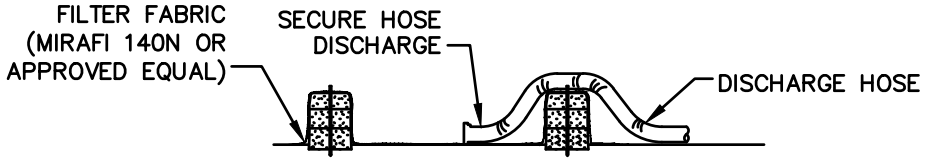
File: Sedimentation_Basin.dwg

BMP DETAIL

SCALE: NONE



PLAN VIEW



CROSS–SECTION

NOTES:

1. NUMBER OF BALES MAY VARY DEPENDING ON SITE CONDITIONS,
2. THE BASIN TO BE SIZED TO PREVENT DISCHARGE WATER FROM OVERTOPPING BASIN.
3. KEEP AS FAR FROM WETLANDS AS PRACTICAL.
4. CLEAN AND REMOVE AS SOON AS DEWATERING IS COMPLETE.

BMP PICTURE



AA-10
DEWATERING BASIN
(SMALL SCALE)

File: Dewat_Bas_Small.dwg

BMP PICTURE

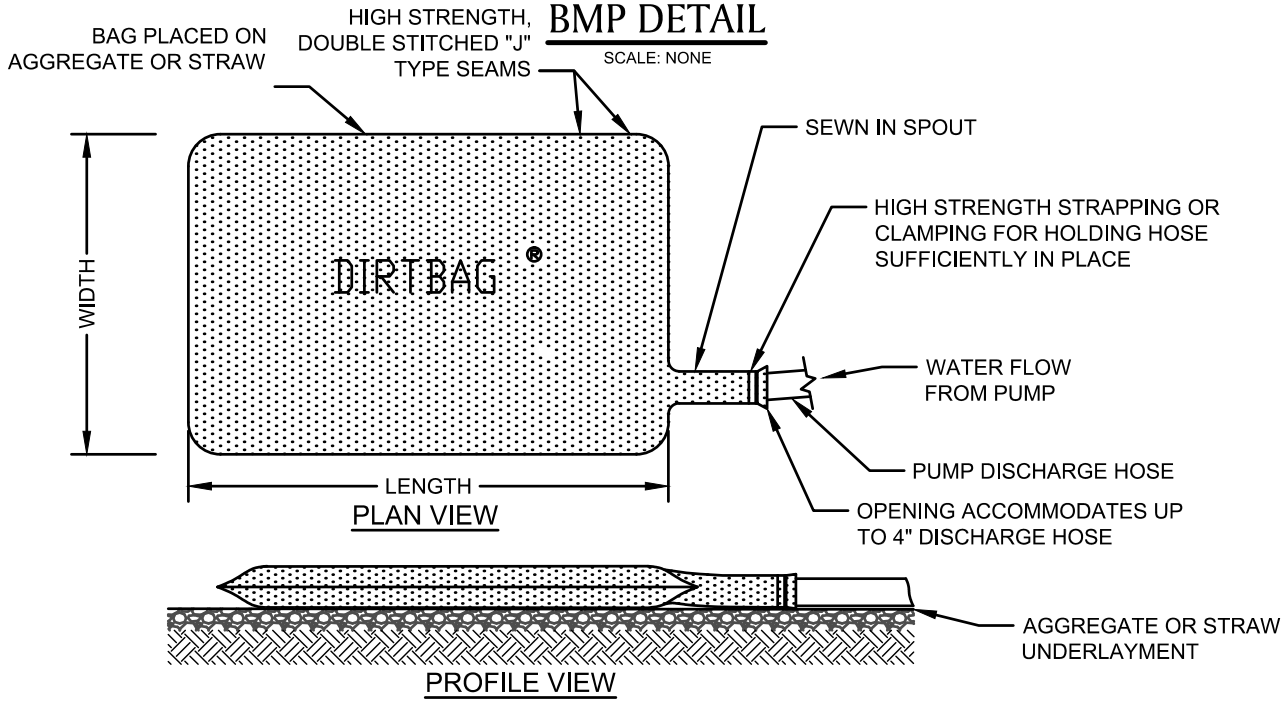


NOTE:

1. EXACT SIZE, LOCATION AND DESIGN IS DEPENDANT ON SITE CONDITIONS, AND LOCAL AND STATE REGULATIONS. COORDINATE THIS BMP WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST PRIOR TO CONSTRUCTION.

BMP DETAIL

SCALE: NONE



NOTE:
ONCE PUMPING COMMENCES, THE DIRT BAG SHALL BE MONITORED FREQUENTLY TO ASSURE THAT THE CONNECTIONS ARE SECURELY FASTENED AND THE RATE OF WATER DELIVERY TO THE STRUCTURE IS LOW ENOUGH TO PREVENT UNFILTERED WATER FROM FLOWING FROM THE HOSE CONNECTIONS OR BAG.

BMP PICTURE



* PICTURE AND DETAIL PROVIDED BY ACF ENVIRONMENTAL

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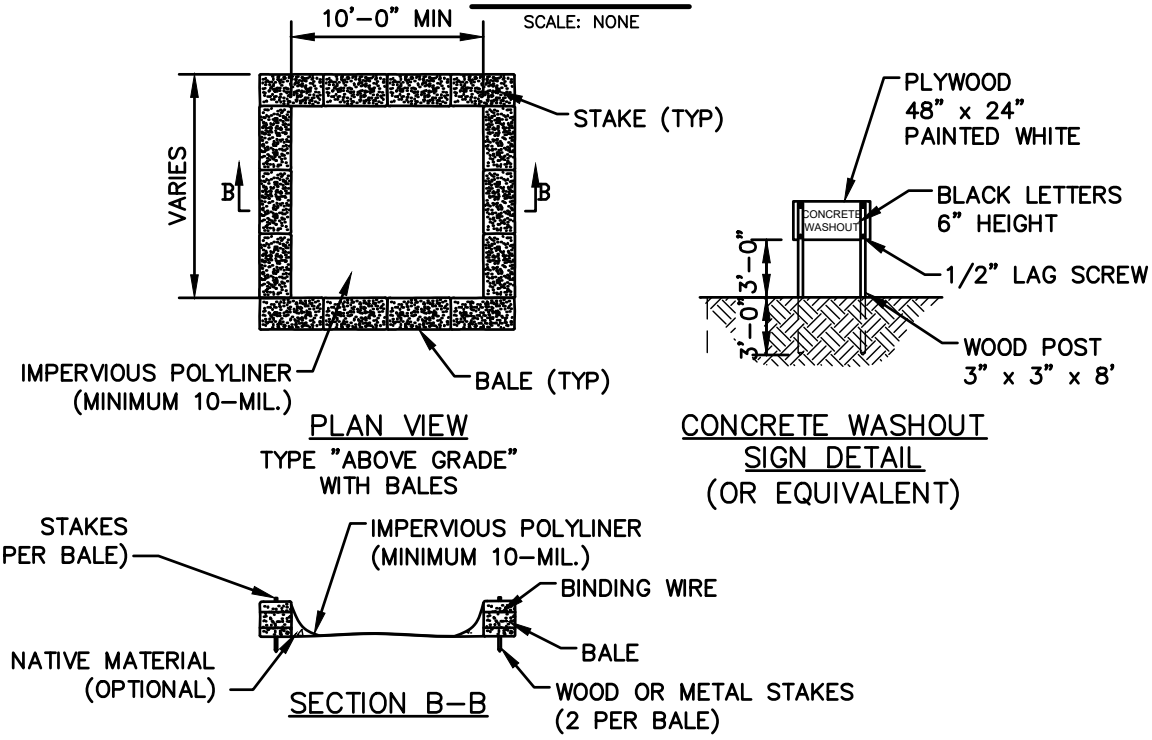
AA-12
DIRTBAG *

File: Dirtbag.dwg

BMP DETAIL



NOTES:

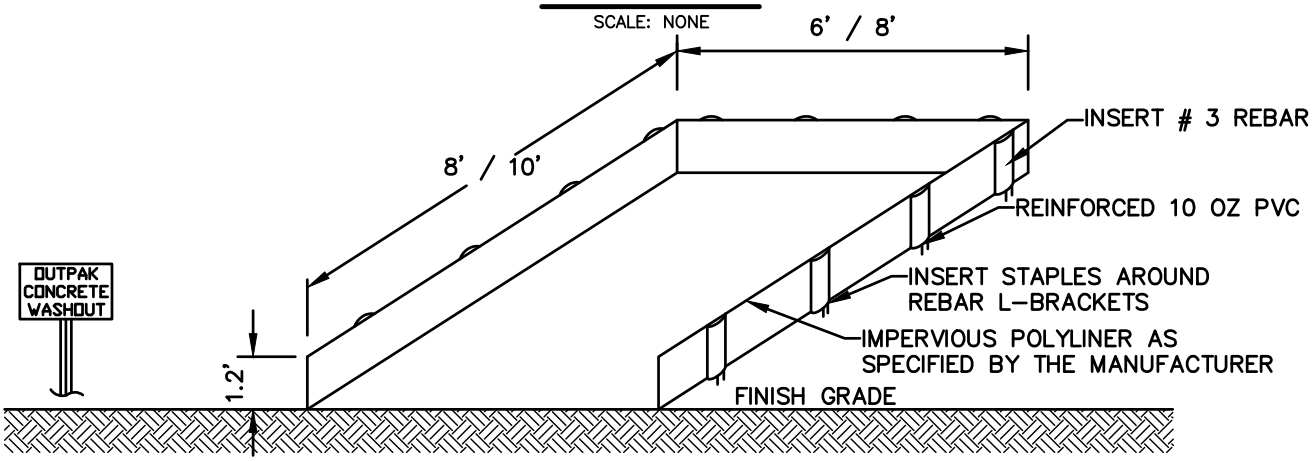
1. NUMBER OF BALES MAY VARY DEPENDING ON SITE CONDITIONS. COORDINATE SIZE AND LOCATION OF CONCRETE WASTE SUMP WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. KEEP AS FAR FROM DRAINAGE CHANNELS AND WETLAND AREAS AS PRACTICAL.
3. SUMPS TO BE CLEANED AND WASTE CONCRETE REMOVED AND PROPERLY DISPOSED OF UPON COMPLETION OF WORK.
4. SEE ADDITIONAL NOTES ON DETAIL AA–14.

BMP PICTURE



BMP DETAIL

SCALE: NONE



CROSS SECTION

NOTES:

1. PRODUCT TO BE OUTPAK PVC CONCRETE WASHOUT OR APPROVED EQUAL BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. THE CONCRETE WASHOUT AREA SHALL BE INSTALLED PRIOR TO ANY CONCRETE PLACEMENT.
3. SIGNS SHALL BE PLACED AS NECESSARY TO CLEARLY INDICATE THE LOCATION OF THE CONCRETE WASHOUT.
4. THE CONCRETE WASHOUT AREA WILL BE REPLACED AS NECESSARY TO MAINTAIN CAPACITY FOR WASTE CONCRETE AND OTHER LIQUID WASTE.
5. WASHOUT RESIDUE SHALL BE REMOVED FROM THE SITE AND DISPENSED OF AT AN APPROVED WASTE SITE.
6. DO NOT MIX EXCESS AMOUNTS OF FRESH CONCRETE OR CEMENT ON-SITE.
7. DO NOT WASH OUT CONCRETE TRUCKS INTO STORM DRAINS, OPEN DITCHES, STREETS, OR STREAMS.
8. AVOID DUMPING EXCESS CONCRETE IN NON-DESIGNATED DUMPING AREAS.
9. LOCATE WASHOUT AREA AT LEAST 50' FROM STORM DRAIN, OPEN DITCHES, OR WATERBODIES. COORDINATE LOCATION WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.
10. WASH OUT WASTES INTO THE OUTPAK WASHOUT WHERE THE CONCRETE CAN SET, BE BROKEN UP, AND THEN DISPOSED OF PROPERLY.
11. A SECURE, NON-COLLAPSING, NON-WATER COLLECTING COVER MUST BE PLACED OVER CONCRETE WASHOUT PRIOR TO PREDICTED WET WEATHER TO PREVENT ACCUMULATION AND OVERFLOW OF PRECIPITATION.

BMP PICTURE



*** PICTURE AND DETAIL PROVIDED BY OUTPAK WASHOUT**

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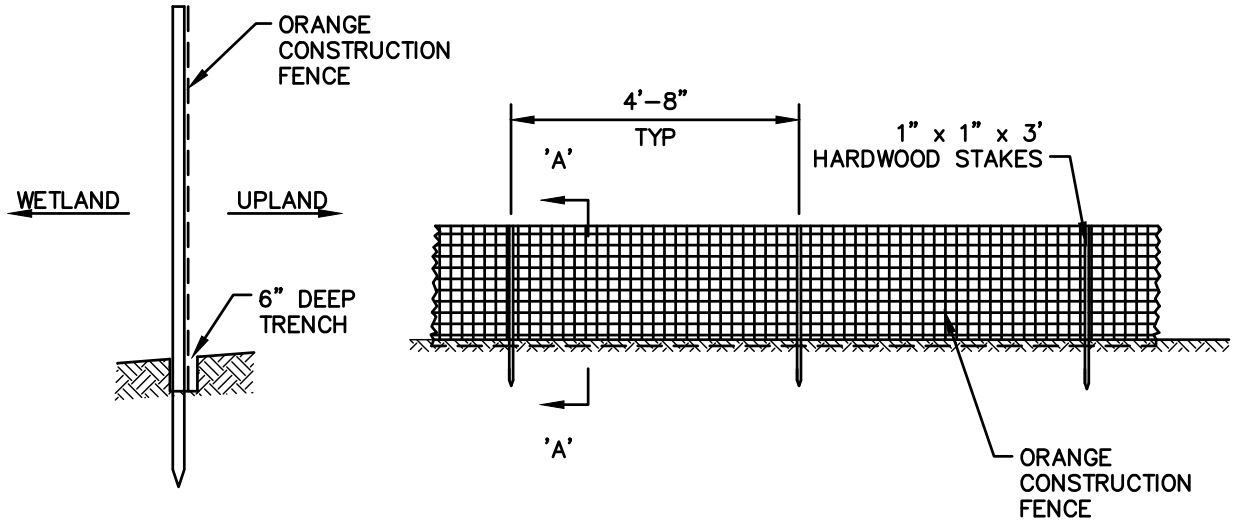
AA-14

OUTPAK CONCRETE WASHOUT *

File: Outpak_Washout.dwg

BMP DETAIL

SCALE: NONE



SECTION A-A

BMP PICTURE



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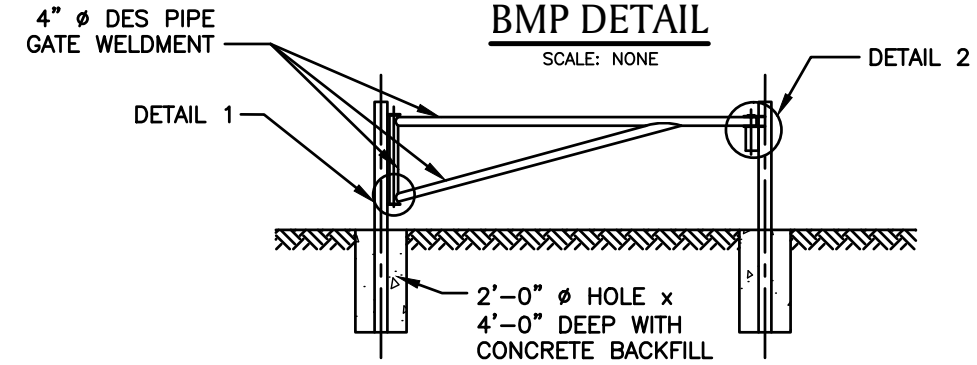
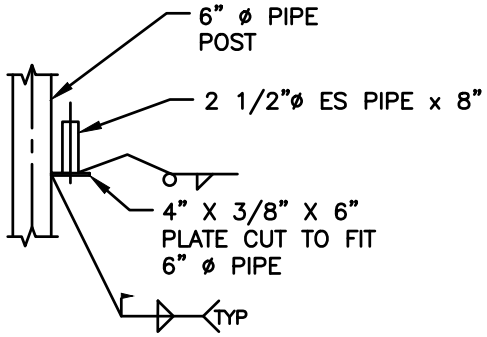
AA-15
BARRIER FENCE
(CONSTRUCTION FENCE)

File: Barrier_Fence.dwg

BMP DETAIL

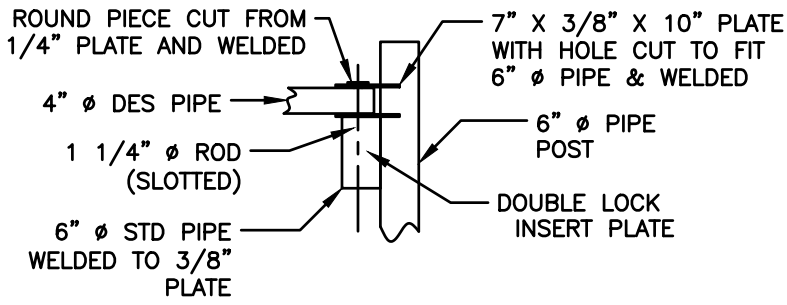
SCALE: NONE





DETAIL 1

SIMILAR DETAIL AT TOP



DETAIL 2

NOTES:

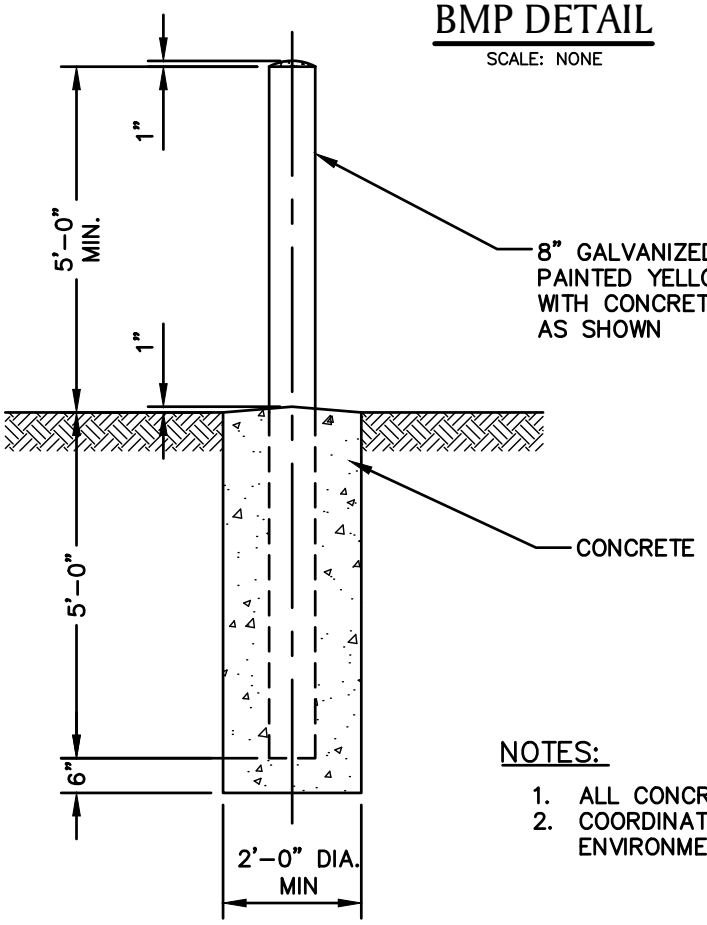
1. ALL GATE STEEL PIPES SHALL BE IN ACCORDANCE WITH ASTM A–501, PLATES SHALL BE ASTM A–36.
2. ALL STEEL PIPES SHALL BE PRIMED WITH ZINC–CHROMATE PRIMER AND FINISHED WITH AN APPROVED OSHA "SAFETY YELLOW" TOP COAT COMPATIBLE WITH THE PRIMER AND FOR EXTERIOR EXPOSURE.
3. REFLECTORS SHALL BE SPACED AT 3 FEET ALONG THE LENGTH OF THE CROSSBAR AND BRACE
4. BACKFILL AT POSTS TO BE COMPACTED.

BMP PICTURE



BMP DETAIL

SCALE: NONE



NOTES:

1. ALL CONCRETE TO BE 2500 P.S.I. MINIMUM.
2. COORDINATE LOCATIONS WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.

BMP PICTURE



BMP



Definition

The control of dust resulting from land-disturbing activities.

Purpose

To prevent surface and air movement of dust from disturbed soil surfaces that may cause off-site damage, health hazards, and traffic safety problems.

Conditions Where Practice Applies

On construction roads, access points, and other disturbed areas subject to surface dust movement and dust blowing where off-site damage may occur if dust is not controlled.

Design Criteria

Construction operations should be scheduled to minimize the amount of area disturbed at one time. Buffer areas of vegetation should be left where practical. Temporary or permanent stabilization measures shall be installed. No specific design criteria is given; see construction specifications below for common methods of dust control.

Water quality must be considered when materials are selected for dust control. Where there is a potential for the material to wash off to a stream, ingredient information must be provided to the local permitting authority.

Construction Specifications

A. Non-driving Areas – These areas use products and materials applied or placed on soil surfaces to prevent airborne migration of soil particles.

Vegetative Cover – For disturbed areas not subject to traffic, vegetation provides the most practical method of dust control (see Section 3).

Mulch (including gravel mulch) – Mulch offers a fast effective means of controlling dust. This can also include rolled erosion control blankets.

Spray adhesives – These are products generally composed of polymers in a liquid or solid form that are mixed with water to form an emulsion that is sprayed on the soil surface with typical hydroseeding equipment. The mixing ratios and application rates will be in accordance with the manufacturer's recommendations for the specific soils on the site. In no case should the application of these adhesives be made on wet soils or if there is a probability of precipitation within 48 hours of its proposed use. Material Safety Data Sheets will be provided to all applicators and others working with the material.

B. Driving Areas – These areas utilize water, polymer emulsions, and barriers to prevent dust movement from the traffic surface into the air.

Sprinkling – The site may be sprayed with water until the surface is wet. This is especially effective on haul roads and access routes.

Polymer Additives – These polymers are mixed with water and applied to the driving surface by a water truck with a gravity feed drip bar, spray bar or automated distributor truck. The mixing ratios and application rates will be in accordance with the manufacturer's recommendations. Incorporation of the emulsion into the soil will be done to the appropriate depth based on expected traffic. Compaction after incorporation will be by vibratory roller to a minimum of 95%. The prepared surface shall be moist and no application of the polymer will be made if there is a probability of precipitation within 48 hours of its proposed use. Material Safety Data Sheets will be provided to all applicators working with the material.

Barriers – Woven geotextiles can be placed on the driving surface to effectively reduce dust throw and particle migration on haul roads. Stone can also be used for construction roads for effective dust control.

Windbreak – A silt fence or similar barrier can control air currents at intervals equal to ten times the barrier height. Preserve existing wind barrier vegetation as much as practical.

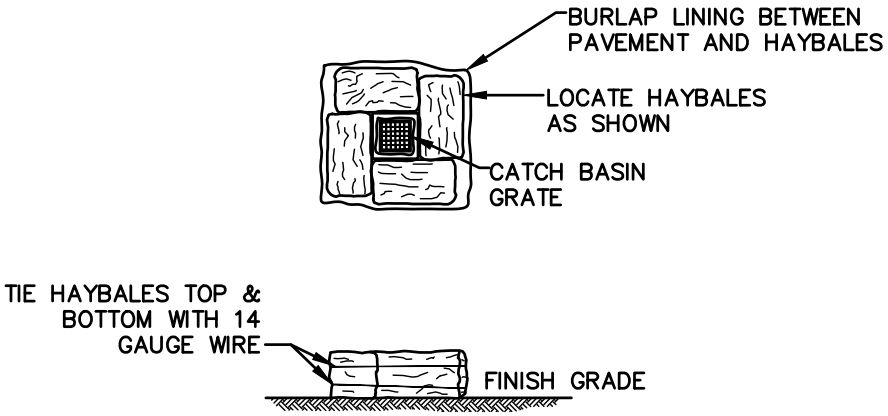
* BMP INFORMATION FROM "NEW YORK STANDARDS AND SPECIFICATIONS FOR EROSION AND SEDIMENT CONTROL (AUGUST, 2005)." INFORMATION OBTAINED VIA WEBSITE: http://www.dec.ny.gov/chemical/29066.html

AA-18
DUST CONTROL (FROM NY) *

File: Dust_Control.dwg

BMP DETAIL

SCALE: NONE



NOTES:

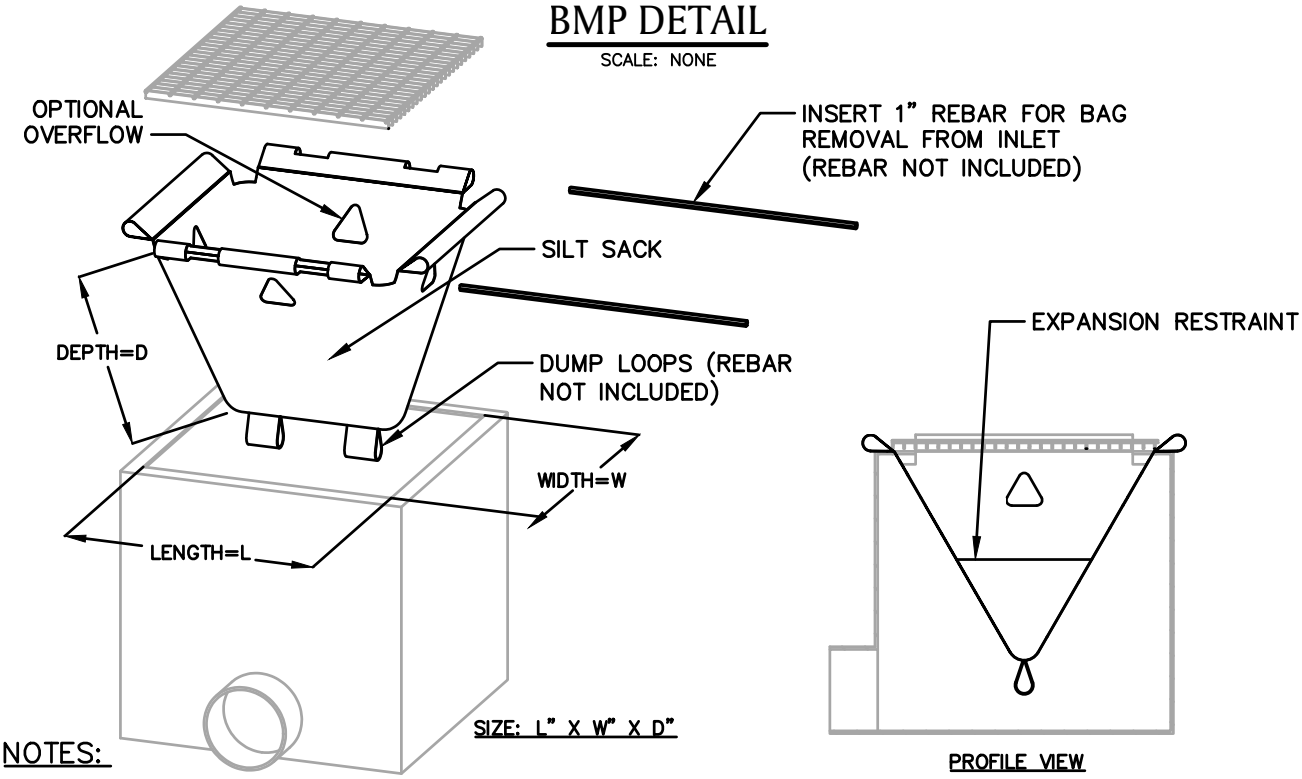
1. SURROUND STREET DRAINAGE STRUCTURE INLET WITH HAY BALES PRIOR TO CONSTRUCTION AND MAINTAIN UNTIL CONSTRUCTION IS COMPLETED. ACCUMULATED SEDIMENTS SHALL BE REMOVED.
2. HAYBALES PLACED ON PAVEMENT SHALL HAVE BURLAP PLACED BETWEEN PAVEMENT AND HAYBALE

BMP PICTURE



BMP DETAIL

SCALE: NONE



NOTES:

1. PRODUCT TO BE SILT SACK OR APPROVED EQUAL BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. THE USE OF A SILT SACK OPTIONAL OVERFLOW AND OVERALL DIMENSIONS ARE TO BE COORDINATED WITH A NATIONAL GRID ENVIRONMENTAL SCIENTIST.

BMP PICTURE



*** DETAIL PROVIDED BY ACF ENVIRONMENTAL**

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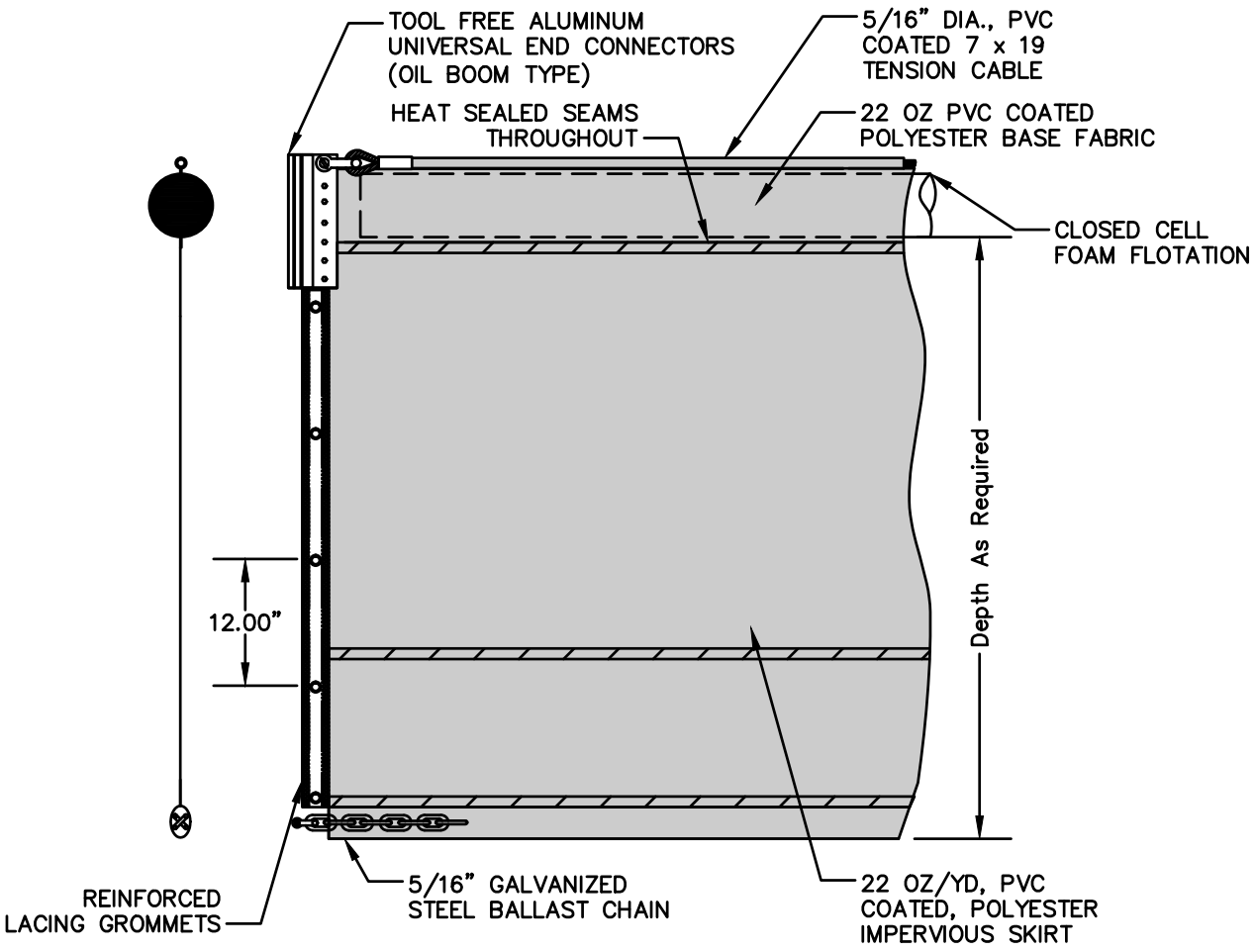
AA-20
SILT SACK *

File: SILT SACK.dwg

BMP DETAIL

SCALE: NONE



BMP PICTURE



*** DETAIL PROVIDED BY BROCKTON EQUIPMENT / SPILLDAM INC.**
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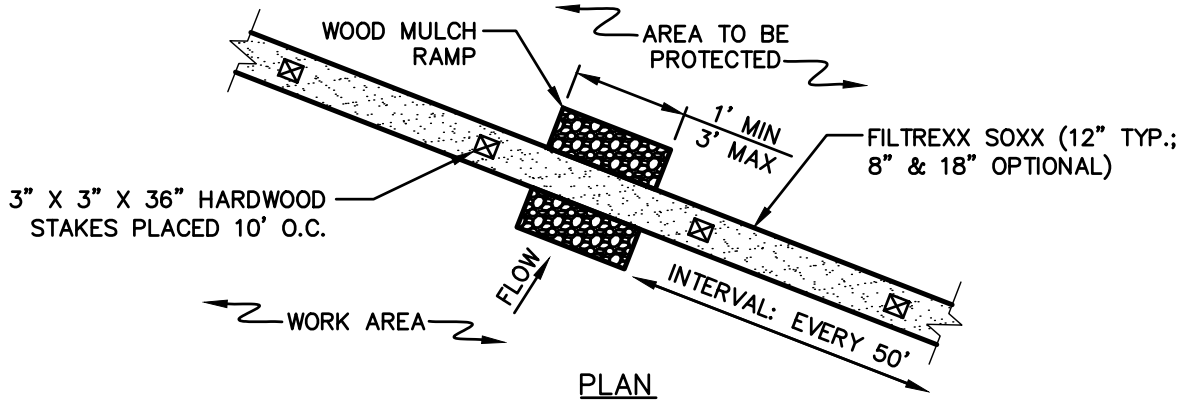
AA-21
TURBIDITY CURTAIN *

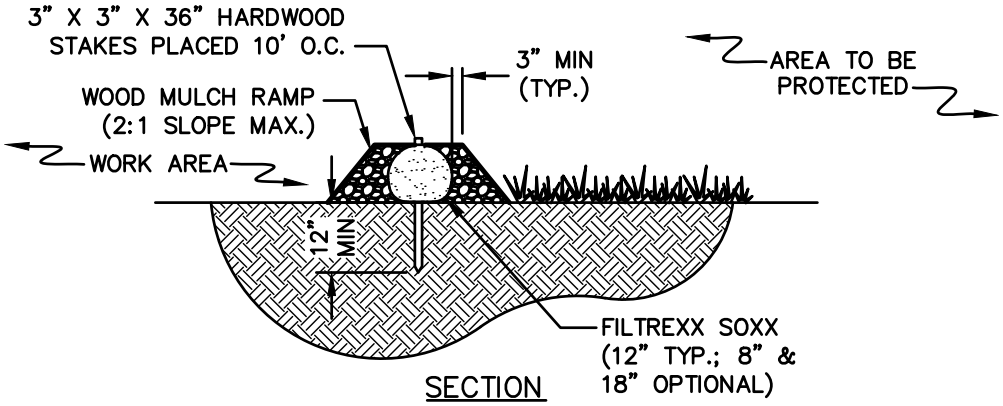
File: Turbidity_Curtain.dwg

BMP DETAIL

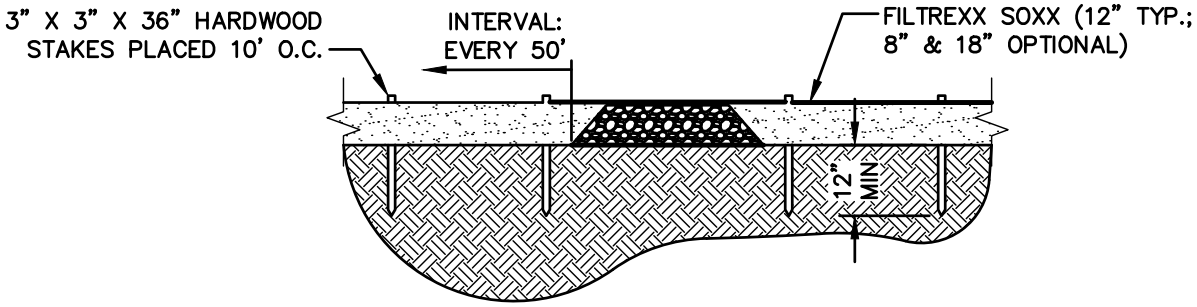
SCALE: NONE



PLAN



SECTION



PROFILE

NOTES

1. PRODUCT TO BE FILTREXX SILT SOXX OR APPROVED EQUAL BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. ALL MATERIAL TO MEET FILTREXX SPECIFICATIONS.
3. FILTER MEDIA FILL TO MEET APPLICATION REQUIREMENTS.
4. NON-MONOFILAMENT CONTAINMENT MATERIAL SHOULD BE KNITTED PHOTODEGRADABLE OR BIODEGRADABLE MATERIAL, WITH OPENING SIZES BETWEEN 1/8" – 1/4".
5. COMPOST MEDIA SHOULD HAVE PARTICLE SIZE WHERE 99% < 2", 50% > 1/2".
6. COMPOST MATERIAL TO BE DISPOSED OF ON-SITE, OR IN ACCORDANCE WITH ENVIRONMENTAL PERMITS AS APPROVED BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
7. WOOD MULCH RAMP IS OPTIONAL DEPENDING ON SUBSTRATE/SITE CONDITIONS, AND TO BE APPROVED BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.

BMP # AA-22
SILTSOXX AMPHIBIAN & REPTILE CROSSING #1 (1 OF 2)

File: Alternate_Mulch_Ramp_Siltsoxx.dwg

BMP PICTURE



SALAMANDER AND SNAKE CROSSING #1

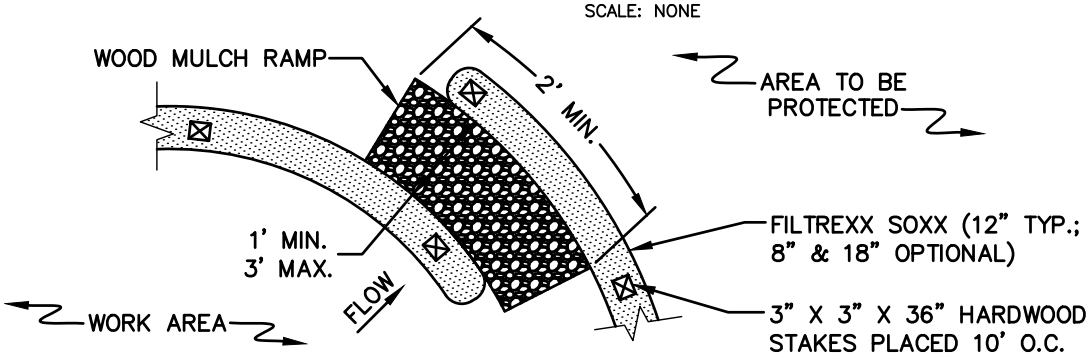
ALTERNATE WOOD MULCH RAMP SILTSOXX NOTES:

1. SILTSOXX, BY FILTREX INTERNATIONAL, OR APPROVED EQUAL PRODUCT SHALL BE INSTALLED AND MAINTAINED IN ACCORDANCE WITH THE MANUFACTURER'S GUIDELINES.

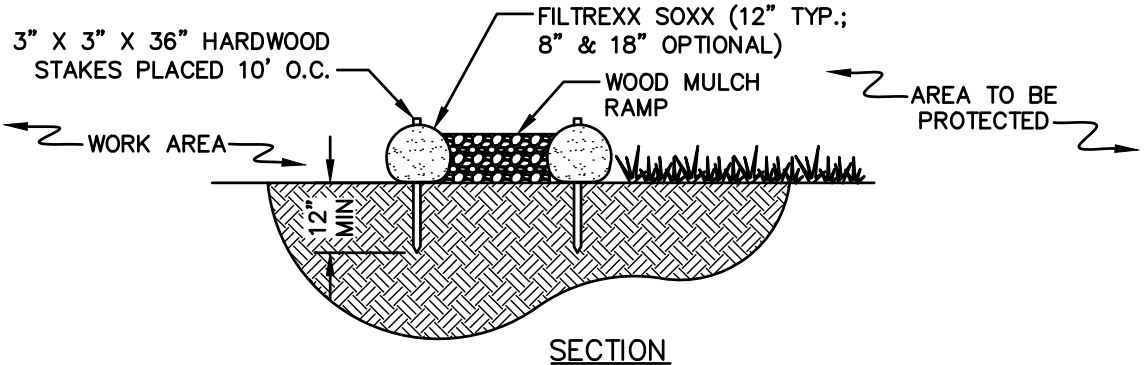
2. BMP SHOULD ONLY BE UTILIZED IN AREAS WHERE RARE SALAMANDER AND SNAKE HABITAT OCCURS, OR AT THE DIRECTION OF THE NATIONAL GRID ENVIRONMENTAL SCIENTIST.

BMP DETAIL

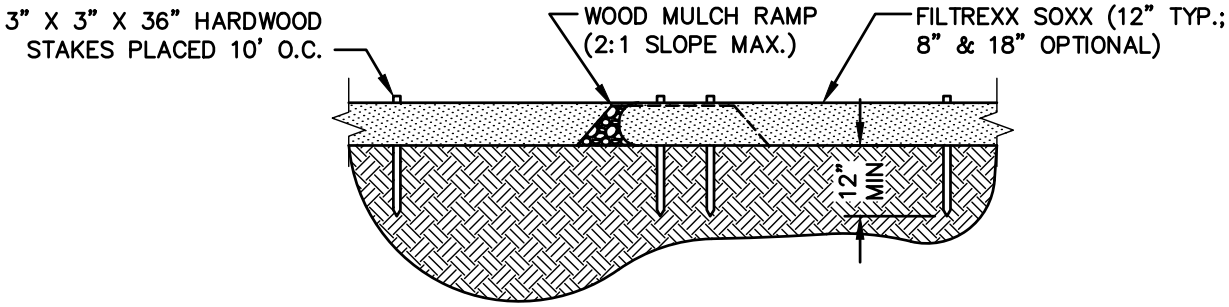
SCALE: NONE



PLAN



SECTION



PROFILE

NOTES

1. PRODUCT TO BE FILTREXX SILT SOXX OR APPROVED EQUAL BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. ALL MATERIAL TO MEET FILTREXX SPECIFICATIONS.
3. FILTER MEDIA FILL TO MEET APPLICATION REQUIREMENTS.
4. NON-MONOFILAMENT CONTAINMENT MATERIAL SHOULD BE KNITTED PHOTODEGRADABLE OR BIODEGRADABLE MATERIAL, WITH OPENING SIZES BETWEEN 1/8" – 1/4".
5. COMPOST MEDIA SHOULD HAVE PARTICLE SIZE WHERE 99% < 2", 50% > 1/2".
6. COMPOST MATERIAL TO BE DISPOSED OF ON-SITE, OR IN ACCORDANCE WITH ENVIRONMENTAL PERMITS AS APPROVED BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
7. WOOD MULCH RAMP IS OPTIONAL DEPENDING ON SUBSTRATE/SITE CONDITIONS, AND TO BE APPROVED BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
8. GAPS TO BE SPACED EVERY 50 FT, IF POSSIBLE GIVEN WETLAND PERMIT CONDITIONS.

BMP # AA-23
SILTSOXX AMPHIBIAN & REPTILE CROSSING #2 (1 OF 2)

File: Alternate_Siltsoxx.dwg

BMP PICTURE



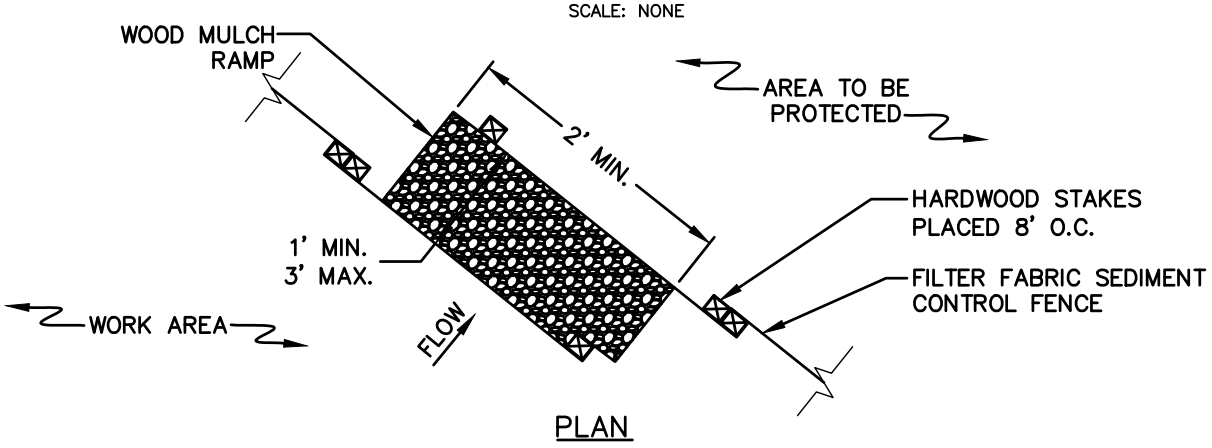
SILTSOXX AMPHIBIAN & REPTILE CROSSING #2

ALTERNATE WOOD MULCH RAMP SILTSOXX NOTES:

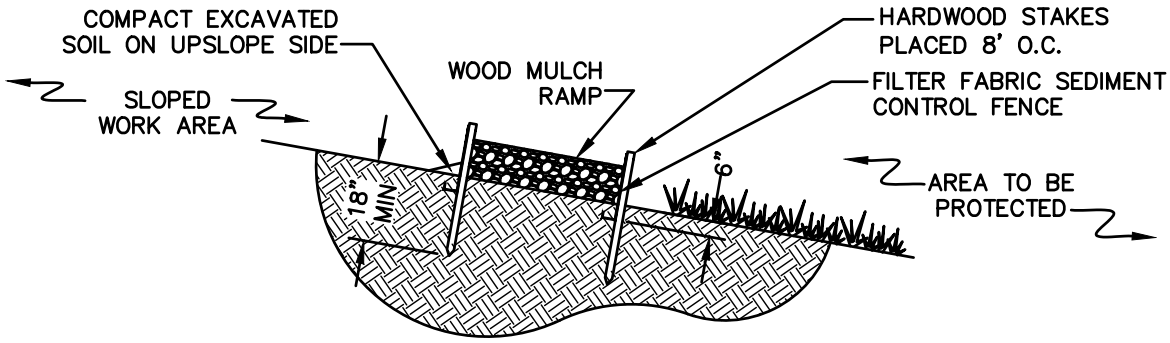
1. SILTSOXX, BY FILTREX INTERNATIONAL, OR APPROVED EQUAL PRODUCT SHALL BE INSTALLED AND MAINTAINED IN ACCORDANCE WITH THE MANUFACTURER'S GUIDELINES.
2. BMP SHOULD ONLY BE UTILIZED IN AREAS WHERE RARE SALAMANDER AND SNAKE HABITAT OCCURS OR AT THE DIRECTION OF THE NATIONAL GRID ENVIRONMENTAL SCIENTIST.

BMP DETAIL

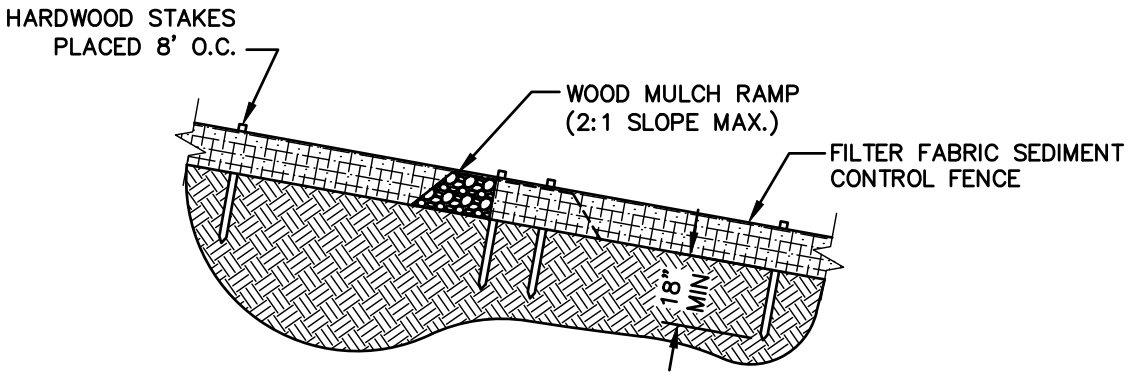
SCALE: NONE



PLAN



SECTION



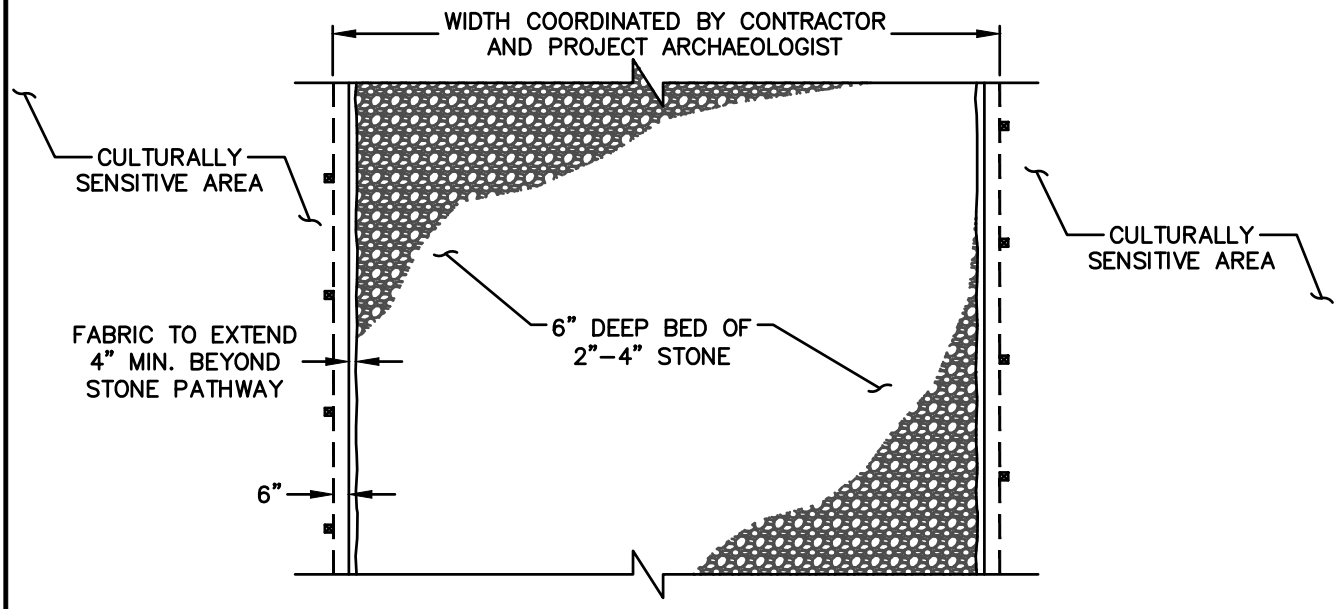
PROFILE

NOTES

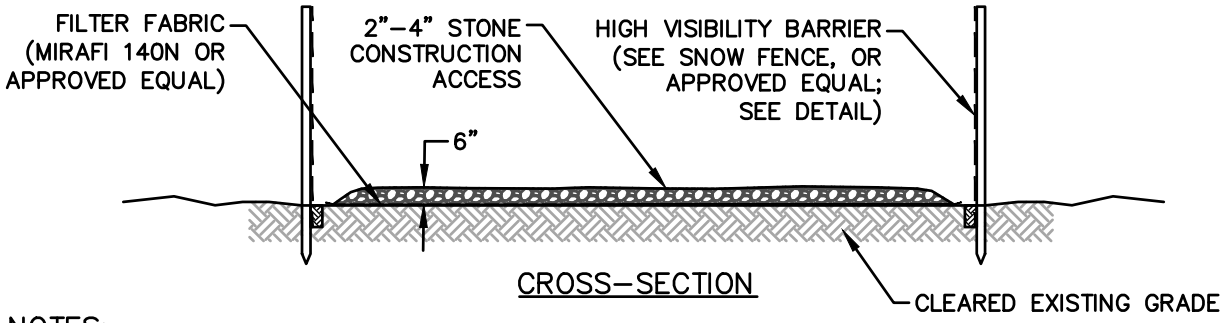
1. IN AREAS WHERE SLOPES OR RUN-OFF VOLUME PROHIBIT USE OF SILTSOXX, CROSSINGS CAN BE PROVIDED THROUGH TRENCHED SILT FENCE.
2. INTALL SILT FENCE TO SPECIFICATIONS IN EG303 APPENDIX 7 "SEC-2 SEDIMENT CONTROL FENCE."
3. WOOD MULCH RAMP IS OPTIONAL DEPENDING ON SUBSTRATE/SITE CONDITIONS, AND TO BE APPROVED BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
4. GAPS TO BE SPACED EVERY 50 FT, IF POSSIBLE GIVEN WETLAND PERMIT CONDITIONS.

BMP DETAIL

SCALE: NONE



PLAN VIEW



CROSS–SECTION

NOTES:

1. ARCHAEOLOGICAL SITE BOUNDARIES, AS DEFINED BY INTENSIVE ARCHAEOLOGICAL SURVEY AND SITE AVOIDANCE AND PROTECTION PLANS, WILL BE DEMARCATED BY STAKING BY THE PROJECT ARCHAEOLOGIST.
2. GEOTEXTILE AND STONE MAY REMAIN IN PLACE FOLLOWING CONSTRUCTION IF PERMANENT PROTECTION IS NECESSARY AND DEPENDENT ON EASEMENT RIGHTS.
3. WHERE APPROVED BY THE PROJECT–SPECIFIC SAPP, CONSTRUCTION MATTING MAY BE ADDED OVER, OR IN PLACE OF, THE FABRIC AND STONE.
4. INSTALLATION AND REMOVAL OF FABRIC AND STONE, EROSION CONTROLS, AND/OR CONSTRUCTION MATTING WILL BE MONITORED BY THE PROJECT ARCHAEOLOGIST AT EACH LOCATION(S).
5. INSTALLATION OF THESE MEASURES WILL BE CONDUCTED WITH LOW–GROUND PRESSURE VEHICLES WHERE FEASIBLE.
6. WHERE REQUIRED BY THE PROJECT–SPECIFIC SAPP, TEMPORARY, HIGH VISIBILITY PROTECTIVE FENCING (E.G., SNOW FENCE OR PLASTIC FENCE) WILL BE ERECTED ALONG THE SITE BOUNDARIES OUTSIDE OF THE WORKSPACE WITHIN THE ROW IN ORDER TO PREVENT VEHICLES FROM TRAVELING THROUGH THOSE SITE AREAS DURING CONSTRUCTION. THE PROTECTIVE FENCE WILL BE POSTED WITH "NO TRESPASSING" SIGNS, SO THAT THE SITES CAN BE AVOIDED BY ALL CONSTRUCTION RELATED ACTIVITIES. THE FENCING WILL BE REMOVED UPON COMPLETION OF THE PROJECT. THE INSTALLATION AND REMOVAL OF FENCING WILL BE MONITORED BY THE PROJECT ARCHAEOLOGIST.

BMP PICTURES





APPENDIX 5
CERTIFICATION FORM FOR INVASIVE SPECIES CONTROL

Certain permit conditions, therefore a Condition of Contracts for the Prime Contractor, any Subcontractors, and any equipment or mat vendors for ***National Grid Projects*** shall be required to Certify their equipment[7] {each piece of equipment used on site} as 'clean'[8].

_____ (*name of firm*) hereby Certifies that

_____ (*make, model, and/or type*)

_____ (*equipment ID tag or #)* meets the following

1. before entry on to the job site, has been sufficiently cleaned to remove all accumulated mud, debris, plant fragments, and detritus that could harbor seeds, roots, or plant fragments of so-called invasive plant species; and

2. that the above piece of equipment has neither been off-loaded nor operated in the interval between cleaning and delivery to the jobsite.

3. that equipment deployed in areas of invasive species (as identified in project plans) shall be cleaned prior to redeployment.

_____ (*signed*) _____ (*dated*)

_____ (*printed name*) _____ (*title*)

_____ (*Firm*)

The signed original of this form {one for each piece of equipment (or lot[9] of mats)} is to be given to the NG Construction Supervisor assigned to the project.

---

7 Equipment may include, but is not limited to bulldozers, excavators, backhoes, bucket trucks (tracked or wheeled), pulling equipment, concrete trucks, compressors, drilling equipment, and mats (composite, wood, or other materials).

8 With regard to invasive species, the definition of clean means free of accumulated mud, debris, plant fragments, and detritus that could harbor seeds, roots, or plant fragments of so-called invasive plant species.

9 Lot of mats is the number of mats that may be transported by one forwarder/truck at a time.

APPENDIX 6
SNOW DISPOSAL GUIDELINES

Finding a place to dispose of collected snow poses a challenge. While we are all aware of the threats to public safety caused by snow, collected snow that is contaminated with road salt, sand, litter, and automotive pollutants such as oil also threatens public health and the environment.

As snow melts, road salt, sand, litter, and other pollutants are transported into surface water or through the soil where they may eventually reach the groundwater. Road salt and other pollutants can contaminate water supplies and are toxic to aquatic life at certain levels. Sand washed into water bodies can create sand bars or fill in wetlands and ponds, impacting aquatic life, causing flooding, and affecting our use of these resources.

There are several steps that should be taken to minimize the impacts of snow disposal on public health and the environment.

- **DO NOT** dump snow into any water body, including rivers, the ocean, reservoirs, ponds, or wetlands. In fact, a buffer of at least 50 feet between any snow disposal area and any the high-water mark of any surface water should be kept. A silt fence or equivalent barrier should be securely placed between the snow storage area and the high-water mark. In addition to water quality impacts and flooding, snow disposed in surface waters can cause navigational hazards when it freezes into ice blocks.
- **DO NOT** dump snow within a wellhead protection area (e.g., a Zone II), in a high or medium-yield aquifer, or within 75 feet of a private well, where road salt may contaminate water supplies**. Ask an Environmental Department representative for guidance in determining if a proposed disposal area is located within one of these sensitive areas.**
- Avoid disposing of snow on top of storm drain catch basins or in storm water drainage swales or ditches. Snow combined with sand and debris may block a storm drainage system, causing localized flooding. A high volume of sand, sediment, and litter released from melting snow also may be quickly transported through the system into surface water.
- All debris in a snow storage area should be cleared from the site and properly disposed of no later than May 15 of each year the area is used for snow storage.

Under extraordinary conditions, when all land-based snow disposal options are exhausted, disposal of snow that is not obviously contaminated with road salt, sand, and other pollutants may be allowed near (within 50 feet) or even in certain water bodies under certain conditions.

In these dire situations, **notify the Environmental Department** so that the local Conservation Commission and the appropriate MassDEP Regional Service Center (in MA), RI DEM Office of Water Resources – RIPDES

Program (in RI), NH Department of Environmental Services – NHDES (in NH) and VT Department of Environmental Conservation - VT DEC (in VT) can be contacted before disposing of snow in a water body.

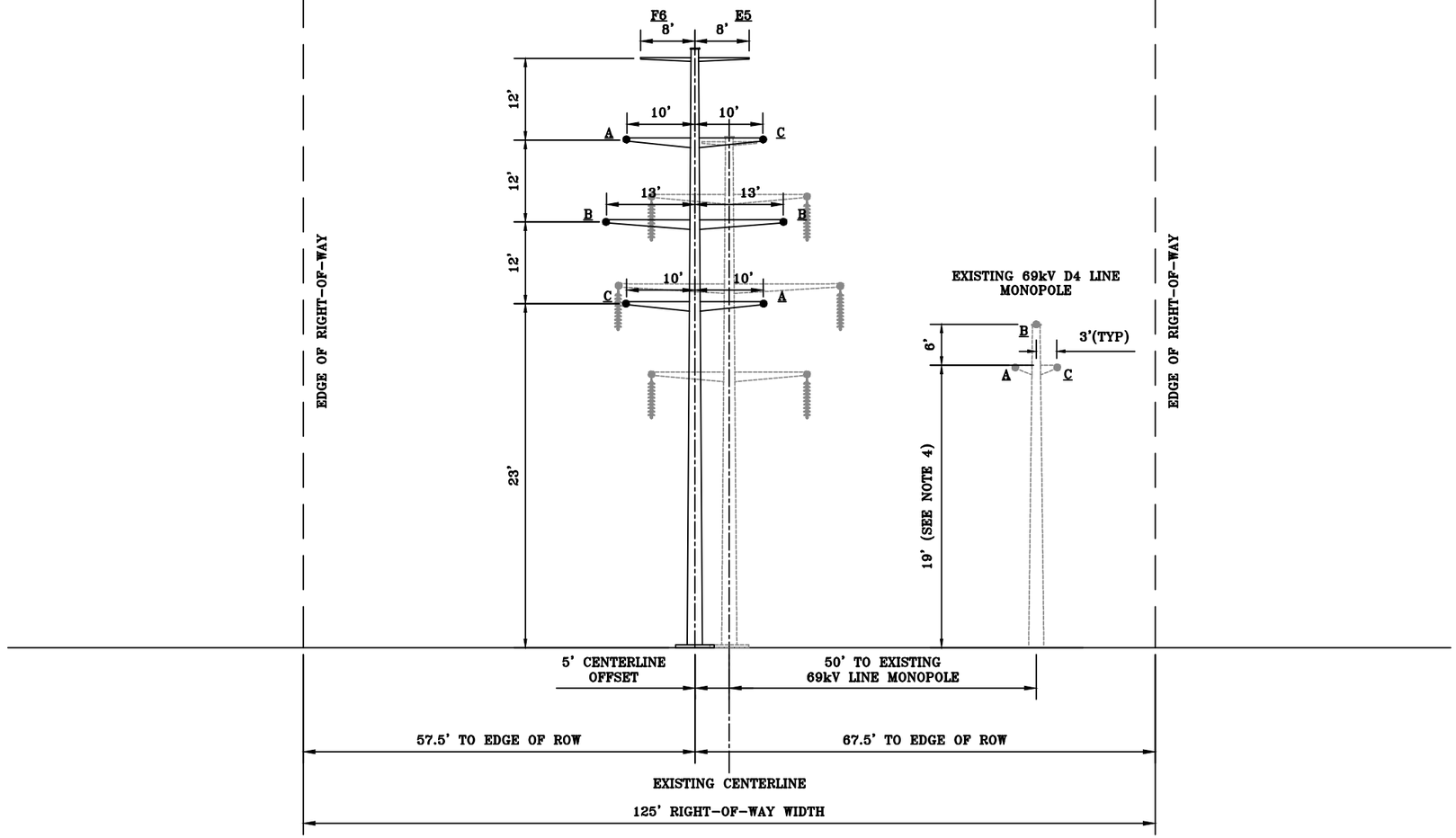
In emergency situations and after consulting an Environmental Department representative the following guidance should be followed:

- Dispose of snow in open water with adequate flow and mixing to prevent ice dams from forming.
- Do not dispose of snow in saltmarshes, vegetated wetlands, certified vernal pools, shellfish beds, mudflats, drinking water reservoirs and their tributaries, wellhead protection areas, or other environmentally sensitive areas.
- Do not dispose of snow where trucks may cause shoreline or stream bank damage or erosion.

Appendix 5-3: Typical ROW Cross Sections

B-13148-NE

PROPOSED 115kV MONOPOLE
EXISTING 69kV TO BE REMOVED
(SEE NOTE 1)



CROSS SECTION 1
LOOKING AHEAD ON LINE TOWARDS DEERFIELD #4 SUB
SEE EMF OVERVIEW MAP FOR STRUCTURE LOCATIONS

NOTES:
1. PROPOSED E5/F6 LINES SHALL BE OPERATED AT 69kV BUT DESIGNED TO ACCOMMODATE 115kV. EMF ANALYSIS REQUIRED AT BOTH 69kV AND 115kV VOLTAGES.
2. SEE TABLES IN APPENDIX FOR EXISTING STRUCTURE GEOMETRY.
3. PHASE SPACING FROM CIRCUIT TO CIRCUIT MAY SLIGHTLY VARY FROM DIMENSIONS SHOWN DEPENDING ON PROPOSED POLE DIAMETERS, WHICH HAVE NOT YET BEEN DETERMINED.
4. THE WIRE SAG UNDER MAXIMUM OPERATING CONDITIONS FOR THE D4 LINE IS UNKNOWN, BUT IS ASSUMED AS CURRENT NESC CODE MINIMUM GROUND CLEARANCE FOR 69kV FOR LAND TRAVERSED BY VEHICLES.

NOT FOR CONSTRUCTION

nationalgrid

E5/F6 LINE REBUILD & UPGRADE
MILLBURY SUB TO DEERFIELD #4 SUB
69kV TRANSMISSION LINE
EMF CROSS SECTION DRAWINGS

SCALE: NTS REV: 1 SHEET 1 OF 8 DATE: 11/03/23

INCHES ON ORIGINAL

B-13148-NE

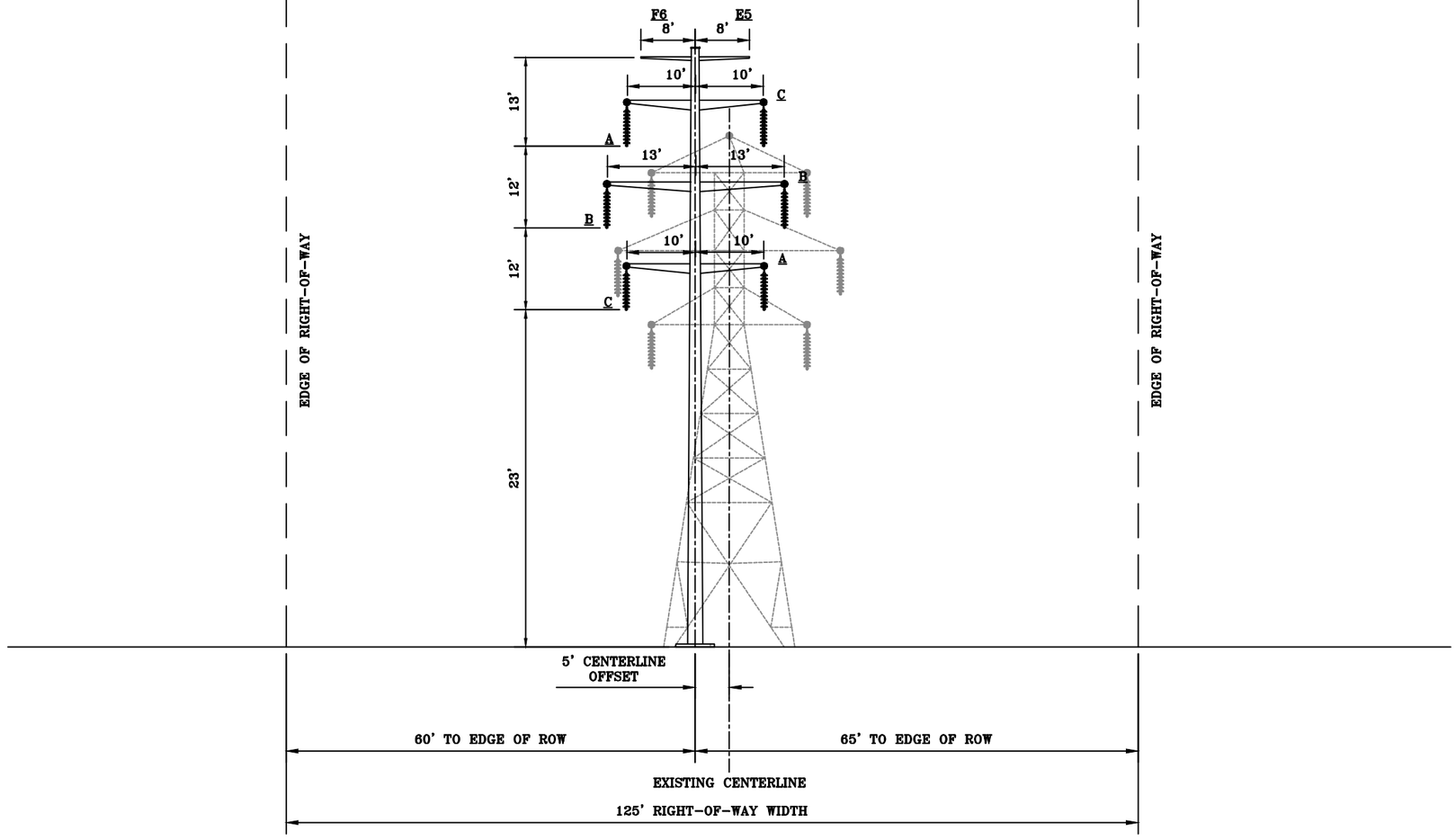
REVISIONS						
REV.	DATE	DESCRIPTION	MADE	CHECKED	INSPECTED	APPROVED	APPROVED
1	11/03/23	ISSUED WITH EMF BID PACKAGE	AM	AW		LMD	
2							
3							
4							
5							
6							

ORIGINAL	
DATE	11/03/23
DESIGNED	AM
CHECKED	AW
DRAWN	EAF
CHECKED	
REVIEWED	
APPROVED	LMD

INCHES

B-13148-NE

PROPOSED 115kV MONOPOLE
EXISTING 69kV TO BE REMOVED
(SEE NOTE 1)



CROSS SECTION 2

LOOKING AHEAD ON LINE TOWARDS DEERFIELD #4 SUB

SEE EMF OVERVIEW 1 FOR STRUCTURE LOCATIONS

NOTES:
1. PROPOSED E5/F6 LINES SHALL BE OPERATED AT 69kV BUT DESIGNED TO ACCOMMODATE 115kV. EMF ANALYSIS REQUIRED AT BOTH 69kV AND 115kV VOLTAGES.
2. SEE TABLES IN APPENDIX FOR EXISTING STRUCTURE GEOMETRY.
3. PHASE SPACING FROM CIRCUIT TO CIRCUIT MAY SLIGHTLY VARY FROM DIMENSIONS SHOWN DEPENDING ON PROPOSED POLE DIAMETERS, WHICH HAVE NOT YET BEEN DETERMINED.
4. DEADEND STRUCTURE LOCATIONS WILL HAVE SLIGHT VARIATION IN ARM LENGTH DUE TO LINE ANGLE.
5. DISTRIBUTION LINES ARE LOCATED ADJACENT TO SOME SPANS ON THE MAIN LINE, BUT ARE NOT INFREQUENT AND INTERMITTENT AND ARE THEREFORE NOT DEPICTED IN THE CROSS SECTION.
6. DUE TO CONSTRUCTION CONSIDERATIONS AT ANGLES, STRUCTURE PLACEMENT IN RIGHT-OF-WAY VARIES IN THESE LOCATIONS. THE CROSS SECTION SHOWN REPRESENTS MOST LOCATION ASSOCIATED WITH THIS CROSS SECTION. HOWEVER, ANGLE STRUCTURES MAY SEE LEFT EDGE OF RIGHT-OF-WAY REDUCED TO UP TO APPROXIMATELY 30 FT.
7. EXISTING RIGHT-OF-WAY WIDTH IN MANY AREAS OF THE LINE IS UNKNOWN OR UNDEFINED. THESE AREAS ARE ASSUMED TO HAVE A 125 FT WIDTH, CENTERED ON THE EXISTING LINE, BASED ON FEEDBACK FROM REAL ESTATE.

NOT FOR CONSTRUCTION

nationalgrid

E5/F6 LINE REBUILD & UPGRADE
MILLBURY SUB TO DEERFIELD #4 SUB
69kV TRANSMISSION LINE
EMF CROSS SECTION DRAWINGS

SCALE: NTS REV: 1 SHEET 2 OF 8 DATE: 11/03/23

B-13148-NE

INCHES ON ORIGINAL

REVISIONS

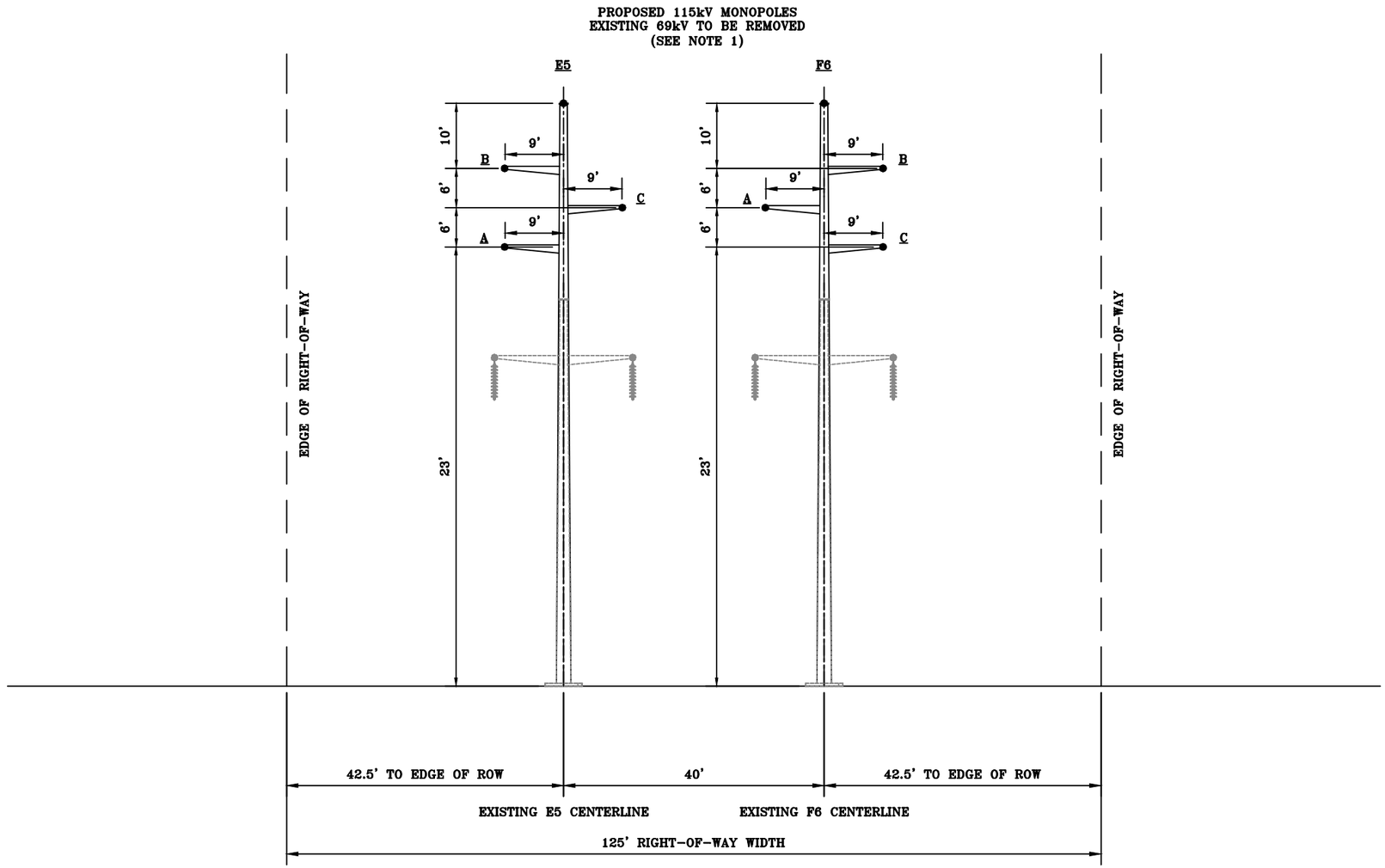
REV.	DATE	DESCRIPTION	MADE	CHECKED	INSPECTED	APPROVED	APPROVED
1	11/03/23	ISSUED WITH EMF BID PACKAGE	AM	AW		LMD	
2							
3							
4							
5							
6							

ORIGINAL

DATE 11/03/23	
DESIGNED	AM
CHECKED	AW
DRAWN	EAF
CHECKED	
REVIEWED	
APPROVED	LMD

INCHES ON ORIGINAL

B-13148-NE



CROSS SECTION 3

LOOKING AHEAD ON LINE TOWARDS DEERFIELD #3 SUB

SEE EMF OVERVIEW MAP FOR STRUCTURE LOCATIONS

NOTES:
1. PROPOSED E5/F6 LINES SHALL BE OPERATED AT 69 kV BUT DESIGNED TO ACCOMMODATE 115kV. EMF ANALYSIS REQUIRED AT BOTH 69kV AND 115kV VOLTAGES.
2. SEE TABLES IN APPENDIX FOR EXISTING STRUCTURE GEOMETRY.
3. PHASE SPACING FROM CIRCUIT TO CIRCUIT MAY SLIGHTLY VARY FROM DIMENSIONS SHOWN DEPENDING ON PROPOSED POLE DIAMETERS, WHICH HAVE NOT YET BEEN DETERMINED.

NOT FOR CONSTRUCTION

nationalgrid

E5/F6 LINE REBUILD & UPGRADE
MILLBURY SUB TO DEERFIELD #4 SUB
69kV TRANSMISSION LINE
EMF CROSS SECTION DRAWINGS

SCALE: NTS REV: 1 SHEET 3 OF 8 DATE: 11/03/23

INCHES ON ORIGINAL

B-13148-NE

REVISIONS							
REV.	DATE	DESCRIPTION	MADE	CHECKED	INSPECTED	APPROVED	APPROVED
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2							
3							
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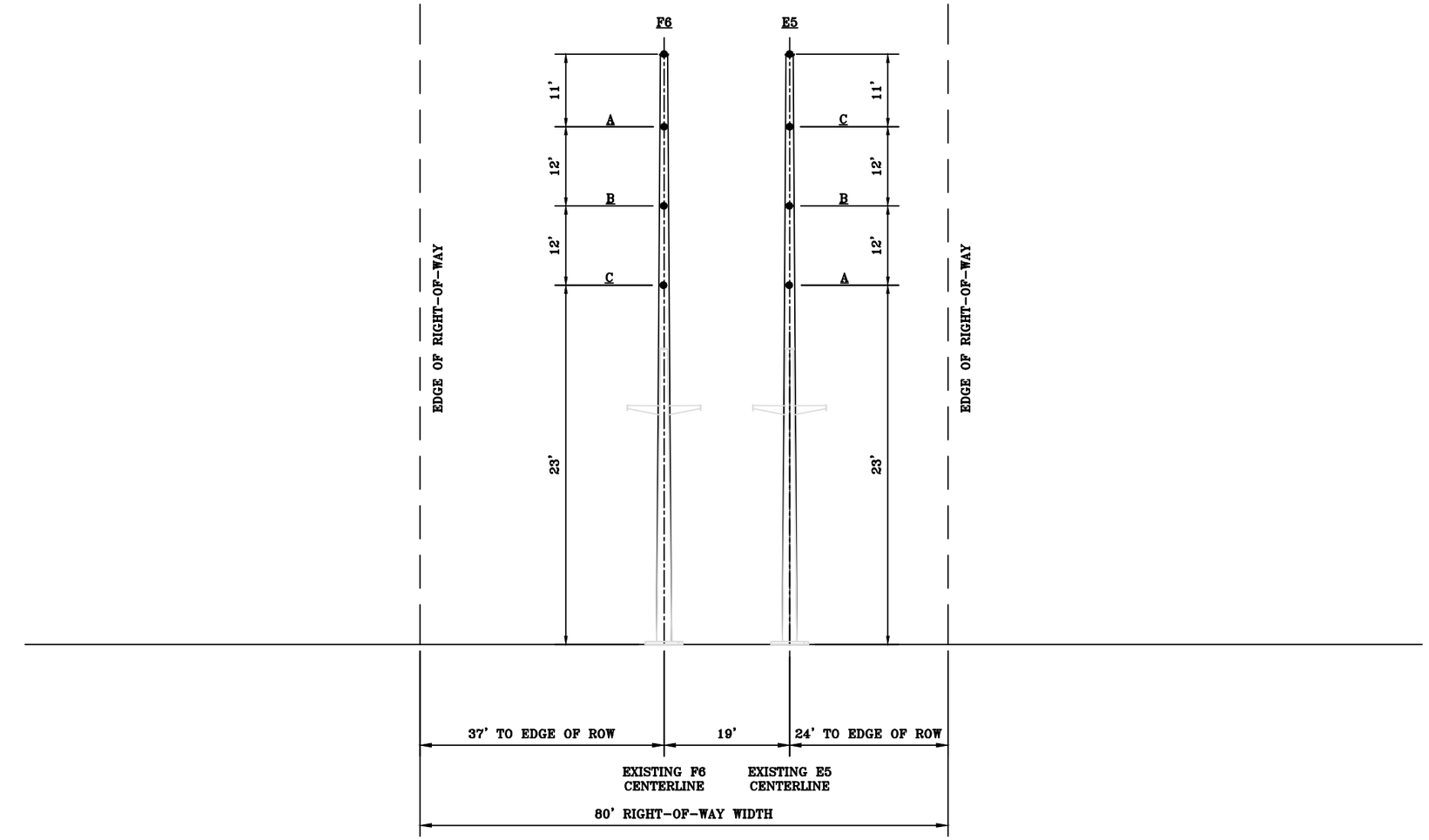
5							
6							

ORIGINAL		
DATE	11/03/23	
DESIGNED	AM	
CHECKED	AW	
DRAWN	EAF	
CHECKED		
REVIEWED		
APPROVED	LMD	

INCHES ON ORIGINAL

B-13148-NE

PROPOSED 115kV MONOPOLES
EXISTING 69kV TO BE REMOVED
(SEE NOTE 1)



CROSS SECTION 4
LOOKING AHEAD ON LINE TOWARDS QUABBIN SUB
SEE EMF OVERVIEW MAP FOR STRUCTURE LOCATIONS

NOTES:
1. PROPOSED E5/F6 LINES SHALL BE OPERATED AT 69kV BUT DESIGNED TO ACCOMMODATE 115kV. EMF ANALYSIS REQUIRED AT BOTH 69kV AND 115kV VOLTAGES.
2. SEE TABLES IN APPENDIX FOR EXISTING STRUCTURE GEOMETRY.
3. PHASE SPACING FROM CIRCUIT TO CIRCUIT MAY SLIGHTLY VARY FROM DIMENSIONS SHOWN DEPENDING ON PROPOSED POLE DIAMETERS, WHICH HAVE NOT YET BEEN DETERMINED.

NOT FOR CONSTRUCTION

nationalgrid

E5/F6 LINE REBUILD & UPGRADE
MILLBURY SUB TO DEERFIELD #4 SUB
69kV TRANSMISSION LINE
EMF CROSS SECTION DRAWINGS

SCALE: NTS REV: 1 SHEET 4 OF 8 DATE: 11/03/23

INCHES ON ORIGINAL

B-13148-NE

REVISIONS

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3							
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ORIGINAL

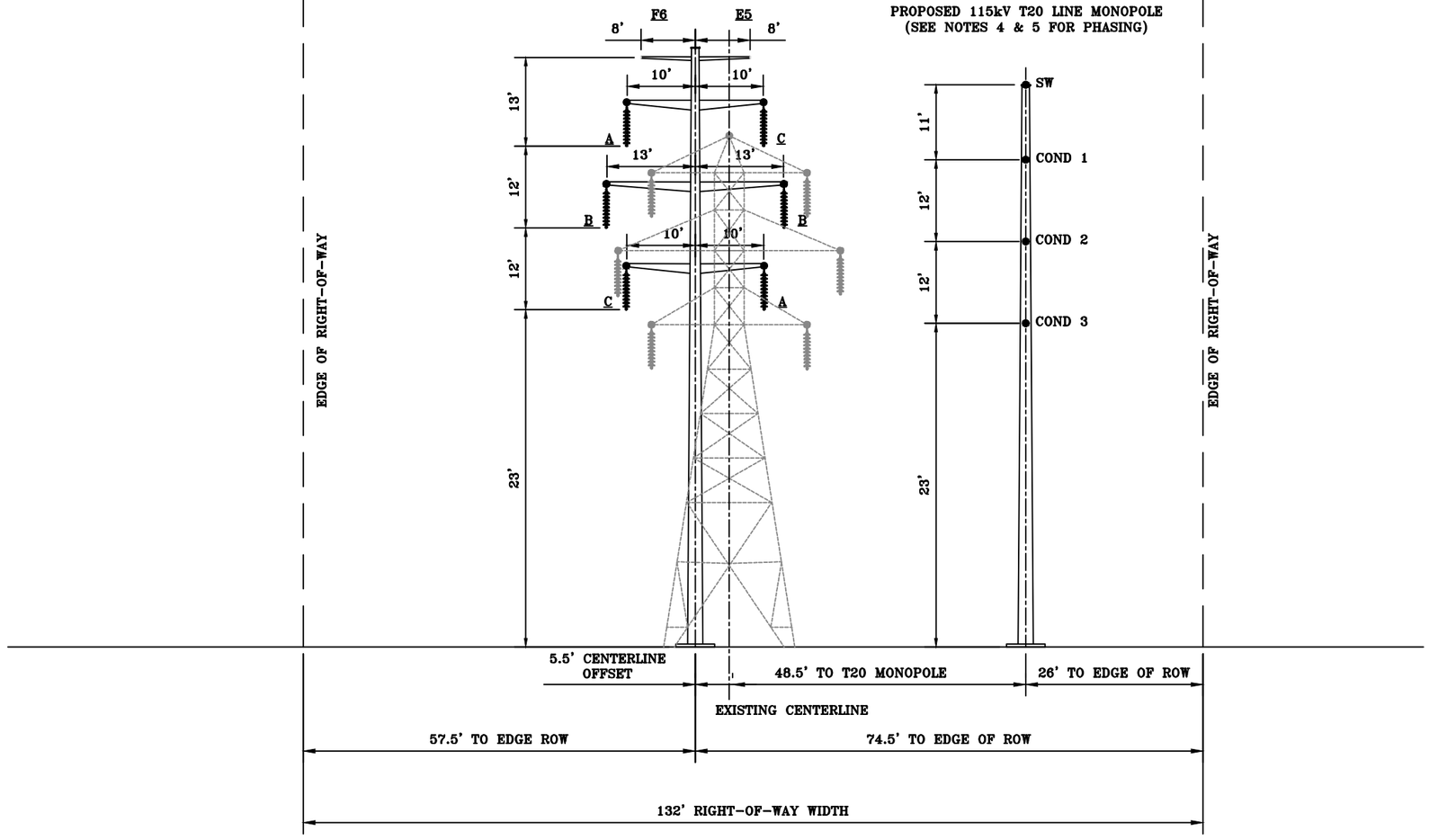
DATE	11/03/23	
DESIGNED	AM	
CHECKED	AW	
DRAWN	EAF	
CHECKED		
REVIEWED		
APPROVED	LMD	

INCHES ON ORIGINAL

B-13148-NE

PROPOSED 115kV MONOPOLE
EXISTING 69kV TO BE REMOVED
(SEE NOTE 1)

PROPOSED 115kV T20 LINE MONOPOLE
(SEE NOTES 4 & 5 FOR PHASING)



CROSS SECTION 5
LOOKING AHEAD ON LINE TOWARDS HARRINGTON SWITCHYARD
SEE EMF OVERVIEW MAP FOR STRUCTURE LOCATIONS

NOTES:
1. PROPOSED E5/F6 LINES SHALL BE OPERATED AT 69kV BUT DESIGNED TO ACCOMMODATE 115kV. EMF ANALYSIS REQUIRED AT BOTH 69kV AND 115kV VOLTAGES.
2. SEE TABLES IN APPENDIX FOR EXISTING STRUCTURE GEOMETRY.
3. PHASE SPACING FROM CIRCUIT TO CIRCUIT MAY SLIGHTLY VARY FROM DIMENSIONS SHOWN DEPENDING ON PROPOSED POLE DIAMETERS, WHICH HAVE NOT YET BEEN DETERMINED.
4. THE T20 LINE WILL OPERATE AT 69kV BUT DESIGNED TO ACCOMMODATE 115kV. EMF ANALYSIS SHOULD ASSUME 115kV OPERATION. PHASING OF THIS LINE IS UNKNOWN. FOR THE PURPOSE OF THE ANALYSIS, THE PHASING CONFIGURATION WHICH GENERATES THE LARGEST EMF SHALL BE CONSIDERED,
5. T20 STRUCTURE FRAMING AND CENTERLINE DETAILS ARE PRELIMINARY.

NOT FOR CONSTRUCTION

nationalgrid

E5/F6 LINE REBUILD & UPGRADE
MILLBURY SUB TO DEERFIELD #4 SUB
69kV TRANSMISSION LINE
EMF CROSS SECTION DRAWINGS

SCALE: NTS REV: 1 SHEET 5 OF 8 DATE: 11/03/23

B-13148-NE

INCHES ON ORIGINAL

REVISIONS						
REV.	DATE	DESCRIPTION	MADE	CHECKED	INSPECTED	APPROVED	APPROVED
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3							
4							
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6							

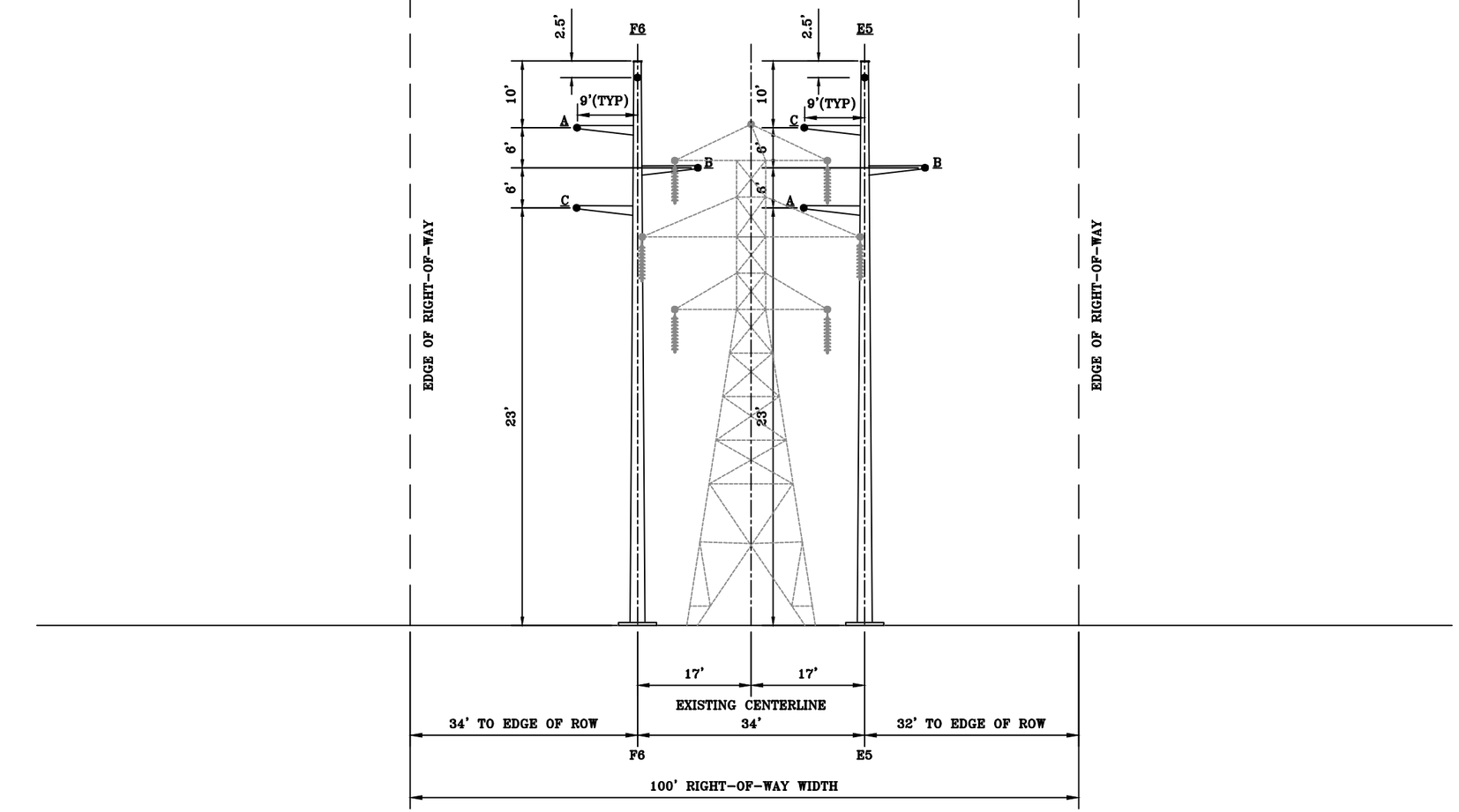
ORIGINAL

DATE 11/03/23	
DESIGNED	AM
CHECKED	AW
DRAWN	EAF
CHECKED	
REVIEWED	
APPROVED	LMD

INCHES ON ORIGINAL

B-13148-NE

PROPOSED 115kV MONOPOLES
EXISTING 69kV TO BE REMOVED
(SEE NOTE 1)



CROSS SECTION 6
LOOKING AHEAD ON LINE TOWARDS DEERFIELD #4 SUB
SEE EMF OVERVIEW MAP FOR STRUCTURE LOCATIONS

NOTES:
1. PROPOSED E5/F6 LINES SHALL BE OPERATED AT 69kV BUT DESIGNED TO ACCOMMODATE 115kV. EMF ANALYSIS REQUIRED AT BOTH 69kV AND 115kV VOLTAGES.
2. SEE TABLES IN APPENDIX FOR EXISTING STRUCTURE GEOMETRY.
3. PHASE SPACING FROM CIRCUIT TO CIRCUIT MAY SLIGHTLY VARY FROM DIMENSIONS SHOWN DEPENDING ON PROPOSED POLE DIAMETERS, WHICH HAVE NOT YET BEEN DETERMINED.

NOT FOR CONSTRUCTION

nationalgrid

E5/F6 LINE REBUILD & UPGRADE
MILLBURY SUB TO DEERFIELD #4 SUB
69kV TRANSMISSION LINE
EMF CROSS SECTION DRAWINGS

SCALE: NTS REV: 1 SHEET 6 OF 8 DATE: 11/03/23

INCHES ON ORIGINAL

B-13148-NE

REVISIONS

REV.	DATE	DESCRIPTION	MADE	CHECKED	INSPECTED	APPROVED	APPROVED
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3							
4							
5							
6							

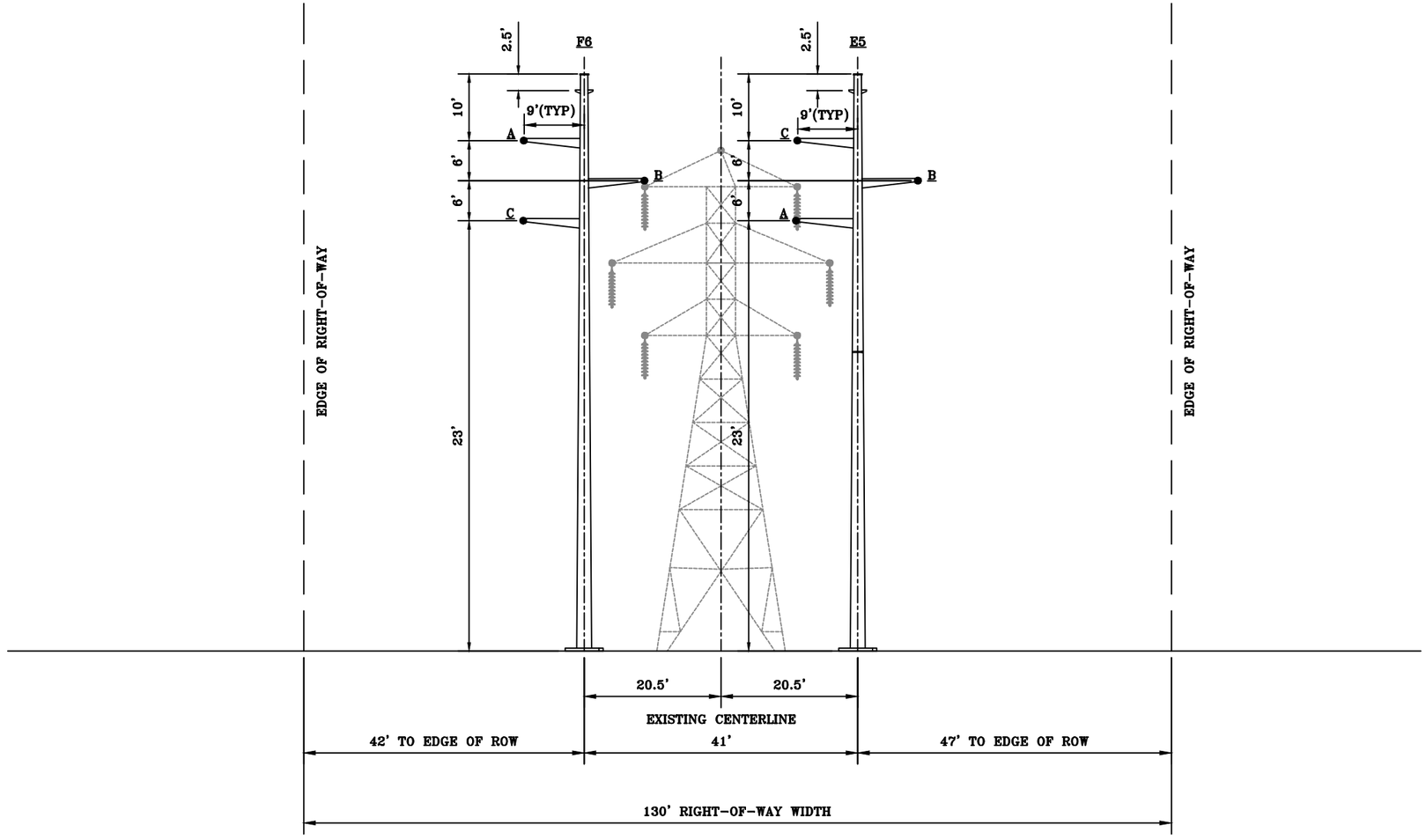
ORIGINAL

DATE	11/03/23
DESIGNED	AM
CHECKED	AW
DRAWN	EAF
CHECKED	
REVIEWED	
APPROVED	LMD

INCHES ON ORIGINAL

B-13148-NE

PROPOSED 115kV MONOPOLES
EXISTING 69kV TO BE REMOVED
(SEE NOTE 1)



CROSS SECTION 7
LOOKING AHEAD ON LINE TOWARDS DEERFIELD #4 SUB
SEE EMF OVERVIEW MAP FOR STRUCTURE LOCATIONS

NOTES:
1. PROPOSED E5/F6 LINES SHALL BE OPERATED AT 69kV BUT DESIGNED TO ACCOMMODATE 115kV. EMF ANALYSIS REQUIRED AT BOTH 69kV AND 115kV VOLTAGES.
2. SEE TABLES IN APPENDIX FOR EXISTING STRUCTURE GEOMETRY.
3. PHASE SPACING FROM CIRCUIT TO CIRCUIT MAY SLIGHTLY VARY FROM DIMENSIONS SHOWN DEPENDING ON PROPOSED POLE DIAMETERS, WHICH HAVE NOT YET BEEN DETERMINED.

NOT FOR CONSTRUCTION

nationalgrid

E5/F6 LINE REBUILD & UPGRADE
MILLBURY SUB TO DEERFIELD #4 SUB
69kV TRANSMISSION LINE
EMF CROSS SECTION DRAWINGS

SCALE: NTS REV: 1 SHEET 7 OF 8 DATE: 11/03/23

INCHES ON ORIGINAL

B-13148-NE

REVISIONS

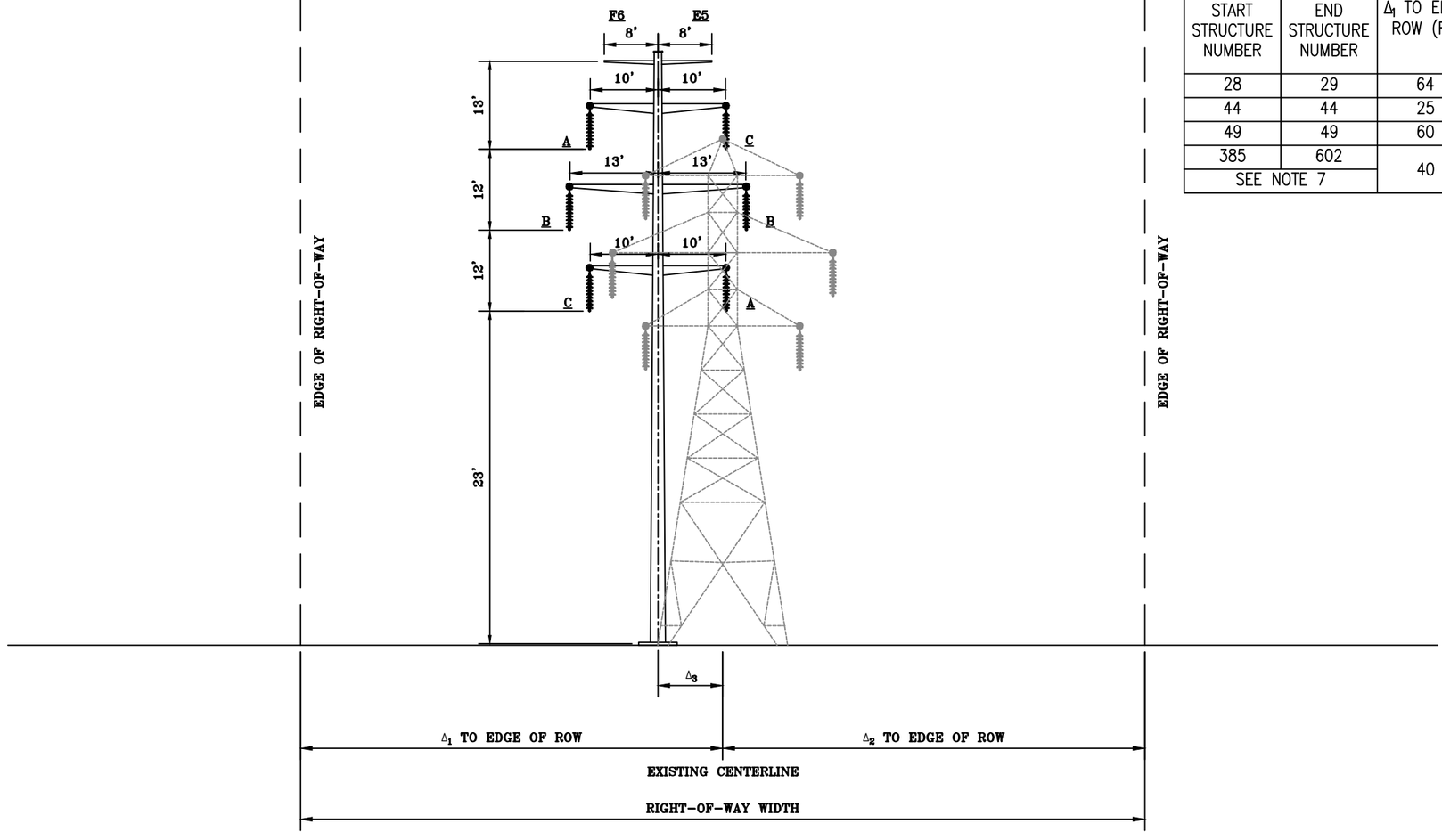
REV.	DATE	DESCRIPTION	MADE	CHECKED	INSPECTED	APPROVED	APPROVED
1	11/03/23	ISSUED WITH EMF BID PACKAGE	AM	AW		LMD	
2							
3							
4							
5							
6							

ORIGINAL

DATE	11/03/23	
DESIGNED	AM	1
CHECKED	AW	2
DRAWN	EAF	3
CHECKED		4
REVIEWED		5
APPROVED	LMD	6

B-13148-NE

PROPOSED 115kV MONOPOLE
EXISTING 69kV TO BE REMOVED
(SEE NOTE 1)



PROPOSED START STRUCTURE NUMBER	PROPOSED END STRUCTURE NUMBER	Δ_1 TO EDGE ROW (FT)	Δ_2 TO EDGE ROW (FT)	ROW WIDTH (FT)	PROPOSED STRUCTURE CENTERLINE OFFSET (Δ_3) (FT)
28	29	64	41	105	4.5
44	44	25	55	80	2
49	49	60	40	100	5
385	602	40	60	100	10
SEE NOTE 7					

CROSS SECTION 8
LOOKING AHEAD ON LINE TOWARDS DEERFIELD #4 SUB
SEE EMF OVERVIEW MAP FOR STRUCTURE LOCATIONS

NOTES:
1. PROPOSED E5/F6 LINES SHALL BE OPERATED AT 69kV BUT DESIGNED TO ACCOMMODATE 115kV. EMF ANALYSIS REQUIRED AT BOTH 69kV AND 115kV VOLTAGES.
2. SEE TABLES IN APPENDIX FOR EXISTING STRUCTURE GEOMETRY.
3. PHASE SPACING FROM CIRCUIT TO CIRCUIT MAY SLIGHTLY VARY FROM DIMENSIONS SHOWN DEPENDING ON PROPOSED POLE DIAMETERS, WHICH HAVE NOT YET BEEN DETERMINED.
4. DEADEND STRUCTURE LOCATIONS WILL HAVE SLIGHT VARIATION IN ARM LENGTH DUE TO LINE ANGLE.
5. DISTRIBUTION LINES ADJACENT TO SOME SPANS ON THE MAIN LINE, BUT ARE INFREQUENT AND INTERMITTENT AND ARE THEREFORE NOT DEPICTED IN THE CROSS SECTION.
6. LOCATIONS IN TABLE ABOVE ONLY CONSIDER UNIQUE RIGHT-OF-WAY AREAS WHERE WIDTH IS LESS THAN 125 FT. WIDER EASEMENTS ARE NOT LISTED AS THE EMF AT EDGE OF RIGHT-OF-WAY WOULD BE REDUCED COMPARED TO THE SCENARIO SHOWN IN SHEET 2. REDUCED EASEMENT WIDTH SOUTHEAST OF PONDVILLE SUSTATION NOT INCLUDED DUE TO EASEMENT ACQISITION BEING UNDERWAY.
7. 100 FT ROW OCCURS INTERMITTENTLY FROM STR.385 TO STR.602.

NOT FOR CONSTRUCTION

nationalgrid

E5/F6 LINE REBUILD & UPGRADE
MILLBURY SUB TO DEERFIELD #4 SUB
69kV TRANSMISSION LINE
EMF CROSS SECTION DRAWINGS

SCALE: NTS REV: 1 SHEET 8 OF 8 DATE: 11/03/23

B-13148-NE

INCHES ON ORIGINAL

REVISIONS						
REV.	DATE	DESCRIPTION	MADE	CHECKED	INSPECTED	APPROVED	APPROVED
1	11/03/23	ISSUED WITH EMF BID PACKAGE	AM	AW			LMD
2							
3							
4							
5							
6							

ORIGINAL		
DATE	11/03/23	
DESIGNED	AM	
CHECKED	AW	
DRAWN	EAF	
CHECKED		
REVIEWED		
APPROVED	LMD	

Appendix 5-4: Visual Simulations



Providence St, Millbury, MA: View 2, Existing



Providence St, Millbury, MA: View 2, Proposed



S Main and Rice Rd, Millbury, MA: View 4, Existing



S Main and Rice Rd, Millbury, MA: View 4, Proposed



Woodland St, Millbury, MA: View 6, Existing



Woodland St, Millbury, MA: View 6, Proposed



Woodland St, Millbury, MA: View 7, Existing



Woodland St, Millbury, MA: View 7, Proposed



Nicole Dr, Millbury, MA: View 18, Existing



Nicole Dr, Millbury, MA: View 18, Proposed



Greenwood St, Millbury, MA: View 20, Existing



Greenwood St, Millbury, MA: View 20, Proposed



Ridgewood Dr, Auburn, MA: View 51, Existing



Ridgewood Dr, Auburn, MA: View 51, Proposed



Leicester St, Auburn, MA: View 68, Existing



Leicester St, Auburn, MA: View 68, Proposed



Bunker Hill Rd, Leicester, MA: View 86, Existing



Bunker Hill Rd, Leicester MA: View 86, Proposed



Douglas Dr, Leicester, MA: View 109, Existing



Douglas Dr, Leicester, MA: View 109, Proposed



Ferncroft Rd, Leicester MA: View 110, Existing



Ferncroft Rd, Leicester MA: View 110, Proposed



Greenville St, Spencer MA: View 112, Existing



Greenville St, Spencer MA: View 112, Proposed



Ash St, Spencer, MA: View 127, Existing



Ash St, Spencer, MA: View 127, Proposed



Smith and Hanson Rd, West Brookfield, MA: View 198, Existing



Smith and Hanson Rd, West Brookfield, MA: View 198, Proposed



Shea Rd, West Brookfield, MA: View 217, Existing



Shea Rd, West Brookfield, MA: View 217, Proposed



Madden Rd, West Brookfield, MA: View 218, Existing



Madden Rd, West Brookfield, MA: View 218, Proposed



Old Gilbertville Rd, Ware, MA: View 256, Existing



Old Gilbertville Rd, Ware, MA: View 256, Proposed



Old Gilbertville Rd, Ware MA: View 256, Existing



Old Gilbertville Rd, Ware MA: View 256, Proposed



Old Gilbertville Rd, Ware, MA: View 257, Existing



Old Gilbertville Rd, Ware, MA: View 257, Proposed



Cushman Rd, Leverett, MA: View 455, Existing



Cushman Rd, Leverett, MA: View 455, Proposed



Stillwater Rd, Deerfield, MA : View 558, Existing



Stillwater Rd, Deerfield, MA: View 558, Proposed

Appendix 5-5: Electric and Magnetic Field Report (“EMF Report”)

Electric and Magnetic Field (EMF) Modeling Analysis for the National Grid 69-kV E5/F6 Line Rebuild Millbury No. 305 to Deerfield No. 4 Project

Prepared for

National Grid
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April 11, 2024

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Abbreviations

A	Ampere
AC	Alternating Current
ACSS	Aluminum Conductor Steel Supported
BPA	Bonneville Power Administration
DC	Direct Current
EF	Electric Field
EMF	Electric and Magnetic Field
G	Gauss
Hz	Hertz
ICNIRP	International Commission on Non-Ionizing Radiation Protection
kcmil	Kilo Circular Mil
kV	Kilovolt
kV/m	Kilovolts Per Meter
MA EFSB	Massachusetts Energy Facilities Siting Board
MF	Magnetic Field
mG	Milligauss
MRI	Magnetic Resonance Imaging
MVA	Megavolt-Ampere
MW	Megawatt
OPGW	Optical Ground Wire
RMS	Root Mean Square
ROW	Right-of-Way
T	Tesla
US	United States
WHO	World Health Organization
µT	Microtesla

1 Introduction and Summary

National Grid requested that Gradient perform an independent assessment of the electric and magnetic field (EMF) levels associated with the 69-kilovolt (kV) E5/F6 Line Rebuild Millbury No. 305 to Deerfield No. 4 Project. This Project involves reconductoring the existing 69-kV overhead E5 and F6 lines, including taps, and replacing the existing steel lattice tower structures between the Millbury No. 305 Substation in Millbury, Massachusetts, and the Deerfield No. 4 Substation in Deerfield, Massachusetts. Double circuit monopole davit arm structures will primarily be used as the new support structures. The existing shield wires will be replaced with optical ground wire (OPGW) throughout the entire line. The total Project route, including taps, is approximately 67 miles in length.

Gradient is a Boston-based environmental and risk sciences consulting firm, nationally renowned for its specialties in toxicology, epidemiology, risk assessment, forensic chemistry, EMF assessment, contaminant fate and transport modeling, risk-based remedial alternatives assessment, and the application of database management and Geographic Information Systems (GIS) tools for addressing environmental contamination. For over 25 years, Gradient scientists have prepared EMF assessments in support of permitting for proposed overhead and underground transmission line projects, electrical substation projects, electrical generation facility projects, and renewable energy projects (*e.g.*, offshore wind, solar, battery storage). Gradient has provided EMF consulting services to regulatory agencies, electric utility companies, municipal utilities, and renewable energy companies. Gradient scientists have experience testifying at regulatory hearings and presenting on EMF at meetings with regulators, stakeholders, and the general public. Gradient scientists have published book chapters and journal articles on EMF-related topics, including the 2019 book chapter "Low-Frequency Magnetic Fields: Potential Environmental Health Impacts" in the 2nd edition of the *Encyclopedia of Environmental Health* (Volume 3).

For this EMF assessment, EMF modeling was conducted at a height of 1 meter (3.28 feet) above the ground surface for 8 representative right-of-way (ROW) cross sections. We performed EMF modeling for the existing overhead circuit configuration in the ROW cross sections (referred to in the report as "pre-Project" case) and for two post-Project cases: (1) for the overhead circuit configuration after the E5 and F6 lines have been replaced and current loadings representative of the in-service year operating at 69-kV, and (2) for a second post-Project case with current loadings for the E5 and F6 lines representative of the in-service year operating at 115-kV. This second post-Project case was included because the E5 and F6 circuits are being rebuilt using 115-kV framing so as to provide the capability to increase the line voltage at a later date. For all but two of the representative cross sections, there are no other circuits within the Project ROW. For representative cross section 1 that occurs for the ROW segment entering the Deerfield No. 4 Substation, the 69-kV D4 line is present in the ROW along with the E5 and F6 lines, and this line was included in the EMF modeling for this cross section to determine the cumulative EMF levels at the ROW edges. For representative cross section 5 that occurs for a ROW segment between the Harrington Switchyard Substation and the Meadow Street Substation, the 69-kV T20 line[1] is present in the ROW along with the E5 and F6 lines, and it was included in the EMF modeling for this cross section to determine the cumulative EMF levels at the ROW edges. EMF modeling was conservatively conducted for the location of lowest conductor sag[2] for each cross section, and for both annual average and system peak load levels.

[1] The T20 circuit is typically open and was thus assumed to carry no current for both the annual average and system peak loading cases included in this EMF modeling assessment. Although it is currently a 69-kV circuit, it was assumed to be energized at 115 kV per National Grid's request.

[2] As provided by National Grid, a minimum conductor height above ground of 19.4 feet was used for pre-Project modeling of all representative cross sections and a minimum conductor height above ground of 23 feet was used for post-Project modeling of all

As discussed in more detail in Section 2 of this report, a number of national and international organizations have developed EMF exposure guidelines or limits designed to protect humans against any adverse health effects. The limit values should not be viewed as demarcation lines between "safe" and "dangerous" levels of EMFs, but rather, levels that assure safety with adequate margins to allow for uncertainties in the science. For magnetic fields (MFs), these health-based guidelines range from about 1,000 to 10,000 milligauss (mG). The International Commission on Non-Ionizing Radiation Protection (ICNIRP) guideline for allowable public exposure to 60-hertz (Hz) MFs is 2,000 mG, while the ICNIRP guideline for allowable public exposure to 60-Hz electric fields (EFs) is 4.2 kilovolts per meter (kV/m) (ICNIRP, 2010).

As discussed in Section 3 of this report, for each representative cross section, all modeled EMF levels, both within the ROW and at the ROW edges, were well below the ICNIRP health-based guidelines. Tables 1.1 and 1.2 summarize the modeled pre-Project and post-Project MF results at the ROW edges for annual average and system peak load levels, respectively, for the 8 representative cross sections. For annual average load levels, the Project will generally result in small increases to edge-of-ROW MF levels as compared to the pre-Project case that are frequently less than 1 mG and that reach a maximum of 10.06 mG. A maximum edge-of-ROW MF level of 12.18 mG was observed for the right (northeast) ROW edge for representative cross section 6 for the post-Project modeling case assuming 115-kV operation of the E5 and F6 lines, and this MF level remains only about 0.6% of the ICNIRP health-based guideline of 2,000 mG. Moreover, MF levels continue to drop off rapidly with increasing distance from the ROW edge, reaching a value of 3.26 mG 50 feet from the ROW edge.

Slightly higher post-Project edge-of ROW MF increases were observed for system peak load levels due to the higher currents typical of this line loading scenario as compared to the modeling for annual average load levels, but edge-of-ROW increases remained small in magnitude and were frequently less than 1-2 mG and <1 mG for the left and right ROW edges, respectively. The highest post-Project edge-of-ROW MF level of 19.08 mG, which was observed for the right (northeast) ROW edge for representative cross section 6 for the modeling case assuming 115-kV operation of the E5 and F6 lines, remained less than 1% of the ICNIRP health-based guideline of 2,000 mG.

Table 1.3 shows that pre-Project and post-Project modeled EF values at the ROW edges are well below the ICNIRP health-based guideline of 4.2 kV/m for all modeled cases. Because EFs are not dependent on conductor loading (*i.e.*, current), only negligible differences in EFs were obtained for annual average and system peak load levels for the post-Project 69-kV operation of the two circuits due to small differences in voltages of the E5 and F6 circuits that were provided by National Grid for the two line loading scenarios. Because EFs are dependent on voltage, higher EFs were obtained for the post-Project 115-kV operation of the two circuits as compared to the post-Project 69-kV operation. For the 69-kV modeling cases, our modeling analysis indicates that the Project will frequently result in negligible changes to EFs at the ROW edges that are less than 0.02 kV/m and a maximum edge-of-ROW increase of 0.50 kV/m. For the 115-kV modeling cases, there are some slightly larger changes in EFs at the ROW edges (ranging from -0.05 kV/m up to 0.86 kV/m), although edge-of-ROW EF levels remain low overall (all $\leq$0.9 kV/m).

representative cross sections based on state code clearance requirements associated with 115-kV design. Modeling at the location of lowest conductor sag is conservative because this is the location with the least clearance between the lines and the ground surface and is thus representative of the highest EMF levels that will be found beneath the lines.

Table 1.1 Summary of Modeled Pre-Project and Post-Project Edge-of-ROW Magnetic Fields for the Representative ROW Cross Sections for Annual Average Load Levels

Representative Cross Section	ROW Segment	Magnetic Field (mG)					
		Left Edge-of-ROW			Right Edge-of-ROW		
		Pre-Project	Post-Project (69-kV)	Post-Project (115-kV)	Pre-Project	Post-Project (69-kV)	Post-Project (115-kV)
Cross Section 1 (D-13148-NE sh. 1)	From Deerfield No. 4 Substation	1.07	2.11	2.53	2.86	3.15	4.53
Cross Section 2 (D-13148-NE sh. 2)	From Deerfield 4 to Deerfield 3 Tap	1.13	1.92	2.24	1.09	1.28	1.69
	From Deerfield 3 Tap to Deerfield 2	0.83	1.58	2.04	1.65	1.84	2.02
	From Deerfield 2 to Shutesbury	1.33	2.23	2.43	1.29	1.53	1.83
	From Shutesbury to Quabbin Switch Tap	1.58	2.52	2.58	0.87	1.09	1.55
	From Quabbin Switch Tap to Ware	0.56	0.64	1.16	2.16	2.33	2.26
	From Ware to Lashaway	0.75	1.38	1.78	1.94	2.14	2.09
	From Lashaway to Harrington St	1.95	2.84	2.65	1.18	1.10	0.87
	From Harrington St to Meadow St	1.76	2.61	2.52	0.97	0.93	0.97
	From Meadow St to Leicester	0.81	1.33	1.75	0.86	0.97	1.36
	From Leicester to Pondville	0.80	1.32	1.74	0.85	0.96	1.35
	From Pondville to Millbury	0.55	0.70	0.98	0.59	0.57	1.01
Cross Section 3 (D-13148-NE sh. 3)	Deerfield 3 Tap	0.34	0.87	0.52	0.10	0.29	0.17
Cross Section 4 (D-13148-NE sh. 4)	Quabbin Switch Tap	1.56	4.08	2.43	1.20	3.37	2.01
Cross Section 5 (D-13148-NE sh. 5)	From Harrington St to Meadow St	1.88	2.79	2.70	0.70	0.68	0.63
Cross Section 6 (D-13148-NE sh. 6)	From Deerfield 2 to Shutesbury	2.33	10.32	11.65	2.12	10.64	12.18
Cross Section 7 (D-13148-NE sh. 7)	From Deerfield 2 to Shutesbury	1.43	7.50	8.47	0.92	6.40	7.32
Cross Section 8 (D-13148-NE sh. 8)	From Deerfield 2 to Shutesbury	3.96	8.21	9.11	1.27	1.24	1.49
	From Shutesbury to Quabbin Switch Tap	4.39	8.61	9.28	0.85	0.86	1.25

Notes:
kV = Kilovolt; mG = Milligauss; ROW = Right-of-Way; sh. = Sheet.
Left and right ROW edges are as shown on the Appendix A cross section diagrams.

Table 1.2 Summary of Modeled Pre-Project and Post-Project Edge-of-ROW Magnetic Fields for the Representative ROW Cross Sections for System Peak Load Levels

Representative Cross Section	ROW Segment	Magnetic Field (mG)					
		Left Edge-of-ROW			Right Edge-of-ROW		
		Pre-Project	Post-Project (69-kV)	Post-Project (115-kV)	Pre-Project	Post-Project (69-kV)	Post-Project (115-kV)
Cross Section 1 (D-13148-NE sh. 1)	From Deerfield No. 4 Substation	1.75	3.26	3.90	4.14	4.23	2.59
Cross Section 2 (D-13148-NE sh. 2)	From Deerfield 4 to Deerfield 3 Tap	1.81	3.00	3.53	1.49	1.78	2.49
	From Deerfield 3 Tap to Deerfield 2	1.21	2.33	3.13	2.61	2.91	3.16
	From Deerfield 2 to Shutesbury	2.18	3.63	3.89	1.95	2.31	2.81
	From Shutesbury to Quabbin Switch Tap	2.37	3.85	4.01	1.62	1.97	2.59
	From Quabbin Switch Tap to Ware	0.82	1.05	1.96	3.46	3.74	3.62
	From Ware to Lashaway	1.18	2.11	2.73	2.19	2.43	2.66
	From Lashaway to Harrington St	2.58	3.77	3.70	1.39	1.16	1.26
	From Harrington St to Meadow St	1.15	2.15	2.73	2.21	2.88	2.95
	From Meadow St to Leicester	1.00	1.74	2.50	0.98	1.20	1.91
	From Leicester to Pondville	1.00	1.73	2.49	0.97	1.19	1.90
	From Pondville to Millbury	0.69	0.88	1.34	0.57	0.61	1.45
Cross Section 3 (D-13148-NE sh. 3)	Deerfield 3 Tap	0.67	1.75	1.05	0.20	0.58	0.35
Cross Section 4 (D-13148-NE sh. 4)	Quabbin Switch Tap	2.25	5.89	3.52	1.73	4.87	2.91
Cross Section 5 (D-13148-NE sh. 5)	From Harrington St to Meadow St	1.25	2.34	2.96	1.52	2.09	2.11
Cross Section 6 (D-13148-NE sh. 6)	From Deerfield 2 to Shutesbury	3.80	16.32	18.36	3.21	16.62	19.08
Cross Section 7 (D-13148-NE sh. 7)	From Deerfield 2 to Shutesbury	2.36	11.86	13.34	1.38	9.99	11.47
Cross Section 8 (D-13148-NE sh. 8)	From Deerfield 2 to Shutesbury	6.43	13.17	14.46	1.91	1.87	2.29
	From Shutesbury to Quabbin Switch Tap	6.75	13.48	14.59	1.58	1.57	2.10

Notes:
kV = Kilovolt; mG = Milligauss; ROW = Right-of-Way; sh. = Sheet.
Left and right ROW edges are as shown on the Appendix A cross section diagrams.

Table 1.3 Summary of Modeled Pre-Project and Post-Project Edge-of-ROW Electric Field Values for the Representative ROW Cross Sections

Representative Cross Section	ROW Segment	Line Loading Scenario	Electric Field (kV/m)					
			Left Edge-of-ROW			Right Edge-of-ROW		
			Pre-Project	Post-Project (69-kV)	Post-Project (115-kV)	Pre-Project	Post-Project (69-kV)	Post-Project (115-kV)
Cross Section 1 (D-13148-NE sh. 1)	From Deerfield No. 4 Substation	Ann. Avg.	0.01	0.05	0.09	0.61	0.60	0.61
		Sys. Pk.	0.03	0.06	0.09	0.62	0.62	0.63
Cross Section 2 (D-13148-NE sh. 2)	From Deerfield 4 to Deerfield 3 Tap	Ann. Avg.	0.03	0.05	0.08	0.03	0.04	0.06
		Sys. Pk.	0.03	0.05	0.08	0.03	0.04	0.06
	From Deerfield 3 Tap to Deerfield 2	Ann. Avg.	0.03	0.05	0.08	0.03	0.04	0.06
		Sys. Pk.	0.03	0.05	0.08	0.03	0.04	0.06
	From Deerfield 2 to Shutesbury	Ann. Avg.	0.03	0.05	0.08	0.03	0.04	0.06
		Sys. Pk.	0.03	0.05	0.08	0.03	0.04	0.06
	From Shutesbury to Quabbin Switch Tap	Ann. Avg.	0.03	0.05	0.08	0.03	0.04	0.06
		Sys. Pk.	0.03	0.05	0.08	0.03	0.04	0.06
	From Quabbin Switch Tap to Ware	Ann. Avg.	0.03	0.04	0.07	0.02	0.03	0.06
		Sys. Pk.	0.03	0.04	0.07	0.02	0.03	0.06
	From Ware to Lashaway	Ann. Avg.	0.02	0.04	0.08	0.02	0.04	0.06
		Sys. Pk.	0.02	0.04	0.08	0.03	0.04	0.06
	From Lashaway to Harrington St	Ann. Avg.	0.04	0.05	0.08	0.04	0.05	0.07
		Sys. Pk.	0.03	0.05	0.08	0.04	0.04	0.07
	From Harrington St to Meadow St	Ann. Avg.	0.03	0.05	0.08	0.04	0.04	0.07
		Sys. Pk.	0.03	0.05	0.08	0.03	0.04	0.07
	From Meadow St to Leicester	Ann. Avg.	0.03	0.05	0.08	0.03	0.04	0.06
		Sys. Pk.	0.03	0.05	0.08	0.03	0.04	0.06
	From Leicester to Pondville	Ann. Avg.	0.03	0.05	0.08	0.03	0.04	0.06
		Sys. Pk.	0.03	0.05	0.08	0.03	0.04	0.06
	From Pondville to Millbury	Ann. Avg.	0.02	0.04	0.08	0.02	0.03	0.06
		Sys. Pk.	0.02	0.04	0.07	0.02	0.03	0.06
Cross Section 3 (D-13148-NE sh. 3)	Deerfield 3 Tap	Ann. Avg.	0.12	0.30	0.50	0.12	0.30	0.50
		Sys. Pk.	0.12	0.30	0.50	0.12	0.30	0.50
Cross Section 4 (D-13148-NE sh. 4)	Quabbin Switch Tap	Ann. Avg.	0.17	0.08	0.13	0.33	0.27	0.44
		Sys. Pk.	0.17	0.08	0.13	0.33	0.26	0.44
Cross Section 5 (D-13148-NE sh. 5)	From Harrington St to Meadow St	Ann. Avg.	0.03	0.07	0.09	0.39	0.39	0.39
		Sys. Pk.	0.01	0.06	0.09	0.39	0.39	0.39
Cross Section 6 (D-13148-NE sh. 6)	From Deerfield 2 to Shutesbury	Ann. Avg.	0.03	0.44	0.73	0.04	0.54	0.90
		Sys. Pk.	0.03	0.44	0.73	0.04	0.53	0.89
Cross Section 7 (D-13148-NE sh. 7)	From Deerfield 2 to Shutesbury	Ann. Avg.	0.03	0.30	0.50	0.02	0.30	0.50
		Sys. Pk.	0.03	0.29	0.49	0.02	0.30	0.49
Cross Section 8 (D-13148-NE sh. 8)	From Deerfield 2 to Shutesbury	Ann. Avg.	0.07	0.36	0.61	0.03	0.03	0.05
		Sys. Pk.	0.07	0.36	0.60	0.03	0.03	0.05
	From Shutesbury to Quabbin Switch Tap	Ann. Avg.	0.07	0.36	0.61	0.03	0.03	0.05
		Sys. Pk.	0.07	0.36	0.60	0.03	0.03	0.05

Notes:
Ann. Avg. = Annual Average; kV = Kilovolt; kV/m = Kilovolts per Meter; ROW = Right-of-Way; sh. = Sheet; Sys. Pk. = System Peak.
Left and right ROW edges are as shown on the Appendix A cross section diagrams.

Section 2 of this report describes the nature of EMFs, provides values for EMF levels from common sources, and reports on EMF exposure guidelines. Section 3 outlines the EMF modeling procedures for calculating EMF strengths as a function of lateral distance from an electric transmission line (or distribution line) and provides tabular results for the modeled cross sections. Section 4 summarizes the conclusions, and the Reference list provides the references for published literature and exposure guidelines cited in this report. Appendix A provides cross section diagrams, showing both existing (pre-Project) and post-Project overhead conductor arrangements, for the representative cross sections, while Appendices B and C provide graphical MF and EF profiles, respectively, for each modeled route segment and line loading scenario. Appendix D provides a summary of the current status of scientific reports regarding potential health effects of power-frequency EMF exposures.

2 Nature of Electric and Magnetic Fields

All matter contains electrically charged particles. Most objects are electrically neutral because positive and negative charges are present in equal numbers. When the balance of electric charges is altered, we experience electrical effects. Common examples are the static electricity attraction between a comb and our hair or a static electricity spark after walking on a synthetic rug in the wintertime. Electrical effects occur both in nature and through our society's use of electric power (generation, transmission, and consumption).

2.1 Units for EMFs Are Kilovolts per Meter (kV/m) and Milligauss (mG)

The electrical tension on utility power lines is expressed in volts or kilovolts (1 kV = 1,000 V). Voltage is the "pressure" of the electricity and can be envisioned as analogous to the pressure of water in a plumbing system. The existence of a voltage difference between power lines and ground results in an EF, usually expressed in units of kV/m. The size of the EF depends on the line voltage, the separation distance between lines and ground, and other factors.

Power lines also carry an electric current that creates a MF. The units for electric current are amperes (A), which is a measure of the "flow" of electricity. Electric current is analogous to the flow of water in a plumbing system. The MF produced by an electric current is usually expressed in units of gauss (G) or mG (1 G = 1,000 mG).[3] The size of the MF depends on the electric current, the distance to the current-carrying conductor, and other factors.

2.2 There Are Many Natural and Man-Made Sources of EMFs

Everyone experiences a variety of natural and man-made EMFs. EMF levels can be steady or slowly varying (often called direct current [DC] fields), or EMF levels can vary in time (often called alternating current [AC] fields). When the time variation corresponds to that of standard North American power line currents (*i.e.*, 60 cycles per second), the fields are called 60-Hz EMFs, or power-frequency EMFs.

Man-made MFs are common in everyday life. For example, many childhood toys contain magnets. Such permanent magnets generate strong, steady (DC) MFs. Typical toy magnets (*e.g.*, refrigerator door magnets) have fields of 100,000-500,000 mG. On a larger scale, Earth's core also creates a steady DC MF that can be easily demonstrated with a compass needle. The size of the Earth's MF in the northern US is about 550 mG (less than 1% of the levels generated by typical refrigerator door magnets).

2.3 Power-Frequency EMFs Are Found Near Electric Lines and Appliances

In North America, electric power transmission lines, distribution lines, and electric wiring in buildings carry AC currents and voltages that change size and direction at a frequency of 60 Hz. These 60-Hz currents and voltages create 60-Hz EMFs nearby. The size of the MF is proportional to the line current, while the size of the EF is proportional to the line voltage. The EMFs associated with electrical wires and electrical equipment decrease rapidly with increasing distance away from the electrical wires. Specifically, EMFs

[3] Another unit for MF levels is the microtesla (μT) (1 μT = 10 mG).

from three-phased, balanced conductors decrease in proportion to the square of the distance from the conductors (*i.e.*, 1/distance^2) (IEEE, 2014).

When EMF derives from different wires or conductors that are in close proximity, or adjacent to one another, the level of the net EMF produced will be somewhere in the range between the sum of EMF from the individual sources and the difference of the EMF from the individual sources. EMF may partially add, or partially cancel but, because adjacent wires are often carrying current in opposite directions, the EMF produced tends generally to cancel. Notably, for three-phase transmission line conductors, the sum of currents going in, for example, the forward direction at any instant, are equal to the sum of currents going in the backward direction.

EMFs in the home arise from electric appliances, indoor wiring, grounding currents on pipes and ground wires, and outdoor distribution or transmission circuits. Inside residences, typical baseline 60-Hz MF levels (away from appliances) range from 0.5-5.0 mG.

Higher 60-Hz MF levels are found near operating appliances. For example, can openers, mixers, blenders, refrigerators, fluorescent lamps, electric ranges, clothes washers, toasters, portable heaters, vacuum cleaners, electric tools, and many other appliances generate MF levels in the range of 40-300 mG at distances of 1 foot (NIEHS, 2002). MF levels from personal care appliances held within half a foot (*e.g.*, shavers, hair dryers, massagers) can produce average fields of 600-700 mG. At school and in the workplace, lights, motors, copy machines, vending machines, video-display terminals, pencil sharpeners, electric tools, electric heaters, and building wiring are all sources of 60-Hz MFs.

Recognizing that magnetic resonance imaging (MRI) is a source of DC fields rather than 60-Hz fields, MRIs are a diagnostic procedure that puts humans in much larger, but steady, MF (*e.g.*, levels of 20,000,000 mG). The scanning MF superimposed on the large, steady static field (which is the source of the characteristic audio noise of MRI scans) exposes the body to time-varying MF similar to time-varying power-frequency MF.

2.4 State, National, and International Guidelines for Power-Frequency EMFs

Table 2.1 shows guidelines for 60-Hz AC EMFs from national and world health and safety organizations that are designed to be protective against any adverse health effects. The limit values should not be viewed as demarcation lines between safe and dangerous levels of EMFs, but rather, levels that assure safety with an adequate margin to allow for uncertainties in the science. Appendix D provides more information on the health-effects science underlying the available exposure guidelines, as well as a summary of EMF health-effect conclusions from international scientific, health, and safety organizations, and governmental public health agencies. As part of its International EMF Project, the World Health Organization (WHO) has conducted comprehensive reviews of EMF health-effects research and existing standards and guidelines. The WHO website for the International EMF Project (WHO, 2024) notes: "The main conclusion from the WHO reviews is that EMF exposures below the limits recommended in the ICNIRP international guidelines do not appear to have any known consequence on health."

The US has no federal standards limiting either residential or occupational exposure to 60-Hz EMFs. The Massachusetts Energy Facilities Siting Board (MA EFSB) assesses EMF levels on a case-by-case basis with a focus on practical options to reduce magnetic fields along transmission line rights-of-way. Some states, including New York and Florida, have adopted EMF guidelines that are not health-effect based and have typically been adopted to maintain the *status quo* for EMFs on and near a transmission line ROW.

Table 2.1 60-Hz AC EMF Guidelines Established by International Health and Safety Organizations

Organization	Electric Field	Magnetic Field
American Conference of Governmental and Industrial Hygienists (ACGIH) (occupational)	25 kV/m[1]	10,000 mG[1] 1,000 mG[2]
International Commission on Non-Ionizing Radiation Protection (ICNIRP) (general public)	4.2 kV/m[3]	2,000 mG[3]
International Commission on Non-Ionizing Radiation Protection (ICNIRP) (occupational)	8.3 kV/m[3]	10,000 mG[3]
Institute of Electrical and Electronics Engineers (IEEE) Standard C95.1™-2019 (general public)	5.0 kV/m[4]	9,040 mG[4]
Institute of Electrical and Electronics Engineers (IEEE) Standard C95.1™-2019 (occupational)	20.0 kV/m[4]	27,100 mG[4]

Notes:
AC = Alternating Current; EMF = Electric and Magnetic Field; Hz = Hertz; kV/m = Kilovolts per Meter; mG = Milligauss.
(1) The ACGIH guidelines for the general worker (ACGIH, 2024).
(2) The ACGIH guideline for workers with cardiac pacemakers (ACGIH, 2024).
(3) ICNIRP (2010).
(4) IEEE (2019); developed by the IEEE International Committee on Electromagnetic Safety (ICES).

3 EMF Modeling

3.1 Software Program Used for Modeling EMFs for Overhead Line Cross Sections

The "EMF and Corona Effects Analysis" spreadsheet-based EMF calculation program, designed by the Bonneville Power Administration (BPA) of the US Department of Energy, was used to calculate EMFs.[4] This program operates using Maxwell's equations, which accurately apply the laws of physics as related to electricity and magnetism (EPRI, 1982, 1993). Modeled fields using this program are both precise and accurate for the input data used. The results of the model have been checked against results from other software (*e.g.*, Southern California Edison's FIELDS program), confirming that the implementation of the laws of physics in this program is consistent.

3.2 Power-Line Loads

MFs produced by the three-phase overhead lines were modeled using line loadings and conductor phase angles provided by National Grid. The current per phase satisfies the relationship:

(Eq. 3.1) $$S = \sqrt{3} \times V \times I_{phase}$$

where:

S	=	The power in kilovolt-amperes (kVA)
V	=	The line voltage in kilovolts (kV)
I_{phase}	=	The current per phase in amperes (A)

Thus, the current per phase conductor is:

(Eq. 3.2) $$I_{phase} = \frac{S}{\sqrt{3} \times V}$$

Real power is typically expressed in megawatts (MW) (P), and apparent power in megavolt-amperes (MVA) (S).[5,6] To convert between power quoted in MW to MVA, one must divide MW by the power factor.

[4] BPA's "EMF and Corona Effects Analysis" spreadsheet-based EMF calculation program reports the root mean square (RMS) values of the real "maximum" rotating electric and magnetic fields, *i.e.*, the RMS values of the semi-major axis magnitudes of the field ellipse that are known as $B_{Maximum}$ or B_{Max} and $E_{Maximum}$ or E_{Max}. While some instruments relying on three fixed orthogonal coils (*e.g.*, fixed-coil instruments like the EMDEX II) calculate the sum of the squares of magnetic fields detected by each orthogonal coil separately and thus report a different metric (*e.g.*, $B_{Resultant}$ or B_{Res}; sometimes referred to as $B_{Product}$ or B_{prod}), B_{Res} and E_{Res} are recognized as being artefactual in nature- *i.e.*, not actual physical entities like B_{Max} and E_{Max} (IEEE, 2021).

[5] MVA is apparent power and is the vector sum of real (active) and imaginary (reactive) power. MW and MVA are not the same unless the power factor = 1.0, which, in a practical AC circuit, is generally not the case.

[6] 1 MVA = 1,000 kVA.

Both pre-Project and post-Project electric current and voltage values provided by National Grid are summarized by line loading scenario (annual average and system peak load levels) in Table 3.1 for the E5 and F6 lines, as well as the D4 line that is present with the E5 and F6 lines in representative cross section 1 for the ROW segment entering the Deerfield No. 4 Substation and the T20 line that is present with the E5 and F6 lines in representative cross section 5 that occurs for a ROW segment between the Harrington Switchyard Substation and the Meadow Street Substation. As indicated in the table, the post-Project 69-kV operation scenario and the post-Project 115-kV operation scenario generally refer to a lower and a higher power delivery, respectively.

Table 3.1 Summary of Line Load Levels for Modeled Line Loading Scenarios

Line	Line Segment	Pre-Project		Post-Project: 69-kV Operation		Post-Project: 115-kV Operation	
		Voltage (kV)	Current (A)	Voltage (kV)	Current (A)	Voltage (kV)	Current (A)
Annual Average Load Levels							
E5	From Deerfield No. 4 Substation	70.89	89.96	70.68	94.99	117.93	119.58
	From Deerfield 4 to Deerfield 3 Tap	70.89	89.94	70.68	94.99	117.93	119.52
	Deerfield 3 Tap	70.87	17.73	70.67	17.66	117.94	10.61
	From Deerfield 3 Tap to Deerfield 2	70.87	107.50	70.67	112.61	117.94	129.97
	From Deerfield 2 to Shutesbury	70.83	107.41	70.66	112.55	118.02	129.74
	From Shutesbury to Quabbin Switch Tap	70.50	92.62	70.52	97.79	118.02	120.10
	Quabbin Switch Tap	70.36	0 (open)	70.47	0 (open)	118.04	0 (open)
	From Quabbin Switch Tap to Ware	70.36	91.89	70.47	97.46	118.04	119.31
	From Ware to Lashaway	70.27	117.24	70.43	120.78	118.02	127.92
	From Lashaway to Harrington St	70.38	54.91	70.57	53.69	118.16	85.04
	From Harrington St to Meadow St	70.48	61.46	70.65	61.57	118.23	90.38
	From Meadow St to Leicester	70.53	68.75	70.70	69.43	118.27	95.23
	From Leicester to Pondville	70.75	67.94	70.90	68.69	118.42	94.45
	From Pondville to Millbury	70.95	45.63	71.06	38.00	118.53	64.69
F6	From Deerfield No. 4 Substation	70.89	95.63	70.68	101.26	117.93	122.97
	From Deerfield 4 to Deerfield 3 Tap	70.88	95.62	70.68	101.26	117.93	122.96
	Deerfield 3 Tap	70.86	0 (open)	70.66	0 (open)	117.94	0 (open)
	From Deerfield 3 Tap to Deerfield 2	70.86	95.56	70.66	101.28	117.94	122.83
	From Deerfield 2 to Shutesbury	70.81	113.73	70.65	118.96	117.99	133.46
	From Shutesbury to Quabbin Switch Tap	70.41	112.95	70.48	118.55	117.99	132.37
	Quabbin Switch Tap	70.15	71.79	70.37	71.57	117.98	42.63
	From Quabbin Switch Tap to Ware	70.15	46.90	70.37	48.70	117.98	90.16
	From Ware to Lashaway	70.27	96.20	70.43	99.00	118.02	114.83
	From Lashaway to Harrington St	70.45	95.45	70.61	98.42	118.19	113.91
	From Harrington St to Meadow St	70.50	95.24	70.66	98.22	118.23	113.66
	From Meadow St to Leicester	70.53	71.27	70.70	72.18	118.27	97.07
	From Leicester to Pondville	70.75	70.47	70.89	71.50	118.42	96.26
	From Pondville to Millbury	70.94	47.22	71.06	38.40	118.53	60.43
D4	From Deerfield No. 4 Substation	70.89	29.80	70.68	29.23	70.44	43.56
T20	From Harrington St to Meadow St	115	0 (open)	115	0 (open)	115	0 (open)

Line	Line Segment	Pre-Project		Post-Project: 69-kV Operation		Post-Project: 115-kV Operation	
		Voltage (kV)	Current (A)	Voltage (kV)	Current (A)	Voltage (kV)	Current (A)
System Peak Load Levels							
E5	From Deerfield No. 4 Substation	70.66	132.41	70.29	139.46	116.87	181.94
	From Deerfield 4 to Deerfield 3 Tap	70.65	132.42	70.29	139.46	116.87	181.90
	Deerfield 3 Tap	70.62	35.42	70.27	35.49	116.89	21.35
	From Deerfield 3 Tap to Deerfield 2	70.62	167.33	70.27	174.72	116.89	202.72
	From Deerfield 2 to Shutesbury	70.55	167.22	70.24	174.70	116.87	202.61
	From Shutesbury to Quabbin Switch Tap	70.08	155.72	69.99	163.36	116.86	195.03
	Quabbin Switch Tap	69.88	0 (open)	69.92	0 (open)	116.89	0 (open)
	From Quabbin Switch Tap to Ware	69.88	154.99	69.92	163.00	116.89	194.26
	From Ware to Lashaway	69.79	146.27	69.90	149.64	116.90	172.89
	From Lashaway to Harrington St	69.90	75.49	69.95	71.36	116.97	124.89
	From Harrington St to Meadow St	70.00	145.96	70.00	158.18	117.01	177.91
	From Meadow St to Leicester	70.04	80.89	70.08	87.53	117.07	135.01
	From Leicester to Pondville	70.20	80.23	70.26	86.98	117.22	134.36
	From Pondville to Millbury	70.34	45.29	70.41	40.67	117.35	91.03
F6	From Deerfield No. 4 Substation	70.66	146.07	70.29	154.02	116.87	190.78
	From Deerfield 4 to Deerfield 3 Tap	70.65	146.09	70.29	153.94	116.87	190.73
	Deerfield 3 Tap	70.61	0 (open)	70.27	0 (open)	116.89	0 (open)
	From Deerfield 3 Tap to Deerfield 2	70.61	145.98	70.27	153.93	116.89	190.61
	From Deerfield 2 to Shutesbury	70.55	180.93	70.25	188.95	116.90	210.84
	From Shutesbury to Quabbin Switch Tap	69.88	180.23	69.90	188.68	116.81	209.91
	Quabbin Switch Tap	69.54	103.58	69.75	103.27	116.78	61.67
	From Quabbin Switch Tap to Ware	69.54	88.13	69.75	89.59	116.78	149.88
	From Ware to Lashaway	69.79	131.68	69.90	135.01	116.90	164.30
	From Lashaway to Harrington St	69.96	130.96	70.02	134.63	117.01	163.64
	From Harrington St to Meadow St	70.01	130.78	70.06	134.44	117.05	163.44
	From Meadow St to Leicester	70.04	85.68	70.08	92.49	117.07	138.14
	From Leicester to Pondville	70.19	85.01	70.25	91.91	117.22	137.51
	From Pondville to Millbury	70.32	50.95	70.39	43.81	117.35	83.72
D4	From Deerfield No. 4 Substation	70.66	39.07	70.29	36.06	70.35	10.25
T20	From Harrington St to Meadow St	115	0 (open)	115	0 (open)	115	0 (open)

Notes:
A = Ampere; kV = Kilovolt.

3.3 Project Representative Cross Sections

Gradient modeled EMFs expected to exist 1 meter (3.28 feet) above the ground surface for 8 representative ROW cross sections. These representative cross sections reflect differences in E5 and F6 conductor arrangements/locations/heights, ROW widths, and the presence of other transmission lines within ROW segments (see Appendix A that includes the 8 representative ROW cross section drawings, as well as a plan view map of the Project route that indicates the locations of the representative cross sections). For the entire project route including the tap lines, the E5 and F6 lines will be reconductored using Drake 795 kilo circular mil (kcmil) aluminum conductor steel supported (ACSS) conductors and the existing shielding will be replaced with OPGW.

The representative ROW cross sections included the following:

- Cross section 1 is for a ROW segment leaving the Deerfield Substation No. 4 where the 69-kV D4 line is present in the ROW along with the E5 and F6 lines. The 125-foot ROW is centered on the existing double-circuit monopoles with the E5/F6 circuits, and the new double-circuit monopole davit arm structures with the reconductored E5/F6 circuits are to be offset 5 feet on the left (south) side of the ROW.
- Cross section 2 shows the most common pre-Project and post-Project conductor arrangements and ROW configuration that occur along the majority of the Project route where the existing steel lattice tower structures with the E5/F6 circuits are to be replaced with double-circuit monopole davit arm structures. There is a 5-foot offset between the existing circuit centerline and the proposed circuit centerline. The ROW width in many areas along the Project route is unknown or undefined, but is conservatively assumed to be 125 feet based on input from National Grid Real Estate.
- Cross section 3 is for the tap line into the Deerfield No. 3 Substation, where the existing single-circuit tap line structures with horizontal conductor arrangements are to be replaced with new single-circuit monopole davit arm structures. For both the annual average and system peak loading conditions, the F6 circuit is normally open and is not carrying any current. The ROW width is 125 feet.
- Cross section 4 is for the Quabbin Switch Tap, where the existing single-circuit tap line structures with horizontal conductor arrangements are to be replaced with new single-circuit monopoles with vertical conductor configurations. For both the annual average and system peak loading conditions, the E5 circuit is normally open and is not carrying any current. The ROW width is 80 feet.
- Cross section 5 is for a ROW segment between the Harrington Street Switchyard Substation and the Meadow Street Substation where the T20 overhead transmission line is also present in the ROW along with the E5 and F6 lines. The 69-kV T20 circuit is normally open and thus not carrying current; it was assumed to be energized at 115-kV per National Grid's request. Similar to cross section 2, the existing steel lattice tower structures with the E5/F6 circuits are to be replaced with double-circuit monopole davit arm structures. The ROW width is 132 feet.
- Cross section 6 is for a ROW segment between the Deerfield No. 2 Substation and the Shutesbury Substation where the existing steel lattice tower structures with the E5/F6 circuits are to be replaced with single-circuit monopole davit arm structures. Within the 100 foot ROW, the new single-circuit monopole davit arm structures with be offset 16 feet and 18 feet on either side of the ROW centerline.
- Cross section 7 is for a ROW segment between the Deerfield No. 2 Substation and the Shutesbury Substation where the existing steel lattice tower structures with the E5/F6 circuits are to be replaced with single-circuit monopole davit arm structures. Within the 130 foot ROW, the new single-circuit monopole davit arm structures with the E5 and F6 circuits are to be offset 18 feet and 23 feet on either side of the ROW centerline.
- Cross section 8 is a variant of cross section 2 where the existing steel lattice tower structures with the E5/F6 circuits are to be replaced with double-circuit monopole davit arm structures, but for a larger 10-foot offset between the existing circuit centerline and the proposed circuit centerline and a smaller ROW width of 100 feet. This representative cross section occurs intermittently between the Deerfield No. 2 Substation and the Quabbin Switch Tap (Structures 385 to 602). Although there are several other variants of cross section 8 that differ in the ROW width, the existing and proposed circuit offsets, and the distances from the circuit centerlines to the ROW edges, these

variants occur for just single span transitions and were not included in the EMF modeling analysis due to their insignificant lengths.

National Grid provided cross section reference drawings showing both existing (pre-Project) and proposed (post-Project) overhead conductor arrangements, which are attached to this report as Appendix A. Conductor phasing arrangements are shown on the cross section drawings.

EMF levels were modeled for both pre-Project and post-Project ROW conditions as a function of distance perpendicular to the direction of current flow for each route segment, assuming that the transmission lines run straight. Modeling was performed assuming the minimum ROW widths as discussed above and shown in each representative cross section drawing (Appendix A); this resulted in conservative estimates of edge-of-ROW EMF levels, as EMF levels will be lower at the ROW edges with a wider ROW. Variation in the height of the nearby grade along the ROW was not accounted for, given that the general National Grid policy is to model EMF for the most conservative location of lowest conductor sag (*i.e.*, closest to the ground surface). As provided by National Grid, a minimum conductor height above ground of 19.4 feet was used for pre-Project modeling of all representative cross sections and a minimum conductor height above ground of 23 feet was used for post-Project modeling of all representative cross sections based on state code clearance requirements associated with 115-kV design. The EMF modeling was conducted out to 50 feet beyond both ROW edges, illustrating the continued decline in EMF levels beyond the ROW edges for the assumed ROW widths.

3.4 EMF Modeling Results

3.4.1 Magnetic Field Results

Results of the MF modeling for the representative cross sections are summarized in Tables 3.2 and 3.3, as well as the figures in Appendix B. In the Appendix B figures, Panel (a) shows the pre- and post-Project modeling results for annual average load levels, and Panel (b) shows the pre- and post-Project modeling results for system peak load levels; both panels show results for the post-Project 69-kV and 115-kV operating cases for the E5 and F6 lines.

The MF modeling results show that all model-predicted MF values, including those within the ROWs, remain well below the ICNIRP health-based guideline of 2,000 mG for allowable public exposure to 60-Hz MF. Due in part to the higher post-Project load levels for both the E5 and F6 circuits, in particular for the 115-kV operation case, the Project will frequently result in increased edge-of-ROW MF levels; however, the magnitudes of the increases are small (frequently <1 mG and <1-2 mG for annual average and system peak load levels, respectively). The largest edge-of-ROW MF increases were observed for representative cross section 6, with MF increases of 7.99 mG and 8.52 mG at the left and right edges, respectively for the post-Project 69-kV operating case, and MF increases of 9.32 mG and 10.06 mG at the left and right edges, respectively for the post-Project 115-kV operating case. For system peak load levels, slightly higher maximum edge-of-ROW MF increases were observed, with MF increases of 12.52 mG and 13.40 mG at the left and right edges, respectively for the post-Project 69-kV operating case, and MF increases of 14.56 mG and 15.87 mG at the left and right edges, respectively for the post-Project 115-kV operating case. In all cases, as illustrated by Tables 3.2 and 3.3, MF values drop off rapidly with increased lateral distance from the overhead lines, such that MF levels decrease to negligible levels at short distances beyond the ROW edges.

Table 3.2 Summary of Modeled Pre-Project and Post-Project Magnetic Fields for the Representative ROW Cross Sections for Annual Average Load Levels

Representative Cross Section	ROW Segment	Modeling Case	Magnetic Field (mG)				
			50 ft from Left ROW Edge	Left ROW Edge	Maximum Within ROW	Right ROW Edge	50 ft from Right ROW Edge
Cross Section 1 (D-13148-NE sh. 1)	From Deerfield No. 4 Substation	Pre-Project	0.22	1.07	18.57	2.86	0.42
		Post-Project (69-kV)	0.43	2.11	17.38	3.15	0.52
		Post-Project (115-kV)	0.52	2.53	21.22	4.53	0.73
Cross Section 2 (D-13148-NE sh. 2)	From Deerfield 4 to Deerfield 3 Tap	Pre-Project	0.26	1.13	19.83	1.09	0.19
		Post-Project (69-kV)	0.43	1.92	17.27	1.28	0.26
		Post-Project (115-kV)	0.48	2.24	21.31	1.69	0.36
	From Deerfield 3 Tap to Deerfield 2	Pre-Project	0.13	0.83	21.85	1.65	0.37
		Post-Project (69-kV)	0.28	1.58	18.90	1.84	0.45
		Post-Project (115-kV)	0.39	2.04	22.25	2.02	0.48
	From Deerfield 2 to Shutesbury	Pre-Project	0.30	1.33	23.69	1.29	0.23
		Post-Project (69-kV)	0.49	2.23	20.37	1.53	0.32
		Post-Project (115-kV)	0.52	2.43	23.15	1.83	0.39
	From Shutesbury to Quabbin Switch Tap	Pre-Project	0.40	1.58	22.35	0.87	0.13
		Post-Project (69-kV)	0.61	2.52	19.32	1.09	0.17
		Post-Project (115-kV)	0.59	2.58	22.28	1.55	0.30
	From Quabbin Switch Tap to Ware	Pre-Project	0.28	0.56	17.28	2.16	0.61
		Post-Project (69-kV)	0.28	0.64	14.97	2.33	0.71
		Post-Project (115-kV)	0.18	1.16	19.11	2.26	0.62
	From Ware to Lashaway	Pre-Project	0.13	0.75	23.40	1.94	0.46
		Post-Project (69-kV)	0.23	1.38	19.74	2.14	0.57
		Post-Project (115-kV)	0.32	1.78	21.52	2.09	0.52
	From Lashaway to Harrington St	Pre-Project	0.58	1.95	18.02	1.18	0.38
		Post-Project (69-kV)	0.81	2.84	15.22	1.10	0.37
		Post-Project (115-kV)	0.68	2.65	18.07	0.87	0.21

Representative Cross Section	ROW Segment	Modeling Case	Magnetic Field (mG)				
			50 ft from Left ROW Edge	Left ROW Edge	Maximum Within ROW	Right ROW Edge	50 ft from Right ROW Edge
	From Harrington St to Meadow St	Pre-Project	0.51	1.76	17.98	0.97	0.29
		Post-Project (69-kV)	0.72	2.61	15.23	0.93	0.28
		Post-Project (115-kV)	0.63	2.52	18.29	0.97	0.19
	From Meadow St to Leicester	Pre-Project	0.18	0.81	14.97	0.86	0.16
		Post-Project (69-kV)	0.29	1.33	12.44	0.97	0.20
		Post-Project (115-kV)	0.37	1.75	16.91	1.36	0.29
	From Leicester to Pondville	Pre-Project	0.18	0.80	14.80	0.85	0.16
		Post-Project (69-kV)	0.29	1.32	12.32	0.96	0.20
		Post-Project (115-kV)	0.37	1.74	16.77	1.35	0.29
	From Pondville to Millbury	Pre-Project	0.13	0.55	10.05	0.59	0.13
		Post-Project (69-kV)	0.17	0.70	6.77	0.57	0.14
		Post-Project (115-kV)	0.19	0.98	11.06	1.01	0.24
Cross Section 3 (D-13148-NE sh. 3)	Deerfield 3 Tap	Pre-Project	0.08	0.34	2.25	0.10	0.04
		Post-Project (69-kV)	0.22	0.87	3.26	0.29	0.12
		Post-Project (115-kV)	0.13	0.52	1.96	0.17	0.07
Cross Section 4 (D-13148-NE sh. 4)	Quabbin Switch Tap	Pre-Project	0.32	1.56	9.10	1.20	0.28
		Post-Project (69-kV)	1.12	4.08	11.59	3.37	1.00
		Post-Project (115-kV)	0.67	2.43	6.90	2.01	0.60
Cross Section 5 (D-13148-NE sh. 5)	From Harrington St to Meadow St	Pre-Project	0.53	1.88	17.98	0.70	0.24
		Post-Project (69-kV)	0.75	2.79	15.23	0.68	0.24
		Post-Project (115-kV)	0.66	2.70	18.29	0.63	0.15
Cross Section 6 (D-13148-NE sh. 6)	From Deerfield 2 to Shutesbury	Pre-Project	0.42	2.33	23.69	2.12	0.31
		Post-Project (69-kV)	2.68	10.32	25.49	10.64	2.85
		Post-Project (115-kV)	3.04	11.65	28.73	12.18	3.26
Cross Section 7 (D-13148-NE sh. 7)	From Deerfield 2 to Shutesbury	Pre-Project	0.31	1.43	23.69	0.92	0.18
		Post-Project (69-kV)	2.23	7.50	24.23	6.40	2.07
		Post-Project (115-kV)	2.52	8.47	27.28	7.32	2.36

Representative Cross Section	ROW Segment	Modeling Case	Magnetic Field (mG)				
			50 ft from Left ROW Edge	Left ROW Edge	Maximum Within ROW	Right ROW Edge	50 ft from Right ROW Edge
Cross Section 8 (D-13148-NE sh. 8)	From Deerfield 2 to Shutesbury	Pre-Project	0.57	3.96	23.69	1.27	0.22
		Post-Project (69-kV)	1.10	8.21	20.38	1.24	0.27
		Post-Project (115-kV)	1.18	9.11	23.14	1.49	0.34
	From Shutesbury to Quabbin Switch Tap	Pre-Project	0.72	4.39	22.35	0.85	0.13
		Post-Project (69-kV)	1.30	8.61	19.33	0.86	0.15
		Post-Project (115-kV)	1.29	9.28	22.27	1.25	0.25

Notes:
ft = Feet; kV = Kilovolt; mG = Milligauss; ROW = Right-of-Way; sh. = Sheet.

Table 3.3 Summary of Modeled Pre-Project and Post-Project Magnetic Fields for the Representative ROW Cross Sections for System Peak Load Levels

Representative Cross Section	ROW Segment	Modeling Case	Magnetic Field (mG)				
			50 ft from Left ROW Edge	Left ROW Edge	Maximum Within ROW	Right ROW Edge	50 ft from Right ROW Edge
Cross Section 1 (D-13148-NE sh. 1)	From Deerfield No. 4 Substation	Pre-Project	0.42	1.75	27.97	4.14	0.50
		Post-Project (69-kV)	0.73	3.26	26.02	4.23	0.52
		Post-Project (115-kV)	0.83	3.90	32.79	2.59	0.40
Cross Section 2 (D-13148-NE sh. 2)	From Deerfield 4 to Deerfield 3 Tap	Pre-Project	0.43	1.81	29.90	1.49	0.24
		Post-Project (69-kV)	0.69	3.00	25.93	1.78	0.34
		Post-Project (115-kV)	0.77	3.53	32.82	2.49	0.52
	From Deerfield 3 Tap to Deerfield 2	Pre-Project	0.19	1.21	33.87	2.61	0.59
		Post-Project (69-kV)	0.40	2.33	29.16	2.91	0.73
		Post-Project (115-kV)	0.60	3.13	34.70	3.16	0.75
	From Deerfield 2 to Shutesbury	Pre-Project	0.50	2.18	37.30	1.95	0.33
		Post-Project (69-kV)	0.82	3.63	32.03	2.31	0.46
		Post-Project (115-kV)	0.84	3.89	36.36	2.81	0.59

Representative Cross Section	ROW Segment	Modeling Case	Magnetic Field (mG)				
			50 ft from Left ROW Edge	Left ROW Edge	Maximum Within ROW	Right ROW Edge	50 ft from Right ROW Edge
	From Shutesbury to Quabbin Switch Tap	Pre-Project	0.58	2.37	36.22	1.62	0.23
		Post-Project (69-kV)	0.91	3.85	31.21	1.97	0.34
		Post-Project (115-kV)	0.90	4.01	35.66	2.59	0.52
	From Quabbin Switch Tap to Ware	Pre-Project	0.42	0.82	29.28	3.46	0.96
		Post-Project (69-kV)	0.38	1.05	25.12	3.74	1.13
		Post-Project (115-kV)	0.31	1.96	31.26	3.62	0.98
	From Ware to Lashaway	Pre-Project	0.21	1.18	30.04	2.19	0.48
		Post-Project (69-kV)	0.39	2.11	25.25	2.43	0.60
		Post-Project (115-kV)	0.53	2.73	29.76	2.66	0.63
	From Lashaway to Harrington St	Pre-Project	3.66	5.18	31.75	9.24	4.85
		Post-Project (69-kV)	1.07	3.77	20.76	1.16	0.40
		Post-Project (115-kV)	0.94	3.70	26.14	1.26	0.24
	From Harrington St to Meadow St	Pre-Project	0.19	1.15	29.81	2.21	0.49
		Post-Project (69-kV)	0.45	2.15	25.74	2.88	0.76
		Post-Project (115-kV)	0.54	2.73	29.87	2.95	0.73
	From Meadow St to Leicester	Pre-Project	0.23	1.00	17.82	0.98	0.17
		Post-Project (69-kV)	0.38	1.74	15.83	1.20	0.25
		Post-Project (115-kV)	0.53	2.50	24.02	1.91	0.41
	From Leicester to Pondville	Pre-Project	0.23	1.00	17.68	0.97	0.17
		Post-Project (69-kV)	0.38	1.73	15.73	1.19	0.25
		Post-Project (115-kV)	0.53	2.49	23.91	1.90	0.41
	From Pondville to Millbury	Pre-Project	0.18	0.69	10.49	0.57	0.13
		Post-Project (69-kV)	0.23	0.88	7.50	0.61	0.16
		Post-Project (115-kV)	0.25	1.34	15.46	1.45	0.35
Cross Section 3 (D-13148-NE sh. 3)	Deerfield 3 Tap	Pre-Project	0.16	0.67	4.49	0.20	0.08
		Post-Project (69-kV)	0.45	1.75	6.55	0.58	0.24
		Post-Project (115-kV)	0.27	1.05	3.94	0.35	0.14

Representative Cross Section	ROW Segment	Modeling Case	Magnetic Field (mG)				
			50 ft from Left ROW Edge	Left ROW Edge	Maximum Within ROW	Right ROW Edge	50 ft from Right ROW Edge
Cross Section 4 (D-13148-NE sh. 4)	Quabbin Switch Tap	Pre-Project	0.46	2.25	13.13	1.73	0.40
		Post-Project (69-kV)	1.62	5.89	16.72	4.87	1.44
		Post-Project (115-kV)	0.97	3.52	9.98	2.91	0.86
Cross Section 5 (D-13148-NE sh. 5)	From Harrington St to Meadow St	Pre-Project	0.20	1.25	29.81	1.52	0.39
		Post-Project (69-kV)	0.47	2.34	25.74	2.09	0.62
		Post-Project (115-kV)	0.57	2.96	29.87	2.11	0.59
Cross Section 6 (D-13148-NE sh. 6)	From Deerfield 2 to Shutesbury	Pre-Project	0.70	3.80	37.31	3.21	0.45
		Post-Project (69-kV)	4.23	16.32	40.30	16.62	4.46
		Post-Project (115-kV)	4.78	18.36	45.28	19.08	5.10
Cross Section 7 (D-13148-NE sh. 7)	From Deerfield 2 to Shutesbury	Pre-Project	0.53	2.36	37.30	1.38	0.26
		Post-Project (69-kV)	3.51	11.86	38.34	9.99	3.24
		Post-Project (115-kV)	3.96	13.34	43.01	11.47	3.70
Cross Section 8 (D-13148-NE sh. 8)	From Deerfield 2 to Shutesbury	Pre-Project	0.94	6.43	37.31	1.91	0.32
		Post-Project (69-kV)	1.80	13.17	32.03	1.87	0.40
		Post-Project (115-kV)	1.90	14.46	36.36	2.29	0.52
	From Shutesbury to Quabbin Switch Tap	Pre-Project	1.06	6.75	36.23	1.58	0.23
		Post-Project (69-kV)	1.96	13.48	31.21	1.57	0.29
		Post-Project (115-kV)	1.99	14.59	35.67	2.10	0.45

Notes:
ft = Feet; kV = Kilovolt; mG = Milligauss; ROW = Right-of-Way; sh. = Sheet.

3.4.2 Electric Field Results

Pre- and post-Project EF modeling results for the representative cross sections are shown in Table 3.4 and the figures in Appendix C. In the Appendix C figures, Panel (a) shows the pre- and post-Project modeling results for annual average load levels, and Panel (b) shows the pre- and post-Project modeling results for system peak load levels; both panels show results for the post-Project 69-kV and 115-kV operating cases for the E5 and F6 lines. Although EFs are not dependent on conductor loading (*i.e.*, current), separate results are provided for annual average and system peak load levels due to small differences in voltages of the E5 and F6 circuits that were provided by National Grid for the two line loading scenarios. In all cases, the modeled edge-of-ROW EFs are well below the ICNIRP health-based guideline of 4.2 kV/m. For the 69-kV modeling cases, our modeling analysis indicates that the Project will frequently result in negligible changes to EFs at the ROW edges that are less than 0.02 kV/m and a maximum edge-of-ROW increase of 0.50 kV/m. For the 115-kV modeling cases, there are some slightly larger changes in EFs at the ROW

edges (ranging from -0.05 kV/m up to 0.86 kV/m), although edge-of-ROW EF levels remain low overall (all ≤0.9 kV/m).

Table 3.4 Summary of Modeled Pre-Project and Post-Project Electric Fields for the Representative ROW Cross Sections

Represent-ative Cross Section	ROW Segment	Loading Scenario	Scenario	Electric Field (kV/m)				
				50 ft from Left ROW Edge	Left ROW Edge	Maximum Within ROW	Right ROW Edge	50 ft from Right ROW Edge
Cross Section 1 (D-13148-NE sh. 1)	From Deerfield No. 4 Substation	Annual Average	Pre-Project	0.01	0.01	0.92	0.61	0.07
			Post (69-kV)	0.01	0.05	0.86	0.60	0.06
			Post (115-kV)	0.02	0.09	1.44	0.61	0.05
		System Peak	Pre-Project	0.01	0.03	0.97	0.62	0.06
			Post (69-kV)	0.02	0.06	0.92	0.62	0.07
			Post (115-kV)	0.03	0.09	1.47	0.63	0.06
Cross Section 2 (D-13148-NE sh. 2)	From Deerfield 4 to Deerfield 3 Tap	Annual Average	Pre-Project	0.01	0.03	1.00	0.03	0.01
			Post (69-kV)	0.01	0.05	0.86	0.04	0.01
			Post (115-kV)	0.02	0.08	1.43	0.06	0.02
		System Peak	Pre-Project	0.01	0.03	0.99	0.03	0.01
			Post (69-kV)	0.01	0.05	0.84	0.04	0.01
			Post (115-kV)	0.02	0.08	1.41	0.06	0.02
	From Deerfield 3 Tap to Deerfield 2	Annual Average	Pre-Project	0.01	0.03	0.99	0.03	0.01
			Post (69-kV)	0.01	0.05	0.85	0.04	0.01
			Post (115-kV)	0.02	0.08	1.42	0.06	0.02
		System Peak	Pre-Project	0.01	0.03	0.98	0.03	0.01
			Post (69-kV)	0.01	0.05	0.84	0.04	0.01
			Post (115-kV)	0.02	0.08	1.40	0.06	0.02
	From Deerfield 2 to Shutesbury	Annual Average	Pre-Project	0.01	0.03	0.99	0.03	0.01
			Post (69-kV)	0.01	0.05	0.85	0.04	0.01
			Post (115-kV)	0.02	0.08	1.42	0.06	0.02
		System Peak	Pre-Project	0.01	0.03	0.99	0.03	0.01
			Post (69-kV)	0.01	0.05	0.85	0.04	0.01
			Post (115-kV)	0.02	0.08	1.41	0.06	0.02
	From Shutesbury to Quabbin Switch Tap	Annual Average	Pre-Project	0.01	0.03	0.99	0.03	0.01
			Post (69-kV)	0.01	0.05	0.86	0.04	0.01
			Post (115-kV)	0.02	0.08	1.43	0.06	0.02
		System Peak	Pre-Project	0.01	0.03	0.99	0.03	0.01
			Post (69-kV)	0.01	0.05	0.85	0.04	0.01
			Post (115-kV)	0.02	0.08	1.41	0.06	0.02
	From Quabbin Switch Tap to Ware	Annual Average	Pre-Project	0.02	0.03	0.92	0.02	0.02
			Post (69-kV)	0.01	0.04	0.81	0.03	0.01
			Post (115-kV)	0.02	0.07	1.40	0.06	0.02
		System Peak	Pre-Project	0.02	0.03	0.91	0.02	0.02
			Post (69-kV)	0.01	0.04	0.81	0.03	0.01
			Post (115-kV)	0.02	0.07	1.38	0.06	0.02

Represent-ative Cross Section	ROW Segment	Loading Scenario	Scenario	Electric Field (kV/m)				
				50 ft from Left ROW Edge	Left ROW Edge	Maximum Within ROW	Right ROW Edge	50 ft from Right ROW Edge
	From Ware to Lashaway	Annual Average	Pre-Project	0.01	0.02	0.95	0.02	0.01
			Post (69-kV)	0.01	0.04	0.83	0.04	0.01
			Post (115-kV)	0.02	0.08	1.41	0.06	0.02
		System Peak	Pre-Project	0.01	0.02	0.96	0.03	0.01
			Post (69-kV)	0.01	0.04	0.83	0.04	0.01
			Post (115-kV)	0.02	0.08	1.39	0.06	0.02
	From Lashaway to Harrington St	Annual Average	Pre-Project	0.01	0.04	1.15	0.04	0.02
			Post (69-kV)	0.02	0.05	0.96	0.05	0.02
			Post (115-kV)	0.03	0.08	1.47	0.07	0.02
		System Peak	Pre-Project	0.01	0.03	1.10	0.04	0.01
			Post (69-kV)	0.02	0.05	0.89	0.04	0.01
			Post (115-kV)	0.03	0.08	1.43	0.07	0.02
	From Harrington St to Meadow St	Annual Average	Pre-Project	0.01	0.03	1.09	0.04	0.01
			Post (69-kV)	0.02	0.05	0.92	0.04	0.02
			Post (115-kV)	0.03	0.08	1.46	0.07	0.02
		System Peak	Pre-Project	0.01	0.03	0.97	0.03	0.01
			Post (69-kV)	0.02	0.05	0.89	0.04	0.01
			Post (115-kV)	0.03	0.08	1.45	0.07	0.02
	From Meadow St to Leicester	Annual Average	Pre-Project	0.01	0.03	0.99	0.03	0.01
			Post (69-kV)	0.01	0.05	0.86	0.04	0.01
			Post (115-kV)	0.02	0.08	1.43	0.06	0.02
		System Peak	Pre-Project	0.01	0.03	0.98	0.03	0.01
			Post (69-kV)	0.01	0.05	0.85	0.04	0.01
			Post (115-kV)	0.02	0.08	1.41	0.06	0.02
	From Leicester to Pondville	Annual Average	Pre-Project	0.01	0.03	0.99	0.03	0.01
			Post (69-kV)	0.01	0.05	0.86	0.04	0.01
			Post (115-kV)	0.02	0.08	1.43	0.06	0.02
		System Peak	Pre-Project	0.01	0.03	0.98	0.03	0.01
			Post (69-kV)	0.01	0.05	0.85	0.04	0.01
			Post (115-kV)	0.02	0.08	1.41	0.06	0.02
	From Pondville to Millbury	Annual Average	Pre-Project	0.01	0.02	0.95	0.02	0.01
			Post (69-kV)	0.01	0.04	0.82	0.03	0.01
			Post (115-kV)	0.02	0.08	1.41	0.06	0.02
		System Peak	Pre-Project	0.02	0.02	0.92	0.02	0.02
			Post (69-kV)	0.02	0.04	0.80	0.03	0.01
			Post (115-kV)	0.02	0.07	1.39	0.06	0.02
Cross Section 3 (D-13148-NE sh. 3)	Deerfield 3 Tap	Annual Average	Pre-Project	0.04	0.12	0.61	0.12	0.04
			Post (69-kV)	0.07	0.30	1.07	0.30	0.07
			Post (115-kV)	0.12	0.50	1.79	0.50	0.12
		System Peak	Pre-Project	0.04	0.12	0.61	0.12	0.04
			Post (69-kV)	0.07	0.30	1.06	0.30	0.07
			Post (115-kV)	0.11	0.50	1.77	0.50	0.11

Represent-ative Cross Section	ROW Segment	Loading Scenario	Scenario	Electric Field (kV/m)				
				50 ft from Left ROW Edge	Left ROW Edge	Maximum Within ROW	Right ROW Edge	50 ft from Right ROW Edge
Cross Section 4 (D-13148-NE sh. 4)	Quabbin Switch Tap	Annual Average	Pre-Project	0.04	0.17	0.80	0.33	0.06
			Post (69-kV)	0.01	0.08	0.83	0.27	0.01
			Post (115-kV)	0.02	0.13	1.39	0.44	0.02
		System Peak	Pre-Project	0.04	0.17	0.79	0.33	0.06
			Post (69-kV)	0.01	0.08	0.83	0.26	0.01
			Post (115-kV)	0.02	0.13	1.38	0.44	0.02
Cross Section 5 (D-13148-NE sh. 5)	From Harrington St to Meadow St	Annual Average	Pre-Project	0.01	0.03	1.90	0.39	0.07
			Post (69-kV)	0.01	0.07	1.91	0.39	0.07
			Post (115-kV)	0.01	0.09	1.95	0.39	0.07
		System Peak	Pre-Project	0.01	0.01	1.90	0.39	0.07
			Post (69-kV)	0.01	0.06	1.90	0.39	0.07
			Post (115-kV)	0.01	0.09	1.95	0.39	0.07
Cross Section 6 (D-13148-NE sh. 6)	From Deerfield 2 to Shutesbury	Annual Average	Pre-Project	0.01	0.03	0.96	0.04	0.01
			Post (69-kV)	0.07	0.44	1.03	0.54	0.09
			Post (115-kV)	0.12	0.73	1.72	0.90	0.15
		System Peak	Pre-Project	0.01	0.03	0.96	0.04	0.01
			Post (69-kV)	0.07	0.44	1.03	0.53	0.09
			Post (115-kV)	0.12	0.73	1.71	0.89	0.15
Cross Section 7 (D-13148-NE sh. 7)	From Deerfield 2 to Shutesbury	Annual Average	Pre-Project	0.01	0.03	0.96	0.02	0.01
			Post (69-kV)	0.06	0.30	1.02	0.30	0.06
			Post (115-kV)	0.10	0.50	1.70	0.50	0.10
		System Peak	Pre-Project	0.01	0.03	0.96	0.02	0.01
			Post (69-kV)	0.06	0.29	1.01	0.30	0.06
			Post (115-kV)	0.09	0.49	1.69	0.49	0.10
Cross Section 8 (D-13148-NE sh. 8)	From Deerfield 2 to Shutesbury	Annual Average	Pre-Project	0.03	0.07	0.98	0.03	0.00
			Post (69-kV)	0.03	0.36	0.85	0.03	0.01
			Post (115-kV)	0.04	0.61	1.42	0.05	0.02
		System Peak	Pre-Project	0.03	0.07	0.98	0.03	0.00
			Post (69-kV)	0.03	0.36	0.85	0.03	0.01
			Post (115-kV)	0.04	0.60	1.41	0.05	0.02
	From Shutesbury to Quabbin Switch Tap	Annual Average	Pre-Project	0.03	0.07	0.99	0.03	0.00
			Post (69-kV)	0.03	0.36	0.85	0.03	0.01
			Post (115-kV)	0.04	0.61	1.43	0.05	0.02
		System Peak	Pre-Project	0.03	0.07	0.98	0.03	0.00
			Post (69-kV)	0.03	0.36	0.85	0.03	0.01
			Post (115-kV)	0.04	0.60	1.41	0.05	0.02

Notes:
ft = Feet; kV = Kilovolt; kV/m = Kilovolts Per Meter; ROW = Right-of-Way; sh. = Sheet.

4 Conclusions

Gradient performed an independent EMF assessment for the National Grid 69-kV E5/F6 Line Rebuild Millbury No. 305 to Deerfield No. 4 Project, which involves reconductoring the existing 69-kV overhead E5 and F6 lines, including taps, and replacing the existing steel lattice tower structures between the Millbury No. 305 Substation in Millbury, Massachusetts, and the Deerfield No. 4 Substation in Deerfield, Massachusetts. The total Project route is approximately 67 miles in length (including the two tap lines to be refurbished). As discussed in this report, EMF modeling was conducted at a height of 1 meter (3.28 feet) above the ground surface for 8 representative ROW cross sections. EMF modeling was performed for a pre-Project case, as well as two post-Project cases, namely for an in-service year case assuming the E5 and F6 lines operate at 69-kV and for an in-service year case assuming the lines operate at 115-kV. For each case, EMF modeling was conducted for both annual average and system peak load levels.

As described in this report, our EMF modeling analysis demonstrated that all model-predicted, post-Project MF levels for the representative cross sections, including for both annual average and system peak load levels, are well below the ICNIRP health-based guideline for allowable public exposure to 60-Hz MF (2,000 mG; ICNIRP, 2010). Due in part to the higher post-Project load levels for both the E5 and F6 circuits, in particular for the 115-kV operation case, the Project will generally result in small increases to edge-of-ROW MF levels for the representative cross sections (frequently <1 mG and <1-2 mG for annual average and system peak load levels, respectively). The EMF modeling analysis also showed that, for the representative cross sections, all model-predicted, post-Project edge-of-ROW EF levels are well below the ICNIRP health-based guideline for allowable public exposure to 60-Hz EF (4.2 kV/m; ICNIRP, 2010). Our modeling analysis indicates that the Project will result in only small changes to EFs at the ROW edges across the modeling results (*i.e.*, all edge-of-ROW EF changes were $\leq$0.5 kV/m and <0.9 kV/m for the post-Project 69-kV and 115-kV operating cases, respectively).

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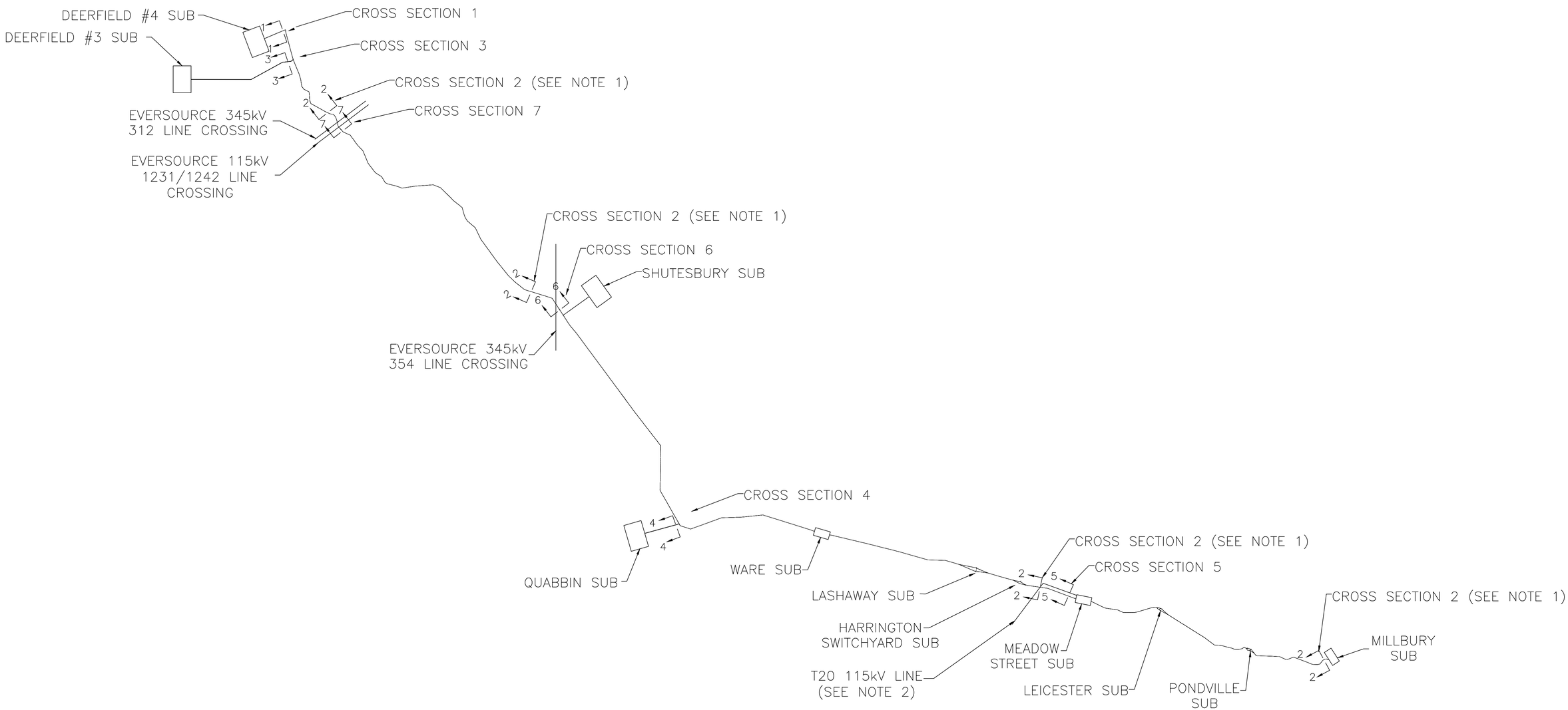
Appendix A

Project Route Overview Map and Representative Pre-Project and Post-Project ROW Overhead Line Cross Sections

CONFIDENTIALITY STATEMENT: THIS DOCUMENT CONTAINS CONFIDENTIAL AND PROPRIETARY INFORMATION OF NATIONAL GRID SOLELY IN CONNECTION WITH THE SPECIFIC PROJECT FOR WHICH IT HAS BEEN TRANSMITTED. ANY OTHER USE, ITS TRANSMITTAL TO THIRD PARTIES, OR ITS REPRODUCTION WITHOUT PRIOR EXPRESS WRITTEN AUTHORIZATION OF NATIONAL GRID IS STRICTLY PROHIBITED.



PLAN VIEW MILLBURY TO DEERFIELD NO. 4 EMF OVERVIEW MAP

NOTES:
1. CROSS SECTION 2 IS REPRESENTATIVE OF MULTIPLE AREAS ON THE MAIN LINE. HOWEVER, SOME LOCATIONS HAVE A VARYING RIGHT OF WAY WIDTH, AS DISPLAYED ON B-13148-NE CROSS SECTION 8.
2. T20 LINE WILL BE DESIGNED TO ACCOMMODATE 115kV BUT OPERATED AT 69kV. FOR THE EMF ANALYSIS, 115kV SHOULD BE ASSUMED.

VER	DATE	VERSION DESCRIPTION	PREPARED/REVIEWED/APPROVED
1	11/03/23	ISSUED WITH EMF BID PACKAGE	PBR/ ACW/ LMD

VERSION 1

PREPARED BY	PBR	11/03/23
REVIEWED BY	ACW	11/03/23
APPROVED BY	LMD	11/03/23
SCALE	NTS	
SHEET	1 OF 1	
INDEX		

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E5/F6 LINE REBUILD & UPGRADE

MILLBURY TO DEERFIELD NO. 4 EMF
OVERVIEW MAP

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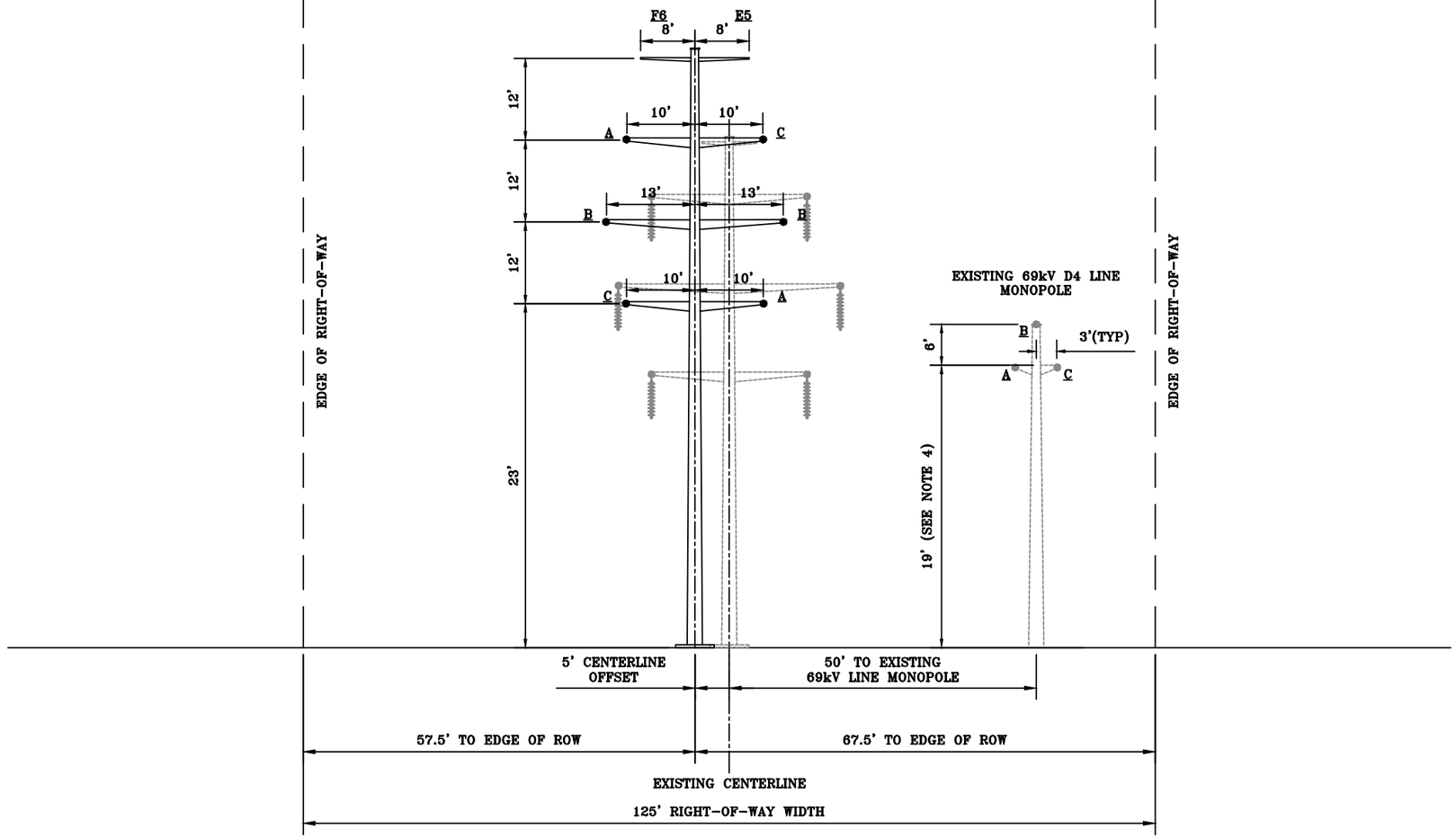
INCHES ON ORIGINAL

B-13148-NE

PROPOSED 115kV MONOPOLE
EXISTING 69kV TO BE REMOVED
(SEE NOTE 1)



CROSS SECTION 1
LOOKING AHEAD ON LINE TOWARDS DEERFIELD #4 SUB
SEE EMF OVERVIEW MAP FOR STRUCTURE LOCATIONS

NOTES:
1. PROPOSED E5/F6 LINES SHALL BE OPERATED AT 69kV BUT DESIGNED TO ACCOMMODATE 115kV. EMF ANALYSIS REQUIRED AT BOTH 69kV AND 115kV VOLTAGES.
2. SEE TABLES IN APPENDIX FOR EXISTING STRUCTURE GEOMETRY.
3. PHASE SPACING FROM CIRCUIT TO CIRCUIT MAY SLIGHTLY VARY FROM DIMENSIONS SHOWN DEPENDING ON PROPOSED POLE DIAMETERS, WHICH HAVE NOT YET BEEN DETERMINED.
4. THE WIRE SAG UNDER MAXIMUM OPERATING CONDITIONS FOR THE D4 LINE IS UNKNOWN, BUT IS ASSUMED AS CURRENT NESC CODE MINIMUM GROUND CLEARANCE FOR 69kV FOR LAND TRAVERSED BY VEHICLES.

NOT FOR CONSTRUCTION

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E5/F6 LINE REBUILD & UPGRADE
MILLBURY SUB TO DEERFIELD #4 SUB
69kV TRANSMISSION LINE
EMF CROSS SECTION DRAWINGS

SCALE: NTS REV: 1 SHEET 1 OF 8 DATE: 11/03/23

INCHES ON ORIGINAL

B-13148-NE

REVISIONS						
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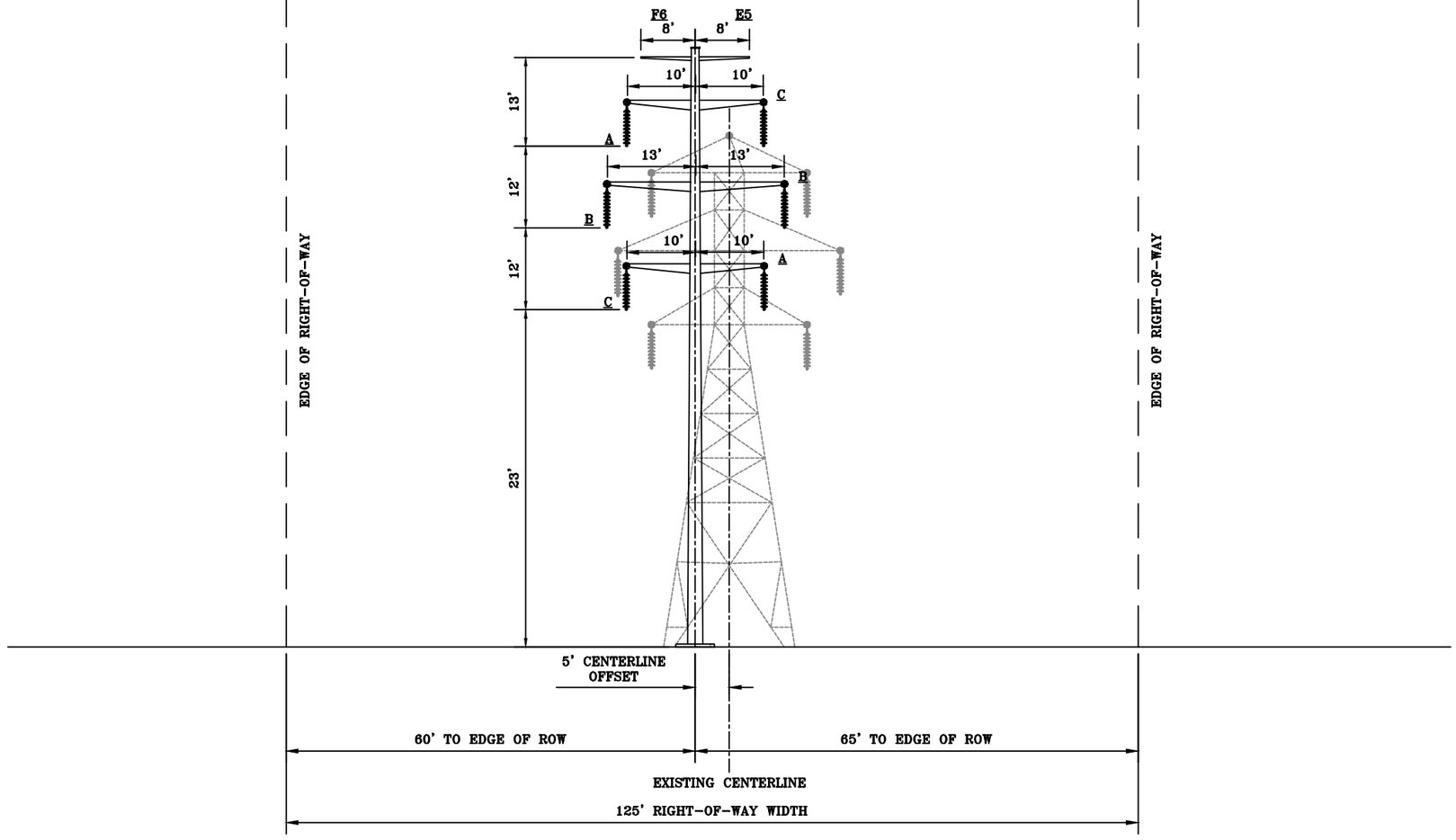
REVIEWED	
APPROVED	LMD

INCHES

B-13148-NE

PROPOSED 115kV MONOPOLE
EXISTING 69kV TO BE REMOVED
(SEE NOTE 1)



CROSS SECTION 2

LOOKING AHEAD ON LINE TOWARDS DEERFIELD #4 SUB

SEE EMF OVERVIEW 1 FOR STRUCTURE LOCATIONS

NOTES:
1. PROPOSED E5/F6 LINES SHALL BE OPERATED AT 69kV BUT DESIGNED TO ACCOMMODATE 115kV. EMF ANALYSIS REQUIRED AT BOTH 69kV AND 115kV VOLTAGES.
2. SEE TABLES IN APPENDIX FOR EXISTING STRUCTURE GEOMETRY.
3. PHASE SPACING FROM CIRCUIT TO CIRCUIT MAY SLIGHTLY VARY FROM DIMENSIONS SHOWN DEPENDING ON PROPOSED POLE DIAMETERS, WHICH HAVE NOT YET BEEN DETERMINED.
4. DEADEND STRUCTURE LOCATIONS WILL HAVE SLIGHT VARIATION IN ARM LENGTH DUE TO LINE ANGLE.
5. DISTRIBUTION LINES ARE LOCATED ADJACENT TO SOME SPANS ON THE MAIN LINE, BUT ARE NOT INFREQUENT AND INTERMITTENT AND ARE THEREFORE NOT DEPICTED IN THE CROSS SECTION.
6. DUE TO CONSTRUCTION CONSIDERATIONS AT ANGLES, STRUCTURE PLACEMENT IN RIGHT-OF-WAY VARIES IN THESE LOCATIONS. THE CROSS SECTION SHOWN REPRESENTS MOST LOCATION ASSOCIATED WITH THIS CROSS SECTION. HOWEVER, ANGLE STRUCTURES MAY SEE LEFT EDGE OF RIGHT-OF-WAY REDUCED TO UP TO APPROXIMATELY 30 FT.
7. EXISTING RIGHT-OF-WAY WIDTH IN MANY AREAS OF THE LINE IS UNKNOWN OR UNDEFINED. THESE AREAS ARE ASSUMED TO HAVE A 125 FT WIDTH, CENTERED ON THE EXISTING LINE, BASED ON FEEDBACK FROM REAL ESTATE.

NOT FOR CONSTRUCTION

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E5/F6 LINE REBUILD & UPGRADE
MILLBURY SUB TO DEERFIELD #4 SUB
69kV TRANSMISSION LINE
EMF CROSS SECTION DRAWINGS

SCALE: NTS REV: 1 SHEET 2 OF 8 DATE: 11/03/23

B-13148-NE

INCHES ON ORIGINAL

REVISIONS

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ORIGINAL

DATE 11/03/23	
DESIGNED	AM
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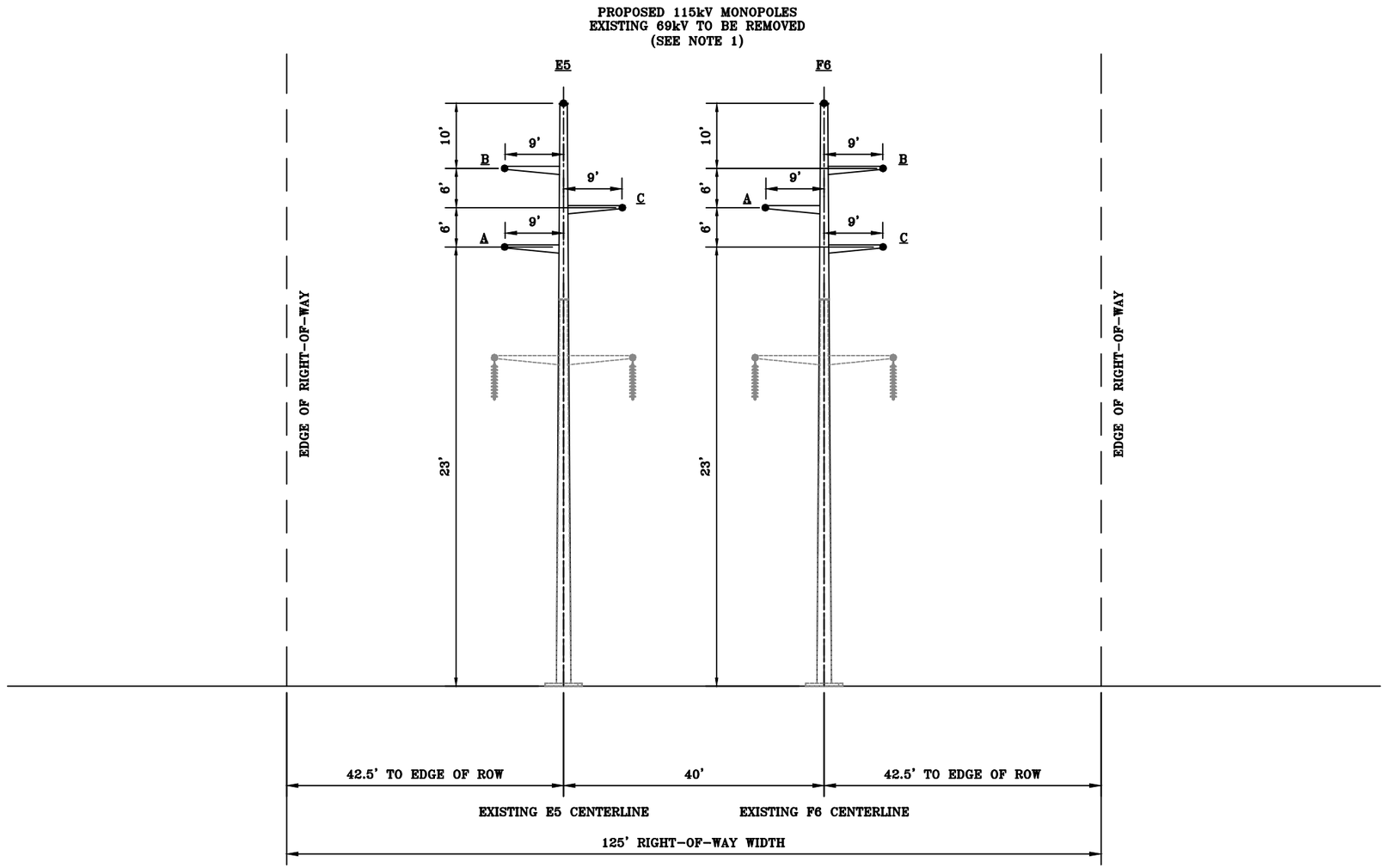
APPROVED	LMD

INCHES ON ORIGINAL

B-13148-NE



CROSS SECTION 3

LOOKING AHEAD ON LINE TOWARDS DEERFIELD #3 SUB

SEE EMF OVERVIEW MAP FOR STRUCTURE LOCATIONS

NOTES:
1. PROPOSED E5/F6 LINES SHALL BE OPERATED AT 69 kV BUT DESIGNED TO ACCOMMODATE 115kV. EMF ANALYSIS REQUIRED AT BOTH 69kV AND 115kV VOLTAGES.
2. SEE TABLES IN APPENDIX FOR EXISTING STRUCTURE GEOMETRY.
3. PHASE SPACING FROM CIRCUIT TO CIRCUIT MAY SLIGHTLY VARY FROM DIMENSIONS SHOWN DEPENDING ON PROPOSED POLE DIAMETERS, WHICH HAVE NOT YET BEEN DETERMINED.

NOT FOR CONSTRUCTION

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E5/F6 LINE REBUILD & UPGRADE
MILLBURY SUB TO DEERFIELD #4 SUB
69kV TRANSMISSION LINE
EMF CROSS SECTION DRAWINGS

SCALE: NTS REV: 1 SHEET 3 OF 8 DATE: 11/03/23

INCHES ON ORIGINAL

B-13148-NE

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DATE	11/03/23	
DESIGNED	AM	
CHECKED	AW	
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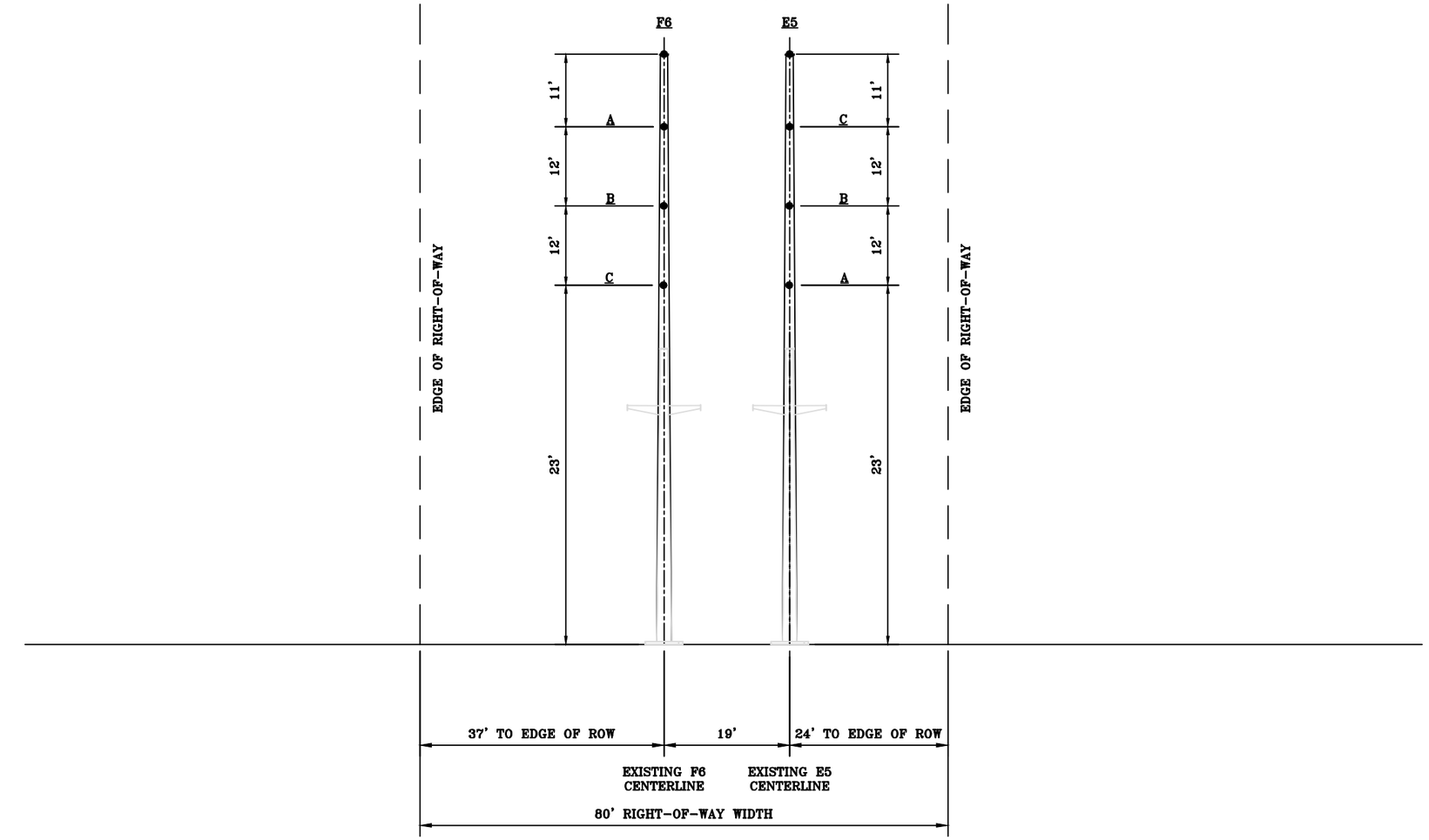
CHECKED		
REVIEWED		
APPROVED	LMD	

INCHES ON ORIGINAL

B-13148-NE

PROPOSED 115kV MONOPOLES
EXISTING 69kV TO BE REMOVED
(SEE NOTE 1)



CROSS SECTION 4
LOOKING AHEAD ON LINE TOWARDS QUABBIN SUB
SEE EMF OVERVIEW MAP FOR STRUCTURE LOCATIONS

NOTES:
1. PROPOSED E5/F6 LINES SHALL BE OPERATED AT 69kV BUT DESIGNED TO ACCOMMODATE 115kV. EMF ANALYSIS REQUIRED AT BOTH 69kV AND 115kV VOLTAGES.
2. SEE TABLES IN APPENDIX FOR EXISTING STRUCTURE GEOMETRY.
3. PHASE SPACING FROM CIRCUIT TO CIRCUIT MAY SLIGHTLY VARY FROM DIMENSIONS SHOWN DEPENDING ON PROPOSED POLE DIAMETERS, WHICH HAVE NOT YET BEEN DETERMINED.

NOT FOR CONSTRUCTION

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E5/F6 LINE REBUILD & UPGRADE
MILLBURY SUB TO DEERFIELD #4 SUB
69kV TRANSMISSION LINE
EMF CROSS SECTION DRAWINGS

SCALE: NTS REV: 1 SHEET 4 OF 8 DATE: 11/03/23

INCHES ON ORIGINAL

B-13148-NE

REVISIONS

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ORIGINAL

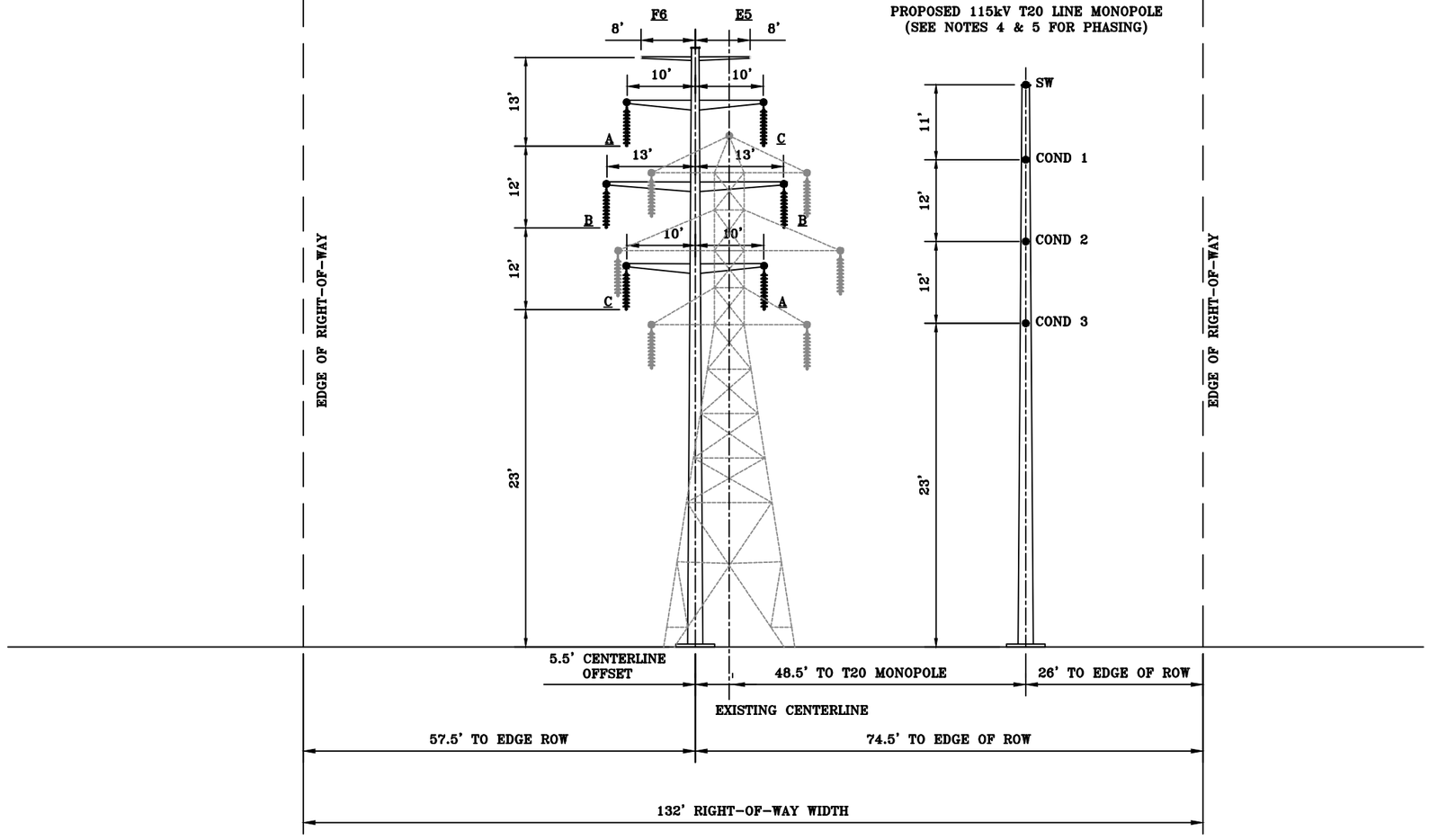
DATE	11/03/23	
DESIGNED	AM	
CHECKED	AW	
DRAWN	EAF	
CHECKED		
REVIEWED		
APPROVED	LMD	

INCHES ON ORIGINAL

B-13148-NE

PROPOSED 115kV MONOPOLE
EXISTING 69kV TO BE REMOVED
(SEE NOTE 1)

PROPOSED 115kV T20 LINE MONOPOLE
(SEE NOTES 4 & 5 FOR PHASING)



CROSS SECTION 5
LOOKING AHEAD ON LINE TOWARDS HARRINGTON SWITCHYARD
SEE EMF OVERVIEW MAP FOR STRUCTURE LOCATIONS

NOTES:
1. PROPOSED E5/F6 LINES SHALL BE OPERATED AT 69kV BUT DESIGNED TO ACCOMMODATE 115kV. EMF ANALYSIS REQUIRED AT BOTH 69kV AND 115kV VOLTAGES.
2. SEE TABLES IN APPENDIX FOR EXISTING STRUCTURE GEOMETRY.
3. PHASE SPACING FROM CIRCUIT TO CIRCUIT MAY SLIGHTLY VARY FROM DIMENSIONS SHOWN DEPENDING ON PROPOSED POLE DIAMETERS, WHICH HAVE NOT YET BEEN DETERMINED.
4. THE T20 LINE WILL OPERATE AT 69kV BUT DESIGNED TO ACCOMMODATE 115kV. EMF ANALYSIS SHOULD ASSUME 115kV OPERATION. PHASING OF THIS LINE IS UNKNOWN. FOR THE PURPOSE OF THE ANALYSIS, THE PHASING CONFIGURATION WHICH GENERATES THE LARGEST EMF SHALL BE CONSIDERED,
5. T20 STRUCTURE FRAMING AND CENTERLINE DETAILS ARE PRELIMINARY.

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E5/F6 LINE REBUILD & UPGRADE
MILLBURY SUB TO DEERFIELD #4 SUB
69kV TRANSMISSION LINE
EMF CROSS SECTION DRAWINGS

SCALE: NTS REV: 1 SHEET 5 OF 8 DATE: 11/03/23

B-13148-NE

INCHES ON ORIGINAL

REVISIONS						
REV.	DATE	DESCRIPTION	MADE	CHECKED	INSPECTED	APPROVED	APPROVED
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ORIGINAL

DATE 11/03/23	
DESIGNED	AM
CHECKED	AW
DRAWN	EAF
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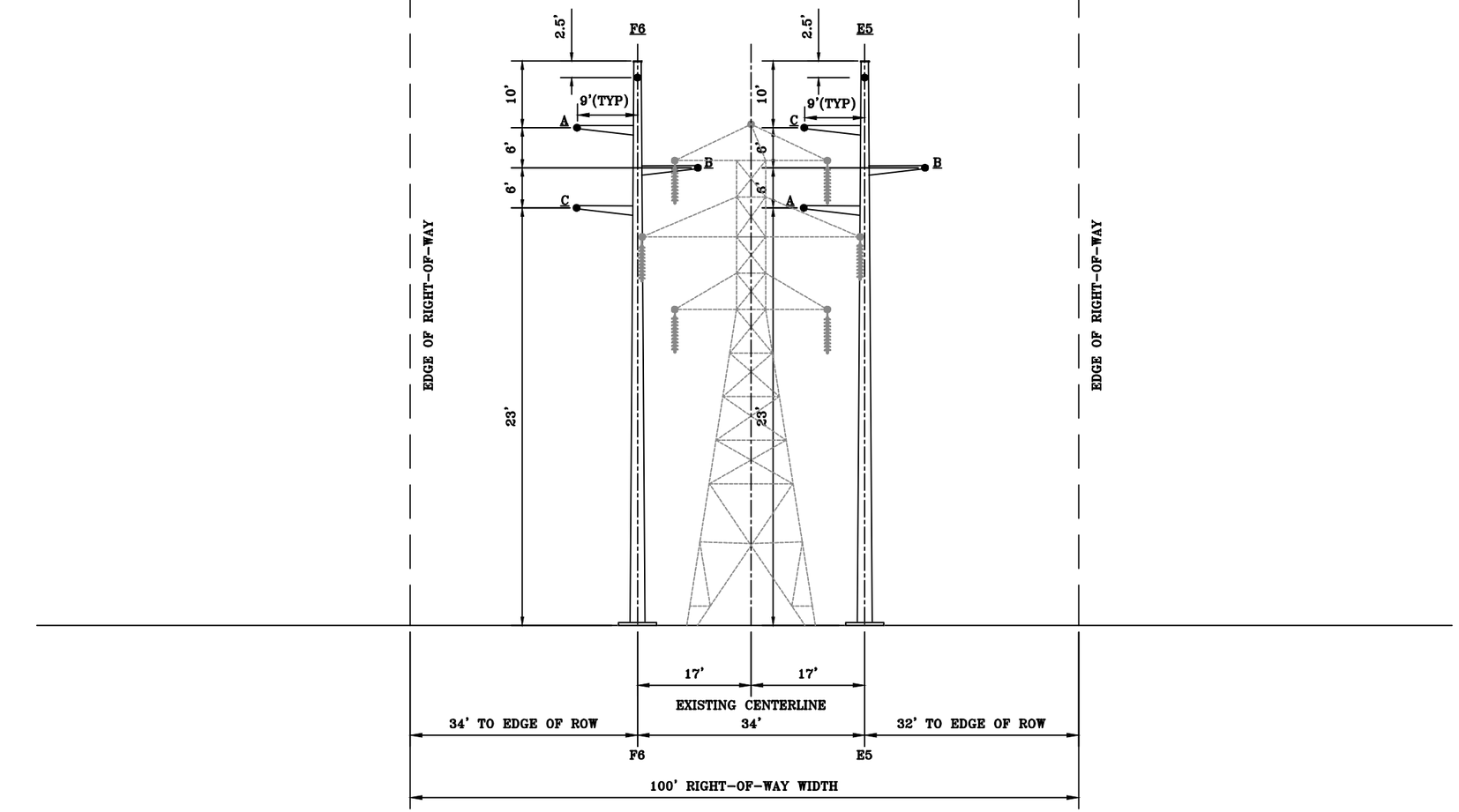
REVIEWED	
APPROVED	LMD

INCHES ON ORIGINAL

B-13148-NE

PROPOSED 115kV MONOPOLES
EXISTING 69kV TO BE REMOVED
(SEE NOTE 1)



CROSS SECTION 6
LOOKING AHEAD ON LINE TOWARDS DEERFIELD #4 SUB
SEE EMF OVERVIEW MAP FOR STRUCTURE LOCATIONS

NOTES:
1. PROPOSED E5/F6 LINES SHALL BE OPERATED AT 69kV BUT DESIGNED TO ACCOMMODATE 115kV. EMF ANALYSIS REQUIRED AT BOTH 69kV AND 115kV VOLTAGES.
2. SEE TABLES IN APPENDIX FOR EXISTING STRUCTURE GEOMETRY.
3. PHASE SPACING FROM CIRCUIT TO CIRCUIT MAY SLIGHTLY VARY FROM DIMENSIONS SHOWN DEPENDING ON PROPOSED POLE DIAMETERS, WHICH HAVE NOT YET BEEN DETERMINED.

NOT FOR CONSTRUCTION

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E5/F6 LINE REBUILD & UPGRADE
MILLBURY SUB TO DEERFIELD #4 SUB
69kV TRANSMISSION LINE
EMF CROSS SECTION DRAWINGS

SCALE: NTS REV: 1 SHEET 6 OF 8 DATE: 11/03/23

INCHES ON ORIGINAL

B-13148-NE

REVISIONS

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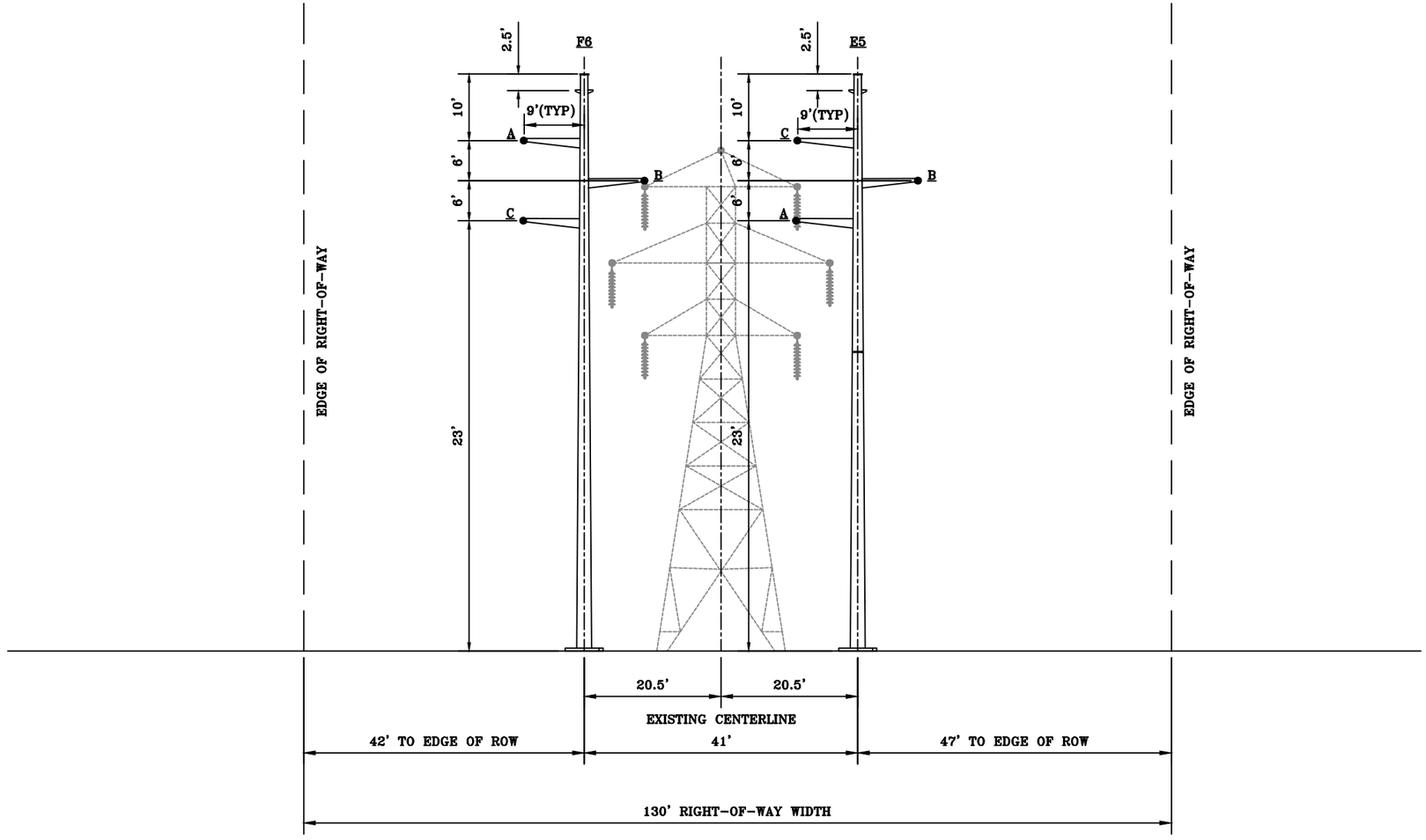
ORIGINAL

DATE	11/03/23
DESIGNED	AM
CHECKED	AW
DRAWN	EAF
CHECKED	
REVIEWED	
APPROVED	LMD

INCHES ON ORIGINAL

B-13148-NE

PROPOSED 115kV MONOPOLES
EXISTING 69kV TO BE REMOVED
(SEE NOTE 1)



CROSS SECTION 7
LOOKING AHEAD ON LINE TOWARDS DEERFIELD #4 SUB
SEE EMF OVERVIEW MAP FOR STRUCTURE LOCATIONS

NOTES:
1. PROPOSED E5/F6 LINES SHALL BE OPERATED AT 69kV BUT DESIGNED TO ACCOMMODATE 115kV. EMF ANALYSIS REQUIRED AT BOTH 69kV AND 115kV VOLTAGES.
2. SEE TABLES IN APPENDIX FOR EXISTING STRUCTURE GEOMETRY.
3. PHASE SPACING FROM CIRCUIT TO CIRCUIT MAY SLIGHTLY VARY FROM DIMENSIONS SHOWN DEPENDING ON PROPOSED POLE DIAMETERS, WHICH HAVE NOT YET BEEN DETERMINED.

NOT FOR CONSTRUCTION

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E5/F6 LINE REBUILD & UPGRADE
MILLBURY SUB TO DEERFIELD #4 SUB
69kV TRANSMISSION LINE
EMF CROSS SECTION DRAWINGS

SCALE: NTS REV: 1 SHEET 7 OF 8 DATE: 11/03/23

INCHES ON ORIGINAL

B-13148-NE

REVISIONS

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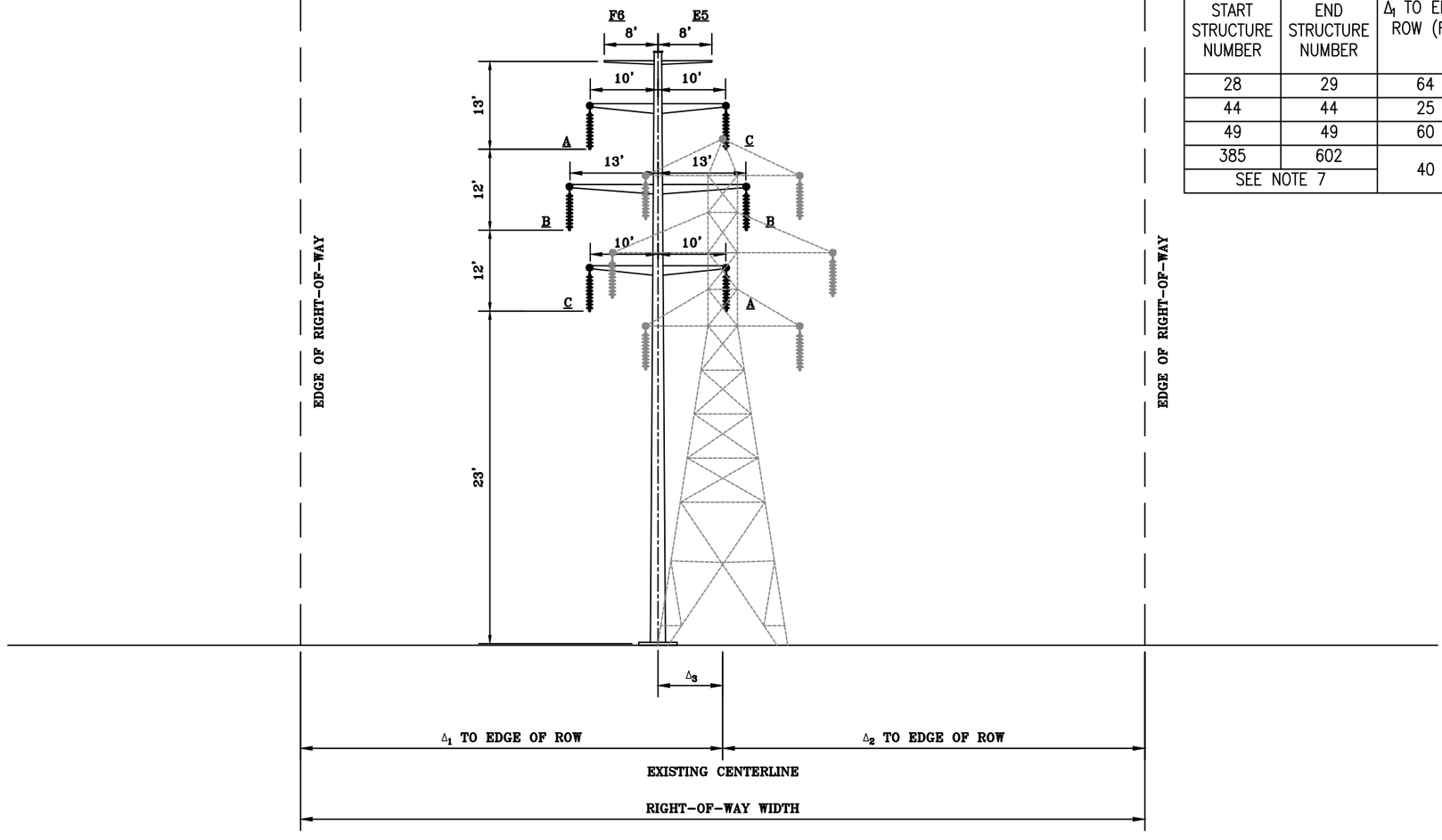
ORIGINAL

DATE	11/03/23	
DESIGNED	AM	1
CHECKED	AW	2
DRAWN	EAF	3
CHECKED		4
REVIEWED		5
APPROVED	LMD	6

B-13148-NE

PROPOSED 115kV MONOPOLE
EXISTING 69kV TO BE REMOVED
(SEE NOTE 1)



PROPOSED START STRUCTURE NUMBER	PROPOSED END STRUCTURE NUMBER	Δ_1 TO EDGE ROW (FT)	Δ_2 TO EDGE ROW (FT)	ROW WIDTH (FT)	PROPOSED STRUCTURE CENTERLINE OFFSET (Δ_3) (FT)
28	29	64	41	105	4.5
44	44	25	55	80	2
49	49	60	40	100	5
385	602	40	60	100	10
SEE NOTE 7					

CROSS SECTION 8
LOOKING AHEAD ON LINE TOWARDS DEERFIELD #4 SUB
SEE EMF OVERVIEW MAP FOR STRUCTURE LOCATIONS

NOTES:
1. PROPOSED E5/F6 LINES SHALL BE OPERATED AT 69kV BUT DESIGNED TO ACCOMMODATE 115kV. EMF ANALYSIS REQUIRED AT BOTH 69kV AND 115kV VOLTAGES.
2. SEE TABLES IN APPENDIX FOR EXISTING STRUCTURE GEOMETRY.
3. PHASE SPACING FROM CIRCUIT TO CIRCUIT MAY SLIGHTLY VARY FROM DIMENSIONS SHOWN DEPENDING ON PROPOSED POLE DIAMETERS, WHICH HAVE NOT YET BEEN DETERMINED.
4. DEADEND STRUCTURE LOCATIONS WILL HAVE SLIGHT VARIATION IN ARM LENGTH DUE TO LINE ANGLE.
5. DISTRIBUTION LINES ADJACENT TO SOME SPANS ON THE MAIN LINE, BUT ARE INFREQUENT AND INTERMITTENT AND ARE THEREFORE NOT DEPICTED IN THE CROSS SECTION.
6. LOCATIONS IN TABLE ABOVE ONLY CONSIDER UNIQUE RIGHT-OF-WAY AREAS WHERE WIDTH IS LESS THAN 125 FT. WIDER EASEMENTS ARE NOT LISTED AS THE EMF AT EDGE OF RIGHT-OF-WAY WOULD BE REDUCED COMPARED TO THE SCENARIO SHOWN IN SHEET 2. REDUCED EASEMENT WIDTH SOUTHEAST OF PONDVILLE SUSTATION NOT INCLUDED DUE TO EASEMENT ACQISITION BEING UNDERWAY.
7. 100 FT ROW OCCURS INTERMITTENTLY FROM STR.385 TO STR.602.

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E5/F6 LINE REBUILD & UPGRADE
MILLBURY SUB TO DEERFIELD #4 SUB
69kV TRANSMISSION LINE
EMF CROSS SECTION DRAWINGS

SCALE: NTS REV: 1 SHEET 8 OF 8 DATE: 11/03/23

B-13148-NE

INCHES ON ORIGINAL

REVISIONS						
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ORIGINAL

DATE 11/03/23	
DESIGNED	AM
CHECKED	AW
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REVIEWED	
APPROVED	LMD

INCHES ON ORIGINAL

Appendix B

Magnetic Field Profiles for Each Representative ROW Cross Section

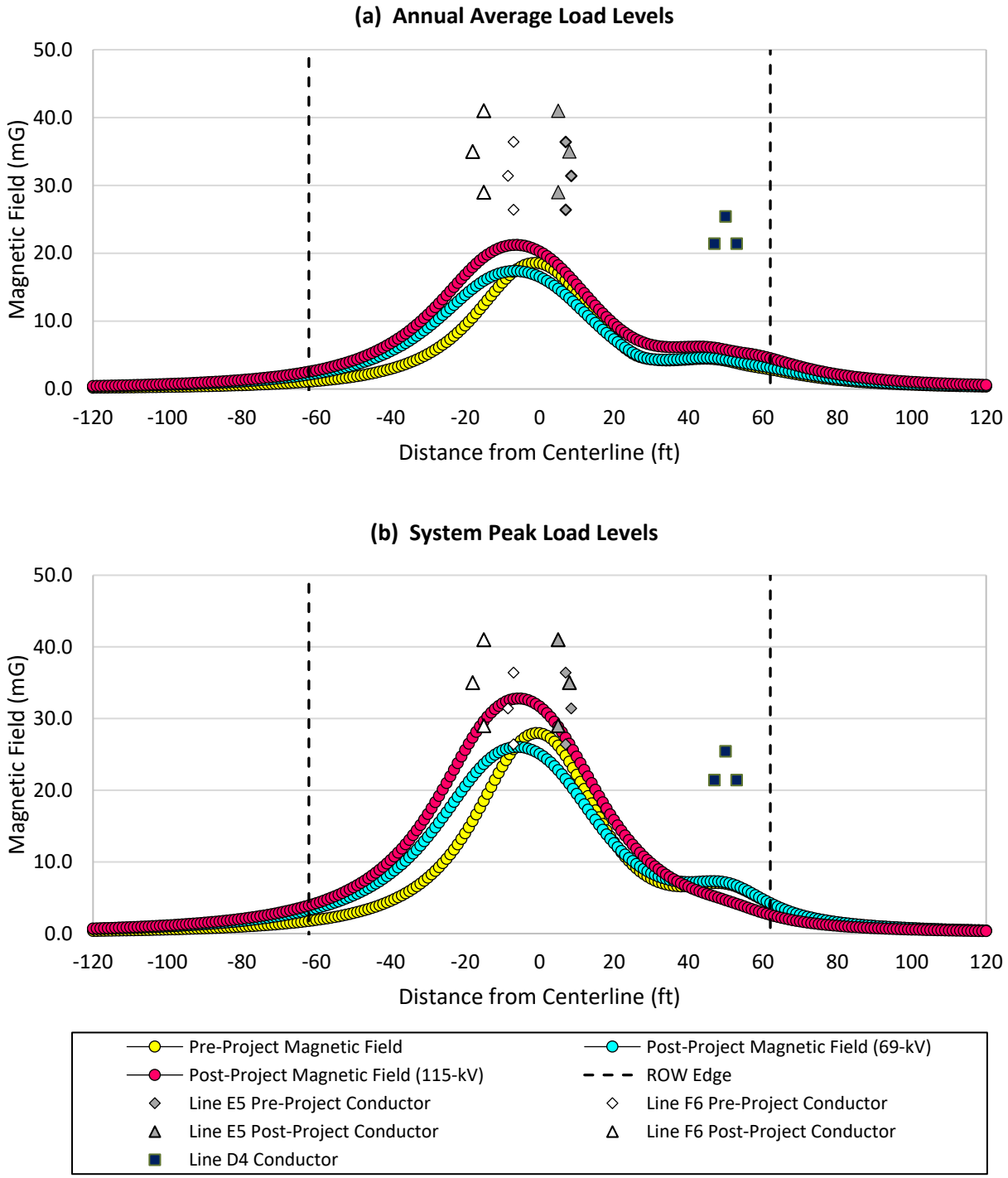

Figure B.1 Magnetic Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 1 (B-13148-NE Sheet 1, ROW Segment from Deerfield No. 4 Substation). ft = Feet; kV = Kilovolt; mG = Milligauss; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

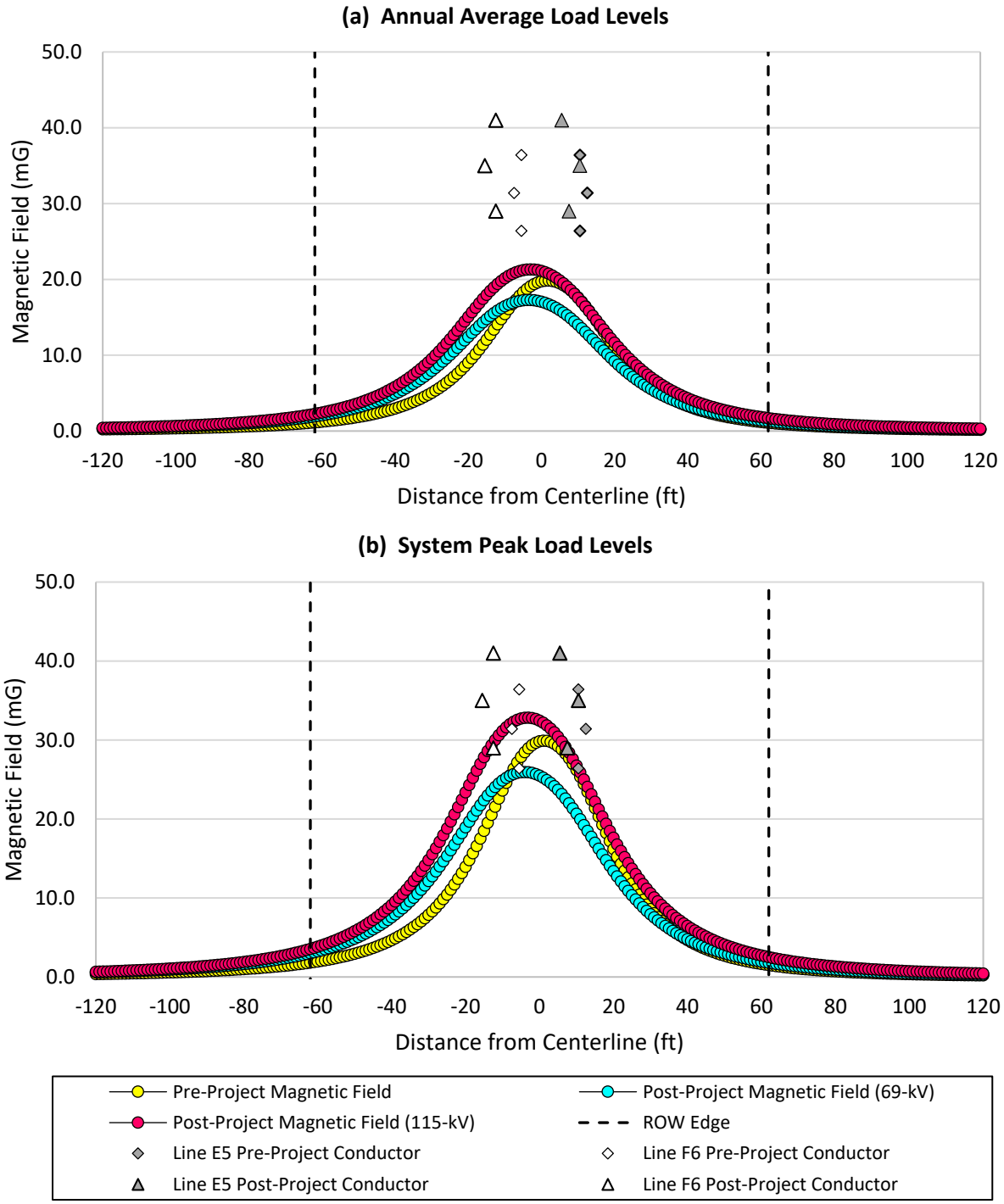

Figure B.2 Magnetic Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 2 (B-13148-NE Sheet 2, ROW Segment from Deerfield 4 to Deerfield 3 Tap). ft = Feet; kV = Kilovolt; mG = Milligauss; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

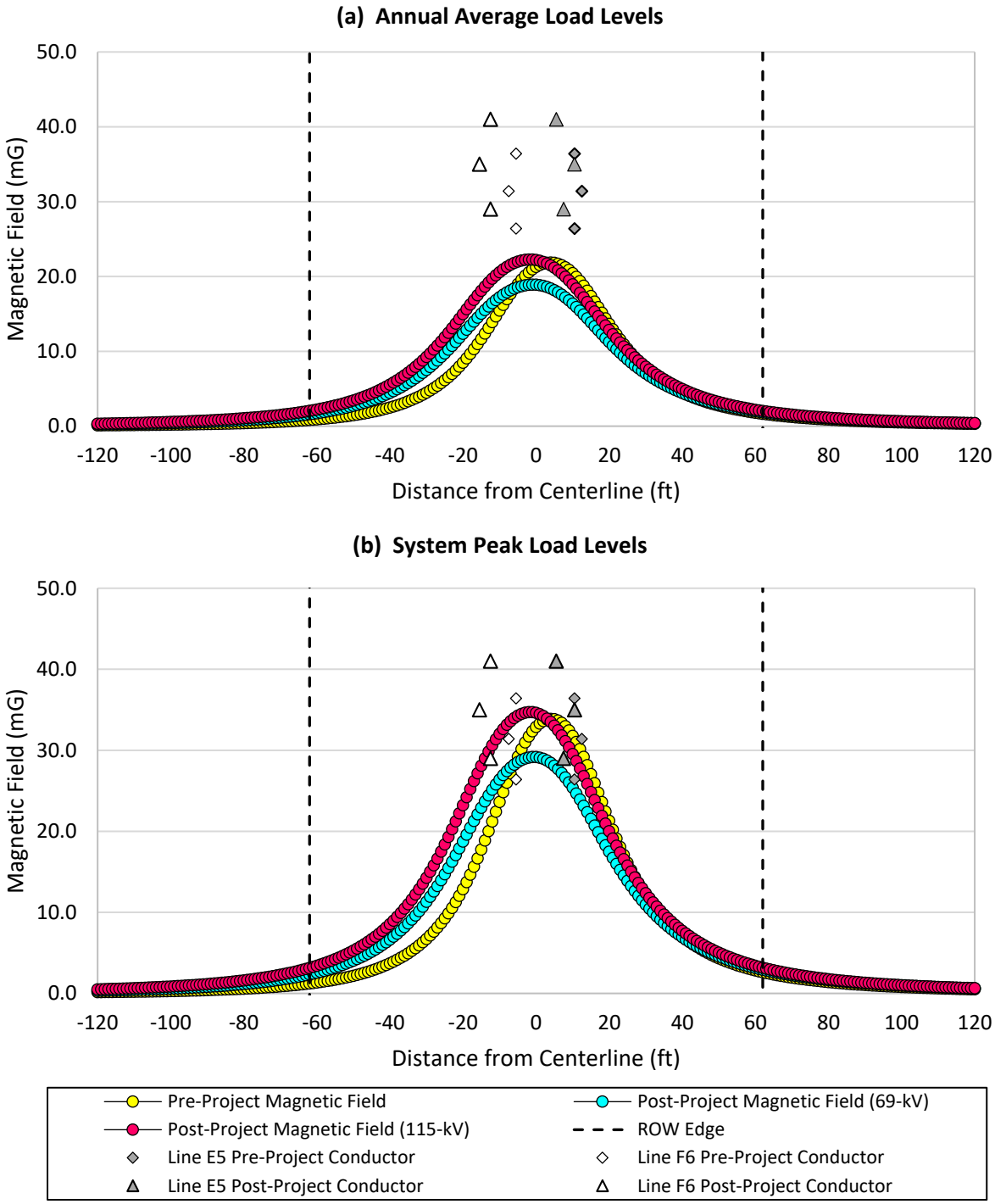

Figure B.3 Magnetic Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 2 (B-13148-NE Sheet 2, ROW Segment from Deerfield 3 Tap to Deerfield 2). ft = Feet; kV = Kilovolt; mG = Milligauss; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

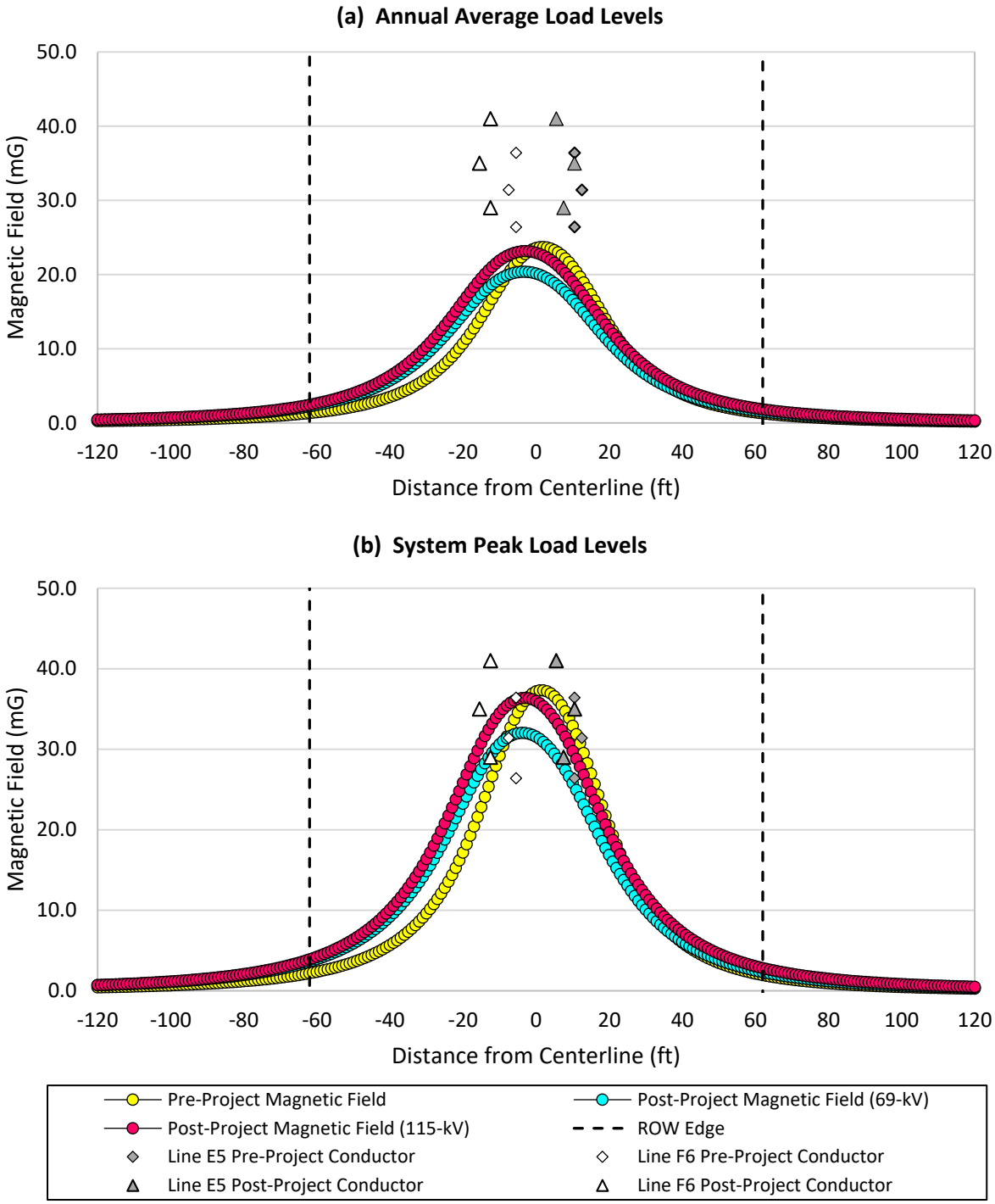

Figure B.4 Magnetic Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 2 (B-13148-NE Sheet 2, ROW Segment from Deerfield 2 to Shutesbury). ft = Feet; kV = Kilovolt; mG = Milligauss; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

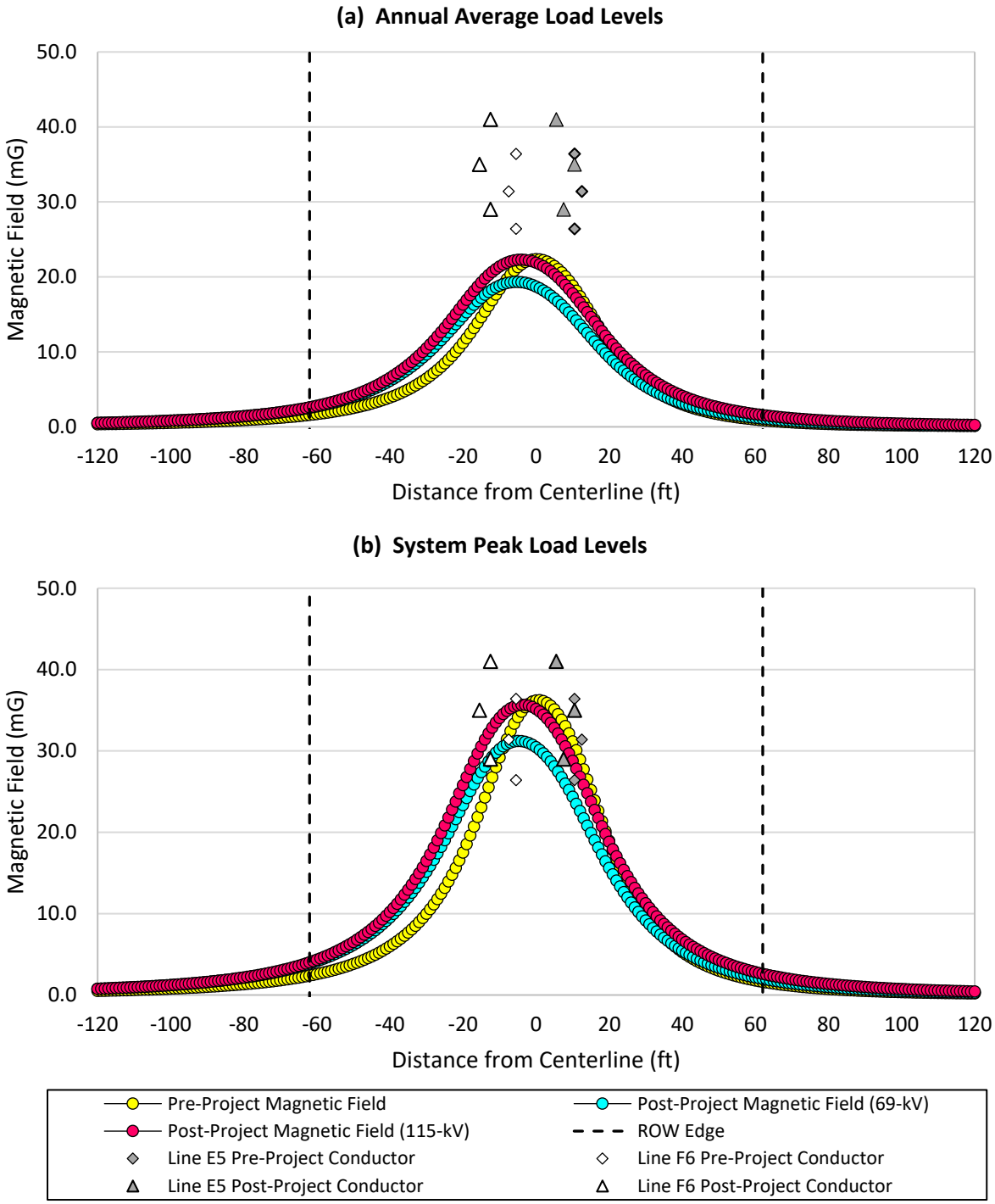

Figure B.5 Magnetic Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 2 (B-13148-NE Sheet 2, ROW Segment from Shutesbury to Quabbin Switch Tap). ft = Feet; kV = Kilovolt; mG = Milligauss; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

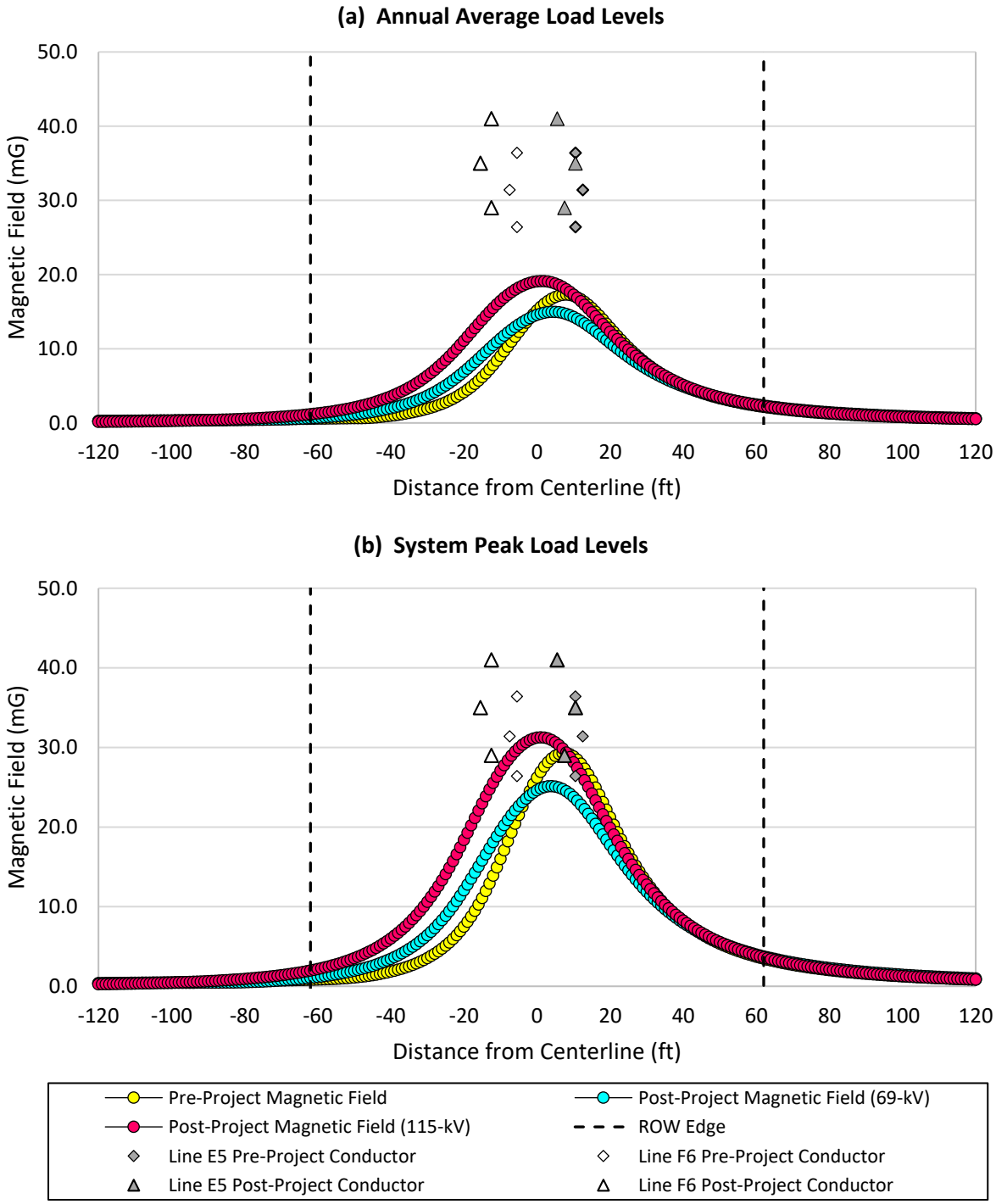

Figure B.6 Magnetic Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 2 (B-13148-NE Sheet 2, ROW Segment from Quabbin Switch Tap to Ware). ft = Feet; kV = Kilovolt; mG = Milligauss; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

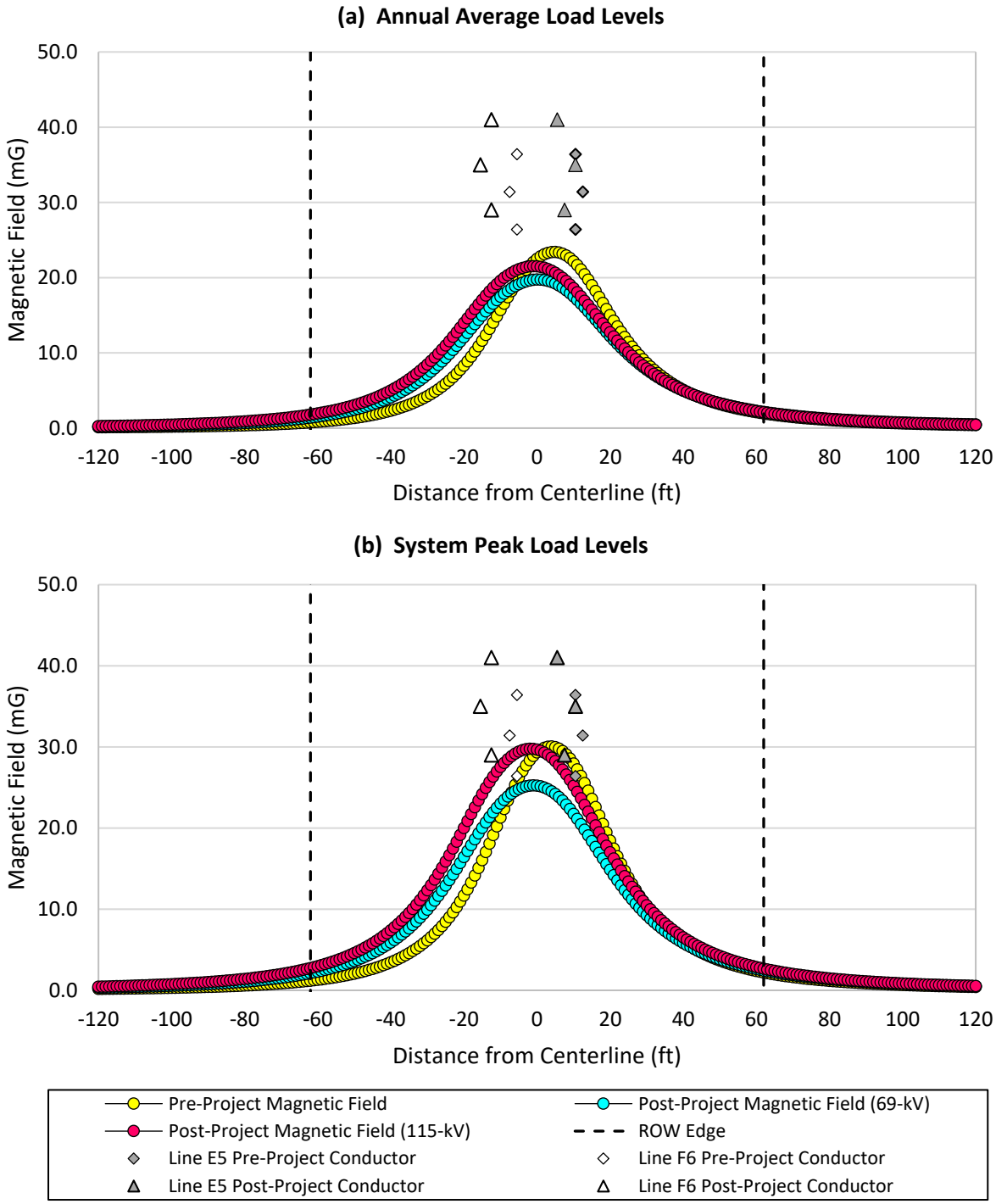

Figure B.7 Magnetic Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 2 (B-13148-NE Sheet 2, ROW Segment from Ware to Lashaway). ft = Feet; kV = Kilovolt; mG = Milligauss; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

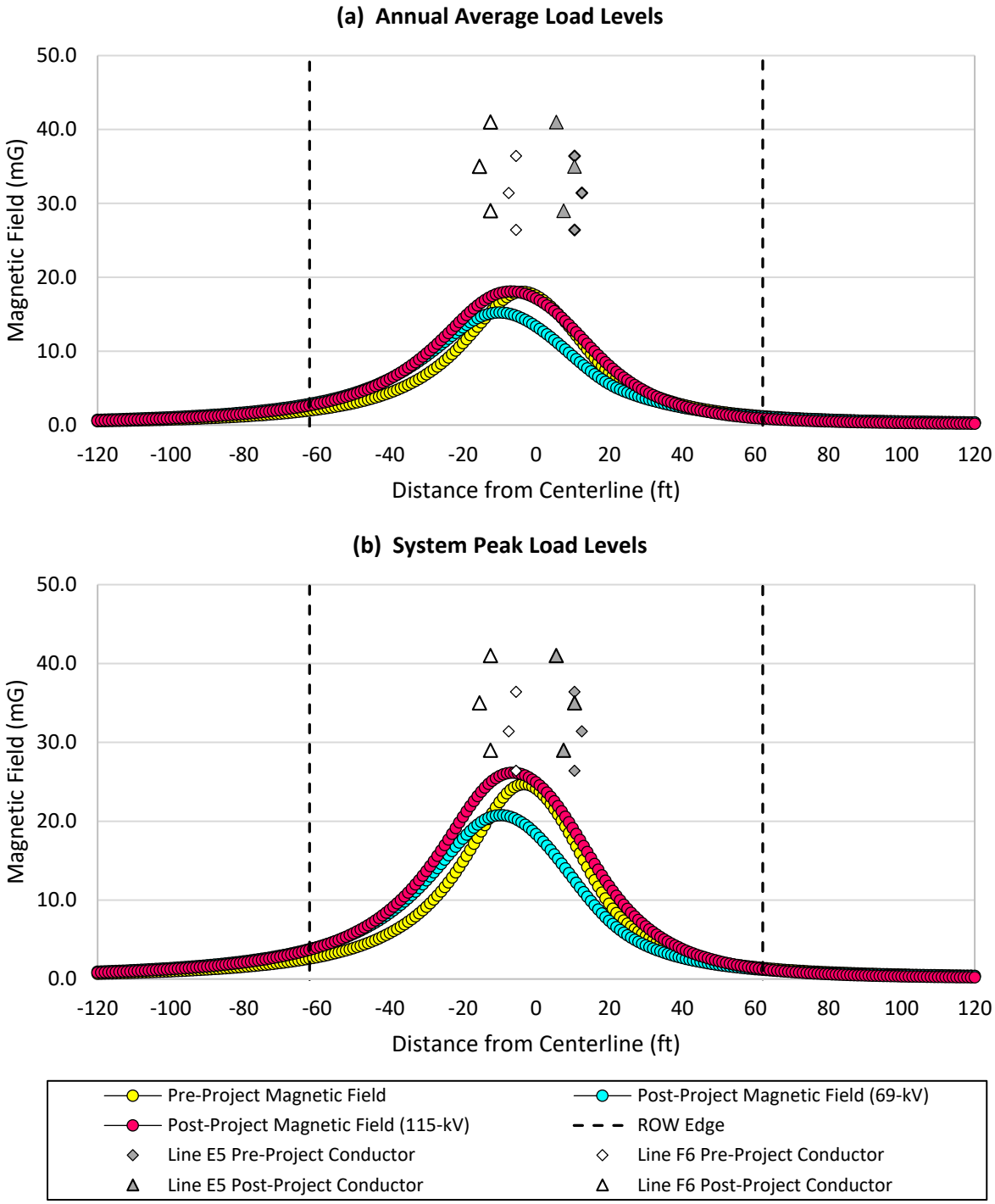

Figure B.8 Magnetic Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 2 (B-13148-NE Sheet 2, ROW Segment from Lashaway to Harrington St). ft = Feet; kV = Kilovolt; mG = Milligauss; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

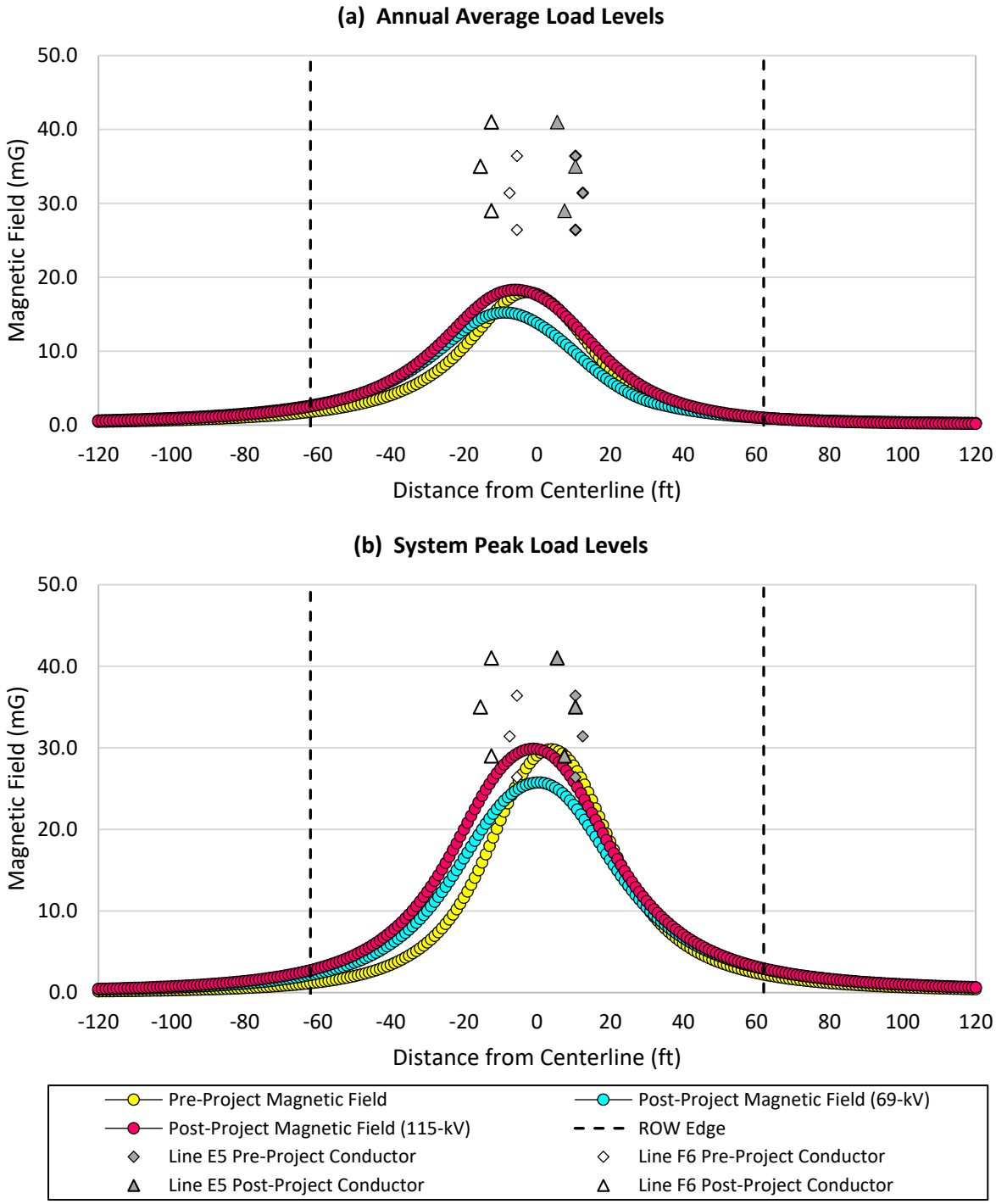

Figure B.9 Magnetic Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 2 (B-13148-NE Sheet 2, ROW Segment from Harrington St to Meadow St). ft = Feet; kV = Kilovolt; mG = Milligauss; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

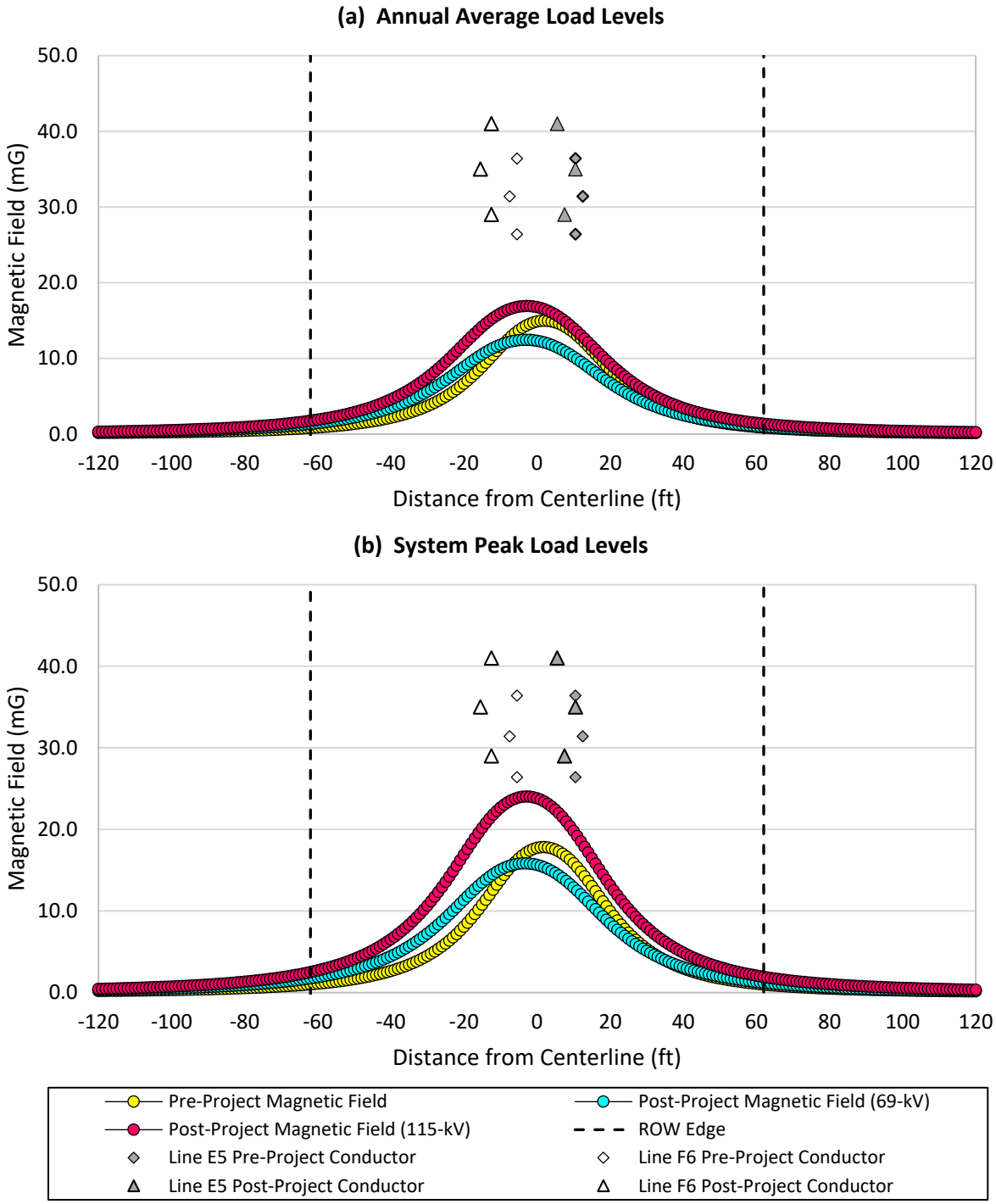

Figure B.10 Magnetic Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 2 (B-13148-NE Sheet 2, ROW Segment from Meadow St to Leicester). ft = Feet; kV = Kilovolt; mG = Milligauss; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

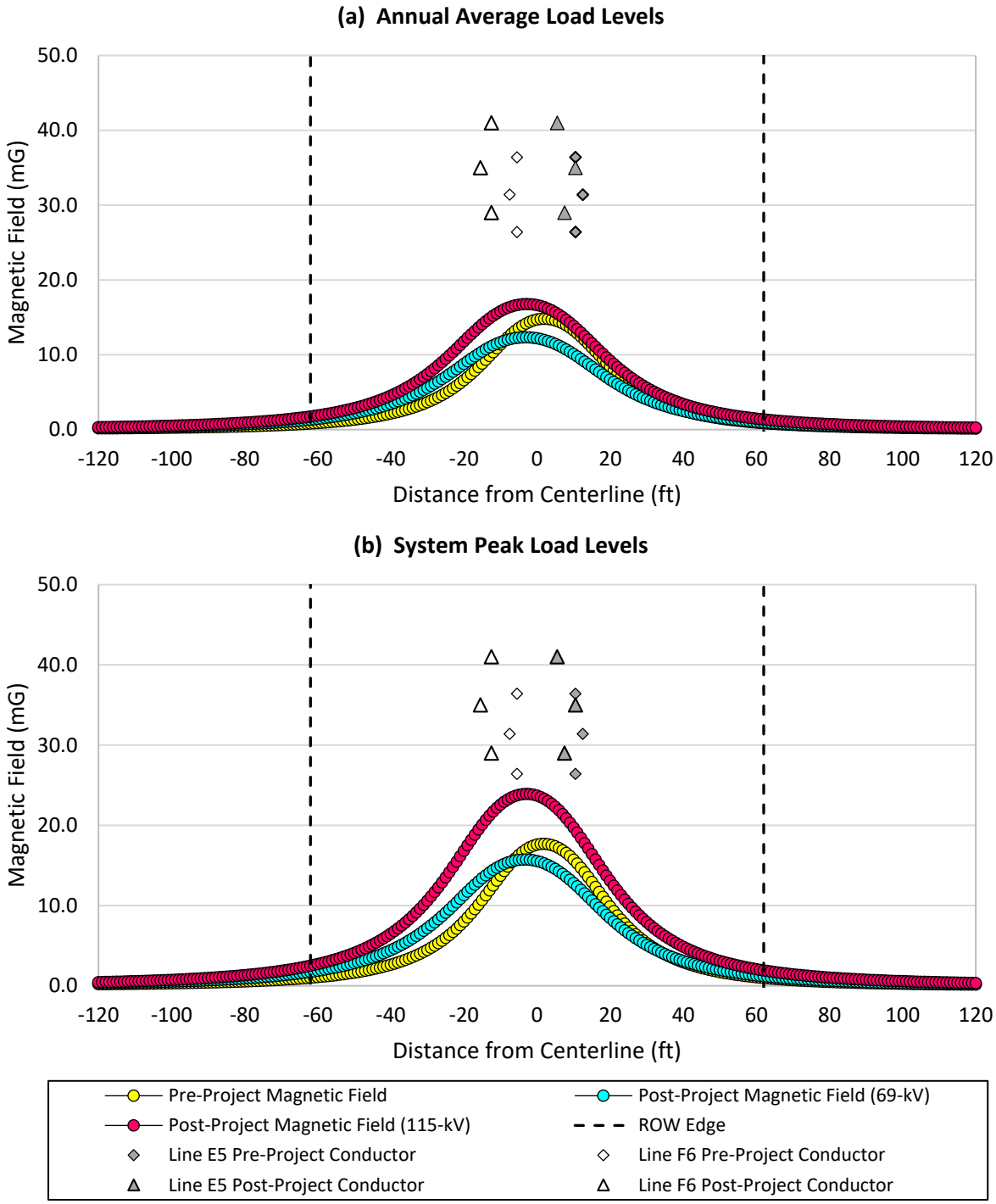

Figure B.11 Magnetic Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 2 (B-13148-NE Sheet 2, ROW Segment from Leicester to Pondville). ft = Feet; kV = Kilovolt; mG = Milligauss; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

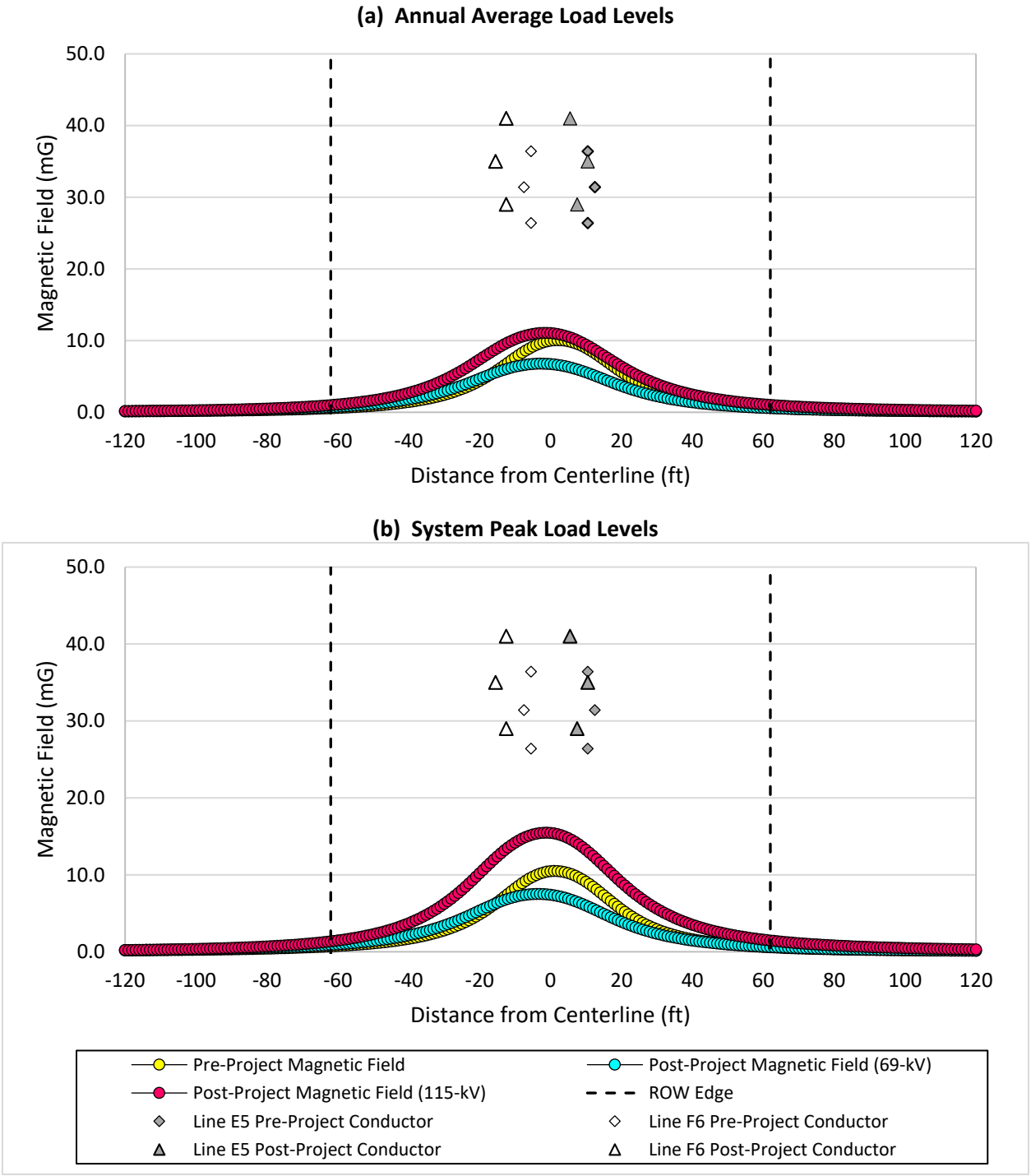

Figure B.12 Magnetic Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 2 (B-13148-NE Sheet 2, ROW Segment from Pondville to Millbury). ft = Feet; kV = Kilovolt; mG = Milligauss; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

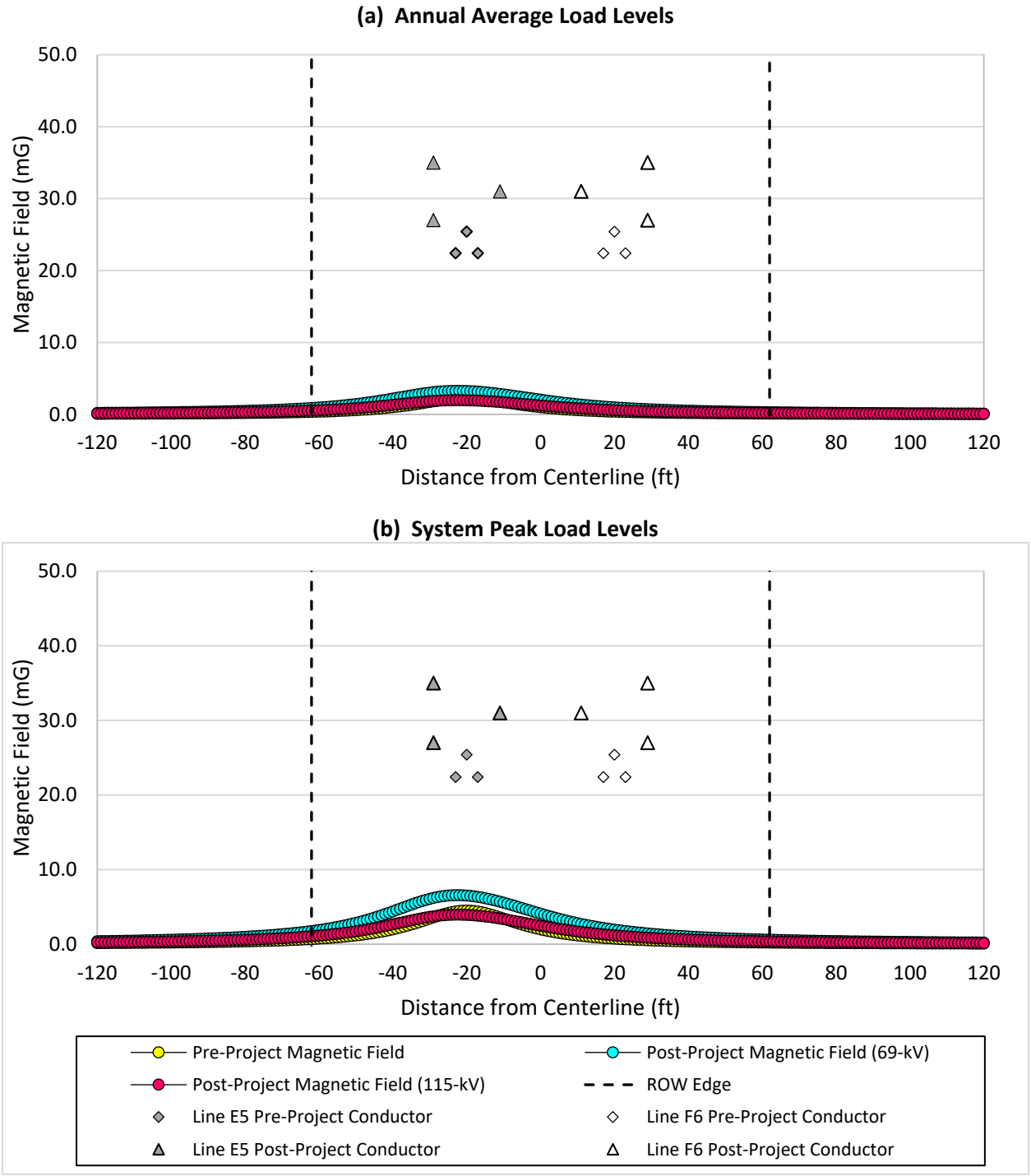

Figure B.13 Magnetic Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 3 (B-13148-NE Sheet 3, ROW Segment from Deerfield 3 Tap). ft = Feet; kV = Kilovolt; mG = Milligauss; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

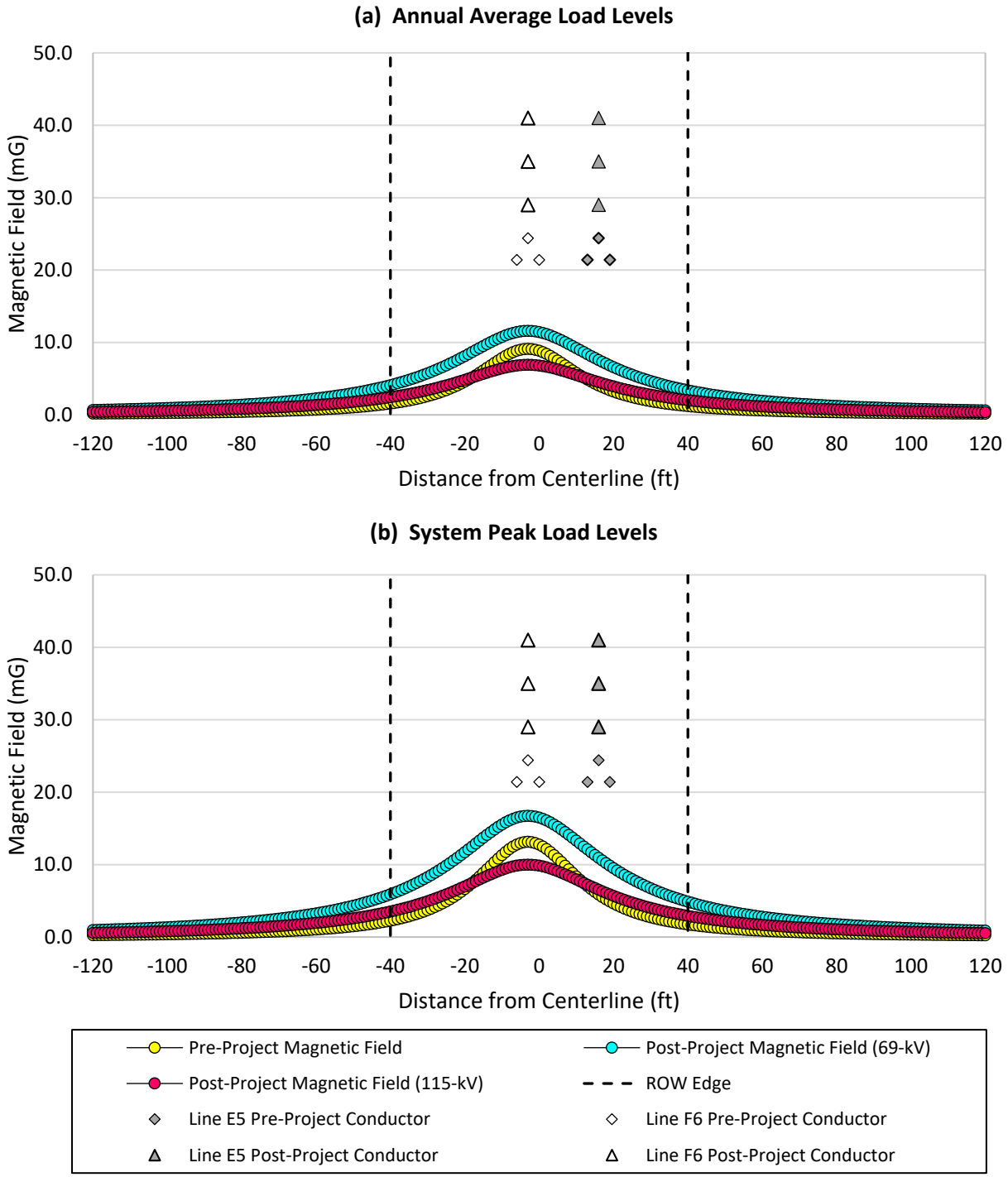

Figure B.14 Magnetic Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 4 (B-13148-NE Sheet 4, ROW Segment from Quabbin Switch Tap). ft = Feet; kV = Kilovolt; mG = Milligauss; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

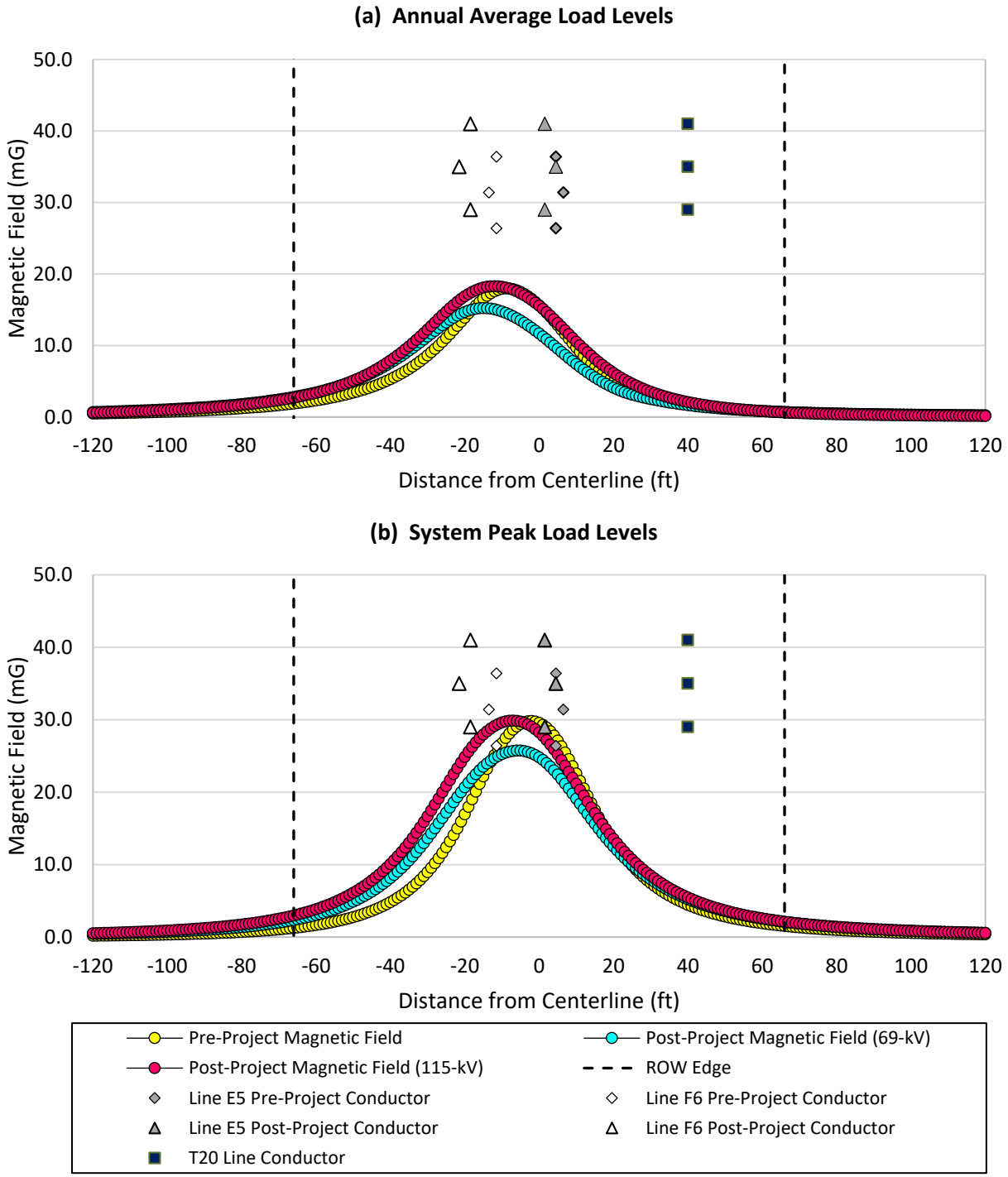

Figure B.15 Magnetic Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 5 (B-13148-NE Sheet 5, ROW Segment from Harrington St to Meadow St). ft = Feet; kV = Kilovolt; mG = Milligauss; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

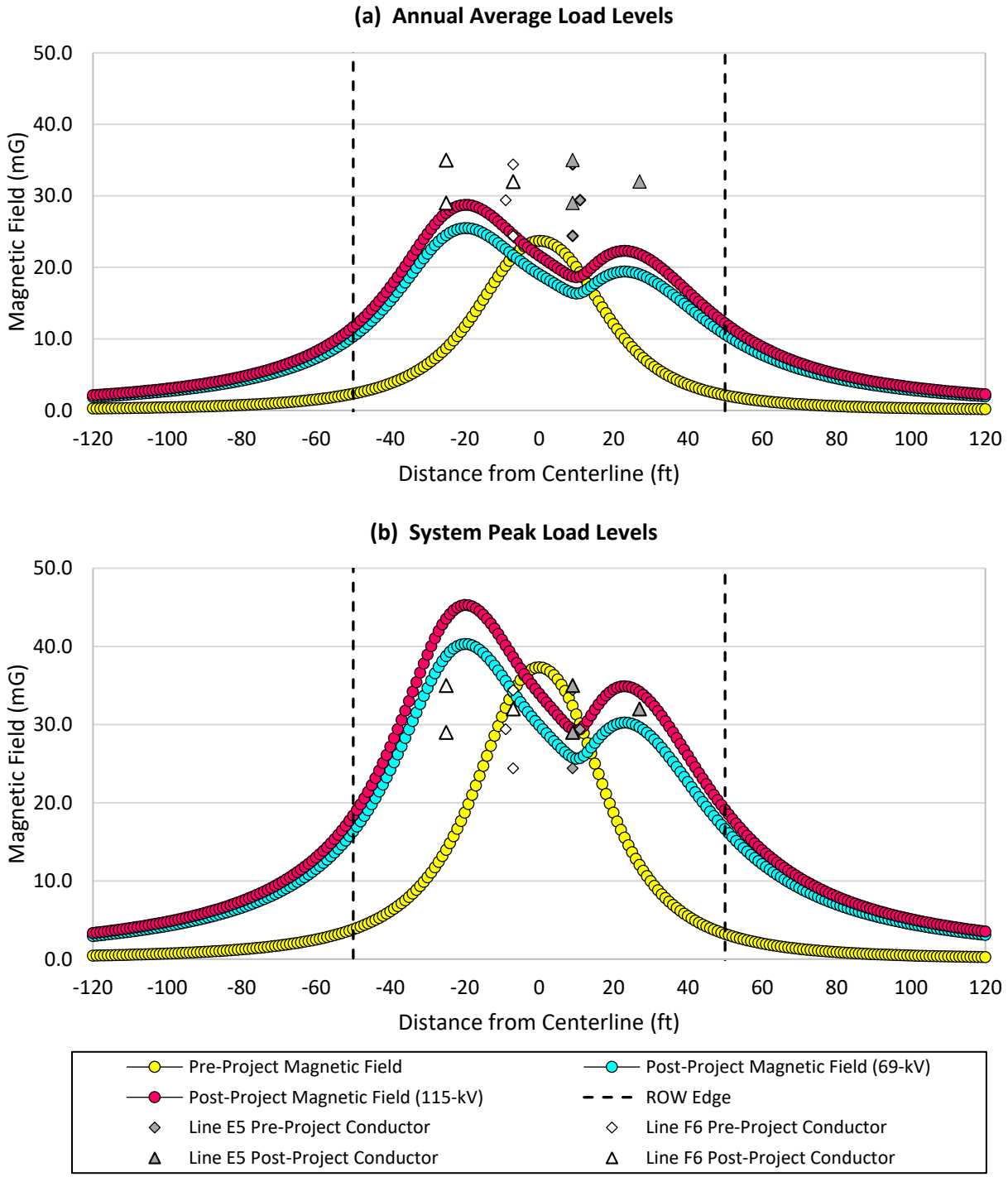

Figure B.16 Magnetic Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 6 (B-13148-NE Sheet 6, ROW Segment from Deerfield 2 to Shutesbury). ft = Feet; kV = Kilovolt; mG = Milligauss; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

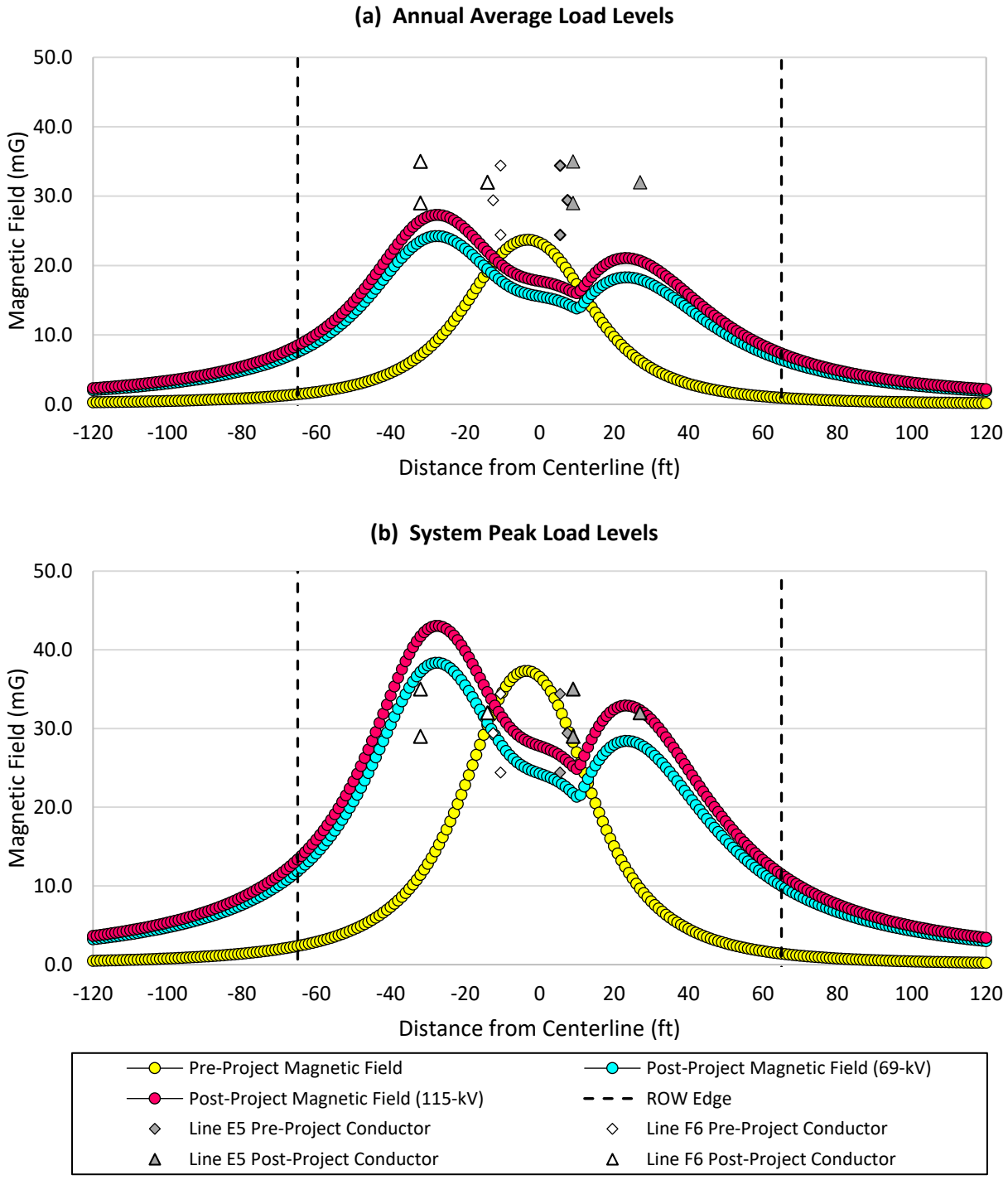

Figure B.17 Magnetic Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 7 (B-13148-NE Sheet 7, ROW Segment from Deerfield 2 to Shutesbury). ft = Feet; kV = Kilovolt; mG = Milligauss; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

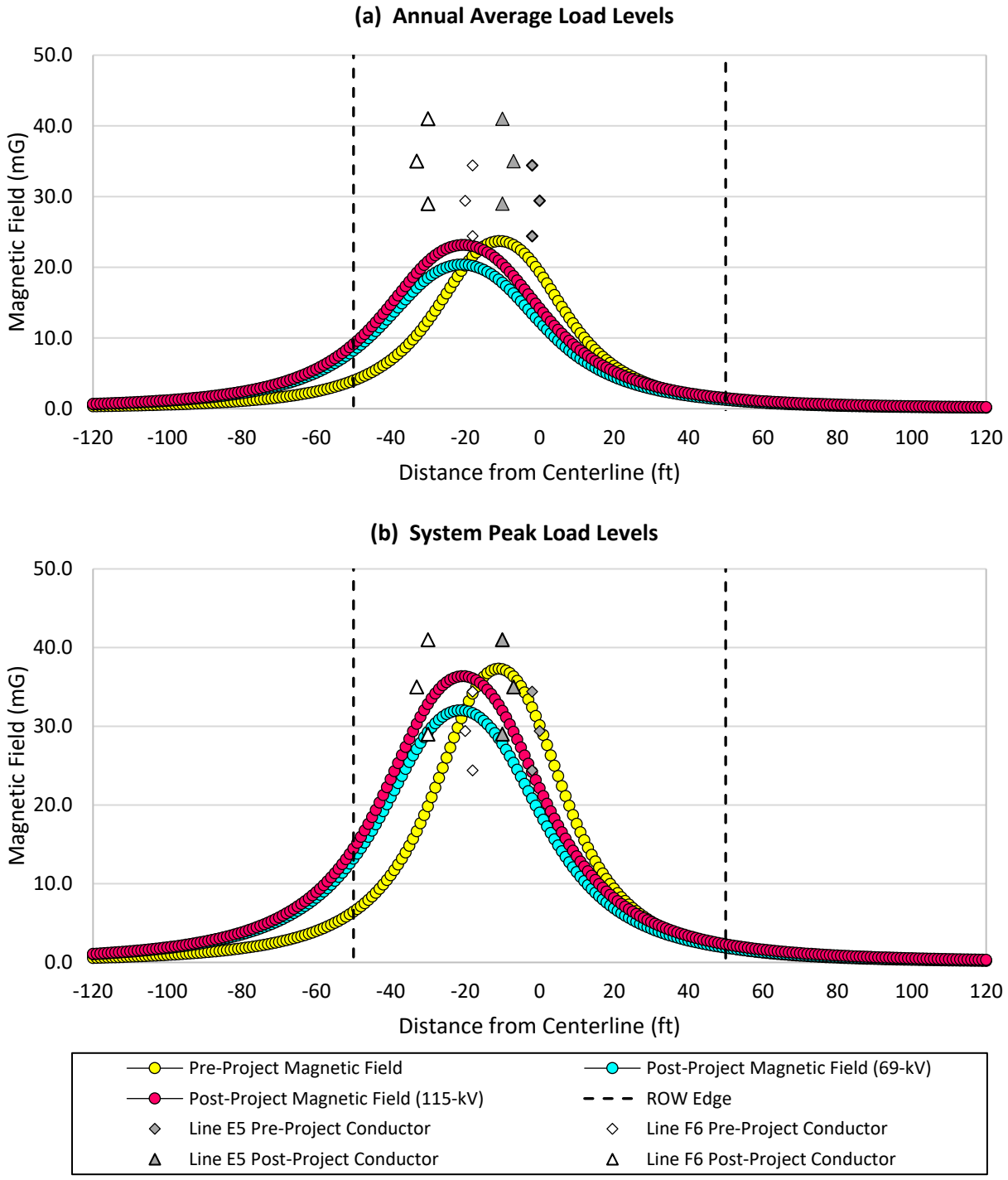

Figure B.18 Magnetic Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 8 (B-13148-NE Sheet 8, ROW Segment from Deerfield 2 to Shutesbury). ft = Feet; kV = Kilovolt; mG = Milligauss; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

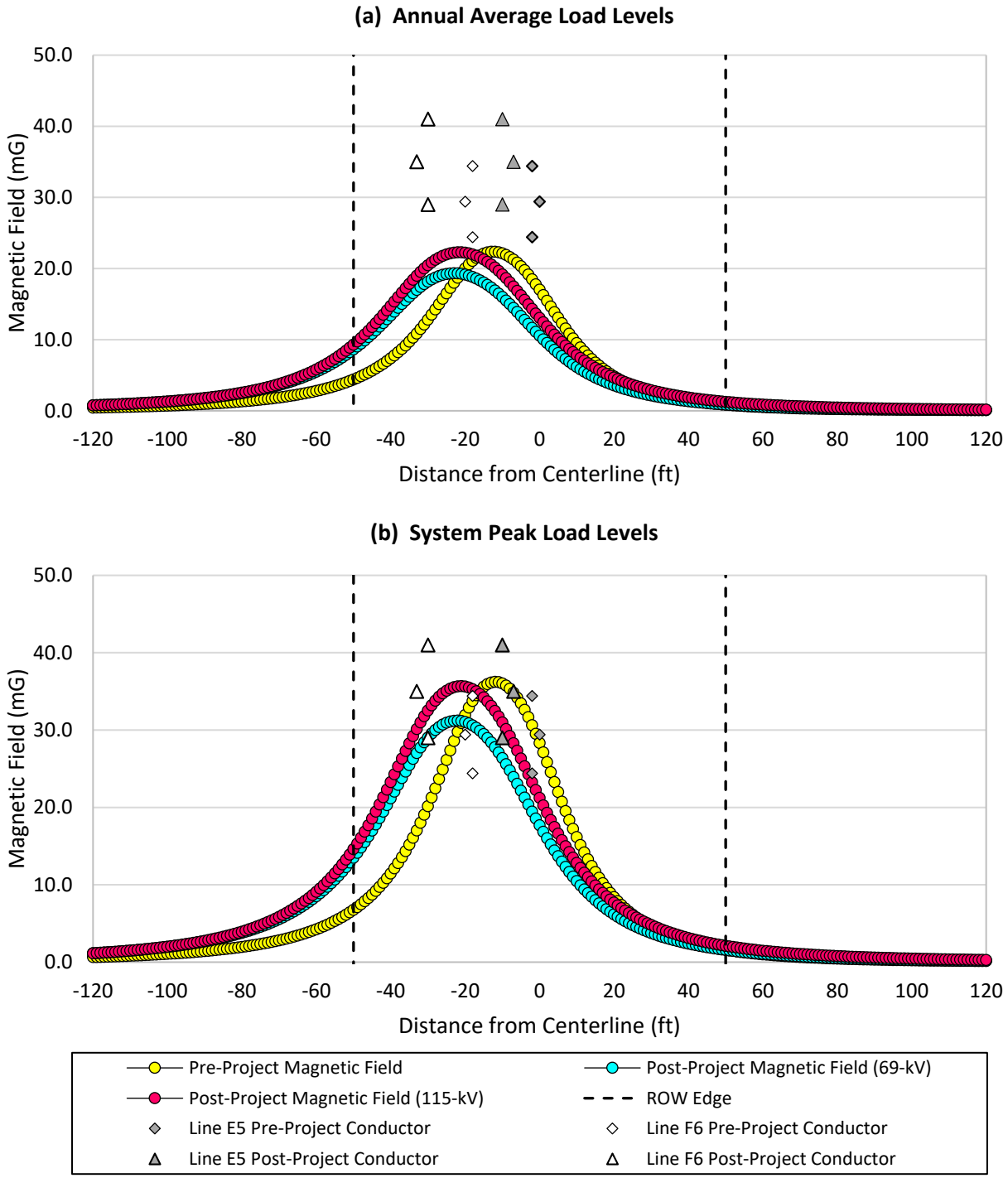

Figure B.19 Magnetic Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 8 (B-13148-NE Sheet 8, ROW Segment from Shutesbury to Quabbin Switch Tap). ft = Feet; kV = Kilovolt; mG = Milligauss; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

Appendix C

Electric Field Profiles for Each Representative ROW Cross Section

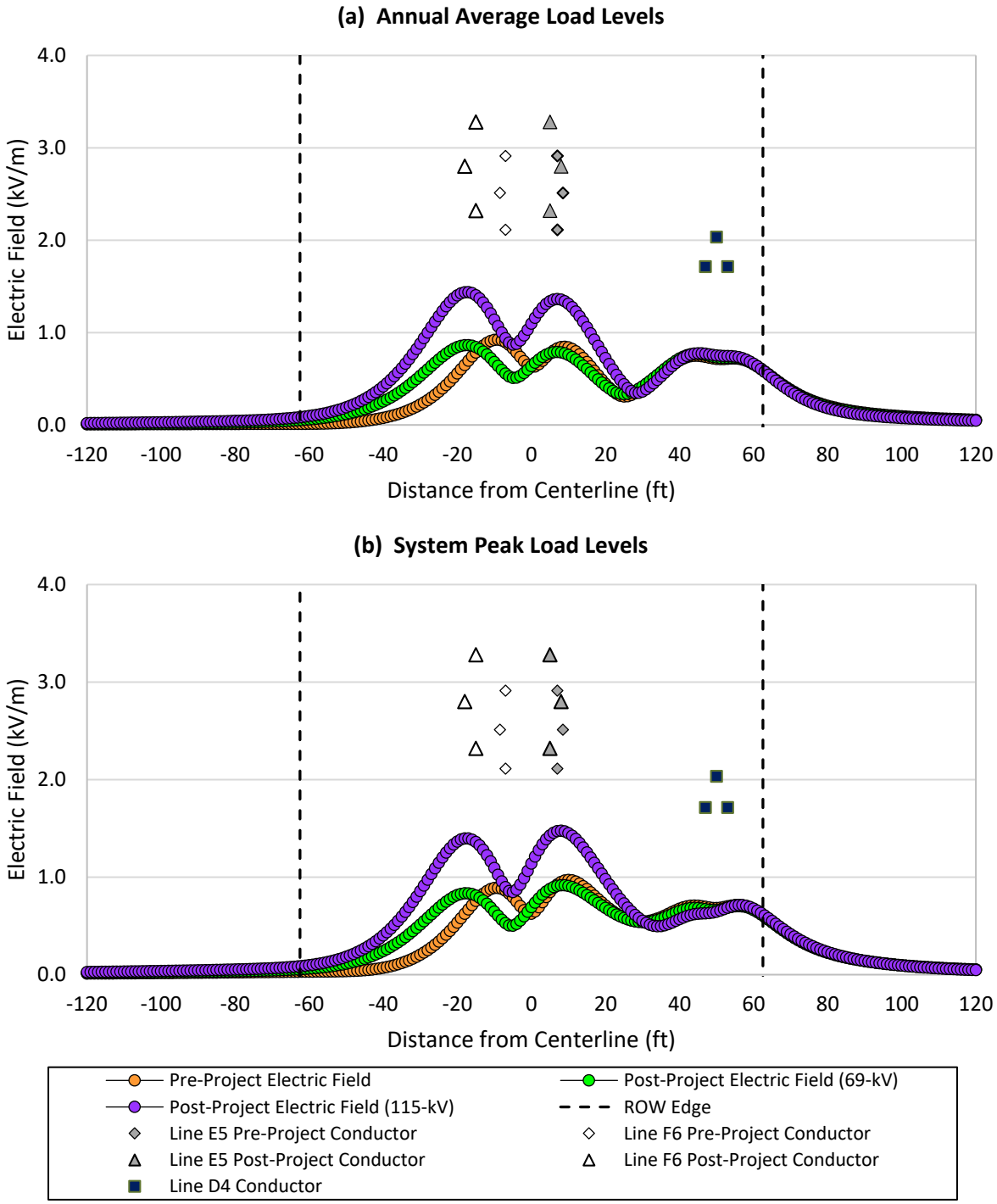

Figure C.1 Electric Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 1 (B-13148-NE Sheet 1, ROW Segment from Deerfield No. 4 Substation). ft = Feet; kV = Kilovolt; kV/m = Kilovolts Per Meter; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

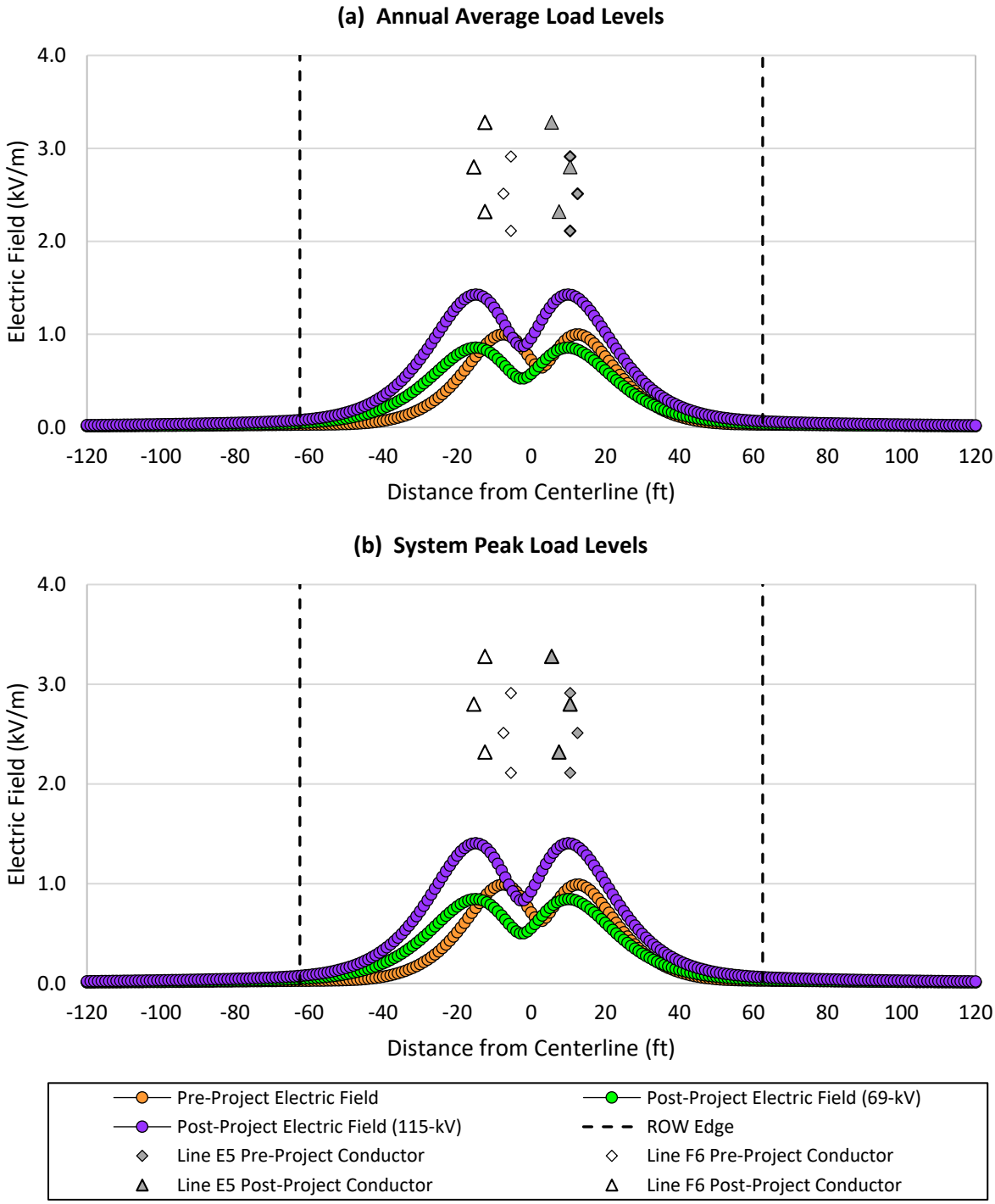

Figure C.2 Electric Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 2 (B-13148-NE Sheet 2, ROW Segment from Deerfield 4 to Deerfield 3 Tap). ft = Feet; kV = Kilovolt; kV/m = Kilovolts Per Meter; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

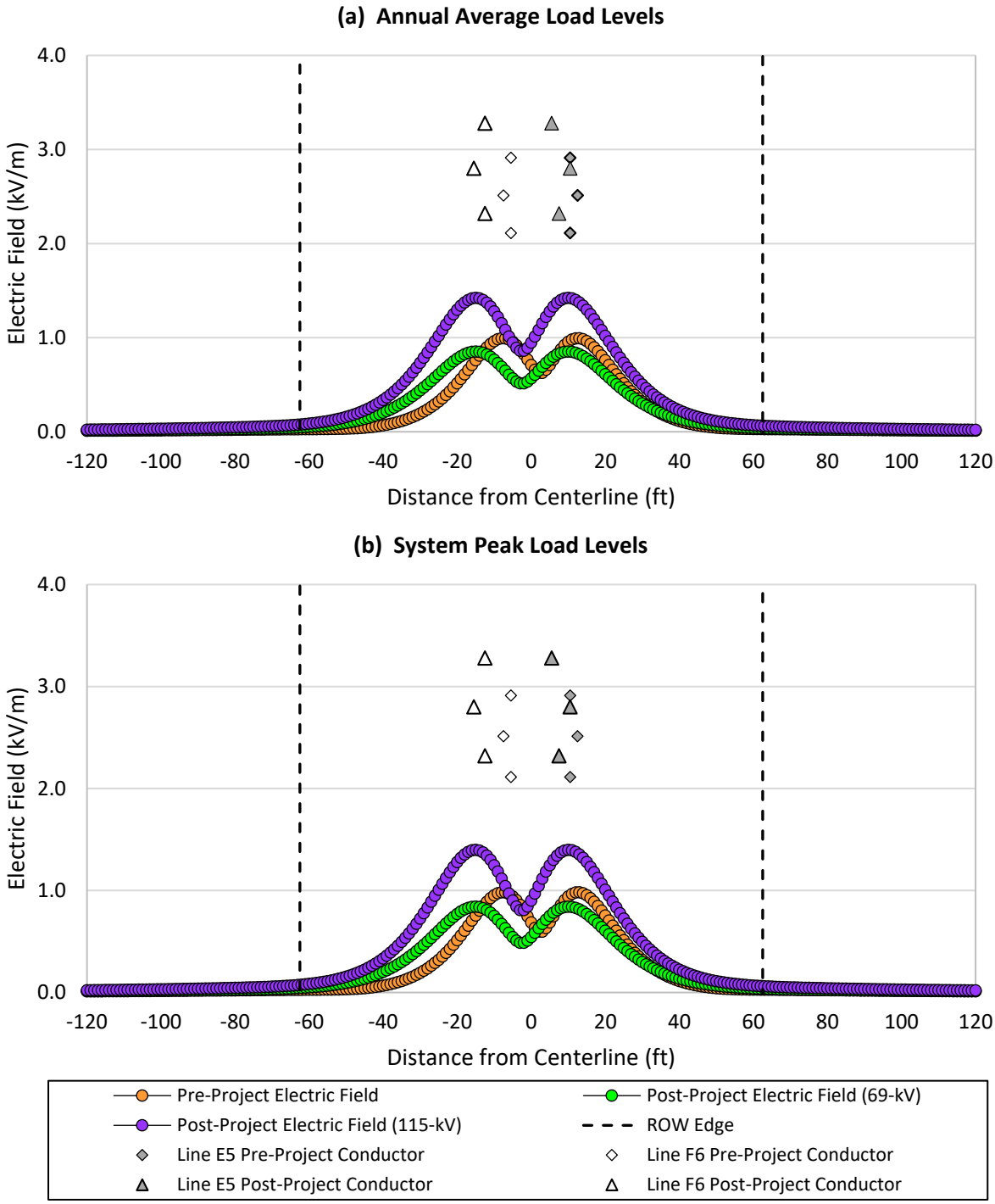

Figure C.3 Electric Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 2 (B-13148-NE Sheet 2, ROW Segment from Deerfield 3 Tap to Deerfield 2). ft = Feet; kV = Kilovolt; kV/m = Kilovolts Per Meter; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

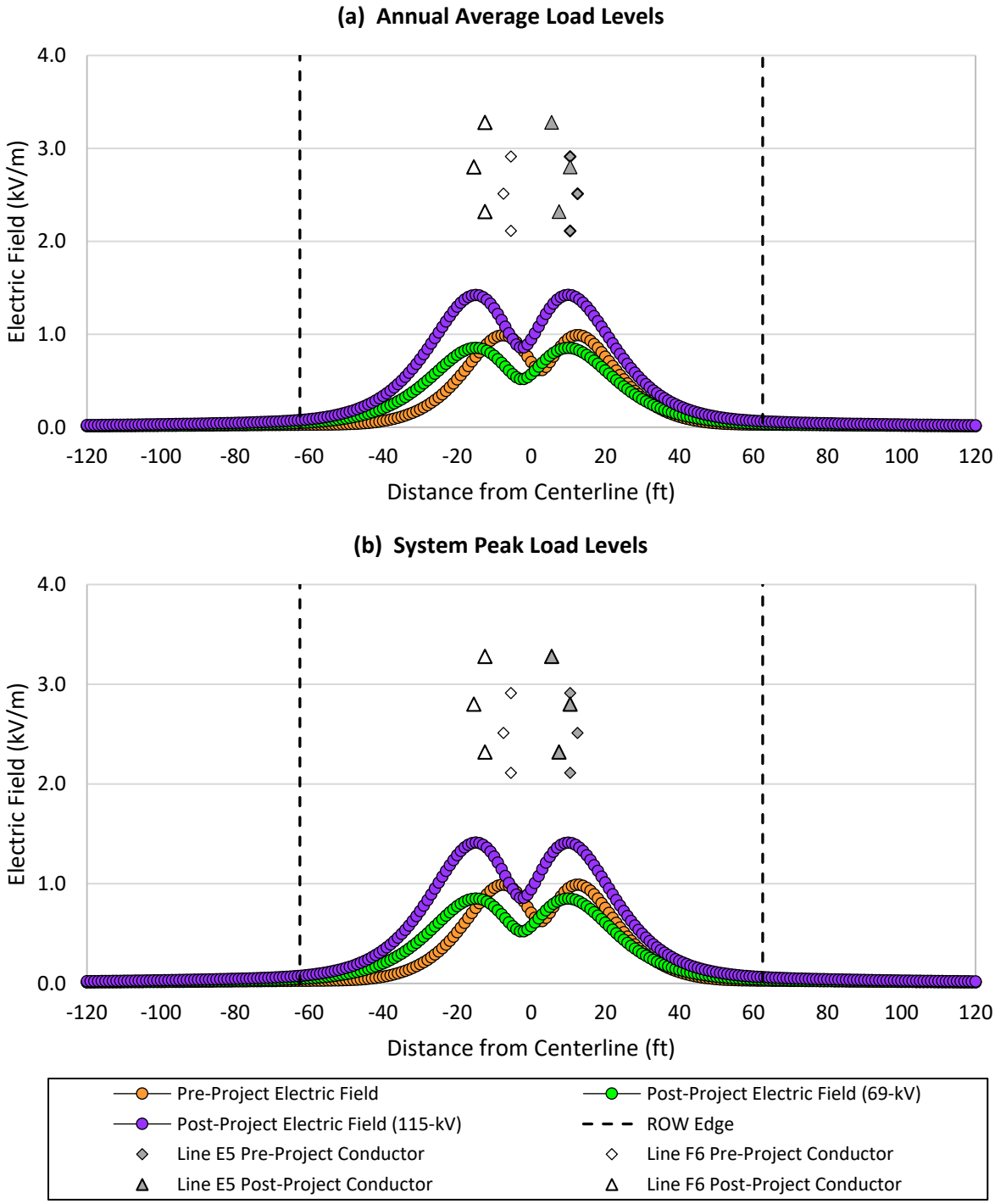

Figure C.4 Electric Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 2 (B-13148-NE Sheet 2, ROW Segment from Deerfield 2 to Shutesbury). ft = Feet; kV = Kilovolt; kV/m = Kilovolts Per Meter; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

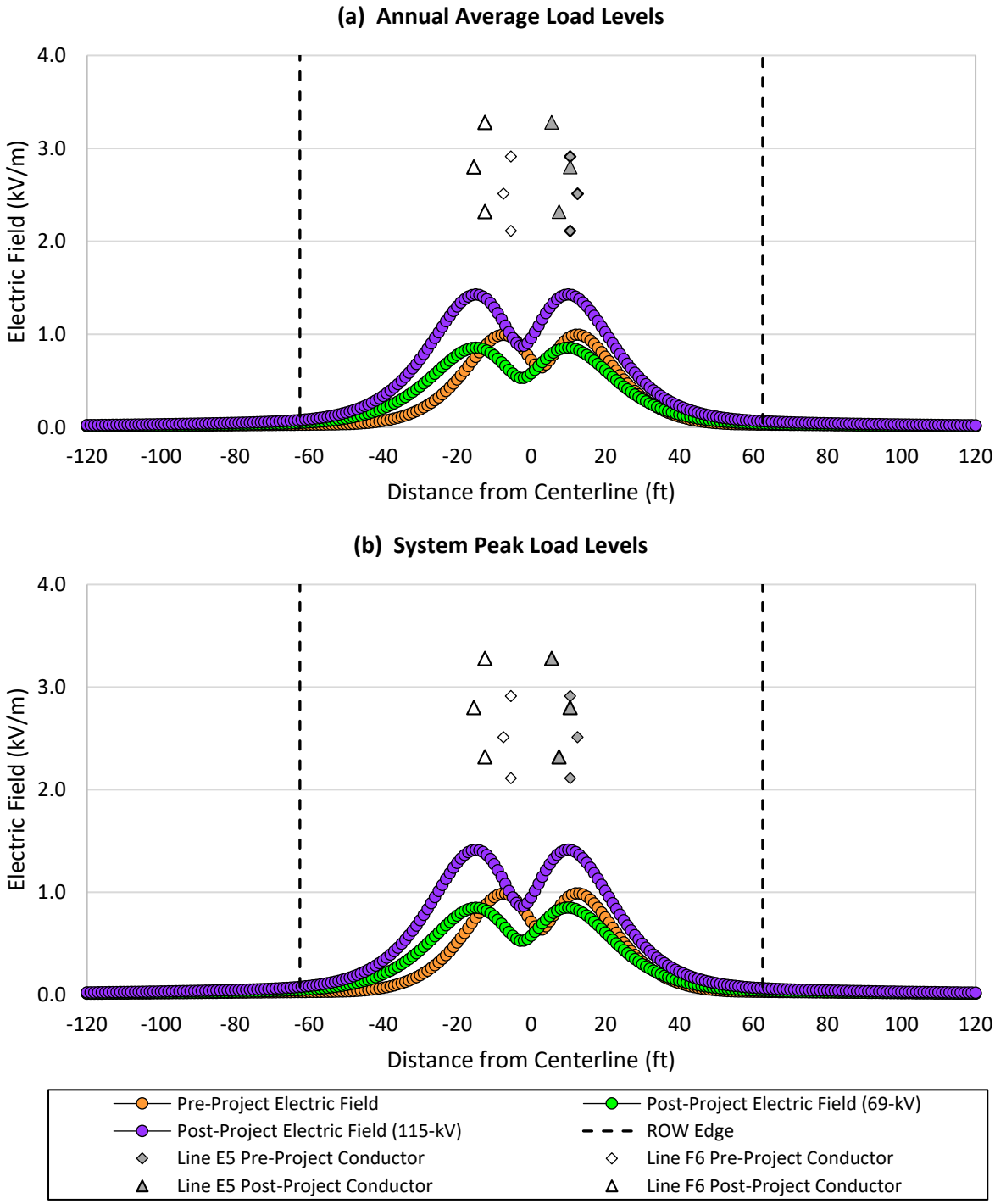

Figure C.5 Electric Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 2 (B-13148-NE Sheet 2, ROW Segment from Shutesbury to Quabbin Switch Tap). ft = Feet; kV = Kilovolt; kV/m = Kilovolts Per Meter; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

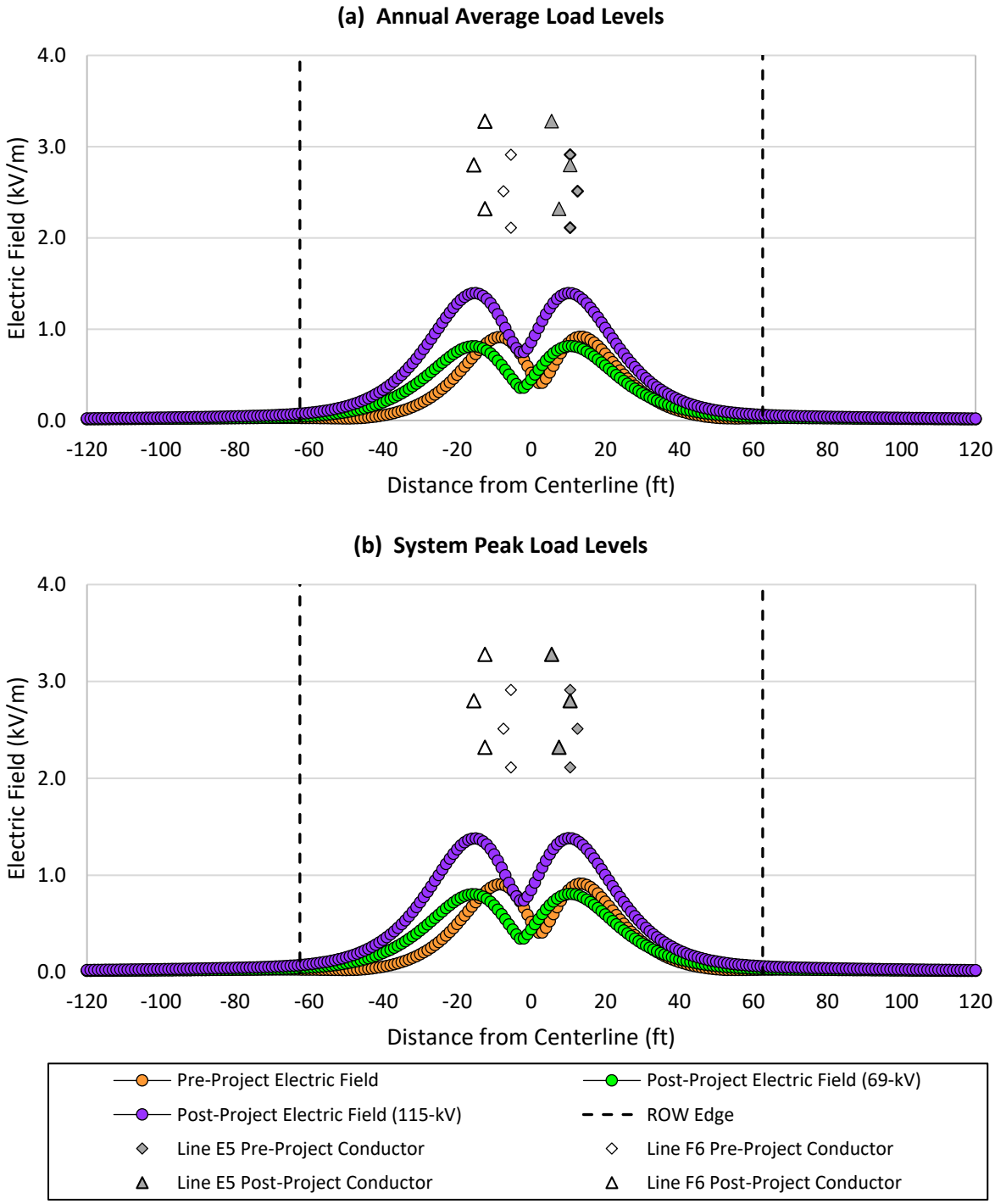

Figure C.6 Electric Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 2 (B-13148-NE Sheet 2, ROW Segment from Quabbin Switch Tap to Ware). ft = Feet; kV = Kilovolt; kV/m = Kilovolts Per Meter; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

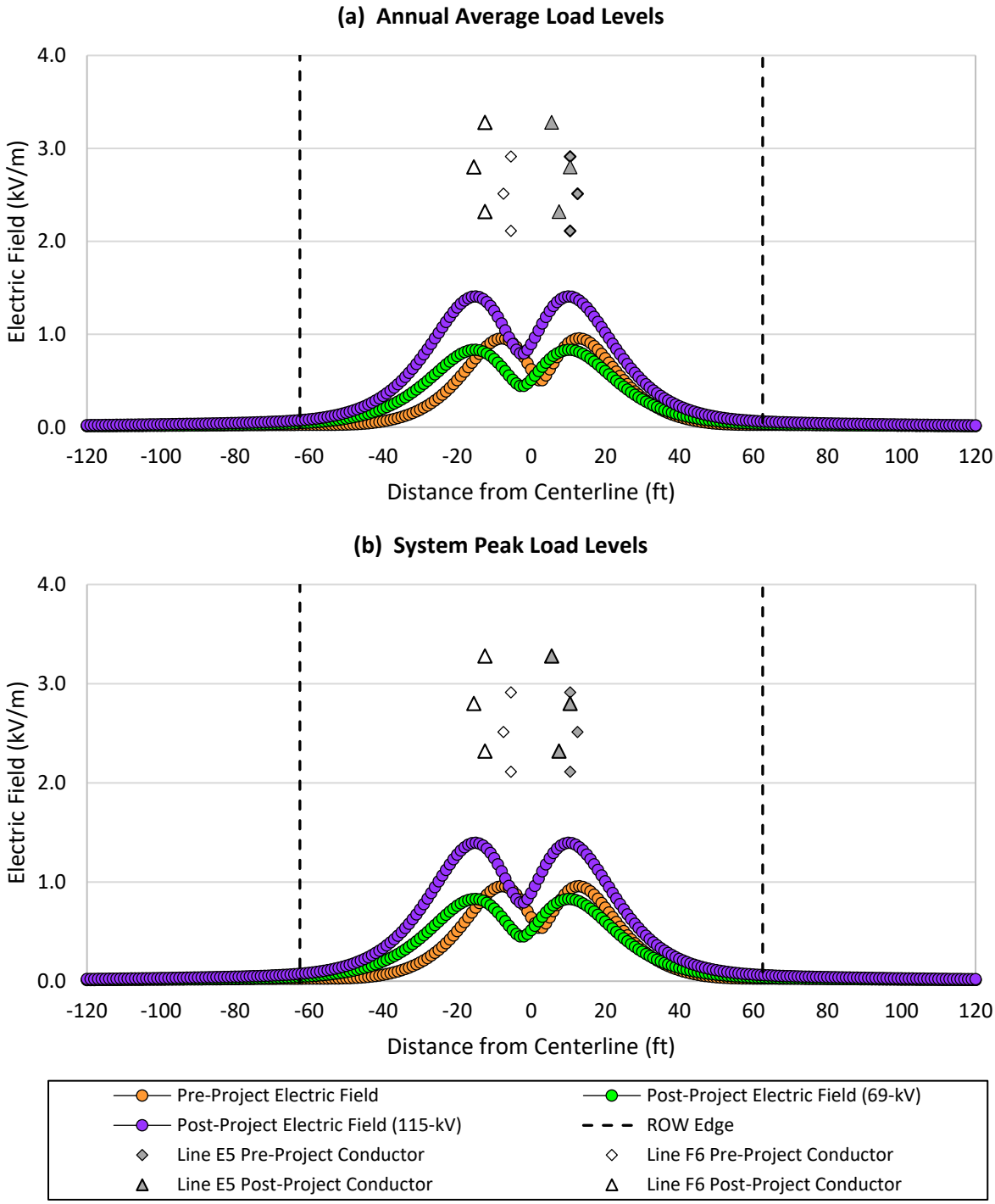

Figure C.7 Electric Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 2 (B-13148-NE Sheet 2, ROW Segment from Ware to Lashaway). ft = Feet; kV = Kilovolt; kV/m = Kilovolts Per Meter; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

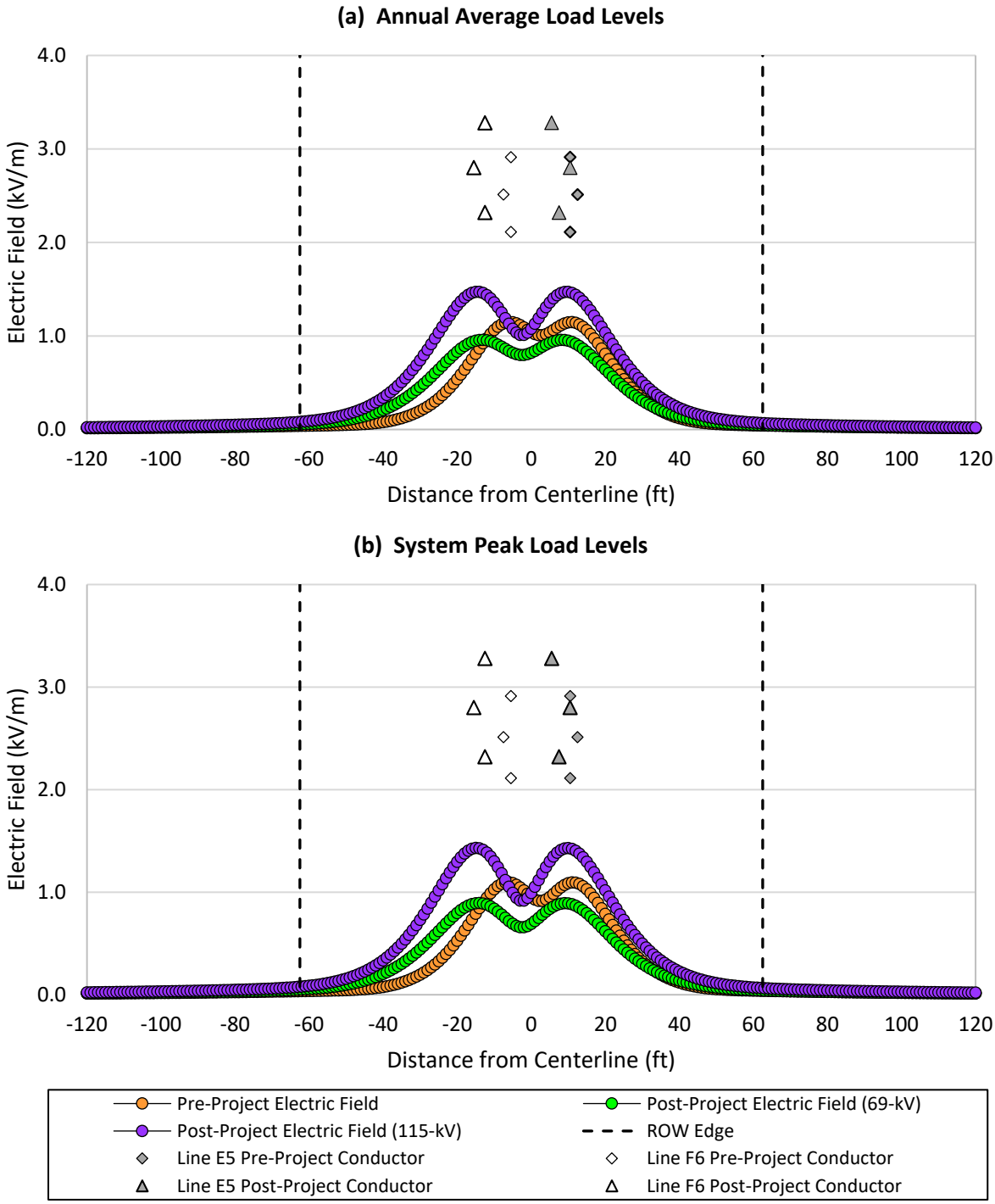

Figure C.8 Electric Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 2 (B-13148-NE Sheet 2, ROW Segment from Lashaway to Harrington St). ft = Feet; kV = Kilovolt; kV/m = Kilovolts Per Meter; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

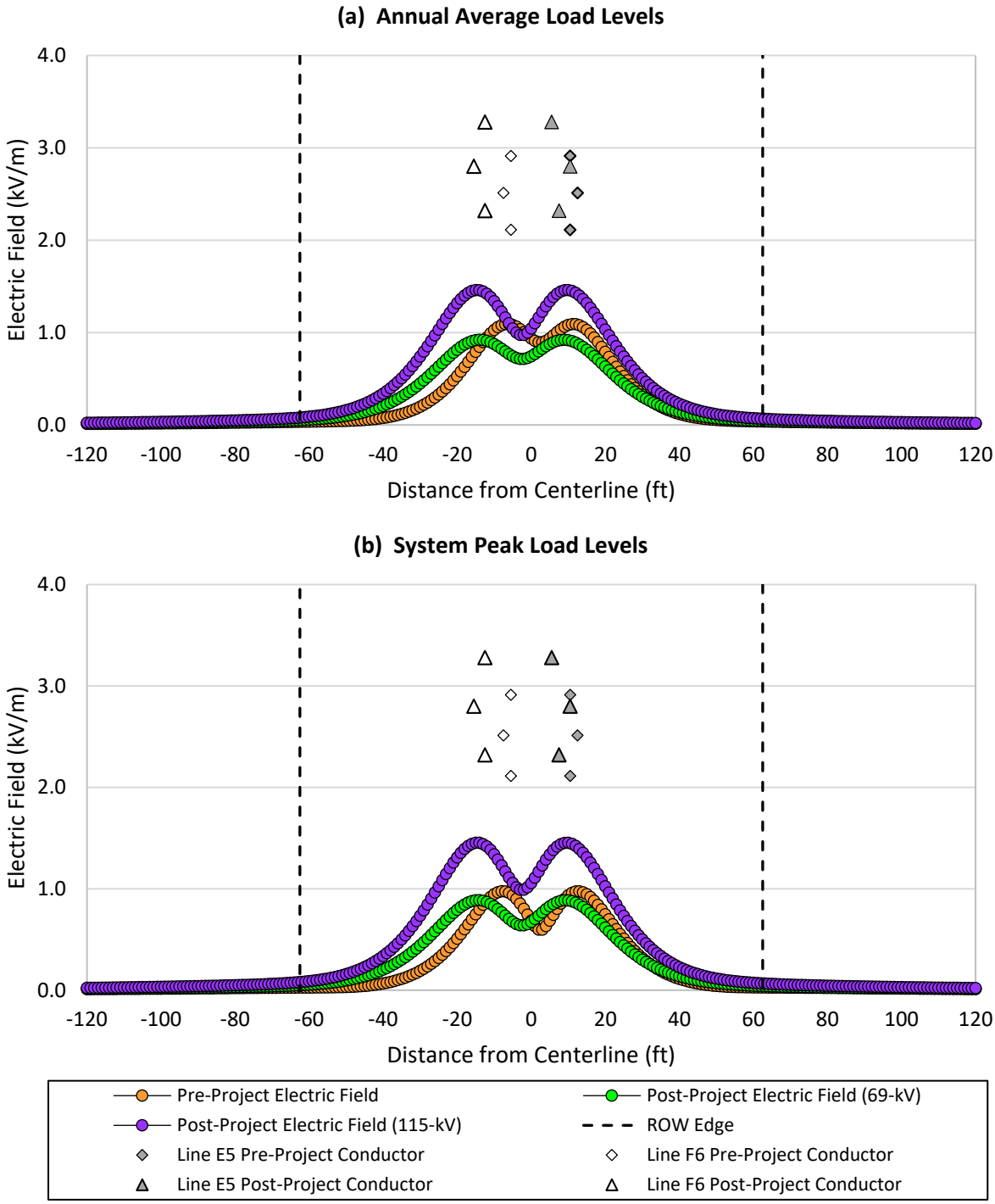

Figure C.9 Electric Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 2 (B-13148-NE Sheet 2, ROW Segment from Harrington St to Meadow St). ft = Feet; kV = Kilovolt; kV/m = Kilovolts Per Meter; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

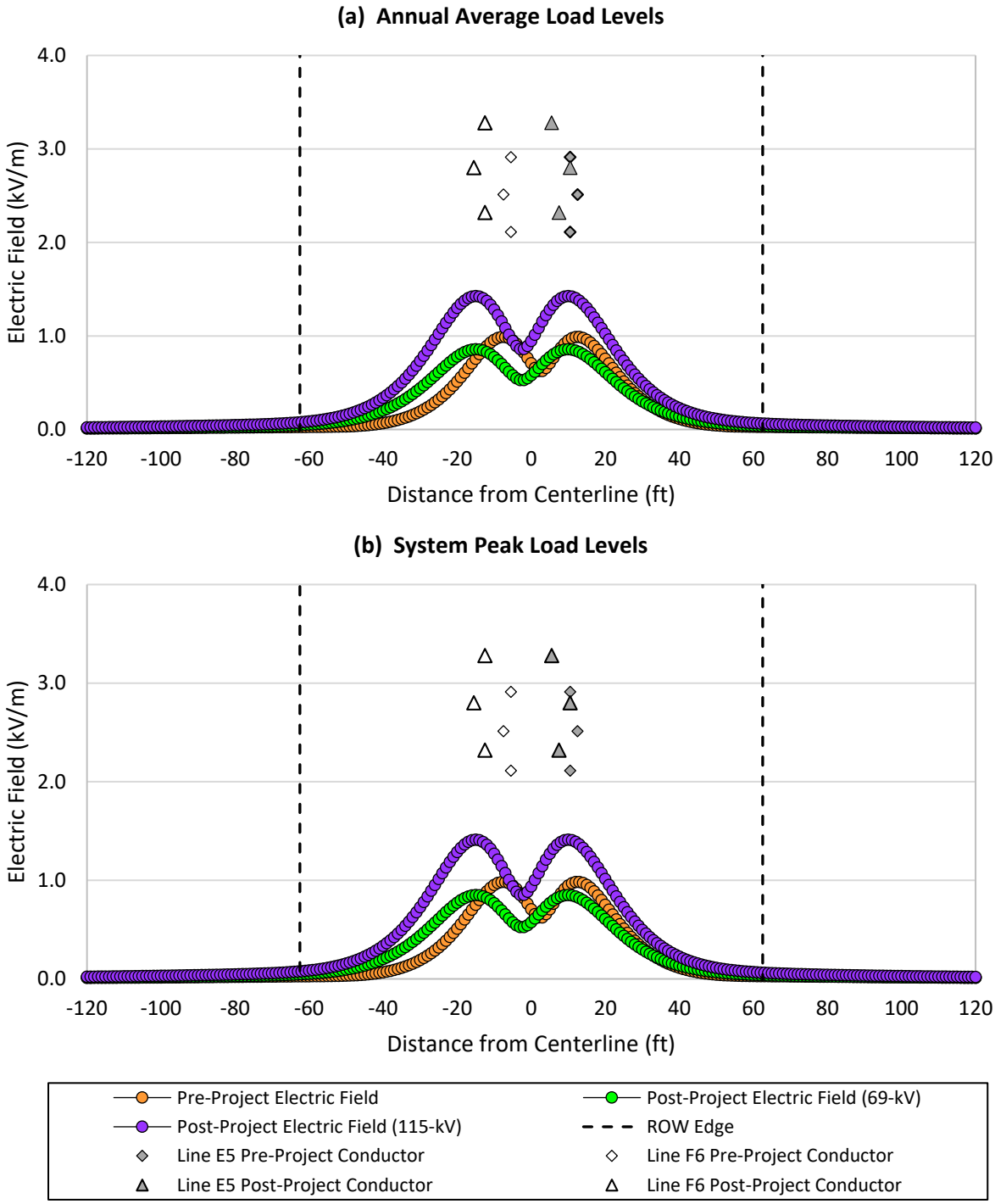

Figure C.10 Electric Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 2 (B-13148-NE Sheet 2, ROW Segment from Meadow St to Leicester). ft = Feet; kV = Kilovolt; kV/m = Kilovolts Per Meter; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

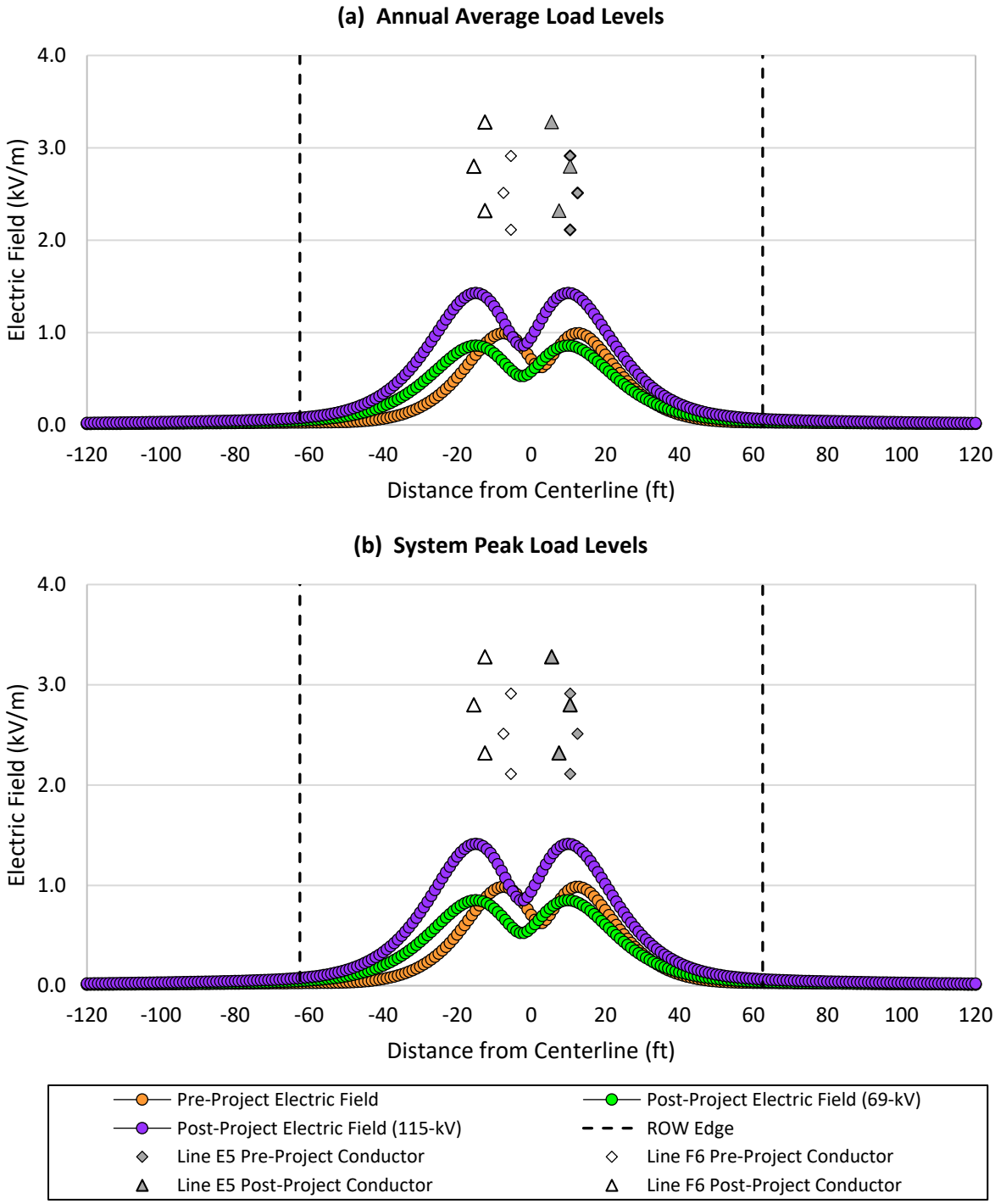

Figure C.11 Electric Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 2 (B-13148-NE Sheet 2, ROW Segment from Leicester to Pondville). ft = Feet; kV = Kilovolt; kV/m = Kilovolts Per Meter; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

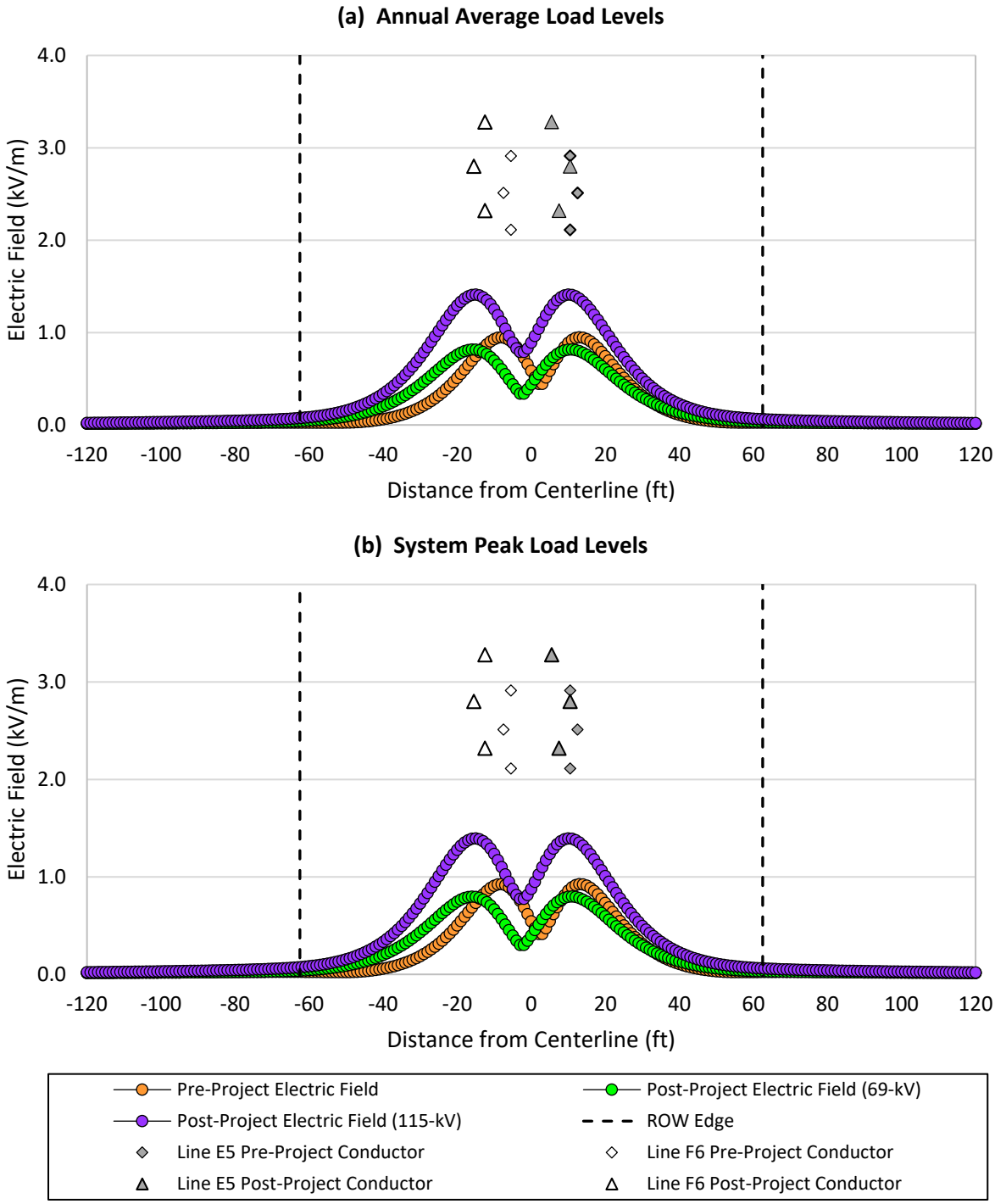

Figure C.12 Electric Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 2 (B-13148-NE Sheet 2, ROW Segment from Pondville to Millbury). ft = Feet; kV = Kilovolt; kV/m = Kilovolts Per Meter; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

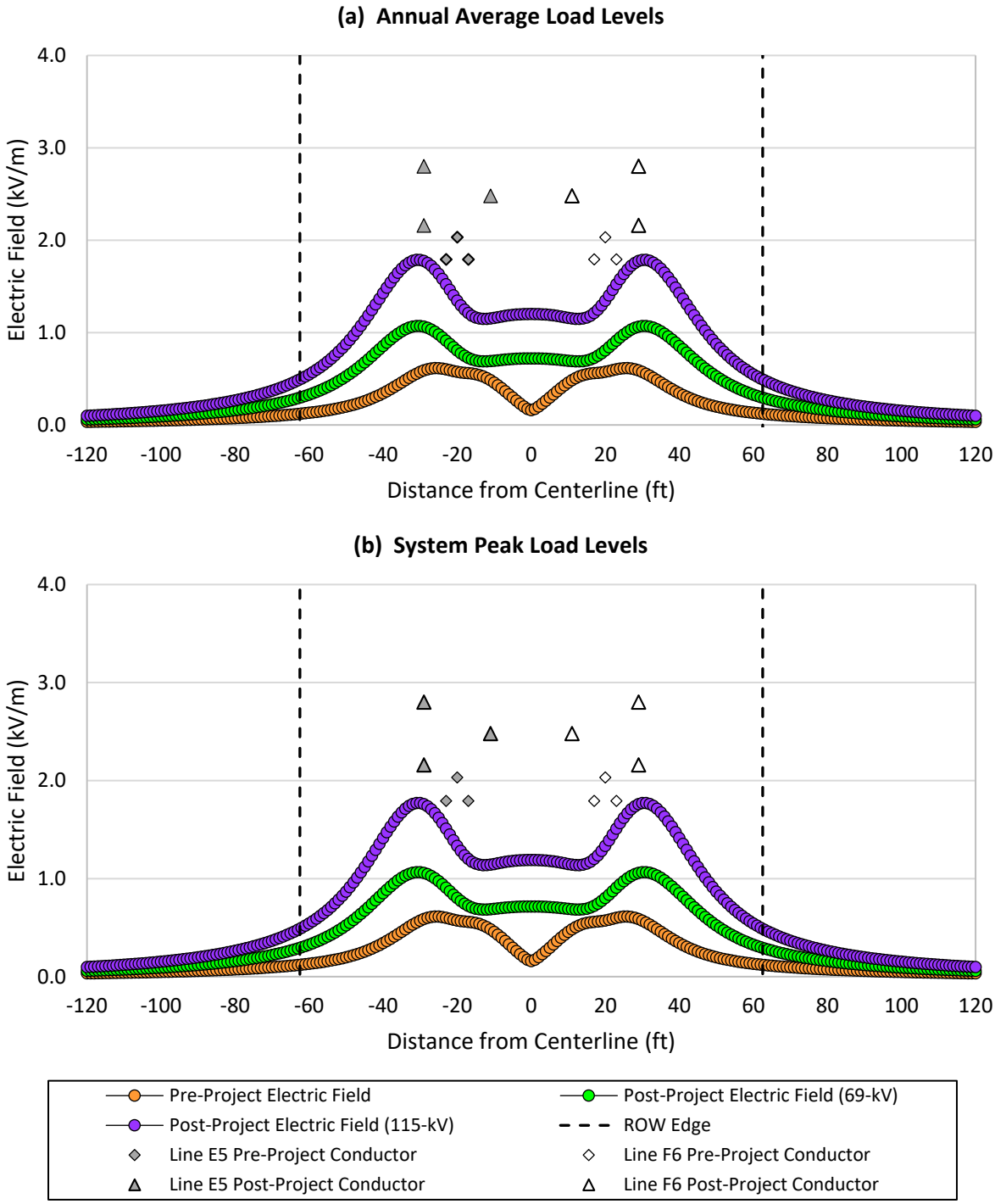

Figure C.13 Electric Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 3 (B-13148-NE Sheet 3, ROW Segment from Deerfield 3 Tap). ft = Feet; kV = Kilovolt; kV/m = Kilovolts Per Meter; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

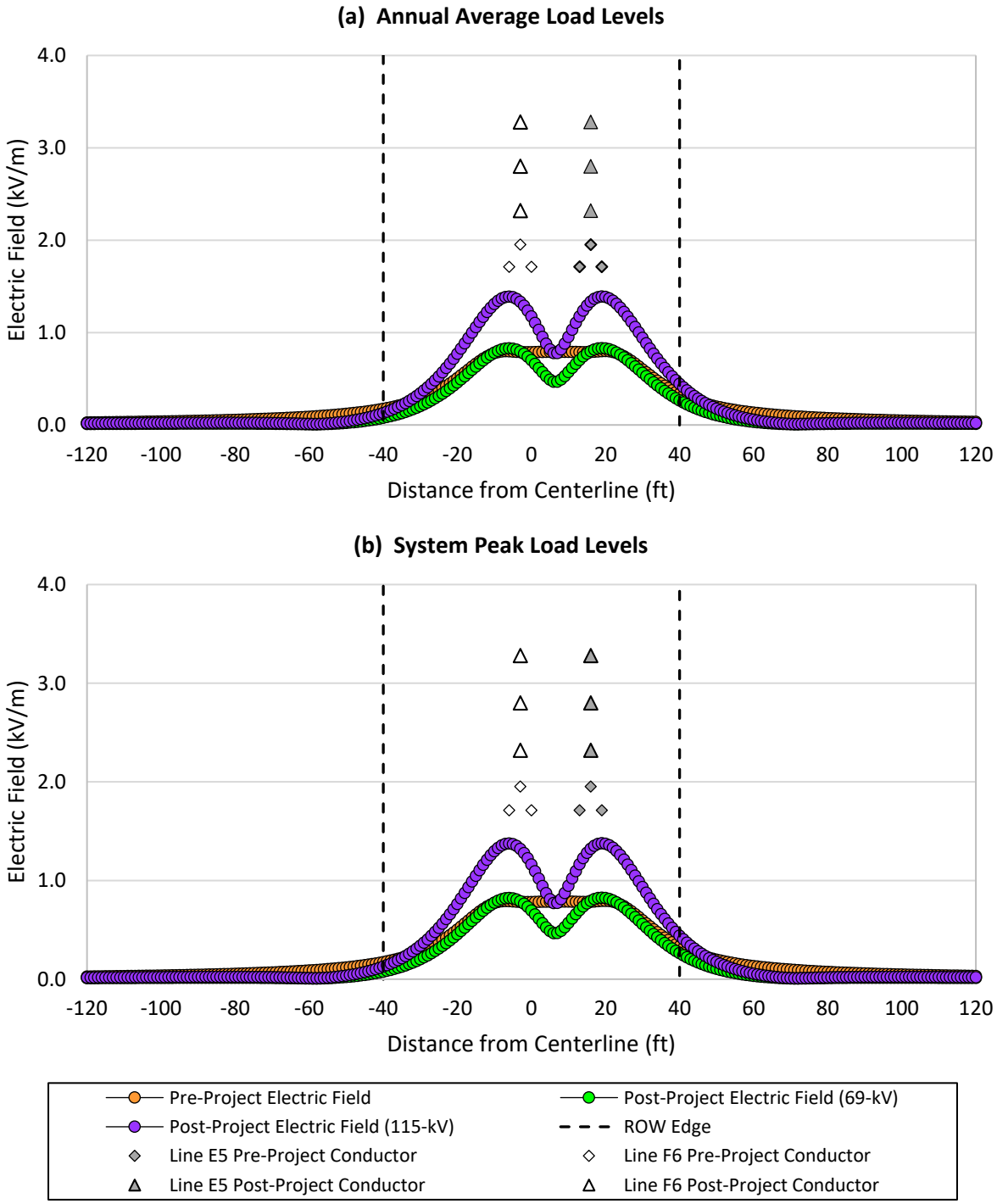

Figure C.14 Electric Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 4 (B-13148-NE Sheet 4, ROW Segment from Quabbin Switch Tap). ft = Feet; kV = Kilovolt; kV/m = Kilovolts Per Meter; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

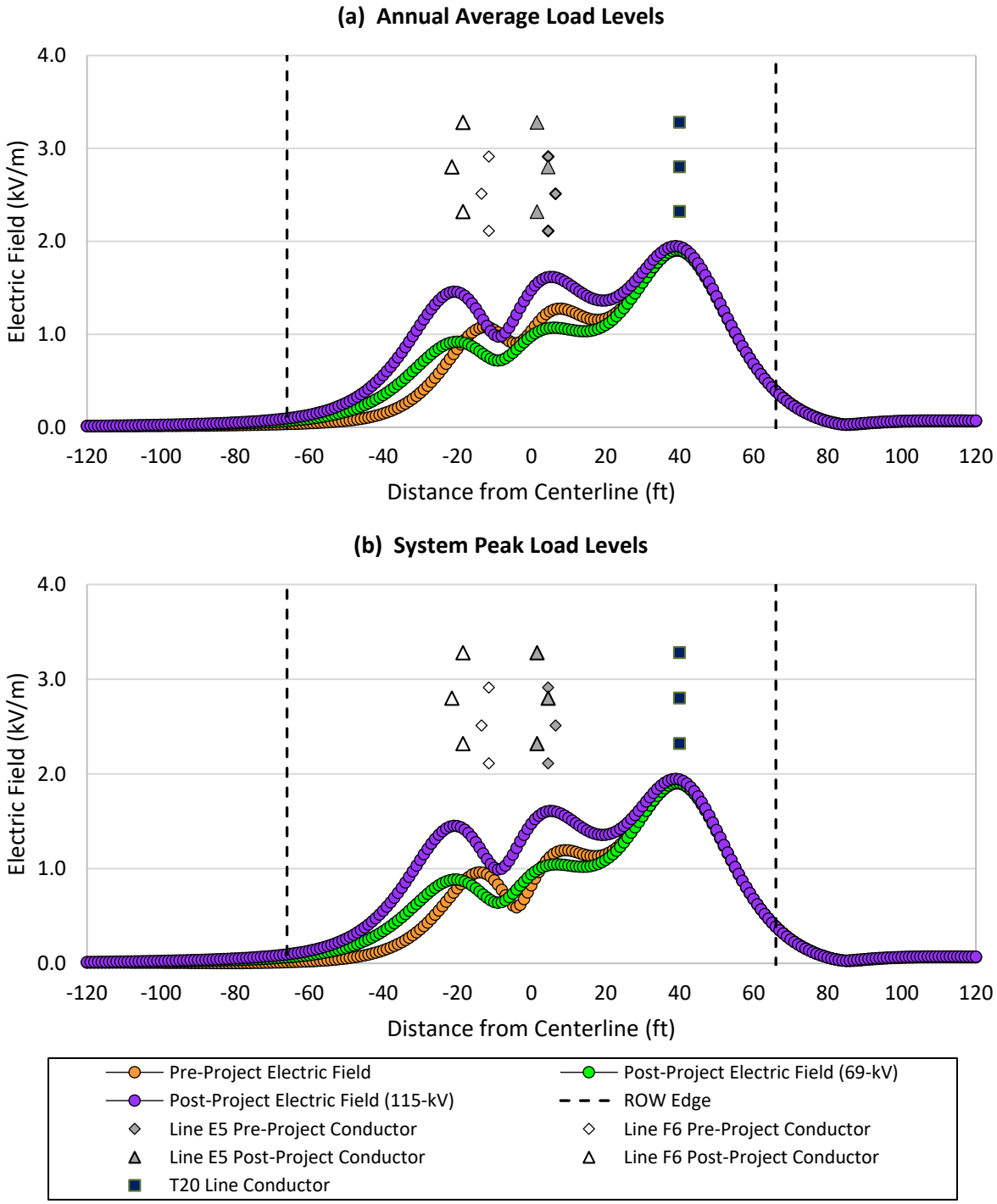

Figure C.15 Electric Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 5 (B-13148-NE Sheet 5, ROW Segment from Harrington St to Meadow St). ft = Feet; kV = Kilovolt; kV/m = Kilovolts Per Meter; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

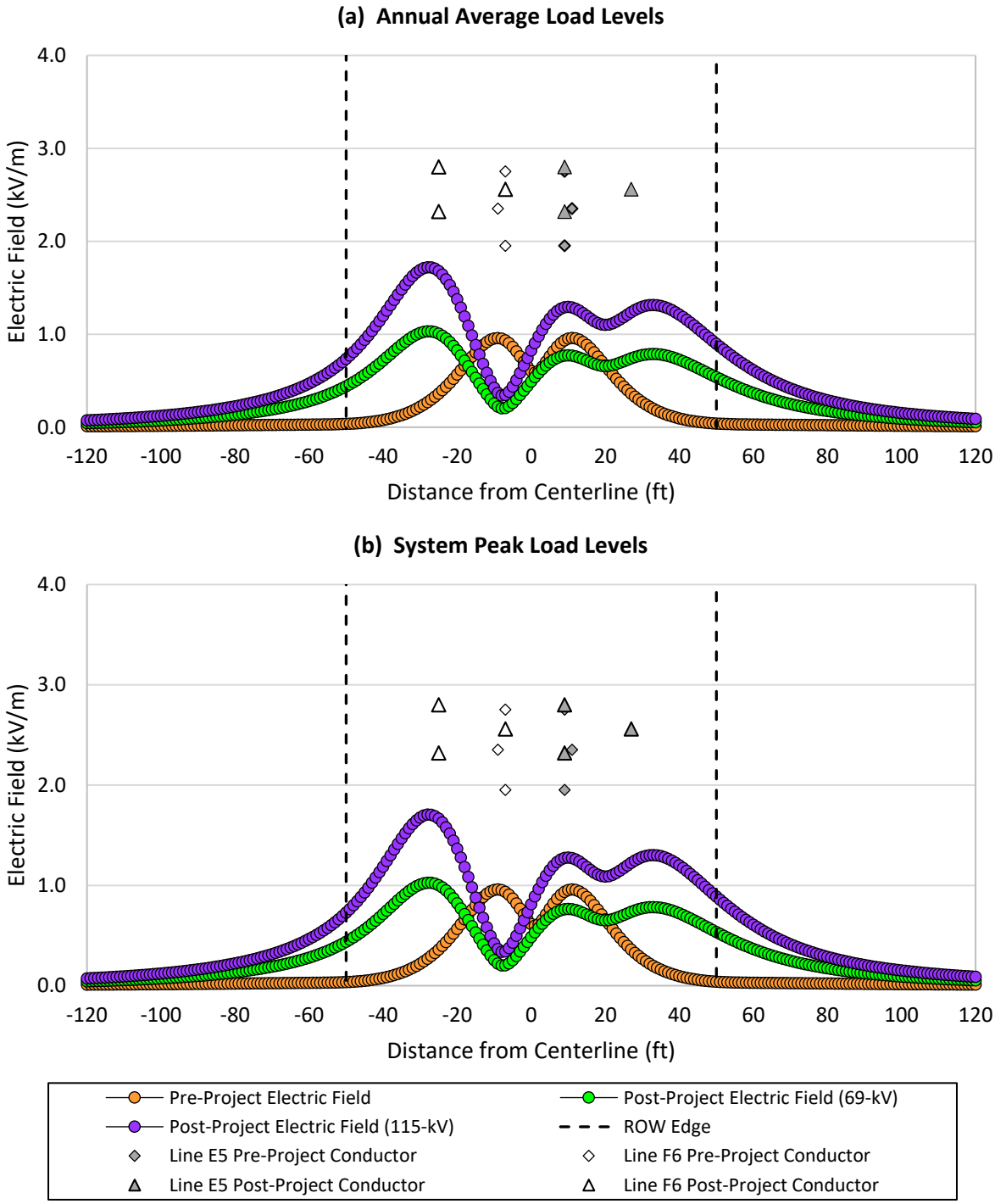

Figure C.16 Electric Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 6 (B-13148-NE Sheet 6, ROW Segment from Deerfield 2 to Shutesbury). ft = Feet; kV = Kilovolt; kV/m = Kilovolts Per Meter; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

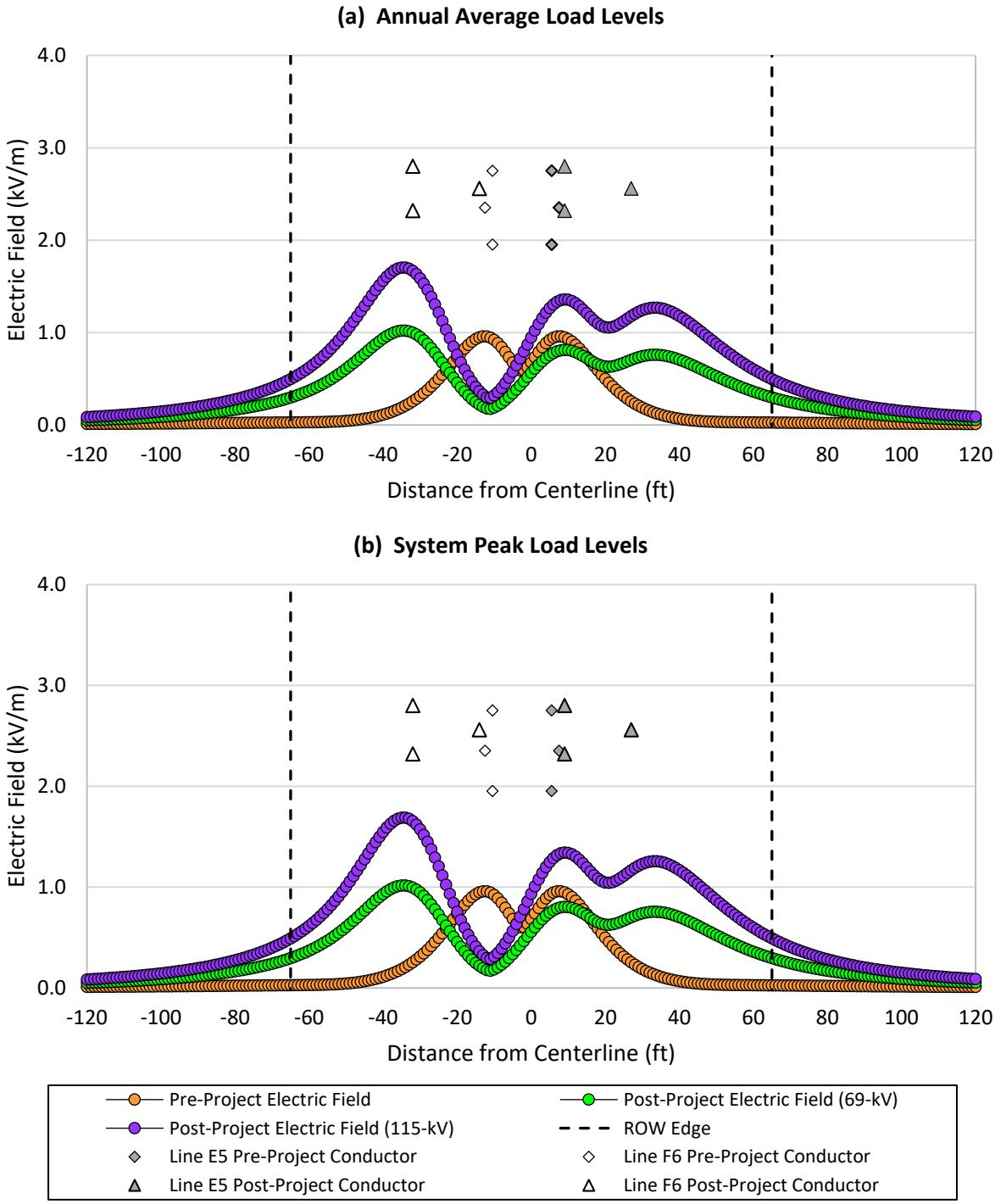

Figure C.17 Electric Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 7 (B-13148-NE Sheet 7, ROW Segment from Deerfield 2 to Shutesbury). ft = Feet; kV = Kilovolt; kV/m = Kilovolts Per Meter; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

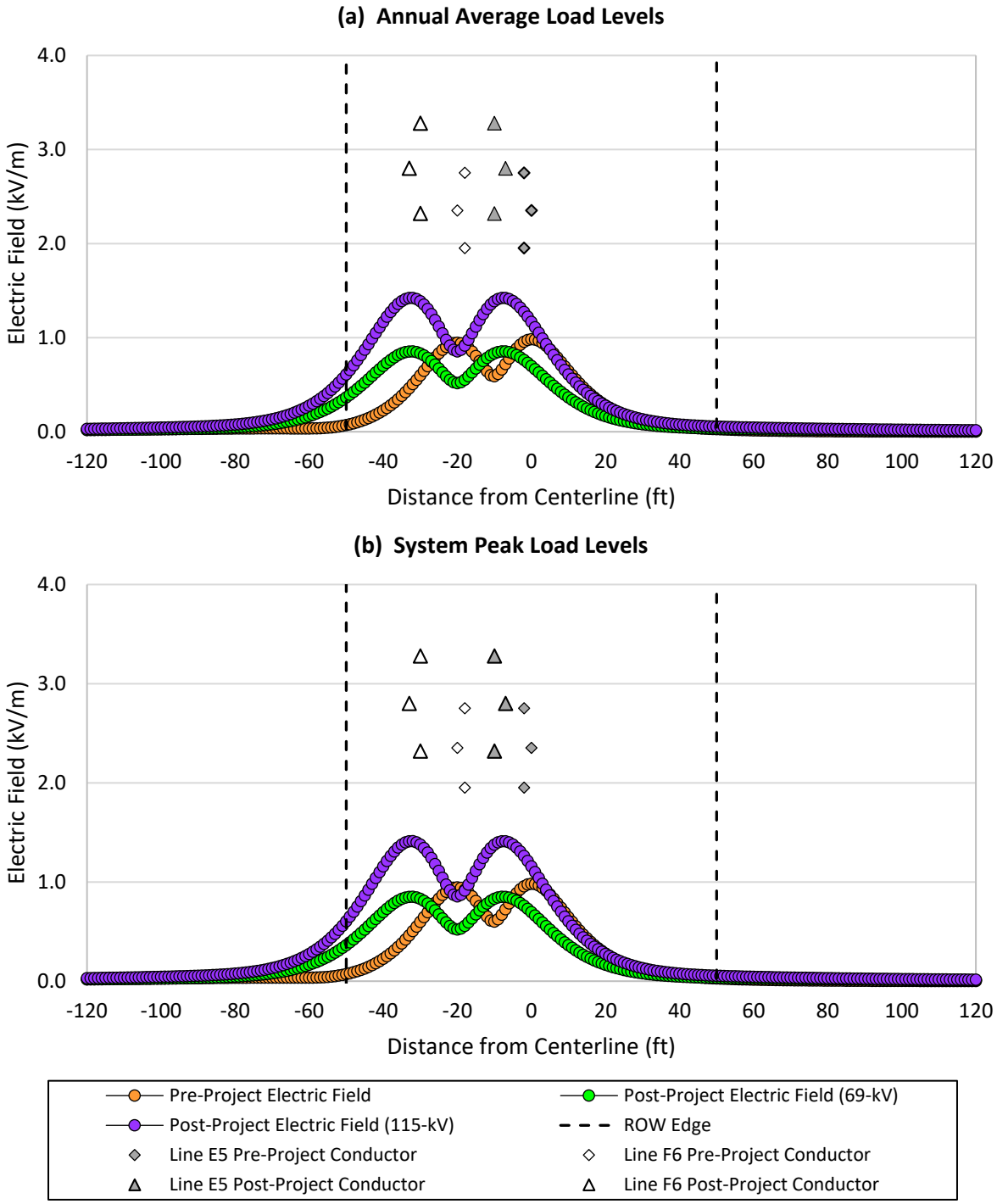

Figure C.18 Electric Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 8 (B-13148-NE Sheet 8, ROW Segment from Deerfield 2 to Shutesbury). ft = Feet; kV = Kilovolt; kV/m = Kilovolts Per Meter; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

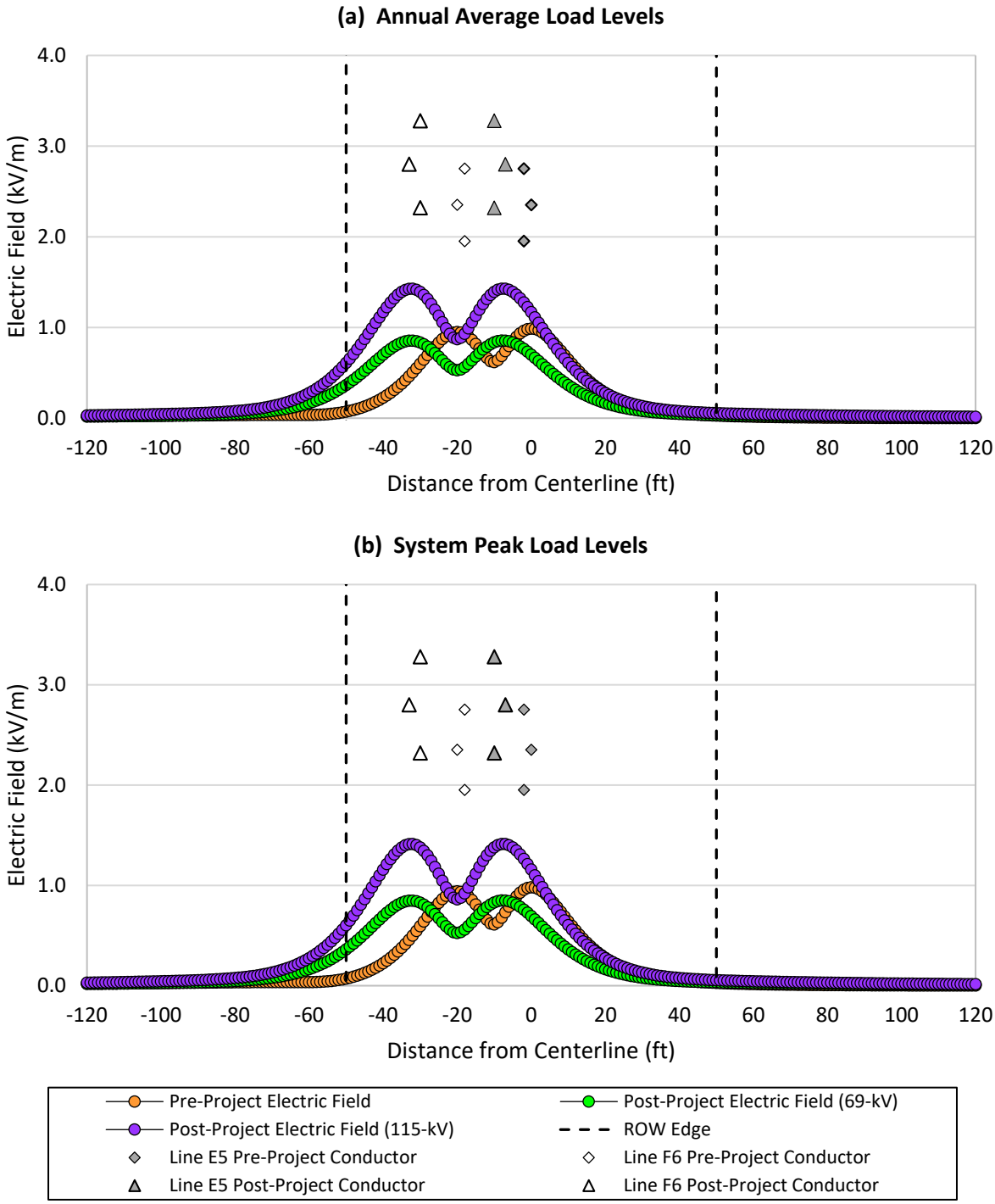

Figure C.19 Electric Field Modeling Results at 1 Meter Aboveground for Representative ROW Cross Section 8 (B-13148-NE Sheet 8, ROW Segment from Shutesbury to Quabbin Switch Tap). ft = Feet; kV = Kilovolt; kV/m = Kilovolts Per Meter; ROW = Right-of-Way. Panel (a) shows the results for annual average load levels, and Panel (b) shows the results for system peak load levels. Conductor locations on the graphs are not to scale and are provided to show relative locations.

Appendix D

Summary of Current Status of Health-Effect Conclusions for 60-Hz Alternating Current Electric and Magnetic Fields

Summary of Current Status of Health-Effect Conclusions for 60-Hz Alternating Current (AC) Electric and Magnetic Fields (EMFs)

Introduction

Electric and magnetic fields (EMFs) are invisible lines of force associated with anything that generates, transmits, or uses electricity, including high-voltage transmission lines and substations, as well as the overhead and underground distribution lines on residential streets, home wiring, and household appliances. As illustrated by Figure D.1, power-frequency (60-hertz [Hz]) alternating current (AC) EMFs are an extremely low frequency form of non-ionizing electromagnetic radiation. Electric fields (EFs) from power lines, which are usually expressed in units of kilovolts per meter (kV/m), are a product of the voltage difference between power lines and ground. Magnetic fields (MFs) are produced by the electric current carried on power lines and are usually expressed in units of gauss (G) or milligauss (mG) (1 G = 1,000 mG).[1] Unlike ionizing radiation (*e.g.*, ultraviolet rays, X-rays, gamma rays), power-frequency EMFs do not carry enough energy to break molecular bonds and damage DNA, biological cells, or tissues.

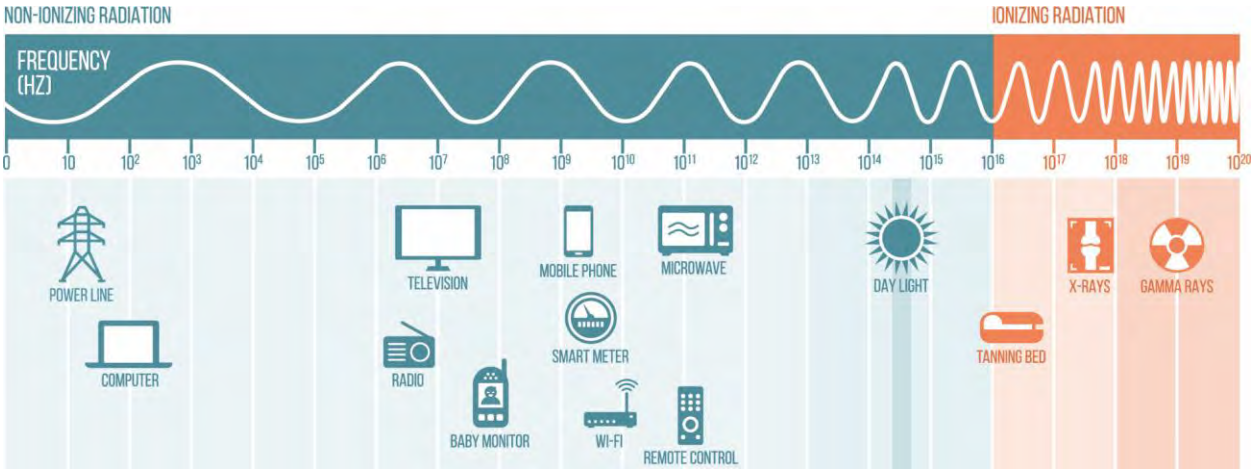

Figure D.1 The Electromagnetic Spectrum. EF = Electric Field; EMF = Electric and Magnetic Field; Hz = Hertz; MF = Magnetic Field; US = United States. As shown in the figure, the US electric power system operates at 60 Hz, and EMFs are thus frequently described as extremely low frequency (ELF) fields (*e.g.*, ELF-MFs and ELF-EFs).

Since the late 1970s when exposure to power-frequency EMFs emerged as a public health concern, following the reporting of epidemiological associations suggesting that children residing in greater proximity to overhead power lines may have a small increased risk of childhood leukemia, there has been a massive international research effort to understand whether and how power-frequency EMFs could cause childhood leukemia and other diseases (see Moulder, 2000). As described in more detail below, the three major lines of health-effects investigation for power-frequency EMFs consist of epidemiology studies of human populations, laboratory animal studies, and mechanistic studies. The biological effects of power-frequency EMFs have now been the focus of scientific research for over four decades, totaling thousands

[1] Another unit for MF levels is the microtesla (μT) (1 μT = 10 mG).

of published studies and tens of millions of dollars of research funding. More than 40 epidemiology studies alone have investigated statistical associations between residential EMF exposures or surrogates of exposure (*e.g.*, distance to transmission lines) and risk of childhood leukemia (Schmidt *et al*., 2021), and epidemiology studies have investigated associations for risks of other health endpoints, including brain cancer, breast cancer, adult leukemia and lymphoma, reproductive and developmental effects, and neurodegenerative diseases.

With a knowledge base that now totals 40 years of scientific research and thousands of published studies, scientists have not been able to identify a plausible mechanism whereby biological processes can be adversely affected by typical levels of power-frequency EMFs. Despite advancements in study designs and larger and larger study populations, the epidemiological associations with childhood leukemia risk remains weak and inconsistent; as discussed later, more recent epidemiology studies with improved study designs and larger study populations have tended to observe weaker associations, and frequently no association at all, as compared to older studies. The scientific basis for reported statistical associations for risk of childhood leukemia remains unexplained, as many subsequent experimental and mechanistic studies have been unable to identify a biologic process whereby power-frequency EMFs can exert such an effect. Moreover, studies of carcinogenicity in animals exposed to elevated levels of EMF have been overwhelmingly negative and do not support the hypothesis that EMF exposure is a significant risk factor for carcinogenesis (NIEHS, 2002). Overall, the accumulated EMF health-effects data fail to provide a clear and coherent picture whereby the levels of power-frequency EMFs that we encounter in our daily lives present a hazard to human health.

It is the consensus opinion of a number of public health agencies and expert scientific committees, including the United States (US) National Institute for Environmental Health Sciences (NIEHS), the World Health Organization (WHO), and the US Environmental Protection Agency (US EPA), that there are no confirmed chronic (*e.g.*, long-term) human health risks from exposure to power-frequency EMFs, such as increasing the risk of developing cancer. In 1999, the NIEHS published its final report for the Electric and Magnetic Fields Research and Public Information Dissemination Program (EMF-RAPID) that was authorized and funded in 1992 by the US Congress to conduct fundamental scientific research to clarify the potential for health risks from power-frequency EMF exposure (NIEHS, 1999). An extensive range of laboratory toxicology and exposure characterization studies were conducted as part of the EMF-RAPID program, with the NIEHS concluding in its final report (NIEHS, 1999):

> The ultimate goal of any risk assessment is to estimate the probability of disease in an exposed population…The NIEHS believes that the probability that ELF-EMF exposure is truly a health hazard is currently small. The weak epidemiological associations and lack of any laboratory support for these associations provide only marginal, scientific support that exposure to this agent is causing any degree of harm.

NIEHS further addressed the body of health-effects evidence in a seminal 2002 question and answer (Q&A) booklet on power-frequency EMFs (NIEHS, 2002):

> Over the past 25 years, research has addressed the question of whether exposure to power-frequency EMF might adversely affect human health. For most health outcomes, there is no evidence that EMF exposures have adverse effects. There is some evidence from epidemiology studies that exposure to power-frequency EMF is associated with an increased risk for childhood leukemia. This association is difficult to interpret in the absence of reproducible laboratory evidence or a scientific explanation that links magnetic fields [MFs] with childhood leukemia.

Currently, on its website,[2] NIEHS (2024) states that utility "Power Lines" fall into the "non-Ionizing" radiation category, and goes on to explain, "Non-ionizing: low-level radiation…is generally perceived as harmless to humans."

In 2007, the WHO published one of the most comprehensive health risk assessments of EMF in the power-frequency range, in which the WHO critically reviewed the cumulative epidemiologic and laboratory research, taking into account the strength and quality of individual research studies (WHO, 2007a). WHO concluded overall:

> Acute biological effects have been established for exposure to ELF electric and magnetic fields [EMFs] in the frequency range up to 100 kHz that may have adverse consequences on health. Therefore, exposure limits are needed. International guidelines exist that have addressed this issue. Compliance with these guidelines provides adequate protection. Consistent epidemiological evidence suggests that chronic low intensity ELF magnetic field [MF] exposure is associated with an increased risk of childhood leukaemia. However, the evidence for a causal relationship is limited, therefore, exposure limits based upon epidemiological evidence are not recommended, but some precautionary measures are warranted. (WHO, 2007a)

As part of its International EMF Project, the WHO has continued to conduct comprehensive reviews of EMF health-effects research and existing standards and guidelines, and has not changed its conclusion that the health-effects evidence for power-line frequencies of EMF does not support a causal relationship of EMF exposure with increased childhood leukemia risk or with other adverse health effects (WHO, 2024a).

US EPA has not established any hazard levels or exposure standards for power-frequency EMFs. On its webpage focused on "Electric and Magnetic Fields [EMFs] from Power Lines," US EPA (2023) states, "Scientific studies have not clearly shown whether exposure to EMF increases cancer risk."[3]

As discussed more below, there is consistency in the conclusions from expert and governmental reviews of the full body of EMF health-effects research performed by international scientific, health, and safety organizations, and governmental public health agencies, that there are no confirmed chronic health risks for power-frequency EMF. While the possible linkage between ELF-MF exposure and risk of childhood leukemia remains a continued focus of researchers, findings from recent studies arguably only add to the uncertainties in this body of evidence. As described below, recent findings are suggestive of a decline in the association between ELF-MF exposure and risk of childhood leukemia in studies of more recent time periods (*e.g.*, post-1990s). These findings cannot be readily explained by MF exposures, and researchers continue to investigate the potential roles of confounding factors and sources of bias as alternative explanations for the observed epidemiological associations (*e.g.*, Amoon *et al.*, 2022; Nguyen *et al.*, 2022; Amoon *et al.*, 2019).

Below, we continue our summary of the current status of power-frequency EMF health-effect conclusions with a brief discussion of the lines of scientific investigation that apply to understanding the potential human health effects of any exposure, including power-frequency EMF. We then present the status of EMF health-effect conclusions from international scientific, health, and safety organizations, and governmental public health agencies. This is followed by a discussion of recent research publications focused on the potential linkage between residential exposure to power-frequency MFs and risk of childhood leukemia, which continues to be the subject of updated epidemiological analyses and systematic reviews. Our review concludes with a summary of available health-based exposure guidelines established by international health

[2] https://www.niehs.nih.gov/health/topics/agents/emf/.
[3] https://www.epa.gov/radtown/electric-and-magnetic-fields-power-lines.

and safety organizations, which are designed to be protective against adverse health effects, as well as state guidelines for power-frequency EMFs.

Lines of Scientific Inquiry into EMF Health Effects

Epidemiology

Because of the statistical associations reported by early EMF epidemiology studies, the International Agency for Research on Cancer (IARC), which is part of WHO, classified power-line MFs as a 'possible' (Group 2B) carcinogen in 2002 (IARC, 2002).[4,5] IARC's cancer classification for power-line MFs was based on "limited" evidence from humans concerning childhood leukemia, "inadequate" evidence from humans concerning all other cancer types, and "inadequate" evidence from animals. Even though some epidemiology studies continue to provide weak suggestions of power-frequency MF health risk, the results among the studies remain inconsistent, poorly linked to actual MF exposures, and insufficient to demonstrate a causal relationship.

Epidemiology can provide statistical, correlative results between presumed exposures and disease patterns in human populations, but such associations are not able to establish causation. That is, while a laboratory scientist can precisely set exposure conditions, randomly allocate groups to be exposed or non-exposed, do careful pathology on the outcome, and can read the results blindly (*i.e.*, without knowing the exposure history), epidemiology is an observational science and cannot utilize these same rigorous scientific methods. Additional problems confound the interpretation of the power-frequency EMF epidemiology. For example, few of the epidemiology studies used actual measurements of MF exposure, and none of the exposure assessments were based on plausible mechanisms of interaction, or on validated MF metrics. Also, an epidemiologic study that reports 'statistically significant' associations is only testing that significance against the role of random chance, given the size of the populations studied. If other sources of uncertainty in epidemiologic studies were to be quantitatively included in the confidence interval (*e.g.*, confounding factors, measurement error, selection bias, misclassification), the margin of error would become wider and may well overlap a null outcome (*i.e.*, 'no association'). Reviews of MF epidemiology emphasize this point, namely that the error bars in reported results do not reflect all sources of uncertainty, and, consequently, the results are less indicative of an actual "statistically significant" link than typical confidence intervals suggest.

Laboratory Animal Studies

Hundreds of laboratory animal studies have examined the biological effects of power-frequency MF exposure in mammalian species expected to have reactions similar to humans. Support from such studies would make interpretation of power-frequency MF epidemiology less clouded and uncertain. However, these other lines of scientific evidence weigh against assigning a causal basis to the associations reported by epidemiology. Scientists have not been able to identify an established laboratory bioassay or animal

[4] Note that IARC's Group 2B possible human carcinogen classification was specific to ELF-MF. For ELF-EF, IARC concluded that there was "inadequate evidence" of carcinogenicity in humans. In general, the remaining health concerns related to power-frequency EMFs are now focused primarily on ELF-MFs rather than ELF-EFs. ELF-EFs are generally considered to be of potential lesser health concern than MFs due to consistent null findings from early research studies and because they are readily shielded by conductive objects like trees and vegetation, as well as buildings. Because they are readily shielded, power lines are generally not significant sources of long-term average EF exposure, even for populations residing nearby to utility rights-of-way (ROWs).

[5] Other agents classified as Group 2B possible human carcinogens by IARC include aloe vera, picked vegetables, and gasoline fumes. Coffee was classified as a Group 2B possible human carcinogen for about 25 years until 2016 when it was re-assessed by IARC and re-classified into Group 3 not classifiable as to its carcinogenicity to humans. Both consumption of red meat and drinking very hot beverages are classified as Group 2A probable human carcinogens by IARC.

model by which power-line MFs can be shown to consistently initiate or accelerate biological changes related to cancer risk. Lifetime exposures to high levels of 60-Hz MFs have been tested in numerous animal studies (using different species), with results failing to show that 60-Hz MFs can initiate or exacerbate any disease or pre-cancerous condition, even in genetically modified and susceptible animals. For example, research by the National Toxicology Program (NTP) extensively tested elevated, lifetime 60-Hz AC MF exposures, and the study scope and quantity of animals tested is unlikely to ever be duplicated (Moulder, 2000). The NTP study found no cancer risks, even at high MF exposure levels (1 to 2 microteslas [μT], or 10,000 to 20,000 mG). Such animal testing is the foundation (or "gold standard") for probing health effects, because it is often through such exhaustive animal studies that regulators can determine what (if any) aspect of an exposure (*e.g.*, what chemicals or what MF parameter [*e.g.*, frequency, intensity, duration, polarization]) should be regulated.

Mechanistic Studies

Studies of 'mechanisms of action' utilize well-established laws of physics, chemistry, and biology to predict and understand how MFs might alter the function of biological structures like cell membranes or genetic (DNA) molecules. Mechanistic MF research to date, representing extensive efforts by scientists worldwide, has not been able to identify plausible mechanisms or causal pathways by which typical levels of power-line MFs can cause adverse health effects. MF interactions with biological systems have been analyzed carefully in light of the biophysics of electromagnetic field interactions with matter in general and biological molecules in particular. Unlike ionizing radiation (*e.g.*, ultraviolet rays, X-rays, gamma rays), non-ionizing radiation does not carry enough energy to break molecular bonds,

The applicability of fundamental physics to all systems, and to biology in particular, permits evaluation of the interaction of MFs with ions, molecules, cells, and organisms. The conclusions are that typical power-line MFs do not create disturbances that are detectable above the many sources of disturbance (electrical, thermal agitation, and other 'noise') that are naturally present in living systems. Notably, a common medical procedure, magnetic resonance imaging (MRI), exposes patients to extremely intense static and time varying MFs *via* both the main static field and the oscillating gradient MFs that generate the MRI image. Yet, such treatments leave no biomarkers of exposure and are safer than conventional X-ray images and computerized tomography (CT) scans or nuclear medicine images. In fact, many studies have been conducted to examine the ability of human beings to detect the existence of MFs, but no convincing evidence of such a sensory ability has been found.

Consideration of different parameters of MF exposure (frequency, intensity, duration, wave shape, polarization, modulation, intermittency, *etc.*) have revealed no firm basis on which to attribute a potential for adverse biological effects to the specific values of, for example, any of the following EMF metrics: (1) electric or MF magnitudes, (2) the fundamental frequency or to harmonic frequencies, (3) continuous exposure *vs*. intermittent exposure, (4) time-averaged fields *vs*. peak fields, (5) constant-frequency MFs *vs*. variable-frequency MFs. Over the years, many hypotheses have been proposed regarding how MFs may elicit a carcinogenic response and many analyses have been performed; however, diligent attention by scientists has not yielded identified aspects, levels, or durations of MF exposure that can be traced to increased cancer risk through a chain of causal events. Without an understanding of mechanism, it remains unknown as to what, if any, aspect of MF exposure should be controlled to reduce health risks.

Integration of Lines of Health-Effects Evidence

Biological-effect evidence that may establish the existence of a health impact is often illustrated as a 'three-legged stool' (Figure D.2), where strength in each line of evidence (each leg) is required for overall strength and stability, and weakness in any one leg makes the stool unstable. That is, lack of support from all three

lines of evidence restricts the conclusions that can be drawn as to the existence of a human health risk. The three legs are: (1) exposure/disease correlations in human populations (epidemiology); (2) empirical laboratory animal studies at controlled and elevated levels of exposure; and (3) *in vitro* and/or mechanistic studies of the agent's mode of action.



Figure D.2 Three-Legged Stool: Health-Effects Research Looks at Three Independent Lines of Evidence – Cellular and Molecular Studies (Mechanism of Action), Laboratory Animal Studies, and Population Studies (Epidemiology). To understand toxicity, support is required in each area.

For low-frequency MFs, evidence suggesting adverse health effects derives primarily from leg (1), but there is a profound lack of support from animal studies and mechanistic studies (legs [2] and [3]). In fact, much of the evidence from legs (2) and (3) suggests an absence of health risks from ELF-MF exposure.

Mechanistic evidence (leg 3) is crucial, as living organisms rely upon the same physical laws that govern all matter. As shown in Figure D.3 below, physics forms the basis of chemistry, which forms the basis of biology and, in turn, forms the basis of physiology and medicine. Hence, even though there is an increase in complexity as you move up in this hierarchy, each successive layer must obey the fundamental laws found to be valid for the layer below. At the most fundamental level are the laws of physics, which have been validated by experiment and internal consistency. Maxwell's laws of electromagnetism are accepted to be invariant in time and space, and their accuracy in describing the interactions between electromagnetic fields and matter underlies the functioning of virtually all technology. No exceptions have been found, despite constant challenges and tests. Likewise, physics has been found to be valid in complex systems, encompassing chemistry, biology, technology, and medicine. Simple conservation laws (*e.g.*, conservation of mass+energy, conservation of electric charge, and conservation of linear and angular momentum) apply universally, without exception.

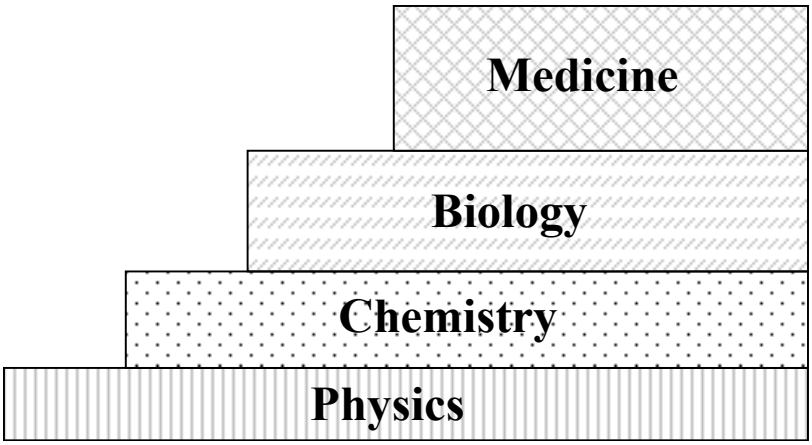

Figure D.3 Each Scientific Discipline Rests on the Underlying Laws of a More Basic Discipline

In order for MFs to cause changes within living cells, the fields must in some manner modify molecules or structures in the organism. By their very definition, MFs interact with matter only by exerting force on stationary or moving electric charges. At sufficiently high levels, these forces will add thermal energy or change the configuration of a charged biological molecule or structure. However, the magnitudes of natural forces that cells use (and are sensitive to) have been measured, and the results demonstrate that biological structures can withstand forces far larger than can be generated by typical MFs. Cells and organs function properly in spite of many internal sources of interfering thermal, chemical, electrical, and physical force effects, which exceed by a large factor the forces that can be caused by power-line MFs.

In summary, for MFs to alter physiological function, initiate dysfunction, or cause the onset of disease in humans or animals there must exist a mechanism by which magnetic forces alter molecules, chemical reactions, cell membranes, or biological structures (*i.e.*, DNA, RNA, plasma membranes, mitochondria). A MF is not a foreign molecular or chemical agent, and biological plausibility must be assessed with this in mind. The initial physical step sets off the following causal chain that must be completed in order to make any connection to disease:

Magnetic fields $\Rightarrow$ matter (physics) $\Rightarrow$ molecules (chemistry) $\Rightarrow$ organisms (biology) $\Rightarrow$ disease

A necessary condition for MFs to impact on human or ecosystem biology is that the MF-induced changes have to exceed chemical and thermal changes from natural or background influences. Changes in biological molecules are coupled to MFs through changes in forces on electrically charged structures, which in turn, must be coupled to metabolically important chemical processes (*e.g.*, reaction rates or transport rates).

Summary of EMF Health-Effect Conclusions from International Scientific, Health, and Safety Organizations, and Governmental Public Health Agencies

As summarized below, a number of international scientific, health, and safety organizations, and governmental public health agencies have reviewed the EMF health-effects literature and provided their interpretations of the EMF health-effects science. Below, we have compiled summaries that are illustrative of the current positions of a number of international scientific, health, and safety organizations, and governmental public health agencies, regarding the EMF health-effects science and the potential for human health risks arising from power-frequency EMF exposure. As discussed below, it is the consensus opinion of a number of international scientific, health, and safety organizations, and public health agencies,

including the WHO, US EPA, and NIEHS, that there are no confirmed chronic human health risks for everyday exposures to power-frequency EMFs, including risk of cancers.

None of the international scientific, health, and safety organizations, and governmental public health agencies that have conducted comprehensive (*i.e.*, weight-of-evidence)[6] reviews of the EMF health-effects science have concluded that there is a sound scientific basis for causally linking long-term exposure to power-frequency EMFs with chronic health risks, and for justifying a need for health-based standards and exposure guidelines to protect against chronic health risks. As noted below and discussed more in the section on "EMF Standards and Guidelines," two international health and safety organizations (International Commission on Non-Ionizing Radiation Protection [ICNIRP] and the International Committee on Electromagnetic Safety [ICES]) have developed health-based exposure guidelines for power-frequency EMFs that are based on protection against acute or short-term effects (*e.g.*, electrostimulation). It also bears mentioning that a number of public health agencies do not even address power-frequency EMF health-effects concerns or provide recommendations on EMF exposure guidelines for power-frequency fields. This suggests that, even though the public's power-frequency EMF exposure is ubiquitous, the potential threat of a health hazard from power-line EMFs is not viewed as sufficiently established to warrant regulation. For example, the US Food and Drug Administration (US FDA), the Centers for Disease Control and Prevention (CDC), the Agency for Toxic Substances and Disease Registry (ATSDR), the Consumer Product Safety Commission (CPSC), the Office of the Surgeon General, and the NTP have not promulgated guidelines on power-frequency EMF exposure limits.

International scientific, health, and safety organizations, and governmental public health agencies, have provided the following conclusions regarding the EMF health-effects science and the potential for human health risks:

American Cancer Society (ACS) (2022):[7] "The possible link between electromagnetic fields and cancer has been a subject of controversy for several decades. It's not clear exactly how electromagnetic fields, a form of low-energy, non-ionizing radiation, could increase cancer risk. Plus, because we are all exposed to different amounts of these fields at different times, the issue has been hard to study."

US EPA (2023):[8] US EPA has not established any hazard levels or exposure standards for power-frequency EMFs, and US EPA states that "Scientific studies have not clearly shown whether exposure to EMF increases cancer risk."

European Commission, Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) (2015):[9]

> In research on health effects of EMF, the lack of clearly focused working hypotheses for chosen biological endpoints is accentuated by the lack of an established biological or biophysical mechanism of action at environmental exposure levels. This does not allow researchers to conclude on the most relevant exposure parameter, and usually several alternative measures of exposure are evaluated (for instance field strength, exposure frequency, cumulative exposure, time since first exposure, *etc.*). In addition, some studies

[6] Weight-of-evidence approaches for reviewing health-effects evidence are well accepted in the public health field, and include such key elements as evaluating the entire body of relevant study findings, including from different types of studies (*e.g.*, epidemiological studies, laboratory animal studies, human clinical studies, mechanistic studies); assessing study quality and giving more weight to higher quality studies when weighing evidence; and using established, transparent, and systematic methods for integrating study evidence and reaching causal conclusions.

[7] https://www.cancer.org/cancer/risk-prevention/radiation-exposure/extremely-low-frequency-radiation.html.

[8] https://www.epa.gov/radtown/electric-and-magnetic-fields-power-lines.

[9] http://ec.europa.eu/health/scientific_committees/emerging/docs/scenihr_o_041.pdf.

> use multiple end-points which are equally prone to false positive results, without adequate statistical corrections. Good research practice requires that all hypotheses evaluated are clearly stated and that all results pertaining to them are reported. Selective reporting, with emphasis on significant findings that were not specified in advance, can mislead the assessment by ignoring the issue of multiple testing…. The new epidemiological studies are consistent with earlier findings of an increased risk of childhood leukaemia with estimated daily average exposures above 0.3 to 0.4 μT [3 – 4 mG]. As stated in the previous [SCENIHR] Opinions, no mechanisms have been identified and no support is existing from experimental studies that could explain these findings, which, together with shortcomings of the epidemiological studies prevent a causal interpretation.

ICNIRP (2010):[10] ICNIRP (2010) conducted a comprehensive review of the body of scientific evidence related to potential adverse health effects from general public and occupational exposure to low frequency AC EMFs, concluding:

> The epidemiological and biological data concerning chronic conditions were carefully reviewed and it was concluded that there is no compelling evidence that they are causally related to low-frequency EMF exposure…. [A] causal relationship between magnetic fields [MFs] and childhood leukemia has not been established. The absence of established causality means that this effect cannot be addressed in the basic restrictions.

ICNIRP (2010) acknowledged the epidemiological evidence, suggesting that long-term exposure to 50-60 Hz MFs might be weakly associated with an increased risk of childhood leukemia, and pointed to uncertainties in this evidence, including the roles of "a combination of selection bias, some degree of confounding and chance" as explaining the epidemiological findings. In addition, ICNIRP (2010) highlighted how "no biophysical mechanism has been identified and the experimental results from the animal and cellular laboratory studies do not support the notion that exposure to 50-60 Hz magnetic fields [MFs] is a cause of childhood leukemia."

Based on basic restrictions for protection against acute health effects (*e.g.*, retinal phosphenes, nerve and muscle stimulation, shocks and burns, surface electric-charge effects such as perception), ICNIRP (2010) has established a health-based guideline for allowable general public exposure to power-frequency MF at 2,000 mG, (200 μT), and a health-based guideline for allowable general public exposure to power-frequency EF at 4.2 kV/m. Importantly, ICNIRP (2010) describes its exposure guidelines as "limiting exposure to electric and magnetic fields (EMF) that will provide protection against all established adverse health effects" [underline emphasis added].

The ICES within the Institute of Electrical and Electronics Engineers (IEEE) (2019)[11] conducted an updated review of the scientific and medical research literature, and retained its safety guidelines for general public exposure to 60 Hz MF and EF at 9,040 mG (904 μT) and 5.0 kV/m, respectively. IEEE (2019) specifically evaluated the evidence of possible adverse health effects for chronic low-level EMF exposure, reaching the following conclusions for exposures to electric, magnetic, and electromagnetic fields at frequencies between 0 Hz and 300 GHz:

> 1. "The weight-of-evidence provides no credible indication of adverse effects caused by chronic exposures below levels specified in this standard."

[10] International Commission for Non-Ionizing Radiation Protection (ICNIRP). 2010. "Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (1 Hz to 100 kHz)." *Health Phys.* 99(6):818–836.

[11] Institute of Electrical & Electronics Engineers (IEEE). 2019. "C95.1-2019 IEEE Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic and Electromagnetic Fields 0 to 300 GHz." IEEE Standards Coordinating Committee 39, NY: IEEE, Inc.

2. "No biophysical mechanisms have been scientifically validated that would link chronic exposures below levels specified in this standard to adverse health effects."

3. "Based on the collective findings of recent reviews, the weight of the evidence continues to indicate that chronic exposure at levels specified in this standard is unlikely to cause adverse health effects."

National Cancer Institute (NCI) (2022)[12] notes on its webpage focused on "Electromagnetic Fields and Cancer" that "No mechanism by which ELF-EMFs or radio frequency radiation could cause cancer has been identified…. Studies of animals have not provided any indications that exposure to ELF-EMFs is associated with cancer." Regarding the evidence from epidemiological studies, NCI (2022) concludes:

> Most of the research has focused on leukemia and brain tumors, the two most common cancers in children. Studies have examined associations of these cancers with living near power lines, with magnetic fields [MFs] in the home, and with exposure of parents to high levels of magnetic fields [MFs] in the workplace. No consistent evidence for an association between any source of non-ionizing EMF and cancer has been found.

NIEHS (2024),[13] which funded and orchestrated a large laboratory-research program on power-frequency EMF, points out on its website that utility "Power Lines" fall into the "non-Ionizing" radiation category. On the website, NIEHS goes on to explain, "Non-ionizing: low-level radiation which is generally perceived as harmless to humans."

WHO published a lengthy monograph (WHO, 2007a) for its "Health Risk Assessment" of power-frequency EMF in 2007, as part of its International EMF Project, and came to several conclusions. WHO (2007a) concluded overall:

> Acute biological effects have been established for exposure to ELF electric and magnetic fields [EMFs] in the frequency range up to 100 kHz that may have adverse consequences on health. Therefore, exposure limits are needed. International guidelines exist that have addressed this issue. Compliance with these guidelines provides adequate protection. Consistent epidemiological evidence suggests that chronic low intensity ELF magnetic field [MF] exposure is associated with an increased risk of childhood leukaemia. However, the evidence for a causal relationship is limited, therefore exposure limits based upon epidemiological evidence are not recommended, but some precautionary measures are warranted.

Specifically, with respect to the interpretation of epidemiology associations, the summary section on p. 12 in WHO (2007a) states:

> Uncertainties in the hazard assessment include the role that control selection bias and exposure misclassification might have on the observed relationship between magnetic fields [MFs] and childhood leukaemia. In addition, virtually all of the laboratory evidence and the mechanistic evidence fail to support a relationship between low-level ELF magnetic fields [MFs] and changes in biological function or disease status. Thus, on balance, the evidence is not strong enough to be considered causal, but sufficiently strong to remain a concern.

[12] https://www.cancer.gov/about-cancer/causes-prevention/risk/radiation/electromagnetic-fields-fact-sheet.
[13] https://www.niehs.nih.gov/health/topics/agents/emf/.

WHO released a fact sheet in June 2007 (WHO, 2007b) to accompany its full environmental health criteria monograph, and it contained similar conclusions regarding important limitations to the epidemiological evidence for childhood leukemia:

> However, the epidemiological evidence is weakened by methodological problems, such as potential selection bias. In addition, there are no accepted biophysical mechanisms that would suggest that low-level exposures are involved in cancer development. Thus, if there were any effects from exposures to these low-level fields, it would have to be through a biological mechanism that is as yet unknown. Additionally, animal studies have been largely negative. Thus, on balance, the evidence related to childhood leukaemia is not strong enough to be considered causal.

WHO (2007b) went on to discuss how the scientific evidence for other health endpoints was even weaker than that for childhood leukemia:

> A number of other adverse health effects have been studied for possible association with ELF magnetic field [MF] exposure. These include other childhood cancers, cancers in adults, depression, suicide, cardiovascular disorders, reproductive dysfunction, developmental disorders, immunological modifications, neurobehavioural effects and neurodegenerative disease. The WHO Task Group concluded that scientific evidence supporting an association between ELF magnetic field [MF] exposure and all of these health effects is much weaker than for childhood leukaemia. In some instances (*i.e.*, for cardiovascular disease or breast cancer) the evidence suggests that these fields do not cause them.

Therefore, WHO (2007b) recommended, "policies based on the adoption of arbitrary low exposure limits are not warranted."

WHO (2024b) maintains and updates a website[14] for its International EMF Project where it provides summaries of existing standards and guidelines and fact sheets, as well as scientific reviews of EMF health-effects research. On this website,[15] WHO (2024a) states, "[T]he main conclusion from the WHO reviews is that EMF exposures below the limits recommended in the ICNIRP international guidelines do not appear to have any known consequence on health." On another webpage with an EMF Q&A,[16] WHO provides the following conclusions regarding EMF health-effects research:

> Despite the feeling of some people that more research needs to be done, scientific knowledge in this area is now more extensive than for most chemicals. Based on a recent in-depth review of the scientific literature, the WHO concluded that current evidence does not confirm the existence of any health consequences from exposure to low level electromagnetic fields. However, some gaps in knowledge about biological effects exist and need further research. (WHO, 2016)

[14] https://www.who.int/health-topics/electromagnetic-fields#tab=tab_1.
[15] https://www.who.int/teams/environment-climate-change-and-health/radiation-and-health/protection-norms.
[16] https://www.who.int/news-room/questions-and-answers/item/radiation-electromagnetic-fields.

Summary of Recent Research Publications on Childhood Leukemia

The potential linkage between residential exposure to power-frequency MFs[17] (*i.e*., ELF-MFs) and risk of childhood leukemia continues to be the subject of updated epidemiological analyses and systematic reviews. In particular, Amoon *et al*. (2022) published an updated analysis that included pooled results from epidemiology studies published from 2010 to 2020 of MFs and childhood leukemia. Led by researchers in the Department of Epidemiology at the University of California, Los Angeles (UCLA) and the Los Angeles County Department of Public Health, this study observed no increased risk of leukemia among children exposed to greater MF levels (odds ratio [OR] = 1.01, for exposure ≥0.4 μT [4 mG] compared with exposures <0.1 μT [1 mG]). The results of the pooled analysis, which combined the primary individual-level data (24,994 cases, 30,769 controls) from either new or updated epidemiological studies conducted in California, Italy, the United Kingdom, and Denmark, are supportive of other study findings indicating a decline in reported leukemia risks from epidemiological studies using more recent (*i.e*., post-1990s) data. Specifically, Amoon *et al*. (2022) concluded, "[O]ur results do not show the risk increase observed in previous pooled analysis and, over time, show a decrease in effect to no association between MF and childhood leukemia."

Consistent with the Amoon *et al*. (2022) findings, researchers from the WHO's IARC reported findings from the Childhood Leukaemia International Consortium (CLIC) supporting a lack of association between occupational ELF-MF exposure of parents and leukemia risk for their children (Talibov *et al*., 2019). Talibov *et al*. (2019) conducted a pooled analysis of individual-level data from 11 case-control studies (9,723 childhood leukemia cases, 17,099 controls) and reported ORs that were not statistically different from one for both paternal and maternal ELF-MF exposures and leukemia risk (including all leukemia subtypes, as well as specifically acute lymphoblastic leukemia [ALL] and acute myeloid leukemia [AML]), indicating no elevation in childhood leukemia risk with increased parental MF exposure. Based on their findings, Talibov *et al*. (2019) concluded:

> In conclusion, using a large international pool of case–control studies and a detailed quantitative JEM [job-exposure matrix], we did not find any evidence for an association between fathers' occupational ELF-MF exposures around the time of conception or mothers' occupational ELF-MF exposures during pregnancy and leukaemia in their offspring. Considering our findings and those of previous smaller less consistent studies together suggests that parental ELF-MF exposure plays no relevant role in the aetiology of childhood leukaemia.

Several meta-analysis and systematic review studies have been published in the last couple years, and despite often examining the results from a similar body of epidemiology studies, have reached different conclusions regarding the strength of the epidemiological evidence for ELF-MF exposure and risk of childhood leukemia. Seomun *et al*. (2021) reported statistically significant associations between exposure to ELF-MFs and childhood leukemia for their meta-analysis that included 27 case-control studies. Since case-control studies are subject to selection bias, as well as other methodological problems, Seomun *et al*. (2021) acknowledged their exclusive reliance on case-control studies as an important limitation to their analysis that reduces the strength of their findings. For their systematic review and meta-analysis of case-control studies and cohort studies, Brabant *et al*. (2022) reported findings indicating a statistically significant association between ELF-MF and childhood leukemia, with analyses indicating that this association was driven by results from studies performed before 2000.

[17] As mentioned previously, most of the remaining health concerns related to power-frequency EMFs are thus focused on MFs rather than EFs.

Onyije *et al*. (2022) conducted an "umbrella review" of environmental risk factors for childhood ALL that integrated findings from previously published systematic reviews or meta-analyses. For ELF-MF, Onyije *et al*. (2022) concluded that there was "some" level of evidence for an association between postnatal ELF-MF exposure and childhood ALL, in particular for the highest MF-exposed categories; in contrast, they concluded that exposure to low doses of ionizing radiation during childhood and general pesticide exposure during pregnancy were both "strongly" associated with childhood ALL. They highlighted ELF-MF as "an example where the epidemiological association was established more than 20 years ago but concerns about bias and the lack of biological plausibility of the association have precluded any conclusions on causality." The English abstract for the Herkert *et al*. (2021)[18] integrative review, which analyzed five case-control studies published between 2012 and 2020 that investigated the association between exposure to ELF-MF and risk of childhood leukemia, includes the following overall conclusion: "Due to methodological heterogeneity and confounding variables in the analyzed articles, the authors concluded that it was not possible to demonstrate the relationship between low-frequency non-ionizing radiation sources and the development of childhood leukemia." Similarly, for their recent review paper, Schmidt *et al*. (2021) emphasized how ELF-MF has yet to be "verified" as a risk factor for childhood leukemia, and they pointed to the lack of a plausible biological mechanism and the inadequate evidence from experimental animal studies: "However, how ELF-MF may cause leukemia is unknown – until today, no plausible biological mechanism has been found, and experimental *in vitro* and *in vivo* studies do not confirm the results of the epidemiological studies."

Finally, epidemiological studies continue to investigate possible alternative explanations for the observed epidemiological associations between ELF-MF exposure and risk of childhood leukemia, with postulated factors including socioeconomic status, residential mobility, residential dwelling type, viral contacts, environmental tobacco smoke, dietary agents, traffic density (as a proxy for air pollution exposure), pesticides, and corona ions (Crespi *et al*., 2019). Using the large dataset from the California Power Line Study (CAPS), several recent studies have examined potential bias and/or confounding from factors that include potential pesticide exposures associated with commercial plant nurseries located in areas underneath power lines (Nguyen *et al*., 2022), dwelling type (*e.g*., single-family homes *vs*. apartments/mobile dwellings; Amoon *et al*., 2020), and residential mobility (Amoon *et al*., 2019). While none of the investigated sources of potential bias and/or confounding have been found to explain the entirety of previously observed associations between power-frequency MFs and risk of childhood leukemia, these studies have reported some findings requiring additional investigation. For example, Nguyen *et al*. (2022) reported findings suggesting close residential proximity to nurseries as an independent risk factor for childhood leukemia, but not as an explanation for observed associations between power-frequency EMFs and childhood leukemia risk; however, they discussed how their ability to fully assess its potential confounding role was limited by the small numbers of study subjects with both high ELF-MF exposures and with close proximity to power lines and plant nurseries. Based on analyses they conducted to probe the confounding effect of residential mobility, Amoon *et al*. (2019) concluded, "We conclude that uncontrolled confounding by residential mobility had some impact on the estimated effect of EMF exposures on childhood leukemia, but that it was unlikely to be the primary explanation behind previously observed largely consistent, but unexplained associations." An additional study using the CAPS data (Crespi *et al*., 2019) conducted modeling analyses to examine the interaction between distance from high voltage lines and calculated MF levels as exposure metrics, and reported findings that "argue against magnetic fields [MFs] as a sole explanation for the association between distance and childhood leukemia and in favor of some other explanation linked to characteristics of power lines."

[18] The full paper is only available in Portuguese and has not been reviewed.

EMF Standards and Guidelines

The US has no federal standards limiting either residential or occupational exposure to 60-Hz AC EMFs. The Massachusetts Energy Facilities Siting Board (MA EFSB) assesses EMF levels on a case-by-case basis with a focus on practical options to reduce magnetic fields along transmission line rights-of-way (ROWs). Some states, including New York and Florida, have adopted EMF guidelines that are not health-effect based and have typically been adopted to maintain the *status quo* for EMFs on and near a transmission line ROW.

Table D.1 shows health-based exposure guidelines established by international health and safety organizations that are designed to be protective against adverse health effects. As mentioned earlier, these exposure guidelines are based on protection against acute or short-term effects (*e.g.*, electrostimulation) as these organizations have concluded that the health-effects evidence is too inconsistent and weak to justify a need for or to support the development of exposure guidelines for chronic health risks. ICNIRP (2010) concluded that there was not sufficient evidence to support the development of an exposure guideline specific to long-term exposure, citing both the lack of any consistent increases in any types of cancer (*e.g.*, hematopoietic, mammary, brain, skin tumors) in large-scale, long-term laboratory animal studies and the weak and inconsistent evidence from human epidemiological studies, including those addressing risk of childhood leukemia. For example, ICNIRP (2010) concluded:

> It is the view of ICNIRP that the currently existing scientific evidence that prolonged exposure to low frequency magnetic fields [MFs] is causally related with an increased risk of childhood leukemia is too weak to form the basis for exposure guidelines. In particular, if the relationship is not causal, then no benefit to health will accrue from reducing exposure.

The limit values should not be viewed as demarcation lines between safe and dangerous levels of EMFs but, rather, levels that assure safety with an adequate margin to allow for uncertainties in the science. This is because they incorporate safety factors; for example, the ICNIRP general public MF guideline of 2,000 mG incorporates a safety factor of 5. In summary, available exposure guidelines such as the ICNIRP general public exposure guidelines are generally applied for both short-term and long-term exposures, and are reasonable for use in both contexts, because there is no scientific rationale for separate guidelines focused specifically on long-term EMF exposure.

Table D.1 60-Hz AC EMF Guidelines Established by International Health and Safety Organizations

Organization	Electric Field	Magnetic Field
American Conference of Governmental and Industrial Hygienists (ACGIH) (occupational)	25 kV/m[(1)]	10,000 mG[(1)] 1,000 mG[(2)]
International Commission on Non-Ionizing Radiation Protection (ICNIRP) (general public)	4.2 kV/m[(3)]	2,000 mG[(3)]
International Commission on Non-Ionizing Radiation Protection (ICNIRP) (occupational)	8.3 kV/m[(3)]	10,000 mG[(3)]
Institute of Electrical and Electronics Engineers (IEEE) Standard C95.1™-2019 (general public)	5.0 kV/m[(4)]	9,040 mG[(4)]
Institute of Electrical and Electronics Engineers (IEEE) Standard C95.1™-2019 (occupational)	20.0 kV/m[(4)]	27,100 mG[(4)]

Notes:
AC = Alternating Current; EMF = Electric and Magnetic Field; Hz = Hertz; kV/m = Kilovolts Per Meter; mG = Milligauss.
(1) The ACGIH guidelines for the general worker (ACGIH, 2024).
(2) The ACGIH guideline for workers with cardiac pacemakers (ACGIH, 2024).
(3) ICNIRP (2010).
(4) IEEE (2019); developed by the IEEE International Committee on Electromagnetic Safety (ICES).

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Appendices

Application to Support the Petition before the Energy Facilities Siting Board

Central to Western Massachusetts Energy Improvement Project

Appendix 6-1: Environmental Notification Form (ENF), EEA #16913

Appendix 6-1: Environmental Notification Form (ENF), EEA #16913

Environmental Notification Form

Central to Western Massachusetts Energy Improvement Project

January 2025

PREPARED FOR

New England Power Company
170 Data Drive
Waltham, MA 02451

PREPARED BY

BSC GROUP
803 Summer Street, Third Floor
Boston, MA 02127

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January 15, 2025

Rebecca Tepper, Secretary
Executive Office of Energy and Environmental Affairs Attn: MEPA Office
100 Cambridge Street, Suite 900
Boston, MA 02114
RE: Central to Western MA Energy Improvement Project Environmental Notification Form

Dear Secretary Tepper,

On behalf of the New England Power Company ("NEP"), BSC Group, Inc. is pleased to submit this Environmental Notification Form ("ENF") for various refurbishment activities and system improvements along approximately 67 miles of the E5/F6 Transmission Lines, which extend through Millbury, Auburn, Leicester, Spencer, East Brookfield, North Brookfield, West Brookfield, Ware, Belchertown, Pelham, Shutesbury, Leverett, Sunderland, Deerfield, Conway, and Shelburne in Massachusetts (the "Project"). The proposed Project includes required maintenance and system improvements to mitigate potential risks of electrical failure and to provide reliable delivery of electrical service.

The Project is located within an active utility Right-of-Way ("ROW") and contains existing utility structures, historically used access routes, and managed vegetation areas along the E5/F6 mainline and Tap Lines. Project impacts are associated with the installation of structures, access improvements, work envelopes, and conversion of vegetative cover types (i.e., tree removal). Additionally, temporary impacts related to construction matting are proposed. The Project has been designed to avoid adverse impacts to the greatest extent practicable.

NEP is submitting this ENF because the Project requires several state agency actions, and exceeds or potentially exceeds seven MEPA thresholds. NEP respectfully requests that MEPA allow a Draft Environmental Impact Report ("DEIR") filing in accordance with 301 CMR 11.06(8).

Please publish the Notice of Availability for this ENF in the January 24, 2025 Environmental Monitor to initiate the 30-day public review and comment period. Electronic copies will be distributed to public agencies, the EJ Reference List, and municipal officials in accordance with 301 CMR 11.16(2) (see Appendix B: MEPA ENF Circulation List) before or on the date of publication. The Public Notice of Environmental Review was published in local newspapers on December 16, 2024 in accordance with 301 CMR 11.15(1).

Please do not hesitate to contact me at (617) 896-4570 or pshrestha@bscgroup.com or Mike Tyrrell with NEP at michael.tyrrell@nationalgrid.com with any questions or comments.

Sincerely,
BSC Group, Inc.



Priyanka Shrestha
Environmental Permitting Specialist, Associate

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Acronyms	
ACEC	Areas of Critical Environmental Concern
ACR	Asset Condition Refurbishment
ACSS	Aluminum-Conductor Steel-Supported Conductor
AUL	Activity and Use Limitation
Bank	Inland Bank
Bgs	Below Ground Surface
BIL	Bipartisan Infrastructure Law
BLSF	Bordering Land Subject to Flooding
BMP	Best Management Practices
BVW	Bordering Vegetated Wetland
CMP	Conservation & Management Permit
CMRPC	Central Massachusetts Regional Planning Commission
CO_2	Carbon dioxide
CSX	Chessie Seaboard X
CVP	Certified Vernal Pools
Cy	Cubic yards
DCR	Department of Conservation and Recreation
DEIR	Draft Environmental Impact Report
DER	Distributed Energy Resources
DGA	Designated Geographic Area
DPS	Downgradient Property Status
DPU	Massachusetts Department of Public Utilities
EEA	Executive Office of Energy and Environmental Affairs
EFSB	Energy Facility Siting Board
EIR	Environmental Impact Report
EJ	Environmental Justice
ENF	Environmental Notification Form
EPA	U.S. Environmental Protection Agency
FAA	Federal Aviation Administration
FERC	Federal Energy Regulatory Commission
ft	Feet/Foot
GHG	Greenhouse Gas
GPD	Gallons per day
GW	Gigawatts
GWSA	Global Warming Solutions Act
HASP	Health and Safety Plan
ISO	Independent System Operator

Acronyms	
ISO-NE	Independent System Operator-New England
kV	Kilovolts
lf	Linear Feet
LOD	Limit of Disturbance
LSCSF	Land Subject to Coastal Storm Flowage
LSP	Licensed Site Professionals
LUW	Land Under Water Bodies and Waterways
MA	Massachusetts
MassDEP	Massachusetts Department of Environmental Protection
MassDOT	Massachusetts Department of Transportation
MCM	Thousands of Circular Mils
MassGIS	Massachusetts Geographic Information Systems
MCP	Massachusetts Contingency Plan
MEPA	Massachusetts Environmental Protection Act
MESA	Massachusetts Endangered Species Act
M.G.L	General Laws of Massachusetts
MHC	Massachusetts Historical Commission
MVP	Massachusetts Municipal Vulnerability Preparedness
NECR	New England Central Railroad
NEP	New England Power Company
NERC	North American Electric Reliability Commission
NESCOE	New England States Committee on Electricity
NHESP	Natural Heritage and Endangered Species Program
NHPA	National Historic Preservation Act
NOI	Notice of Intent
NPCC	Northeast Power Coordinating Council, Inc.
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
OPGW	Optical Primary Ground Wires
ORW	Outstanding Resource Water
P&W	Providence and Worcester
PAL	Public Archaeology Laboratory, Inc.
PAR	Pan Am Railways
PAS	Pan Am Systems
PCB	Polychlorinated biphenyls
PPE	Personal Protective Equipment
PVPs	Potential Vernal Pools

Acronyms	
RA	Riverfront Area
RAO	Response Action Outcome
RGGI	Regional Greenhouse Gas Initiative
RMAT	Resilient Mass Action Team
ROW	Right-of-Way
RTN	Release Tracking Number
SMP	Soil Management Plan
SWPPP	Stormwater Pollution Prevention Plan
TMDL	Total Maximum Daily Load
UMass	University of Massachusetts
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
UTM	Universal Transverse Mercator Coordinates
VP	Vernal Pool
WPA	Wetlands Protection Act
WQC	Water Quality Certification
WsPA	Watershed Protection Act Permit

Environmental Notification Form

For Office Use Only

EEA#:

MEPA Analyst:_____

The information requested on this form must be completed in order to submit a document electronically for review under the Massachusetts Environmental Policy Act, 301 CMR 11.00.

Project Name: Central to Western Massachusetts Energy Improvement Project		
Street Address: Existing E5/F6 Overhead Transmission Lines Right-of-Way ("ROW")		
Municipality: Auburn, Belchertown, Conway, Deerfield, East Brookfield, Leicester, Leverett, Millbury, North Brookfield, Pelham, Shelburne, Shutesbury, Spencer, Sunderland, Ware, and West Brookfield	**Watershed:** Blackstone, Chicopee, Connecticut, Deerfield, and French	
Universal Transverse Mercator Coordinates: UTM Easting UTM Northing 273240.974 4674544.309 685667.242 4721167.475	**Latitude:** 42° 11' 24.687" to 42° 37' 14.1096" **Longitude:** -71° 44' 46.107" to -72° 44' 9.7362"	
Estimated commencement date: April 2029	**Estimated completion date:** November 2034	
Project Type: Overhead Transmission Line	**Status of project design:** 75% complete	
Proponent: New England Power Company ("NEP")		
Street Address: 170 Data Drive		
Municipality: Waltham	**State:** MA	**Zip Code:** 02451
Name of Contact Person: Priyanka Shrestha		
Firm/Agency: BSC Group, Inc.	**Street Address:** 803 Summer Street, Floor 3	
Municipality: Boston	**State:** MA	**Zip Code:** 02127
Phone: +1 617-896-4570	**Fax:**	**E-mail:** CWMA-EIP@bscgroup.com

Does this project meet or exceed a mandatory EIR threshold (see 301 CMR 11.03)?
☒Yes ☐No

If this is an Expanded Environmental Notification Form (ENF) (see 301 CMR 11.05(7)) or a Notice of Project Change (NPC), are you requesting:

a Single EIR? (see 301 CMR 11.06(8)) ☐Yes ☐No
a Rollover EIR? (see 301 CMR 11.06(13)) ☐Yes ☐No
a Special Review Procedure? (see 301CMR 11.09) ☐Yes ☐No
a Waiver of mandatory EIR? (see 301 CMR 11.11) ☐Yes ☐No
a Phase I Waiver? (see 301 CMR 11.11) ☐Yes ☐No

(Note: Greenhouse Gas Emissions analysis must be included in the Expanded ENF.)

Which MEPA review threshold(s) does the project meet or exceed (see 301 CMR 11.03)?

This Project exceeds or potentially exceeds the following Massachusetts Environmental Protection Act ("MEPA"), Environmental Impact Report ("EIR") and Environmental Notification Form ("ENF") thresholds:

Table 1: MEPA EIR and ENF Thresholds Potentially Exceeded by the Project

MEPA EIR Threshold
EIR: Land: Direct alteration of 50 or more acres of land, unless the Project is consistent with an approved conservation farm plan or forest cutting plan or other similar generally accepted agricultural or forestry practices. (301 CMR 11.03(1)(a))
EIR: Wetlands, Waterways and Tidelands: Alteration of one or more acres of Bordering Vegetated Wetlands ("BVW"). (301 CMR 11.03(3)(a)(1)(a))
EIR: Wetlands, Waterways and Tidelands: Alteration of ten or more acres of any other wetlands. (301 CMR 11.03(3)(a)(1)(b))
EIR: Environmental Justice ("EJ"): The Secretary shall require an Environmental Impact Report ("EIR") for any Project that is located within a Designated Geographic Area ("DGA") around an EJ Population. (301 CMR 11.06(7)(b))
MEPA ENF Thresholds
ENF: Wetlands, Waterways and Tidelands: Alteration of 500 or more linear feet ("lf") of bank along a fish run or Inland Bank ("Bank"). (301 CMR 11.03(3)(b)(1)(b))
ENF: Wetlands, Waterways and Tidelands: Alteration of one half or more acres of any other wetlands. (301 CMR 11.03(3)(b)(1)(f))
ENF: Rare Species: "Taking" of an endangered or threatened species or species of special concern, provided that the Project site is two or more acres and includes an area mapped as a Priority Site of Rare Species Habitats and Exemplary Natural Communities. (301 CMR 11.03(2)(b)(2)). (Potential: consultation with Natural Heritage and Endangered Species Program ("NHESP") ongoing.)

Which State Agency Permits will the project require?

The following State Agency Permit or Approvals are anticipated:

Table 2: Anticipated State Agency Permits and Approvals

Agency	Permit/Review/Approval
Executive Office of Energy and Environmental Affairs ("EEA")	MEPA Review – Secretary's Certificate
Massachusetts Department of Environmental Protection ("MassDEP")	Section 401 Individual Water Quality Certificate ("WQC") and Variance
Massachusetts Natural Heritage and Endangered Species Program ("NHESP")	Massachusetts Endangered Species Act ("MESA") – Determination of "take" or No "take"; Conservation & Management Permit ("CMP") (if needed)
Massachusetts Historical Commission ("MHC")	Consultation under General Laws of Massachusetts ("M.G.L.") c. 9 in accordance with 950 70-71
Energy Facilities Siting Board ("EFSB")	G.L. c. 164, §69J Petition for Approval to Construct Transmission Lines
Massachusetts Department of Public Utilities ("DPU")	G.L. c. 164, §72 Petition for Determination of Public Necessity and Convenience
Department of Conservation and Recreation ("DCR")	Watershed Protection Act ("WsPA") Determination of Applicability or Variance (if required); Construction & Access Permit; and Short-term and Vehicle Access to Quabbin and Ware River Watershed System Permit
Massachusetts Department of Transportation ("MassDOT")	Permit to Access State Highway/Non-Municipal Utility Permits for crossing over of state roads with utility lines.

Identify any financial assistance or land transfer from an Agency of the Commonwealth, including the Agency name and the amount of funding or land area in acres:

Not applicable. No financial assistance or land transfer will be associated with this Project.

Table 3: Summary of Project Size and Environmental Impacts

Summary of Project Size and Environmental Impacts	Existing	Change	Total
Land			
Total site acreage	1,125 +/-		
New acres of land altered		561 +/-[1]	
Acres of impervious area	35 +/-	0.25 +/-[2]	35.25
Square feet of new bordering vegetated wetlands alteration		2,704,439[1]	
Square feet of new other wetland alteration[1]		Bordering Land Subject to Flooding ("BLSF"): 355,418[1] Riverfront Area ("RA"): 2,623,699[1] Bank: 16,471 (linear feet)[1] Land Under Water Bodies and Waterways ("LUW"): 38,916[1,3] Isolated Wetland: 95,327[1]	
Acres of new non-water dependent use of tidelands or waterways		N/A	
Structures			
Gross square footage	N/A	N/A	N/A
Number of housing units	N/A	N/A	N/A
Maximum height (feet)	95	50	145
Transportation			
Vehicle trips per day	N/A	N/A	N/A
Parking spaces	N/A	N/A	N/A
Wastewater			
Water Use (Gallons per day ["GPD"])	N/A	N/A	N/A
Water withdrawal (GPD)	N/A	N/A	N/A
Wastewater generation/treatment (GPD)	N/A	N/A	N/A
Length of water mains (miles)	N/A	N/A	N/A
Length of sewer mains (miles)	N/A	N/A	N/A

Note: Values are conservative estimates. Some resource areas overlap and may result in overlapping impacts.

1 Alteration includes conversion of vegetative cover types, temporary construction matting, permanent and temporary work and pull pad areas, and new and improved access.

2 Includes the replacement of existing structures with larger caisson supported structures.

3 Includes LUW resources that are greater than 30-feet wide.

Has this project been filed with MEPA before?

☐ Yes (EEA #_____) ☒ No

Has any project on this site been filed with MEPA before?

☐ Yes (EEA #_____) ☒ No

GENERAL PROJECT INFORMATION – all proponents must fill out this section

PROJECT DESCRIPTION:

Describe the existing conditions and land uses on the project site:

New England Power Company ("NEP") is proposing an asset condition refurbishment ("ACR") of the existing E5 and F6 69 kilovolt ("kV") double-circuit overhead electric transmission lines ("E5/F6 Lines" or "the Lines") and seven interconnecting 69 kV Tap Lines[1] ("Taps" or "the Tap Lines"). The overall project is referred to as the Central to Western Massachusetts Energy Improvement Project (the "Project"). The Project will be located within the existing E5/F6 mainline Right-of-Way ("ROW") as well as the existing Tap Line ROWs. The E5/F6 mainline connects the Deerfield #4 Substation to the Millbury #305 Substation in Millbury, and supplies power to NEP's Pondville, Leicester, Harrington, Lashaway, Belchertown, and Shutesbury Substations. The seven interconnecting Tap Lines include:

- Pondville #26 Tap in Auburn;
- Leicester #21 Tap in Leicester;
- Harrington #2234 Tap in East Brookfield;
- Lashaway #525 Tap in North Brookfield;
- Quabbin Switch Tap in Belchertown;
- Shutesbury #704 Tap in Shutesbury; and
- Deerfield #3 Tap in Shelburne.

Please refer to the United States Geological Survey ("USGS") Map and MEPA General Purpose Plans (the "Plans") in **Attachment A: Project Figures** for more information.

The Project ROW is generally oriented northwest-to-southeast, through the Towns of Shelburne, Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn, and Millbury, MA. All Project activities will be located within these 16 municipalities. The existing E5/F6 Lines are supported primarily on double-circuit lattice towers and steel pole structures ("structures"). The existing Tap Lines consist of two parallel single circuit lines, and are comprised of steel and wood pole structures. Please refer to **Figure 1** for an overview of the Project ROW.

1 Tap Lines are transmission lines that serve as a connection between a primary transmission line (i.e., the mainline) and a substation facility.

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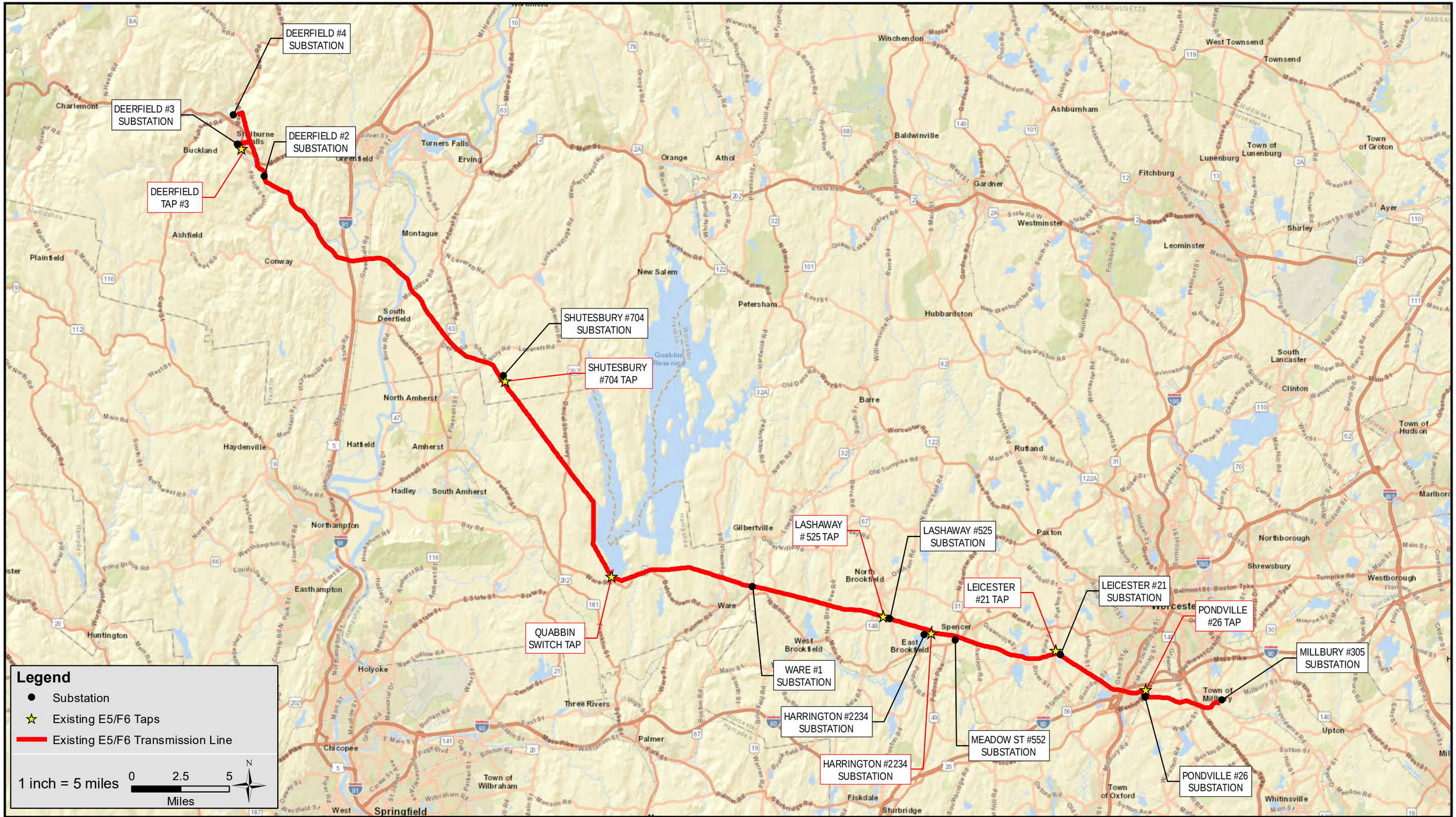

Central to Western Massachusetts Energy Improvement Project

nationalgrid
BSC GROUP

Figure 1-1
Overview of the Project Route

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Existing Conditions and Land Use

The land within the ROW has been actively utilized and maintained as a transmission line corridor since the 1900s. Today, the Lines and Tap Lines provide electricity to 26 cities and towns in Massachusetts and transmit power from the Deerfield #2, #3, and #4 generating stations to the New England region. The Existing Lines are the sole transmission source for approximately 24,000 customers in 12 Massachusetts municipalities. The Project ROW[2] is approximately 67 miles long; 80-feet ("ft") to 125-ft in easement width, with some areas up to 200-ft in easement width; and 1,125 acres in total land area.

Using current MassGIS Land Use/Land Cover data layers, land use characteristics were evaluated for the existing ROW and a 300-ft buffer on either side of the ROW. Land use is predominantly Exempt Property.[3] Vacant land use is the second most common parcel designation within the ROW, followed by industrial land use, and residential land use. Similarly, residential land use is the second most common parcel designation within 300-ft of the ROW designation, followed by mixed and vacant land uses. The ROW crosses three reservoirs (Atkins, Ludlow, and Quabbin), and rivers, ponds, streams, and wetland systems.

Table 4 summarizes the Massachusetts Geographic Information Systems ("MassGIS") land use information for the ROW and adjacent uses.

Table 4: Land Use

Land Use Type	Within the ROW (acres)	% Within ROW	Study Buffer (acres)	% Within 300-ft of ROW
Agricultural/Horticultural	41	4%	185	4%
Commercial	12	1%	67	1%
Exempt Property	264	23%	1,328	26%
Forest Land	86	8%	391	8%
Industrial	167	15%	367	7%
Mixed Use	138	12%	708	14%
Recreation	17	1.5%	73	1%
Residential	167	15%	1,032	21%
Transportation	2	<1%	147	3%
Unknown*	2	<1%	4	<1%
Vacant	221	20%	645	13%
Water	7	1%	86	2%
Total	**1,124**	**100%**	**5,033**	**100%**

Source: Massachusetts Geographic Information Systems ("MassGIS"), June 2022. 2020-2022 municipality parcel data and corresponding codes as land use type. Percent values are rounded.

Note: Based on guidelines developed by the Department of Revenue, each Board of Assessors determines the proper classification of property according to its use. "Unknown" Land Use has not yet been classified by the applicable municipality and/or passed the MassGIS Quality Assurance procedures required for publishing.

2 Henceforth, Project ROW refers to the mainline and Tap Line ROWs, unless noted otherwise.

3 Exempt Property qualifies for tax exemption under various provisions of the law and include public land and facilities, hospitals, schools, churches and cultural institutions, M.G.L. Chp. 59 §5. This category of land use includes federal, state, and local land (municipal and authorities); charitable (hospitals, cemeteries); and educational institutions.

Fifty federal, state, private, municipal, and non-profit owned open space lands are located within or adjacent to the Project ROWs, consisting of a total of approximately 2,181 acres of open space. Of this total, 377 acres are within the Project ROW. The primary purposes of these protected lands include recreation, conservation, water supply protection, and cultural/historical preservation. The Department of Conservation and Recreation ("DCR") owns reservoirs, conservation lands, and State forests that fall within the 300-ft buffer, including the Connecticut River Greenway State Park, Daniel S. Horgan Memorial Skating Rink, Quabbin Reservoir Watershed, South River State Forest, Spencer State Forest, and West Brookfield State Forest.

The majority of Project construction activities will take place within the existing ROWs to minimize impacts to adjacent open spaces. NEP's easements for the Lines and Tap Lines predate the establishment of DCR properties and state forests in these areas. The Project is proposed to be constructed on NEP-owned land or easement, and within an existing transmission line ROW, and necessary measures will be taken to ensure no damage to open space resources. The Project has been designed to utilize existing access within NEP easements wherever feasible. However, temporary improvements to existing off-ROW access will be required within state forest lands. Any off-ROW access improvements will be restored in coordination with DCR as part of the Construction Access Permit ("CAP") process.

Describe the proposed project and its programmatic and physical elements:

NOTE: The project description should summarize both the project's direct and indirect impacts (including construction period impacts) in terms of their magnitude, geographic extent, duration and frequency, and reversibility, as applicable. It should also discuss the infrastructure requirements of the project and the capacity of the municipal and/or regional infrastructure to sustain these requirements into the future.

The Lines have been among the least reliable lines on the NEP transmission system, consistently experiencing an unusually high rate of outages; in the past 5 years, the Lines have experienced 61 outages. Originally constructed in the early 1900s and refurbished in 2001, and reinsulated in 2020, they are among the oldest transmission lines in New England and are supported by the original 711 structures. The structures and wires are in need of replacement due to asset condition and aging infrastructure. When compared to industry standards, shielding angles are poor. There are close, tall trees along the ROW likely contributing to the poor performance of the Lines. As with the Lines, the existing Tap Lines have a poor operating history and have insufficient capacity to interconnect renewables to the electric grid. The Tap Lines are currently supported on 34 wood and steel structures. Generally, the aging structures along the Lines pose a threat to the reliability of the transmission system.

In addition, the access conditions vary considerably throughout the ROW. In some areas, existing access is in need of significant repair and does not meet NEP's standard to safely support specialized equipment. As such, the Project's primary purpose is to complete required system improvements that will address poor asset condition, mitigate potential risks of electrical failure, and provide long-term reliable delivery of electrical service and maintenance of the lines. As part of the proposed refurbishment and to provide high speed communications between substations, optical ground wires ("OPGWs") will be used to replace the existing shield wire. Refer to **Attachment A: Project Figures** that depict existing conditions and the proposed activities along the length of the ROW.

To address these concerns, NEP proposes to replace the Lines and Tap Lines within their existing ROWs. Replacing these degraded assets will increase the reliability of the lines. The

Project also includes installation of two new OPGWs, one for each line, which will provide improved fault protection[4] and an upgraded communications path that will allow for high-speed communication between the remote ends of the Lines. NEP proposes to construct the Lines using its 115 kV design standards even though there are currently no immediate reliability needs that would necessitate the operation of the Lines at 115 kV within the 10-year planning horizon. Even when operating at 69 kV, the Lines will provide increased capacity due to the proposed use of Aluminum Conductor Steel Supported ("ACSS") conductor. Notably, the Lines will support future operation at 115 kV, which will provide flexibility in meeting future transmission system needs as the implementation of electrification and climate change initiatives in the Commonwealth increase across the state. Furthermore, the grid is designed to meet reliability standards and criteria developed by the North American Electric Reliability Commission ("NERC"), which sets the minimum standards for electric power transmission for all North America, the Northeast Power Coordinating Council, Inc. ("NPCC") and the Independent System Operator-New England ("ISO-NE").

Project Activities:

The existing Project ROW is currently used for utility activities, including existing utility structures, access, and active vegetation management. Construction activities will be confined to the Limit of Disturbance ("LOD") as shown in **Attachment A: Project Figures**. The Project ROW is generally 80-ft to 125-ft in easement width, with an easement width in some areas of up to 200-ft in both the mainline and Tap Lines ROWs.

Information on system improvement activities for the purpose of refurbishment work, including construction access, are summarized below. Updated and additional information on means and methods of construction and maintenance activities will be provided in the Draft Environmental Impact Report ("DEIR").

The refurbishment activities will include:

- Replacing the existing double circuit steel, lattice tower, and wood structures with a combination of steel double circuit monopole davit arm and steel single circuit monopole structures. The replacement structures are on average 85 ft aboveground,[5] and will provide improved reliability and climate resilience. Suspension type structures will be supported by either direct embedded or caisson foundations. Alternative foundation types such as helical piles, steel vibratory caisson foundations, or micro pile foundations may be utilized if warranted by site conditions or other factors.
- Performing vegetation management (mowing and tree removals) to provide access to the proposed structure locations, to facilitate safe vehicular and equipment passage, to provide safe work sites for personnel, and to meet conductor clearance requirements. The Project will remove vegetation in some areas that currently do not meet these widths, of up to 125-ft in easement width.

4 Fault protection helps prevent contact with live wires during atypical conditions, such as downed power lines from storm events.

5 Due to the outage constraints associated with the E5/F6 Lines, construction will occur with energized lines and utilize live line construction techniques. As such, the proposed replacement structures must be installed at a height above the existing structures that ensures worker and equipment safety.

- Performing access improvements, including grading and the addition of stone to existing access, as well as the construction of new access routes (where required). Efforts were made to align access with previously utilized routes and pathways along and adjacent to the ROW where feasible. New access was sited within the existing ROW easement to the extent feasible; however, due to existing site constraints (e.g., steep slopes, rocky outcrops, proximity to wetland resource areas), some access routes are sited outside the current easement but within NEP access rights. All new access (including those which extend outside the current easement) will be maintained by NEP.[6,7]
- Replacing the existing copper conductor with 795 Thousands of Circular Mils ("MCM") ACSS conductor which will improve system reliability and allow the lines to operate at 115 kV voltage at a future date.
- Replacing the existing shield wire with two OPGWs. These serve the dual function of providing shielding for the conductor, as well as allowing for high-speed communications between substations.
- Install 20 new 115kV manually operated 3000A load break switches.

Proposed Impacts:

Because this Project is a refurbishment of an existing transmission line, area residents and businesses will benefit directly from the upgrades through increased system reliability. The Project has been designed to avoid adverse impacts to the extent feasible. As an active ROW, most of the Project ROW is already disturbed and maintained. Project impacts include tree removal and vegetation management; work within wetland resource areas; and work within mapped rare species habitat. The majority of wetland impacts are temporary and are related to the use of construction matting and the temporary use of stabilizing material within work areas during construction. Permanent wetland alteration is primarily associated with the conversion of forested edge wetland areas to scrub-shrub due to tree removal, which is necessary for the safe and reliable operation of the Lines and is anticipated to create a benefit to successional wildlife. New structures in Bordering Vegetated Wetland ("BVW"), Bordering Land Subject to Flooding ("BLSF"), and Riverfront Area ("RA") have been avoided and minimized to the extent feasible and the remaining permanent impacts in these resource areas will be minimal amounts of permanent fill and conversion of vegetative cover types. Additional information on procedures and policies implemented during construction for ROW access, maintenance, and construction Best Management Practices ("BMPs") will be provided in the DEIR.

The Project exceeds or potentially exceeds the MEPA thresholds identified **Table 1**. Potential and temporary impacts, including alterations, to all resource categories are summarized in **Table 5** below. A total resource area impact cannot be summed from this table due to overlapping resource areas and conflicting units.

6 Any off-ROW access will be restored. A Construction Access Plan will be developed, and will include the planned restoration process.

7 New and improved access are categorized as follows, as seen in **Attachment A: Project Figures**: "Type R" access, where only minor repairs are required (such as the filling of ruts and potholes) and no widening of these accesses are proposed. "Type S" access (typically found in environmentally sensitive areas), where widening through the addition of stone/gravel may be proposed and grading is restricted. "Type 1-5" access, more extensive grading and widening is required. "Type S" and "Type R" are considered access improvements, while "Types 1-5" may be considered new construction.

Table 5: Summary of E5/F6 Transmission Lines Refurbishment Impacts

Resource Area	Temporary Impacts	Permanent Impacts/Conversion
New Land Altered	N/A	Total – approximately 561 +/- acres • Conversion of vegetative cover types (240 +/- acres)[1]
Bordering Vegetated Wetland ("BVW")	Total – approximately 42 +/- acres • Construction mats for access where BVW crossings could not be avoided • Temporary work envelopes, including construction mats for work pads and pull pads that overlap with BVW	Total – approximately 20 +/- acres • Fill for replacement structure foundations in BVW (0.03 acres +/-) • Conversion of vegetative cover types[1]
Other Wetland Resource Areas		
Inland Bank ("Bank")	Total – approximately 6,803 linear ft • Construction mats where access cross Bank[2]	Total – approximately 9,668 linear ft
Riverfront Area ("RA")	Total – approximately 31 +/- acres • Vegetation management activities • Temporary work envelopes, including construction mats for work pads and pull pads • Temporary access modifications, which will be restored postconstruction	Total – approximately 29 +/- acres • New/improved access • New/replacement structure foundations • Cut/fill for access, and work envelopes • Stabilization material in new/improved sections of existing access
Bordering Land Subject to Flooding ("BLSF")	Total – approximately 4 +/- acres • Vegetation management activities • Temporary work envelopes and pull pads, including construction mats for work pads and pull pads where BLSF overlaps with residential lawn or agricultural land	Total – approximately: 4 +/- acres sf • New/improved access • New/replacement structure foundations • Cut/fill for work envelopes and access; areas will be over-excavated so that no loss in flood storage occurs
Land Under Water Bodies and Waterways ("LUW")	Total – approximately 0.4 +/- acre • Temporary work envelopes, including construction mats for work pads where spanning open water is not feasible	N/A[3]
Isolated Wetland	Total – approximately 2 +/- acres • Vegetation management activities • Temporary work envelopes, including construction mats for access and work envelopes that overlap with Isolated Wetlands	Total – approximately 0.6 +/- acre • Fill for new/replacement structure foundations • Cut/fill for access and work envelopes

Resource Area	Impacts
Waterways	Waterways crossings do not involve structures within the waterways, only temporary access for construction. No adverse impacts are anticipated from waterways crossings.
Rare Species Impacts	Rare species may have potential impacts where construction-related activities occur within designated habitat. A "take" has the potential to occur due to access improvement activities, consultations with Natural Heritage and Endangered Species Program ("NHESP") are in progress to identify areas of concern, and to identify appropriate avoidance measures for implementation, as required.
Historical/ Archaeological Impacts	Historical/Archaeological areas may have potential impacts where construction -related activities occur within areas of high archaeological sensitivity. Surveys are ongoing to identify areas of concern, and to identify appropriate avoidance measures for implementation, as required.

Note: Impacts located within the limits of RA overlap with impacts to BLSF, BVW, and the 100-foot Buffer Zone. Therefore, the total impacts are not equal to the sum of alterations.

1 This value includes the conversion of vegetated types (e.g., trees) to other vegetated types (e.g., shrubs).

2 In most cases, construction mat crossing will span the banks of rivers and streams; however, the potential for impact has been accounted for in total linear ft.

3 The existing canopy cover to be removed as a result of the conversion of vegetative cover types within the ROW does not result in a direct impact to LUW.

Describe the on-site project alternatives (and alternative off-site locations, if applicable), considered by the proponent, including at least one feasible alternative that is allowed under current zoning, and the reasons(s) that they were not selected as the preferred alternative:

NOTE: The purpose of the alternatives analysis is to consider what effect changing the parameters and/or siting of a project, or components thereof, will have on the environment, keeping in mind that the objective of the MEPA review process is to avoid or minimize damage to the environment to the greatest extent feasible. Examples of alternative projects include alternative site locations, alternative site uses, and alternative site configurations.

No-Build Alternative:

Under the No-Build Alternative, the Lines would remain in place and NEP would not execute a capital project to address performance issues and physical issues on the Lines or the need for increased fiber optic capability. NEP would continue to address line components that are imminently about to fail on an ad hoc basis, as it does with all its transmission assets. Accordingly, the NEP would repair or replace structures on an as-needed basis to address deterioration.

The Lines are experiencing poor performance, are in deteriorating condition, have inherent design issues and will have insufficient capacity to meet anticipated future needs. While repairing and replacing structures on an as-needed basis would address physical issues on individual structures, it would not address the inherent design issues that affect the entire line. Further, because OPGW cannot be added to the existing Lines, the No-Build Alternative would not provide fiber optic capability that would improve communications between substations. In short, the Lines should be rebuilt to improve their performance and reliability. Because the No-Build Alternative would not meet the identified need, it was eliminated from further consideration.

Partial Rebuild Alternatives

NEP considered two Partial Rebuild Alternatives, one with minimal work and one with more

extensive work. The Partial Rebuild Alternatives are targeted structure repair programs that would address the most pressing concerns regarding the deteriorating structures. Under the minimal work alternative, NEP would repair twenty lattice towers with deflecting or damaged components and replace one lattice tower that is leaning. NEP also would update grounding on five lattice towers and complete routine structure maintenance on lattice towers and routine foundation maintenance on both the lattice towers and steel pole structures. Under a more extensive Partial Rebuild Alternative, NEP would also replace ten wood pole structures with steel structures.

Targeted repair programs like the Partial Rebuild Alternatives can be low-cost, low-impact strategies for extending the life of transmission lines if the primary issue is a limited number of damaged structures. However, this approach is not a reasonable alternative for the Project because it would leave all, or the majority of existing structures in place and, therefore, would not address the underlying reliability issues associated with the inherent design issues (i.e., poor shielding angle and inadequate conductor spacing). Given that the original structures would mostly be retained rather than replaced, the Partial Rebuild Alternatives would not reduce the incidence of line outages associated with lightning strikes, downed trees, thunderstorms, and avian interference. Even under the more extensive Partial Rebuild Alternative, reliability improvements would be limited because these individual replacement structures would need to be physically consistent with the existing towers, which would remain unimproved. Because these alternatives do not address the key structure design issues associated with the poor reliability of the Lines nor meet the other identified needs, they were dismissed from further consideration.

Complete Rebuild Alternative (the Project)

The Project involves rebuilding the Lines and Tap Lines within their current ROWs by replacing all structures, conductors, and shield wires. This includes installing new steel monopole structures with either direct-buried foundations or micro pile foundations and all dead end or angle structures will be supported by drilled shaft foundations, installing new, davit arm, steel monopole structures, on the Lines and Tap Lines and thereafter removing the existing 538 lattice towers, 75 steel poles, and 98 wood poles, and replacing the conductor with larger aluminum conductors and two new OPGWs.

Upgrades include installing flyover switches, performing vegetation management, upgrading existing, and creating new access. These improvements address reliability issues by correcting poor shielding angles, reducing outages from lightning and tree strikes, and discouraging bird nesting. The new 795 MCM ACSS conductor will increase thermal capacity by 27%, support future distributed energy resource (“DER”) interconnections, and accommodate load growth. Dual OPGWs will enhance fault protection and enable high-speed substation communication, ensuring the Lines are more reliable, resilient, and capable of meeting future needs.

The Complete Rebuild Alternative is the only alternative that will address the Projects needs for improved performance of the Lines and Tap Lines by addressing all of the issues and provide the additional thermal capacity and voltage support required to support future load growth. Replacing the existing structures with taller structures will correct the poor shielding angle and avoid many of the outages caused by lightning. In addition, the new, taller monopole structures will reduce opportunities for trees striking the line and for bird nesting. Taken together, these design changes will significantly reduce the frequency of outages on the Lines and increase their reliability. In addition, access improvements will improve NEP’s ability to quickly repair damage to the lines when an outage does occur. Accordingly, NEP

selected it and dismissed other alternatives from further consideration.

69 kV and 115 kV Design Alternatives

NEP has established design criteria for its transmission lines to assure acceptable reliability of its bulk transmission system facilities. These criteria apply to conductors, structures, and equipment and establish insulation levels and required clearances for various voltage transmission lines. For this Project, NEP evaluated the 69 kV and the 115 kV Design options. NEP evaluated reliability, environmental and cost considerations of constructing the E5/F6 Lines and Taps to 115 kV Design standards. The 69 kV and 115 kV Designs both address the design issues associated with the poor performance record of the Existing Lines. Notably, however, construction of the E5/F6 Lines and Taps to the 115 kV Design standard, even if operated at 69 kV, will provide both near-term and longer-term transmission system reliability benefits that the 69 kV Design would not.

Reliability Comparison

The 69 kV and 115 kV Designs both address the design issues associated with the poor performance record of the Existing Lines. In particular, the replacement structures under either design would have an approximately 15 degree shielding angle, consistent with the current industry practice of limiting the shielding angle to 30 degrees or less. Similarly, the higher elevation of the conductors on the Rebuilt Lines will reduce the probability of faults resulting from off-ROW vegetation striking the energized lines. In addition, the change in structure type from lattice towers to monopole structures will reduce the potential for avian-related outages. Birds are prone to use horizontal members on the existing lattice towers to construct nests, which results in greater opportunity for avian interaction to create momentary outages on the circuits. Overall, either design will result in significant improvements in line performance.

Notably, however, construction of the Lines and Taps to the 115 kV Design standard, even if operated at 69 kV, will provide both near-term and longer-term transmission system reliability benefits that the 69 kV Design would not.

Environmental Comparison

NEP anticipates that the environmental impacts of the Project, using the 115 kV Design—which include temporary and permanent impacts to wetlands and water resources, vegetation management and removal, access improvements, visual impacts from the proposed increase in structure heights, as well as construction noise and traffic—would not be significantly reduced with the 69 kV Design. Tree removal requirements are primarily dictated by the line voltage, and distance between the lines and the edge of ROW;[8] however, NEP considers additional construction constraints when determining tree removal requirements. The same construction techniques would be used and, as a result, construction-related impacts, including vegetative removal, access improvements, wetlands and water resource impacts, and construction noise and traffic, would be similar or identical. Although there would be an approximately five to ten-foot difference in structure height, visual impacts from the new structures will be minimal in either case. NEP anticipates that use of the 69 kV Design would not significantly reduce any impacts.

The use of the 115 kV Design for the Project also obviates the possible need to construct a new 115 kV line when reliability needs call for additional capacity. Using the 69 kV Design for the E5/F6 Line now would require the future construction of a new line using the 115 kV

8 In accordance with NERC regulations, high voltage transmission lines, such as 115 kV, are allowed the least amount of risk of interruptions from danger trees.

Design, including replacement of all structures. This would require a re-mobilization and significant redundant construction efforts, which would place a repeat burden on the abutters along this ROW, as well as create an approximate doubling of environmental impacts.

Summarize the mitigation measures proposed to offset the impacts of the preferred alternative:

NEP follows a set of policies for ROW access, maintenance, and construction BMPs. By consistently implementing these procedures, NEP ensures that transmission lines are maintained and constructed by trained personnel in a manner that minimizes potential impacts to the environment, adheres to permit conditions, and meets industry standards. Key elements of the construction policy include pre-construction field investigations, field inspections during construction, and post-construction inspections.

Throughout construction, appropriate consideration will be given to Project implementation in a manner consistent with conditions of permits/authorizations and approved mitigation measures. To minimize Project impacts, NEP has incorporated the following actions and considerations throughout planning and design:

- Several asset condition and reliability needs were combined into one Project scope in an effort to reduce the need for repeat disturbances to wetlands and adjacent property owners in this shared ROW;
- Existing ROW and access are being used to avoid new land disturbance, where feasible;
- Field investigations were completed to assess constructability and avoid/mitigate sensitive resources;
- Agency consultations are in progress;
- Replacement structures are being located outside of BVWs, where feasible; and
- Temporary construction mat BMPs will be utilized to minimize wetland impacts.

Temporary work areas, including work envelopes and specified access modifications, will be restored to pre-construction conditions at the conclusion of construction activities.

Additional mitigation measures will be implemented as required by federal, state, and local requirements. NEP anticipates that the final mitigation package will be developed during the permitting processes outlined in the next section, and that the package will fully address the required permit conditions and agency concerns. Further information on the mitigation package will be provided in the DEIR. NEP anticipates that mitigation will demonstrate no net loss of existing wetland functions, values, and statutory interests within the watersheds.

If the project is proposed to be constructed in phases, please describe each phase:

The Project is not proposed to be constructed in phases.

AREAS OF CRITICAL ENVIRONMENTAL CONCERN:

Is the project within or adjacent to an Area of Critical Environmental Concern?

☐ Yes (Specify_____) ☒ No

If yes, does the ACEC have an approved Resource Management Plan? __ Yes __ No;
If yes, describe how the project complies with this plan. _____

Will there be stormwater runoff or discharge to the designated ACEC? __ Yes __ No;
If yes, describe and assess the potential impacts of such stormwater runoff/discharge to the designated ACEC. _____

RARE SPECIES:

Does the project site include Estimated and/or Priority Habitat of State-Listed Rare Species? (see http://www.mass.gov/dfwele/dfw/nhesp/regulatory_review/priority_habitat/priority_habitat_home.htm)

☒ Yes (Specify: PH 1160, PH 1153, PH 1140, PH 1167, PH 1166, PH 1356, PH 1335, PH 1224, PH 1488, PH 1475, PH 2084, PH 1623, PH 1741, PH 1731, PH 1743, PH 1799, PH 1796, and PH 1798, EH 845, EH 839, EH 830, EH 839, EH 845) ☐ No

Three bird, three reptile, one amphibian, five invertebrate, one fish, and 13 plant species are mapped along portions of the Project route in Spencer, East Brookfield, North Brookfield, West Brookfield, Ware, Belchertown, Shutesbury, Leverett, Sunderland, Deerfield, Conway, and Shelburne. The names and locations of these species are not provided, as requested by Natural Heritage and Endangered Species Program ("NHESP").

HISTORICAL/ARCHAEOLOGICAL RESOURCES:

Does the project site include any structure, site or district listed in the State Register of Historic Place or the inventory of Historic and Archaeological Assets of the Commonwealth?

☒ Yes (Specify AUB.B, AUB.C, AUB.D, AUB.E, AUB.F, BLC.H, BLC.J, BUC.F, BUC.163, DEE.A, LEV.A, LEV.B, MLB.M, MLB.U, SHL.A, SHL.B, SHL.C, SPE.A, SUN.A, WAR.M, and WBK.D.) ☐ No

NEP has conducted a cultural resources due diligence and sensitivity assessment, and is conducting an archeological survey and historic architectural properties assessment, under a permit issued by the MHC. See below for inventoried districts:

- Auburn Center, Auburn (AUB.B)
- Pondville, Auburn (AUB.C)
- West Auburn, Auburn (AUB.D)
- Stoneville, Auburn (AUB.E)
- Drury Square, Auburn (AUB.F)
- Quabbin Reservoir Administration Complex, Belchertown (BLC.H)
- Blue Meadow Road, Belchertown (Quabbin Reservoir Worker Housing) (BLC.J)
- Deerfield River Hydroelectric Development #3, Buckland (BUC.F)
- Development #3 Hydroelectric Powerhouse, Buckland (BUC.163)
- Gunn-Sadoski Farm (Pine Nook), Deerfield (DEE.A)
- Leverett Center Historic District, Leverett (LEV.A)
- East Leverett, Leverett (LEV.B)
- South Main Street Area, Millbury (MLB.M)
- Blackstone Canal Historic District, Millbury (MLB.U)
- Development #2 Hydroelectric Power Facility, Shelburne (SHL.C)
- Development #3 Hydroelectric Power Facility, Shelburne (SHL.B)
- Development #4 Hydroelectric Power Facility, Shelburne (SHL.A)
- Main Street Area, Spencer (SPE.A)

- Whitmore's Mills, Sunderland (SUN.A)
- Quabbin Reservoir, Ware (WAR.M)
- Wickaboag Valley Road Historic Area, West Brookfield (WBK.D)

If yes, does the project involve any demolition or destruction of any listed or inventoried historic or archaeological resources? ☐ Yes (Specify_____) ☒ No

WATER RESOURCES:

Is there an Outstanding Resource Water (ORW) on or within a half-mile radius of the project site? X Yes __ No;
If yes, identify the ORW and its location:

(NOTE: Outstanding Resource Waters include Class A public water supplies, their tributaries, and bordering wetlands; active and inactive reservoirs approved by MassDEP; certain waters within Areas of Critical Environmental Concern, and certified vernal pools. Outstanding resource waters are listed in the Surface Water Quality Standards, 314 CMR 4.00.)

Table 6: Outstanding Resource Waters Within 0.5 Miles of the Project ROW

Outstanding Resource Waters ("ORW")	Location
Henshaw Pond	Leicester, MA
Amethyst Brook	Amherst, MA
Ludlow Reservoir	Ludlow, MA
Atkins Reservoir	Shutesbury, MA
Quabbin Reservoir	Worcester County, MA

Source: Massachusetts Geographic Information Systems ("MassGIS"), Outstanding Resource Waters data layer. 2010.

Approximately 52 Certified Vernal Pools ("CVPs") are located within a 0.5-mile radius of the ROW in Auburn, Belchertown, Deerfield, Leverett, North Brookfield, Pelham, Shutesbury, Spencer, Sunderland, Ware, and West Brookfield. There are 22 Confirmed Vernal Pools ("VPs") within or immediately adjacent to the Project ROW by field evaluation, 10 of which are Certified by NHESP.

Are there any impaired water bodies on or within a half-mile radius of the project site?
_X_ Yes __ No; **If yes, identify the water body and pollutant(s) causing the impairment:**

Table 7: Impaired Water Bodies Within 0.5 Miles of the Project ROW

Waterbody	Watershed	Water Type Category	Category # & Classification	Pollutant Causing Impairment	TMDL Count
Brookhaven Lake	Chicopee	Freshwater Lake	5 Impaired – TMDL Required	Turbidity	0
Dark Brook Reservoir	Blackstone	Freshwater Lake	4C Impairment Not Caused by a Pollutant	N/A	0
Pondville Pond	Blackstone	Freshwater Lake	4A Impaired – TMDL Completed	Algae	1
Knights Pond	Chicopee	Freshwater Lake	3 No Uses Assessed	N/A	0
Woolshop Pond	Blackstone	Freshwater Lake	5 Impaired – TMDL Required	Aquatic Plants (Macrophytes)	0
Peppers Mill Pond	Chicopee	Freshwater Lake	3 No Uses Assessed	N/A	0
Slaughterhouse Pond	Blackstone	Freshwater Lake	3 No Uses Assessed	N/A	0
Hathaway Pond	Blackstone	Freshwater Lake	3 No Uses Assessed	N/A	0
Henshaw Pond	French	Freshwater Lake	3 No Uses Assessed	N/A	0
Cedar Meadow Pond	French	Freshwater Lake	4C Impairment Not Caused by a Pollutant	N/A	0
Bouchard Pond	French	Freshwater Lake	4C Impairment Not Caused by a Pollutant	N/A	0
Stiles Reservoir	French	Freshwater Lake	3 No Uses Assessed	N/A	0
Lake Lashaway	Chicopee	Freshwater Lake	4A Impaired – TMDL Completed	N/A	1
Quabbin Reservoir	Chicopee	Freshwater Lake	4A Impaired – TMDL Completed	N/A	1
Stoneville Reservoir	Blackstone	Freshwater Lake	3 No Uses Assessed	N/A	0
Atkins Reservoir	Connecticut	Freshwater Lake	5 Impaired – TMDL Required	N/A	0
Leverett Pond	Connecticut	Freshwater Lake	4A Impaired – TMDL Completed	Eurasian Water Milfoil, (*Myriophyllum spicatum)*	1

Source: Massachusetts Department of Environmental Protection ("MassDEP"), 2022 Integrated List of Waters (305(b)/303(d)).

Notes: Total Maximum Daily Load ("TMDL")

Is the project within a medium or high stress basin, as established by the Massachusetts Water Resources Commission? _X_ Yes __ No;

STORMWATER MANAGEMENT:

Generally, describe the project's stormwater impacts and measures that the project will take to comply with the standards found in MassDEP's Stormwater Management Regulations:

NEP will employ construction-phase BMPs for stormwater management including sediment and erosion controls. Additionally, during the construction of the Project, NEP will construct stormwater management features such as swales, water bars, plunge pools, and/or check dams. These stormwater management features will promote stability of the constructed access improvements, reducing the potential for significant erosion and/or washout, and protecting sensitive resource areas. NEP will prepare a Stormwater Report to document compliance with the Massachusetts Stormwater Management Standards.

In addition, NEP will prepare a Stormwater Pollution Prevention Plan ("SWPPP") for the Project in compliance with the U.S. Environmental Protection Agency's ("EPA's") National Pollutant Discharge Elimination System ("NPDES") program under the Stormwater Construction General Permit. The SWPPP establishes a construction period contact list, presents a description of the proposed work, and identifies stormwater controls, spill prevention, and inspection practices to be implemented for the management of construction-related stormwater discharges from the Project. The SWPPP clearly identifies parties responsible for monitoring and reporting any activities out of compliance with the SWPPP or other environmental permits or approvals, and for handling extraordinary situations. The SWPPP also defines monitoring to occur until all disturbed areas on the site have been stabilized using standard BMPs. In this manner, the potential impacts associated with land disturbance (e.g., erosion and sedimentation) will be proactively managed so that impacts can be avoided.

MASSACHUSETTS CONTINGENCY PLAN:

Has the project site been, or is it currently being, regulated under M.G.L.c.21E or the Massachusetts Contingency Plan? _X_ Yes ___ No;

If yes, please describe the current status of the site (including Release Tracking Number (RTN), cleanup phase, and Response Action Outcome classification):

Table 8: Proximal Sites Under M.G.L. c.21E of the Massachusetts Contingency Plan

Release Tracking Number ("RTN")	City/Town	Address	Site Name	Compliance	Response Action Outcome ("RAO") Class*
2-0018190	Spencer	8 Meadow Road	Meadow Road and Olde Main	Downgradient Property Status ("DPS")	
2-0017396	Spencer	18 Olde Main St	Gobis Auto Service	TIERI	
2-0016701	Spencer	89 Smithville Rd	Zukus Farm Road	RAO	A2
2-0015795	Auburn	26 Millbury St	Worcester Envelope	RAO	A1

Release Tracking Number ("RTN")	City/Town	Address	Site Name	Compliance	Response Action Outcome ("RAO") Class*
2-0000016	Auburn	314 Washington St	Colony Press Fmr	Massachusetts Department of Environmental Protection ("MassDEP") No Further Action	
2-0019062	West Brookfield	46 Madden Rd Unit 37 Millbrook Cir	Madden Estates	Permanent Solution with No Conditions	PN
1-0017040	Shutesbury	491 Pratts Corner Rd	National Grid Substation	RAO	A1
1-0018465	Shelburne	232 Main Street, Route 112	Deerfield No. 4 Switchyard	RAO	A2
1-0017655	Shelburne	244 Main St	Wmeco Substation 29r	RAO	A2
2-0022315	Millbury	27 Providence Street	Commercial Property	Unclassified	
2-0017792	Millbury	137 North Providence	Town Of Millbury Highway Garage	RAO	A2
2-0015935	Millbury	58 Elmwood St	Shaw Elementary School	RAO	A2
2-0014362	Millbury	50 Grafton St	Millbury Substation No. 2	RAO	B1
2-0014312	Millbury	33 Providence St	Substation	RTN Closed	
2-0014039	Millbury	50 Grafton St	Millbury Substation No. 4	RAO	B1
2-0013614	Millbury	50 Grafton St	MECO Substation No. 2	RAO	A2
2-0012306	Millbury	33 Providence St	Substation	RAO	A2
2-0011459	Millbury	33 Providence St	Massachusetts Electric Substation	RAO	A3
2-0000958	Millbury	Providence Rd	Millbury Substation No. 1	RAO	A3
2-0014166	Millbury	33 Providence Rd	MECO Millbury Substation No. 1	RAO	A3
1-0010805	Belchertown	Blue Meadow Rd	Quabbin Reservoir	RAO	A1

Source: Massachusetts Department of Environmental Protection ("MassDEP"), Oil and/or Hazardous Material Sites.

Note: For Class A-1 RAOs, contamination has been cleaned up to background levels. At sites with Class A-2 RAOs, contamination may be above background levels but below Method 1 cleanup standards, or otherwise at "No Significant Risk." Similarly, sites with Class B-1 RAOs may have contaminant levels at background levels or may be below Method 1 Standards and/or otherwise at No Significant Risk. Class A-3, A-4, B-2 and B-3 RAOs are sites that are closed with Activity and Use Limitations ("AULs"). PN is the new designation indicating a Permanent Solution has been achieved with no conditions.

Is there an Activity and Use Limitation (AUL) on any portion of the project site?

_X_ Yes __ No;

If yes, describe which portion of the site and how the project will be consistent with the AUL:

Table 9: Activity and Use Limitations Within the Project ROW

Release Tracking Number ("RTN")	City/Town	Address	Site Name	Compliance	Response Action Outcome ("RAO")
2-0000958	Millbury	Providence Rd	Millbury Substation No.1	RAO	A3
2-0011459	Millbury	33 Providence St	Massachusetts Electric Substation	ROA	A3
2-0014166	Millbury	33 Providence Rd	MECO Millbury Substation No. 1	RAO	A3

Source: Massachusetts Department of Environmental Protection (MassDEP), Oil and/or Hazardous Material Sites with Activity and Use Limitations ("AUL") MassGIS layer. Updated December 4, 2024.

Based on the information available, it appears that work at structures 1A, 1, and potentially 2 will be conducted within the limits of the Activity and Use Limitations ("AUL") that has been filed for Release Tracking Numbers ("RTNs") 2-0000958, 2-0011459, and 2-0014166. The Project activities are not prohibited by the AUL and NEP will comply with the applicable conditions of the AUL governing soil management and disposal under the supervision of Licensed Site Professional.

Are you aware of any Reportable Conditions at the property that have not yet been assigned an RTN? Yes __ No _X_; **if yes, please describe:** _____

SOLID AND HAZARDOUS WASTE:

If the project will generate solid waste during demolition or construction, describe alternatives considered for re-use, recycling, and disposal of, e.g., asphalt, brick, concrete, gypsum, metal, wood:

(NOTE: Asphalt pavement, brick, concrete and metal are banned from disposal at Massachusetts landfills and waste combustion facilities and wood is banned from disposal at Massachusetts landfills. See 310 CMR 19.017 for the complete list of banned materials.)

The intent is for all existing wood and steel towers proposed for removal to be transported to an appropriate recycling facility. The removal and recycling will be consistent with all applicable regulations.

Will your project disturb asbestos containing materials? Yes __ No X ;

If yes, please consult state asbestos requirements at http://mass.gov/MassDEP/air/asbhom01.htm

NEP will comply with state laws regulating the use of diesel-powered equipment and vehicle idling times during construction. NEP will also take measures to limit vehicle idling times and to reduce air emissions, including the following:

- Any diesel-powered non-road construction equipment with engine horsepower ratings of 50 and above to be used for 30 or more days over the course of construction will either be EPA-Tier 4-compliant or will be retrofitted with EPA-verified (or equivalent) emission control devices such as oxidation catalysts or other comparable technologies (to the extent that they are commercially available) and installed on the exhaust system side of the diesel combustion engine.
- NEP requires the use of ultra-low sulfur diesel fuel in its diesel-powered construction equipment and limits idling time to five minutes except when engine power is necessary for the delivery of materials or to operate accessories to the vehicle such as power lifts.
- Vehicle idling is to be minimized during construction activities, in compliance with Massachusetts Anti-idling Law, G.L. c. 90 § 16A, c. 111 §§ 142A – 142M, and 310 CMR 7.11.

DESIGNATED WILD AND SCENIC RIVER:

Is this project site located wholly or partially within a defined river corridor of a federally designated Wild and Scenic River or a state designated Scenic River?

Yes ___ No X ; **If yes, specify name of river and designation:**

If yes, does the project have the potential to impact any of the "outstandingly remarkable" resources of a federally Wild and Scenic River or the stated purpose of a state designated Scenic River? Yes ___ No ___;

If yes, specify name of river and designation: _____;

If yes, will the project will result in any impacts to any of the designated "outstandingly remarkable" resources of the Wild and Scenic River or the stated purposes of a Scenic River. Yes ___ No ___;

If yes, describe the potential impacts to one or more of the "outstandingly remarkable" resources or stated purposes and mitigation measures proposed.

ATTACHMENTS:

1. **List of all attachments to this document.**

   Refer to List Below

2. **U.S.G.S. map (good quality color copy, 8-½ x 11 inches or larger, at a scale of 1:24,000) indicating the project location and boundaries.**

   Refer to **Attachment A: Project Figures**

3. **Plan, at an appropriate scale, of existing conditions on the project site and its immediate environs, showing all known structures, roadways and parking lots, railroad rights-of-way, wetlands and water bodies, wooded areas, farmland, steep slopes, public open spaces, and major utilities.**

   Refer to **Attachment A: Project Figures**

4. **Plan, at an appropriate scale, depicting environmental constraints on or adjacent to the project site such as Priority and/or Estimated Habitat of state-listed rare species, Areas of Critical Environmental Concern, Chapter 91 jurisdictional areas, Article 97 lands, wetland resource area delineations, water supply protection areas, and historic resources and/or districts.**

   Refer to **Attachment A: Project Figures**

5. **Plan, at an appropriate scale, of proposed conditions upon completion of project (if construction of the project is proposed to be phased, there should be a site plan showing condition upon the completion of each phase).**

   Refer to **Attachment A: Project Figures**

6. **List of all agencies and persons to whom the proponent circulated the ENF, in accordance with 301 CMR 11.16(2).**

   Refer to **Attachment B: ENF Distribution List**

7. **List of municipal and federal permits and reviews required by the project, as applicable.**

   Refer to **Attachment E for a list of federal, state, and municipal permits and reviews required by the Project.**

8. **Printout of output report from RMAT Climate Resilience Design Standards Tool, available here.**

   Refer to **Attachment C: RMAT**

9. **Printout from the EEA EJ Maps Viewer showing the project location relative to Environmental Justice ("EJ") Populations located in whole or in part within a 1-mile and 5-mile radius of the project site.**

   Refer to **Attachment D: Environmental Justice**

LAND SECTION – all proponents must fill out this section

I. Thresholds / Permits

A. Does the project meet or exceed any review thresholds related to land (see 301 CMR 11.03(1) _X_ Yes __No; **If yes, specify each threshold:**

Direct alteration of 50 or more acres of land, unless the Project is consistent with an approved conservation farm plan or forest cutting plan or similar. (301 CMR 11.03(1)(a)).

Approximately 561 acres of permanent alteration is proposed, which includes conversion of vegetative cover types, temporary construction matting, permanent and temporary work and pull pad areas, and access improvements.

II. Impacts and Permits

A. Describe, in acres, the current and proposed character of the project site, as follows:

	Existing	Change	Total
Footprint of buildings	N/A	N/A	N/A
Internal roadways	N/A	N/A	N/A
Parking and other paved areas	N/A	N/A	N/A
Other altered areas	1,125 acres	561 acres	1,125 acres
Undeveloped areas	N/A	N/A	N/A
Total: Project Site Acreage	1,125 acres	561 acres	1,125 acres

B. Has any part of the project site been in active agricultural use in the last five years? _X_ Yes __No; **If yes, how many acres of land in agricultural use (with prime state or locally important agricultural soils) will be converted to nonagricultural use?**

No land in agricultural use will be converted to nonagricultural use.

C. Is any part of the project site currently or proposed to be in active forestry use? _X_ Yes ___ No; **If yes, please describe current and proposed forestry activities and indicate whether any part of the site is the subject of a forest management plan approved by the Department of Conservation and Recreation:**

The Project ROW transects four areas in active forestry use (see **Table 10** below). In all cases, Project activities are within NEP's easements (an active transmission line ROW), which are not currently, nor in the future, managed for forestry activities.

Table 10: Active Forestry Areas Transected by the Project ROW

Name	Municipality	Structure Numbers (existing)
Buffam Brook Community Forest	Pelham	413 - 416; 418 - 422
Cadwell Memorial Forest	Pelham	387 - 397
South River State Forest	Conway	562 - 586; 589 - 595
Amherst Watershed	Pelham	401- 412

The Buffam Brook Community Forest follows the Forest Stewardship Plan (approved in November 2017), which prioritizes sustainable forest management through selective timber harvest and promotes late-successional forest conditions. Riparian zones and rare species habitat are managed particularly sensitively, and invasive plant control and public access are also strongly emphasized. Collaborations with organizations like the Kestrel Land Trust, Hitchcock Center, and the University of Massachusetts ("UMass"), create opportunities for forest-based experiential learning and stewardship education.[9] Proposed Project activities, which will be located within the existing and historically managed ROW, will not interfere with the wider uses of the Buffam Brook Community Forest for wildlife, public recreation, water quality, and sustainable timber harvests.

The Cadwell Memorial Forest covers an area of 1,950 acres and is owned by UMass Amherst. The site is a secondary growth mixed hardwood forest, in an area originally cleared for pasture. Since 1952, the site has functioned as an outdoor laboratory for ecology, forestry, and natural resources management. Forest management prioritizes sustainable timber practices, biodiversity enhancement, research, and public engagement, as well as public recreation via numerous trails.[10] Project activities will not impact these functions and will not impair public access to the forest.

The South River State Forest is managed under a 2014 Forest Management Proposal and vegetation management plan, overseen by DCR and the Bureau of Forest Fire Control and Forestry. Forest management prioritizes sustainability through the application of different management techniques for different forest types, with a focus on biodiversity and forest health[11]. Project activities will not impact the functions and values of the South River State Forest, nor impact biodiversity or tree health outside of the managed Project ROW.

The Amherst Watershed is managed under the Town of Amherst's Watershed Management Plan, which aims to ensure the sustainable management of the 2,662-acre forested area. Management strategies are tailored to different forest cover types and to different habitats (including wetlands and tributaries). Measures such as selective harvesting and thinning are employed to enhance forest quality, preserve wildlife values, and maintain scenic landscapes. Management prioritizes water quality, wildlife habitat, and passive recreational activities.[12] Project activities within the managed ROW will not impact the careful management of the wider Amherst Watershed and will employ BMPs to ensure protection of sensitive wetland resource areas, streams, and tributaries.

9 *Buffam Brook Community Forest Stewardship Plan* (Pelham, MA: Town of Pelham Conservation Commission, Kestrel Land Trust, MA Department of Conservation & Recreation, and U.S. Forest Service Open Space and Community Forest Program, November 2017).

10 Anthony D'Amato et al., *Cadwell Forest Management Plan* (Amherst, MA: Department of Natural Resources Conservation, University of Massachusetts Amherst, n.d.).

11 Massachusetts Department of Conservation and Recreation, Bureau of Forest Fire Control and Forestry, *Forest Management Proposal: South River 2014* (Pittsfield, MA: Massachusetts Department of Conservation and Recreation, January 21, 2015).

12 Conservation Department, Watershed Management Plan, accessed [12/11/2024], https://www.amherstma.gov/1259/Watershed-Management-Plan.

D. Does any part of the project involve conversion of land held for natural resources purposes in accordance with Article 97 of the Amendments to the Constitution of the Commonwealth to any purpose not in accordance with Article 97? __ Yes X No; **If yes, describe:**

E. Is any part of the project site currently subject to a conservation restriction, preservation restriction, agricultural preservation restriction or watershed preservation restriction? X Yes __ No; **If yes, does the project involve the release or modification of such restriction?** __ Yes X No; **If yes, describe:**

F. Does the project require approval of a new urban redevelopment project or a fundamental change in an existing urban redevelopment project under M.G.L.c.121A? __ Yes X No; **If yes, describe:**

G. Does the project require approval of a new urban renewal plan or a major modification of an existing urban renewal plan under M.G.L.c.121B?

__ Yes X No; **If yes, describe:**

III. Consistency

A. Identify the current municipal comprehensive land use plan

Title: See Below **Date:** See Below

The current municipal comprehensive land use plans are:

- Millbury, Massachusetts (Town of Millbury Comprehensive Master Plan - 2019)
- Auburn, Massachusetts (Master Plan - 2019)
- Spencer, Massachusetts (Spencer, Massachusetts Community Master Plan - 2003)
- East Brookfield, Massachusetts (East Brookfield Massachusetts 2008 Community Master Plan)
- North Brookfield, Massachusetts (Master Plan Town of North Brookfield - 2022)
- West Brookfield, Massachusetts (West Brookfield Master Plan - 2017)
- Ware, Massachusetts (A Window to Ware's Future – The 2016 Master Plan)
- Belchertown, Massachusetts (Belchertown Community Plan - 2023)
- Pelham, Massachusetts (Pelham Master Plan Studio - 2017)
- Shutesbury, Massachusetts (Shutesbury Master Plan - 2004)
- Deerfield, Massachusetts (Deerfield Master Plan - 2000)

The Towns of Leicester, Sunderland, Leverett, Conway and Shelburne do not have comprehensive plans, and therefore, are not cited.

B. Describe the project's consistency with that plan with regard to:

1) economic development See below
2) adequacy of infrastructure See below
3) open space impacts See below
4) compatibility with adjacent land uses See below

The Project proposes construction on NEP-owned lands or easements and within an existing transmission line ROW, and necessary measures to ensure no damage to natural, historical,

and open space resources. Therefore, it is not anticipated that the Project will have any impact on land use, open space, economic development, housing, historic and cultural resources, transportation and circulation, service and facilities, recreation, community health, and well-being. The proposed refurbishment and upgrades to the Lines will improve regional system electrical reliability, promoting economic development while minimizing environmental and land use impacts. As such, the Project supports the overall goals of all municipal land use plans, as discussed below.

Town of Millbury

The Town of Millbury's Comprehensive Master Plan (the "Plan") outlines the Town's specific plans for Land Use and Zoning, Community Facilities and Housing, Economic Development, Historic and Scenic Resources, Transportation, Capital Improvement, and Recreation. A review of the Plan's economic development, land use, and open space goals has concluded that the Project and its impacts are compatible with the Plan. In particular, one of the major economic goals in the Plan is to build robust infrastructure to bolster local industries – something which the refurbishment and improvement of the E5/F6 Lines will directly support. By utilizing the existing ROW and refurbishing existing structures, the proposed Project conforms with the Plan's land use and open space goals, minimizing the footprint of new developments and preserving landscapes. The Project also contributes to the Plan's land use goals of sustainable growth and development, promoting electrification of the grid, while minimizing new impacts to land use.

Town of Auburn

The Town of Auburn's Master Plan (the "Plan") outlines the Town's specific plans for land use, facilities and services, housing and population, economic development, open space and recreation, transportation, and natural cultural and historic resources. Review of the Plan's Economic goals, as well as the Town's Energy Efficiency & Climate Resiliency goals, has concluded that the Project and its impacts are compatible with the Plan. Specifically, the improved electrical reliability provided by the Project will contribute to the Town's plans to redevelop modern office space and create resilient infrastructure that supports contemporary office spaces and businesses. Rebuilding the E5/F6 Lines will not only improve reliability for existing customers, but will enable the connection of more electrical customers, fostering an environment where additional businesses and industries can thrive. By performing the line refurbishment within the existing ROW (rather than constructing a new transmission line), the Project conforms with Auburn's municipal facility operations and infrastructure management goals. The Project will also contribute to the Plan's Energy Efficiency & Climate Resiliency goals - replacing existing structures with more resilient steel structures, increasing line capacity, and performing conductor upgrades, will all enhance energy efficiency and reduce environmental impacts.

Town of Spencer

The Town of Spencer's Master Plan (the "Plan") describes the Town's goals and policies, a brief town history, and goals relating to facilities and services, transportation network, housing, economic development, and land use and zoning. The proposed Project will contribute to improved electrical reliability and resilience, in a manner consistent with the goals of the Plan's Land Use and Zoning Chapter. Refurbishment of the E5/F6 Lines within its existing ROW aligns with the Plan's emphasis on rural preservation. By committing to necessary measures to prevent damage to natural, historical, and open space resources, the proposed Project contributes to infrastructure development that respects the town's

character.

Town of North Brookfield

The Town of North Brookfield's Master Plan (the "Plan") describes the Town's plans specific to government facilities and services, open space and recreation, and economic development. As described previously, the Project will contribute to these overall goals by improving electrical reliability and capacity (supporting economic development within the Town), while minimizing impacts to open space and recreation (by rebuilding the transmission line within its existing ROW).

Town of East Brookfield

The Town of East Brookfield's Community Master Plan (the "Plan") describes the Town's plans specific to population and housing, land use, economic development, open space and recreation natural, cultural, and historic resources, transportation, and town facilities and services. By investing in critical infrastructure, and improving electrical reliability and resilience, the Project contributes to the enhancement of the local economy as outlined in the Economic Development Chapter of the Plan. Impacts to open space and recreation, and the Town's natural, cultural, and historic resources, will be minimized by re-using the existing ROW, and through the use of appropriate BMPs and restoration measures before and after construction. No impacts to overall community health and well-being are anticipated.

Town of West Brookfield

The Town of West Brookfield's Community Master Plan (the "Plan") describes the Town's plans specific to population and housing, land use, economic development, open space and recreation, natural, cultural, and historic resources, transportation, and town facilities and services. By investing in critical infrastructure, and improving electrical reliability and resilience, the Project contributes to the economic development goals outlined in the Plan. While the Project is not directly tied to light industrial opportunities and development (a key interest outlined in the Plan), it will support these developments by ensuring a reliable and efficient energy supply. Impacts to open space and recreation, and the Town's natural, cultural, and historic resources, will be minimized by re-using the existing ROW, and through the use of appropriate BMPs and restoration measures before and after construction. No impacts to overall community health and well-being are anticipated.

Town of Ware

The Town of Ware's Master Plan (the "Plan") includes the visions and aspirations, a snapshot of Ware, concerns, issues, and recommendations. The proposed Project aligns with the Plan's vision for the adequacy of infrastructure. Refurbishment of the E5/F6 Lines will contribute to making Ware more attractive for investment, by ensuring the Town is serviced with robust and reliable energy infrastructure. While the Project does not directly address all aspects mentioned in the Plan (such as sewer lines, transit, streets, and sidewalks), it underscores the commitment to critical infrastructure improvements. The Project aligns with the broader Plan goal of enhancing infrastructure, making Ware an appealing destination for economic development and potential investors.

Town of Belchertown

Belchertown's Community Plan (the "Plan") describes the Town's goals and policies, and plans for land use, housing, economic development, natural and cultural resources, open space and recreation, services and facilities, circulation, and implementation. The proposed

Project aligns with the Plan's commitment to enhancing the adequacy of infrastructure, particularly in addressing the impact of power outages. By rebuilding and modernizing the E5/F6 Lines, the Project contributes to the reliability and resilience of the energy infrastructure serving Belchertown, ensuring a more robust and consistent power supply for the community.

Town of Shutesbury

The Town of Shutesbury's Master Plan (the "Plan") describes the Town's plans for natural resources and open space, economic development, housing, community facilities and services, transportation, historic and scenic resources, and land use and zoning. The proposed Project aligns with the Plan's goal of exploring and promoting economic development that is compatible with the town's environment and rural character. Rebuilding the E5/F6 Lines within its existing ROW will provide improved electrical reliability and resilience, while minimizing impacts to the environment, open space, and historic and scenic character of the Town of Shutesbury. By taking necessary measures to prevent damage, the Project ensures the continuity of large blocks of contiguous forestland and open space, in harmony with the Shutesbury Master Plan's goal to preserve the rural character of the Town. The Project also contributes to the Plan's long-term objective of investing in alternative power sources (where suitable). The refurbishment of the E5/F6 Lines will contribute to the efficiency and resilience of vital electrical infrastructure, supporting green energy solutions that contribute to the grid and the Town revenues. Overall, the Project is consistent with the Plan's economic development goals by laying the foundation for sustainable growth and resilience.

Town of Pelham

The Town of Pelham's Master Plan (the "Plan") describes the Town's plans for economic development, housing, land use, open space and natural resources, creation, cultural and historic resources, community services and facilities, circulation, and transportation. As part of the Plan's Land Use Chapter goals, land use that favors residential spaces, open areas, and watershed protection is encouraged. In addition, development should aim to maintain the rural character of Pelham, while allowing for (limited) commercial and economic development in suitable areas. By providing essential upgrades to electrical infrastructure, the proposed Project will complement the Plan's economic development goals, providing reliable and resilient electrical supply to support commercial and domestic uses. Rebuilding the E5/F6 Lines within its existing ROW will minimize impacts to the environment, open space, and historic and rural character of Pelham.

Town of Deerfield

The Town of Deerfield's Master Plan (the "Plan") describes the Town's plans for farmland, open space and natural resources, community facilities and services, housing, historic and scenic resources, transportation resources, economic development, land use and zoning. The refurbishment of the E5/F6 Lines will help to ensure reliable and efficient energy infrastructure, supporting economic vitality, job retention, and employment opportunities within the Town of Deerfield. The Project's commitment to protecting historic character and minimizing impacts to agricultural land aligns with the Plan's vision for sustainable development. By utilizing the existing ROW and rebuilding existing structures, the Project reduces impacts to Deerfield's unique environment, demonstrating a consistent approach to economic development in step with the town's values and goals.

C. Identify the current Regional Policy Plan of the applicable Regional Planning Agency (RPA)

RPA: See Below

Title: See Below **Date:** See Below

D. Describe the project's consistency with that plan with regard to:

1) economic development See Below
2) adequacy of infrastructure See Below
3) open space impacts See Below

There are three Regional Policy Plans in operation over the length of the Project. The "2023 Central Massachusetts Infrastructure Plan" covers the Central Massachusetts Region (Towns of Millbury, Auburn, North Brookfield, West Brookfield, East Brookfield, Spencer, and Leicester). The "Pioneer Valley Plan for Progress (2015 - 2025)" covers the Pioneer Valley Region (Towns of Ware, Belchertown, and Pelham). Finally, the "Sustainable Franklin County: A Regional Plan for Sustainable Development" covers the Franklin Region (Towns of Sunderland, Leverett, Conway, Deerfield, and Shelburne). The Project's consistency with each Plan, in relation to economic development, infrastructure, and open space impacts, is discussed below.

Central Massachusetts Regional Planning Commission ("CMRPC"), *The 2023 Central Massachusetts Infrastructure Plan and the "Imagine 2050: A Vision for Central Massachusetts" initiative*

Millbury, Auburn, North Brookfield, West Brookfield, East Brookfield, Spencer, and Leicester

The "Imagine 2050: A Vision for Central Massachusetts" initiative (the "initiative"), led by CMRPC, outlines regional goals and strategies for the next 25 years. Central Massachusetts residents have voiced a need for more affordable housing, small businesses, and local food operations. Existing infrastructure has been highlighted as a challenge for potential developers, and the initiative stresses the need for investment in essential infrastructure, including electric infrastructure, for building a prosperous region. The Initiative also stresses that addressing the effects of climate change requires the creation of sustainable and resilient infrastructure. The proposed Project will address several of these concerns – the refurbishment of the E5/F6 Lines will directly contribute to improvements in energy infrastructure, and the new lines will be more reliable and able to meet higher electrical demand. By rebuilding the lines using new, more resilient steel structures (and higher capacity conductors), the system will be more resilient to the impacts of climate change, including increased flooding, storm frequency, and temperature extremes.

The Project also aligns with the Central Massachusetts Infrastructure Plan (the "Plan") goals of providing adequate energy infrastructure, and the Economic Implications of reaching Net-Zero. The refurbishment of the E5/F6 Lines signifies a dedicated effort to enhance electric grid capacity and resilience, directly addressing the Plan's objective to explore and invest in grid modernization strategies. This underscores a proactive stance toward infrastructure enhancement, in line with the Plan's vision for a more modern and robust electric grid, capable of meeting the region's present and future needs. By improving the reliability and capacity of the electric transmission system, the Project will also help to meet increasing adoption of electric heating and transportation, as anticipated by the Plan (and by NEP's own modelling of future trends in electric demand for the region). Upgrades to the E5/F6 Lines will

not only contribute to enhancing the grid's capacity and resilience, but also its flexibility in responding to challenges in energy storage and demand fluctuations caused by (for example), weather conditions or low renewable energy production. The Project's commitment to maintaining grid reliability through strategic improvements supports the broader economic implications outlined in the Plan, for a robust and adaptable energy system in the transition to Net-Zero.

The Project also aligns with the Plan's open space considerations. By rebuilding the E5/F6 Lines within the existing ROW (and by implementing appropriate BMPs to minimize impacts during and after construction), the Project has minimized land impacts, a key element in the Plan's focus on smart land use decisions and low impact development. By selecting the existing ROW, the Project effectively mitigates disruption to open spaces, reinforcing the overarching goal of achieving Net-Zero by avoiding unnecessary land use. This strategic approach complements the Plan's recommendation for reforestation projects on vacant and derelict land, acknowledging the value of open spaces and the environmental benefits they offer.

Pioneer Valley Planning Commission, *The Pioneer Valley Plan for Progress (2015-2025)*

Ware, Belchertown, and Pelham

The Pioneer Valley Plan for Progress (the “Plan”), describes the Pioneer Valley Region’s Plans specific for talent pool, thriving businesses, infrastructure, and economic development. In particular, the Project contributes to the infrastructure goal of the Plan, which focuses on “implementing and enhancing the infrastructure that sustains and ensures the safety and resiliency of the region and its economy”. The Project’s explicit aim is to improve the reliability and resilience of the E5/F6 Lines, in order to provide safe and reliable electrical service across the region. Additionally, the Project supports economic development across the region, by helping to ensure reliable and efficient energy supply. By rebuilding the E5/F6 Lines within the existing ROW, and by implementing appropriate BMPs throughout construction, the Project will contribute to the infrastructure and economic development goals of the Plan, while taking the necessary measures to prevent damage to natural, historical, and open space resources. In summary, the Project exemplifies a consistent and integrated approach to economic development, open space impacts, and the adequacy of infrastructure in alignment with regional goals.

Franklin Regional Council of Governments, *Sustainable Franklin County: A Regional Plan for Sustainable Development*

Sunderland, Leverett, Conway, Deerfield, and Shelburne

The Franklin County Regional Plan for Sustainable Development (the “Plan”) describes the Region’s Plans specific to housing, transportation, economic development, energy, natural resources, cultural resources and land use, and infrastructure.

The Project complements the Plan in several key areas. Upgrades to the E5/F6 Lines address concerns around aging infrastructure, and redevelopment of underutilized infrastructure, as outlined in Chapter 6 of the Plan. Improvements to the electric transmission system can contribute to advancing sustainable economic development, in particular for key high-energy use business sectors addressed by the Plan (including manufacturing, agriculture, and clean energy). The proposed Project contributes to the Plan's overarching vision of fostering economic growth through strategic investments in critical infrastructure. Furthermore, the proposed Project contributes to the goals of Chapter 7 of the Plan, creating

a sustainable energy future for the region. By upgrading the transmission infrastructure, the Project contributes significantly to mitigating current energy challenges faced by the county and will enable the system to respond to future increases in energy demand. By rebuilding the E5/F6 Lines within the existing ROW and minimizing environmental impacts through the appropriate use of BMPS, the Project also aligns with the region's goal of reducing environmental impact and promoting sustainability during development.

Finally, the Project aligns with the Plan's goals (outlined in Chapter 10 of the Plan), for land use and infrastructure. Through its focus on upgrading existing transmission line structures, optimizing their use, and prolonging their lifespan, the refurbishment of the E5/F6 Lines will complement existing transportation, water, and sewer infrastructure, promoting sustainable land use and integration of utility infrastructure.

RARE SPECIES SECTION

I. Thresholds / Permits

A. Will the project meet or exceed any review thresholds related to rare species or habitat (see 301 CMR 11.03(2))? _ Yes _ No; If yes, specify, in quantitative terms:

(NOTE: If you are uncertain, it is recommended that you consult with the Natural Heritage and Endangered Species Program (NHESP) prior to submitting the ENF.)

ENF: Rare Species - taking of an endangered or threatened species or species of special concern, provided that the Project site is two or more acres and includes an area mapped as a Priority Site of Rare Species Habitats and Exemplary Natural Communities. (301 CMR 11.03(2)(b)(2)).

NEP is consulting with NHESP on potential impacts to rare species or habitat. If after consulting, the Project will result in a "take," a CMP will be prepared, and NEP will mitigate determined impacts based on NHESP's recommendation.

B. Does the project require any state permits related to rare species or habitat?
___ Yes ___ No

C. Does the project site fall within mapped rare species habitat (Priority or Estimated Habitat?) in the current Massachusetts Natural Heritage Atlas (attach relevant page)?
X Yes ___ No

D. If you answered "No" to all questions A, B and C, proceed to the Wetlands, Waterways, and Tidelands Section. If you answered "Yes" to either question A or question B, fill out the remainder of the Rare Species section below.

II. Impacts and Permits

A. Does the project site fall within Priority or Estimated Habitat in the current Massachusetts Natural Heritage Atlas (attach relevant page)? X Yes ___ No;

1. If yes, have you consulted with the Division of Fisheries and Wildlife Natural Heritage and Endangered Species Program (NHESP)? X Yes ___ No; **If yes, have you received a determination as to whether the project will result in the "take" of a rare species? _**Yes ___ No; **If yes, attach the letter of determination to this submission.**

Consultations with NHESP are ongoing for the Project.

2. Will the project "take" an endangered, threatened, and/or species of special concern in accordance with M.G.L. c.131A (see also 321 CMR 10.04)? ___ Yes ___ No; **If yes, provide a summary of proposed measures to minimize and mitigate rare species impacts**

Consultations with NHESP are ongoing for the Project.

3. Which rare species are known to occur within the Priority or Estimated Habitat?

The Project ROW overlaps with Estimated and/or Priority Habitat for three bird, three reptile, one amphibian, five invertebrates, one fish, and 13 plant species. The names and locations of these species are not provided, as requested by NHESP.

4. Has the site been surveyed for rare species in accordance with the Massachusetts Endangered Species Act? X Yes ___ No;

5. If your project is within Estimated Habitat, have you filed a Notice of Intent or received an Order of Conditions for this project? ___ Yes X No; **If yes, did you send a copy of the Notice of Intent to the Natural Heritage and Endangered Species Program, in accordance with the Wetlands Protection Act regulations?** ___ Yes X No;

Notices of Intent ("NOI") will be submitted at a later date to each municipality as required under the Wetlands Protection Act ("WPA"). Copies of the NOI will be provided to the NHESP in accordance with the regulations at that time.

B. Will the project "take" an endangered, threatened, and/or species of special concern in accordance with M.G.L. c.131A (see also 321 CMR 10.04)?

___ Yes ___ No; **If yes, provide a summary of proposed measures to minimize and mitigate impacts to significant habitat:**

Consultations with NHESP are ongoing for the Project. If after consulting, the Project will result in a "take," a CMP will be prepared to compliance with the MESA.

WETLANDS, WATERWAYS, AND TIDELANDS SECTION

I. Thresholds / Permits

A. Will the project meet or exceed any review thresholds related to wetlands, waterways, and tidelands (see 301 CMR 11.03(3))? X Yes ___ No; **If yes, specify, in quantitative terms:**

The Project is anticipated to trigger four wetland MEPA thresholds. Refer to **Table 5** for the quantification of impacts associated with the following thresholds:

- 301 CMR 11.03(3)(a)(1)(a) – Alteration of 1 or more acres of BVW
- 301 CMR 11.03(3)(a)(1)(b) – Alteration of 10 or more acres of any other wetlands
- 301 CMR 11.03(3)(b)(1)(b) – Alteration of 500 or more linear feet of Bank along a fish run or Bank
- 301 CMR 11.03(3)(b)(1)(f) – Alteration of 0.5 or more acres of any other wetlands

B. Does the project require any state permits (or a local Order of Conditions) related to wetlands, waterways, or tidelands? X Yes ___ No; **If yes, specify which permit:**

- Individual Section 401 Water Quality Certification ("WQC") and Variance from MassDEP.
- Orders of Conditions from local Conservation Commissions.

C. If you answered "No" to both questions A and B, proceed to the Water Supply Section. If you answered "Yes" to either question A or question B, fill out the remainder of the Wetlands, Waterways, and Tidelands Section below.

II. Wetlands Impacts and Permits

A. Does the project require a new or amended Order of Conditions under the Wetlands Protection Act (M.G.L. c.131A)? X Yes ___ No; **If yes, has a Notice of Intent been filed?** ___ Yes X No;

If yes, list the date and MassDEP file number: _____; If yes, has a local Order of Conditions been issued? ___ Yes ___ No; **Was the Order of Conditions appealed?** ___ Yes ___ No; **Will the project require a Variance from the Wetlands regulations?** ___ Yes ___ No;

B. Describe any proposed permanent or temporary impacts to wetland resource areas located on the project site:

Temporary impacts associated with construction matting are proposed within areas that are jurisdictional under the WPA regulations. Permanent impacts associated with access improvement and grading are proposed within buffer zones, RA, BLSF, BVW, and Land Under Water Bodies and Waterways ("LUW"). No permanent impacts are proposed within Inland Bank as a result of the Project.

C. Estimate the extent and type of impact that the project will have on wetland resources, and indicate whether the impacts are temporary or permanent:

Coastal Wetlands	Area (sf) or Length (linear ft)	Temporary or Permanent Impact?
Land Under the Ocean	0	N/A
Designated Port Areas	0	N/A
Coastal Beaches	0	N/A
Coastal Dunes	0	N/A
Barrier Beaches	0	N/A
Coastal Banks	0	N/A
Rocky Intertidal Shores	0	N/A
Salt Marshes	0	N/A
Land Under Salt Ponds	0	N/A
Land Containing Shellfish	0	N/A
Fish Runs	0	N/A
Land Subject to Coastal Storm Flowage	0	N/A
Inland Wetlands		
Bank (linear ft)	See Table 5	See Table 5
Bordering Vegetated Wetlands	See Table 5	See Table 5
Isolated Vegetated Wetlands	See Table 5	See Table 5
Land under Water	See Table 5	See Table 5
Isolated Land Subject to Flooding	See Table 5	See Table 5
Bordering Land Subject to Flooding	See Table 5	See Table 5
Riverfront Area	See Table 5	See Table 5

D. Is any part of the project:

1. Proposed as a limited project? X Yes __ No; **If yes, what is the area (in sf)?**

The entire Project can be considered a limited Project.

2. The construction or alteration of a dam? ___ Yes X No; **If yes, describe:**

3. Fill or structure in a velocity zone or regulatory floodway? __ Yes X No;

4. Dredging or disposal of dredged material? ___ Yes X No; **If yes, describe the volume of dredged material and the proposed disposal site:**

5. A discharge to an Outstanding Resource Water ("ORW") or an Area of Critical Environmental Concern ("ACEC")? X Yes __ No;

6. Subject to a wetlands restriction order? ___ Yes X No; **If yes, identify the area (in sf):**

7. Located in buffer zones? X Yes ___ No; **If yes, how much (in sf) _____**

E. Will the project:

1. Be subject to a local wetlands ordinance or bylaw? X Yes ___ No;

2. Alter any federally-protected wetlands not regulated under state law? X Yes ___ No; **If yes, what is the area (sf)?**

For the purpose of this filing, it assumed that all Isolated Vegetated Wetlands not meeting the

criteria for Isolated Land Subject to Flooding are federally jurisdictional. Temporary impacts from construction matting total approximately 68,654 sf; permanent impacts from access and structure work total approximately 253 sf; and permanent alterations from the conversion of vegetative cover types total approximately 24,995 sf.

III. Waterways and Tidelands Impacts and Permits

A. Does the project site contain waterways or tidelands (including filled former tidelands) that are subject to the Waterways Act, M.G.L.c.91? _X_ Yes ___ No; **If yes, is there a current Chapter 91 License or Permit affecting the project site?** ___ Yes _X_ No; **If yes, list the date and license or permit number and provide a copy of the historic map used to determine extent of filled tidelands:**

Pursuant to 310 CMR 9.05(3)(g)(1), because a final Order of Conditions issued under M.G.L. c. 131, §40 and 310 CMR 10.00 will be issued for all Project waterways crossing, the crossings do not require authorization under c. 91.

B. Does the project require a new or modified license or permit under M.G.L.c.91? ___ Yes _X_ No; **If yes, how many acres of the project site subject to M.G.L.c.91 will be for non-water-dependent use?**

Current ___ Change ___ Total ___ **If yes, how many square feet of solid fill or pile-supported structures (in sf)?**

C. For non-water-dependent use projects, indicate the following:

Area of filled tidelands on the site: N/A____

Area of filled tidelands covered by buildings: N/A____

For portions of site on filled tidelands, list ground floor uses and area of each use: N/A____

Does the project include new non-water-dependent uses located over flowed tidelands? ___ Yes _X_ No;

Height of building on filled tidelands N/A____

Also show the following on a site plan: Mean High Water, Mean Low Water, Water-dependent Use Zone, location of uses within buildings on tidelands, and interior and exterior areas and facilities dedicated for public use, and historic high and historic low water marks.

D. Is the project located on landlocked tidelands? ___ Yes _X_ No; **If yes, describe the project's impact on the public's right to access, use and enjoy jurisdictional tidelands and describe measures the project will implement to avoid, minimize or mitigate any adverse impact:**

E. Is the project located in an area where low groundwater levels have been identified by a municipality or by a state or federal agency as a threat to building foundations? ___ Yes _X_ No; **If yes, describe the project's impact on groundwater levels and describe measures the project will implement to avoid, minimize, or mitigate any adverse impact:**

F. Is the project non-water-dependent and located on landlocked tidelands or waterways or tidelands subject to the Waterways Act and subject to a mandatory EIR? ___ Yes _X_ No;

(NOTE: If yes, then the project will be subject to Public Benefit Review and Determination.)

G. Does the project include dredging? ___ Yes _X_ No; **If yes, answer the following**

questions:

What type of dredging? Improvement ___ Maintenance ___ Both ____

What is the proposed dredge volume, in cubic yards (cys) _____

What is the proposed dredge footprint ____length (ft) ___width (ft) ____depth (ft);

Will dredging impact the following resource areas?

Intertidal ___ Yes X No; **If yes,** ___ sq ft

Outstanding Resource Waters ___ Yes X No; **If yes,** ___ sq ft

Other resource area (i.e. shellfish beds, eel grass beds) _ Yes X No; **If yes,** __ sq ft

If yes to any of the above, have you evaluated appropriate and practicable steps to: 1) avoidance; 2) if avoidance is not possible, minimization; 3) if either avoidance or minimize is not possible, mitigation?

If no to any of the above, what information or documentation was used to support this determination?

Provide a comprehensive analysis of practicable alternatives for improvement dredging in accordance with 314 CMR 9.07(1)(b). Physical and chemical data of the sediment shall be included in the comprehensive analysis.

Sediment Characterization

Existing gradation analysis results? __ Yes __ No: **If yes, provide results.**

Existing chemical results for parameters listed in 314 CMR 9.07(2)(b)6? ___Yes ____No; **If yes, provide results.**

Do you have sufficient information to evaluate feasibility of the following management options for dredged sediment? If yes, check the appropriate option.

Beach Nourishment ___

Unconfined Ocean Disposal ___

Confined Disposal:

Confined Aquatic Disposal (CAD) ___

Confined Disposal Facility (CDF) ___

Landfill Reuse in accordance with COMM-97-001 ___

Shoreline Placement ___

Upland Material Reuse____

In-State landfill disposal____

Out-of-state landfill disposal ____

(NOTE: This information is required for a 401 Water Quality Certification.)

IV. Consistency:

A. Does the project have effects on the coastal resources or uses, and/or is the project located within the Coastal Zone? ___ Yes _X_ No; **If yes, describe these effects and the projects consistency with the policies of the Office of Coastal Zone Management:**

B. Is the project located within an area subject to a Municipal Harbor Plan? ___ Yes _X_ No; **If yes, identify the Municipal Harbor Plan and describe the project's consistency with that plan:**

WATER SUPPLY SECTION

I. Thresholds / Permits

A. Will the project meet or exceed any review thresholds related to water supply (see 301 CMR 11.03(4))? ___ Yes _X_ No; **if yes, specify, in quantitative terms:**

B. Does the project require any state permits related to water supply?

___ Yes _X_ No; **if yes, specify which permit:**

C. If you answered "No" to both questions A and B, proceed to the Wastewater Section. If you answered "Yes" to either question A or question B, fill out the remainder of the Water Supply Section below.

II. Impacts and Permits

A. Describe, in gallons per day (gpd), the volume and source of water use for existing and proposed activities at the project site:

	Existing	Change	Total
Municipal or regional water supply	_____	_____	_____
Withdrawal from groundwater	_____	_____	_____
Withdrawal from surface water	_____	_____	_____
Interbasin transfer	_____	_____	_____

(NOTE: Interbasin Transfer approval will be required if the basin and community where the proposed water supply source is located is different from the basin and community where the wastewater from the source will be discharged.)

B. If the source is a municipal or regional supply, has the municipality or region indicated that there is adequate capacity in the system to accommodate the project? ___ Yes ___ No

C. If the project involves a new or expanded withdrawal from a groundwater or surface water source, has a pumping test been conducted? ___ Yes ___ No; **If yes, attach a map of the drilling sites and a summary of the alternatives considered and the results. _____**

D. What is the currently permitted withdrawal at the proposed water supply source (in gallons per day)? Will the project require an increase in that withdrawal? ___Yes ___No; **if yes, then how much of an increase (gpd)? _____**

E. Does the project site currently contain a water supply well, a drinking water treatment facility, water main, or other water supply facility, or will the project

involve construction of a new facility? ___ Yes ___ No. **If yes, describe existing and proposed water supply facilities at the project site:**

	Permitted Flow	Existing Avg Daily Flow	Project Flow	Total
Capacity of water supply well(s) (gpd)	_____	_____	_____	_____
Capacity of water treatment plant (gpd)	_____	_____	_____	_____

F. If the project involves a new interbasin transfer of water, which basins are involved, what is the direction of the transfer, and is the interbasin transfer existing or proposed?

G. Does the project involve:

1. new water service by the Massachusetts Water Resources Authority or other agency of the Commonwealth to a municipality or water district?

___ Yes ___ No

2. a Watershed Protection Act variance? ___ Yes ___ No; **If yes, how many acres of alteration?**

3. a non-bridged stream crossing 1,000 or less feet upstream of a public surface drinking water supply for purpose of forest harvesting activities? ___ Yes ___ No

III. Consistency

Describe the project's consistency with water conservation plans or other plans to enhance water resources, quality, facilities and services:

WASTEWATER SECTION

I. Thresholds / Permits

A. Will the project meet or exceed any review thresholds related to wastewater (see 301 CMR 11.03(5))? ___ Yes _X_ No; **If yes, specify, in quantitative terms:**

B. Does the project require any state permits related to wastewater?

___ Yes _X_ No; **If yes, specify which permit:**

C. If you answered "No" to both questions A and B, proceed to the Transportation - Traffic Generation Section. If you answered "Yes" to either question A or question B, fill out the remainder of the Wastewater Section below.

II. Impacts and Permits

A. Describe the volume (in gallons per day) and type of disposal of wastewater generation for existing and proposed activities at the project site (calculate according to 310 CMR 15.00 for septic systems or 314 CMR 7.00 for sewer systems):

	Existing	Change	Total
Discharge of sanitary wastewater	_____	_____	_____
Discharge of industrial wastewater	_____	_____	_____
TOTAL	_____	_____	_____

	Existing	Change	Total
Discharge to groundwater	_____	_____	_____
Discharge to outstanding resource water	_____	_____	_____
Discharge to surface water	_____	_____	_____
Discharge to municipal or regional wastewater facility	_____	_____	_____
TOTAL	_____	_____	_____

B. Is the existing collection system at or near its capacity? ___ Yes ___ No; **If yes, then describe the measures to be undertaken to accommodate the project's wastewater flows:**

C. Is the existing wastewater disposal facility at or near its permitted capacity? ___ Yes___ No; **If yes, then describe the measures to be undertaken to accommodate the project's wastewater flows:**

D. Does the project site currently contain a wastewater treatment facility, sewer main, or other wastewater disposal facility, or will the project involve construction of a new facility? ___ Yes ___ No; **if yes, describe as follows:**

	Permitted	Existing Avg Daily Flow	Project Flow	Total
Wastewater treatment plant capacity (in gallons per day)	_____	_____	_____	_____

E. If the project requires an interbasin transfer of wastewater, which basins are involved, what is the direction of the transfer, and is the interbasin transfer existing or new?

(NOTE: Interbasin Transfer approval may be needed if the basin and community where wastewater will be discharged is different from the basin and community where the source of water supply is located.)

F. Does the project involve new sewer service by the Massachusetts Water Resources Authority (MWRA) or other Agency of the Commonwealth to a municipality or sewer district? ___ Yes ___ No

G. Is there an existing facility, or is a new facility proposed at the project site for the storage, treatment, processing, combustion or disposal of sewage sludge, sludge ash, grit, screenings, wastewater reuse (gray water) or other sewage residual materials? ___ Yes ___ No; **If yes, what is the capacity (tons per day):**

	Existing	Change	Total
Storage	_____	_____	_____
Treatment	_____	_____	_____
Processing	_____	_____	_____
Combustion	_____	_____	_____
Disposal	_____	_____	_____

H. Describe the water conservation measures to be undertaken by the project, and other wastewater mitigation, such as infiltration and inflow removal.

III. Consistency

A. Describe measures that the proponent will take to comply with applicable state, regional, and local plans and policies related to wastewater management:

B. If the project requires a sewer extension permit, is that extension included in a comprehensive wastewater management plan? ___ Yes ___ No; **If yes, indicate the EEA number for the plan and whether the project site is within a sewer service area recommended or approved in that plan:**

TRANSPORTATION SECTION (TRAFFIC GENERATION)

I. Thresholds / Permit

A. Will the project meet or exceed any review thresholds related to traffic generation (see 301 CMR 11.03(6))? ___ Yes _X_ No; **If yes, specify, in quantitative terms:**

Massachusetts Department of Environmental Protection ("MassDOT") is expected to review the Project for:

- Overhead wire crossings of state highways
- Temporary access during construction onto the NEP Project ROW from state highways Permanent Access Permit for new access and proposed structures within the Highway Layout

B. Does the project require any state permits related to state-controlled roadways? _X_ Yes ___ No; **If yes, specify which permit:**

Table 5: State Highway Access Permit for Non-Municipal Utility

Municipality	State-controlled Roadway
DISTRICT 1	
Shelburne	Main Street (MA-112)
	Mohawk Trail (MA-2)
DISTRICT 2	
Deerfield	Interstate 91
	Greenfield Road (US-5/MA-10)
Leverett	Long Plain Road (MA-63)
Pelham	Daniel Shay Highway (US-202)
Ware	Belchertown Road (MA-9)
	Gilbertville Road (MA-32)
DISTRICT 3	
Spencer	West Main Street (MA-9)
Auburn	Interstate 290
	Southbridge Street (MA-12)
	Massachusetts Turnpike (I-90)
	Washington Street (US-20)
Millbury	Worcester-Providence Turnpike (MA-146)

C. If you answered "No" to both questions A and B, proceed to the Roadways and Other Transportation Facilities Section. If you answered "Yes" to either question A or question B, fill out the remainder of the Traffic Generation Section below.

II. Traffic Impacts and Permits

A. Describe existing and proposed vehicular traffic generated by activities at the project site:

	Existing	Change	Total
Number of parking spaces	N/A	N/A	_____
Number of vehicle trips per day	N/A	N/A	_____
ITE Land Use Code(s):	N/A	N/A	_____

The Project will not cause permanent traffic impacts and is not anticipated to cause significant temporary traffic impacts. During construction, shield wires and conductors will be installed using tensioning equipment to pull the conductors through the stringing blocks. When this activity occurs near state roadways, temporary guard structures or boom trucks may be placed at road and highway crossings to ensure public safety. NEP is reviewing the proposed location of guard structures.

Proposed construction traffic will be temporary in nature, occurring along different sections of NEP's Project ROW during the various stages of construction. Traffic will be limited to construction-related vehicles accessing the utility ROW using existing routes off state highways. Traffic volume during construction of the utility line will not significantly affect existing volumes or adversely impact the ability of existing traffic to safely navigate the roadway.

B. What is the estimated average daily traffic on roadways serving the site?

Roadway	Existing	Change	Total
1. _____	N/A	N/A	_____
2. _____	N/A	N/A	_____
3. _____	N/A	N/A	_____

Intermittent construction-related traffic associated with Project construction will occur over the entire construction period. Construction equipment typically will gain access to the ROWs from public roadways crossing the ROWs in various locations along the route. Because each of the construction tasks will occur at different times and locations over the course of the construction, traffic will be intermittent at these entry roadways. Traffic will consist of vehicles ranging from pick-up trucks to heavy construction equipment to large trailers delivering materials.

Proposed construction traffic will be temporary in nature, occurring along different sections of NEP's Project ROW during the various stages of construction. Traffic will be limited to construction-related vehicles accessing the utility ROW using existing routes off state highways. Traffic volume during construction or maintenance of the utility line will not significantly affect existing volumes or adversely impact the ability of existing traffic to safely navigate the roadway.

C. If applicable, describe proposed mitigation measures on state-controlled roadways that the project proponent will implement:

MassDOT Districts 1, 2 and 3 will be contacted to discuss specific design information and anticipated Project activities within highway jurisdiction. With MassDOT's input, Traffic Management Plans with complete details of proposed work will be developed and submitted to MassDOT for review and approval prior to the start of Project construction. Enforceable

commitments in the Traffic Management Plans will be carried out by NEP to ensure that all proposed traffic mitigation strategies will be implemented as the Project proceeds. Such strategies may include, as appropriate, traffic management procedures; construction time restrictions; signage; installation of track pads to minimize soil in roadways; and/or restoration of vegetation along soft shoulders after construction. All work will occur in accordance with NEP's Policy for ROW Access, Maintenance, and Construction BMPs; further information on construction BMPs will be provided in the DEIR.

C. How will the project implement and/or promote the use of transit, pedestrian and bicycle facilities and services to provide access to and from the project site?

Not Applicable.

D. Is there a Transportation Management Association (TMA) that provides transportation demand management (TDM) services in the area of the project site? ____ Yes ____ No; **If yes, describe if and how the project will participate in the TMA:**

Not Applicable.

E. Will the project use (or occur in the immediate vicinity of) water, rail, or air transportation facilities? _X_ Yes _ No; **If yes, generally describe:**

Project activities will occur in the immediate vicinity of the following rail lines:

- Pan Am Systems ("PAS") (Patriot Corridor) – Conway, MA
- PAS (Conn River Main Line) – Deerfield, MA
- New England Central Railroad ("NECR") (Central Vermont) – Leverett, MA
- Pan Am Railways ("PAR") (Central Mass) – Ware, MA
- MassDOT- Rail (Ware River Branch) – Ware, MA
- Chessie Seaboard X ("CSX") (Boston) – Auburn, MA
- Providence and Worcester ("P&W") (Norwich & Worcester) – Auburn, MA
- P&W – Millbury, MA

E. If the project will penetrate approach airspace of a nearby airport, has the proponent filed a Massachusetts Aeronautics Commission Airspace Review Form (780 CMR 111.7) and a Notice of Proposed Construction or Alteration with the Federal Aviation Administration (FAA) (CFR Title 14 Part 77.13, forms 7460-1 and 7460-2)?

The E5/F6 Line Project ROW is approximately 3.03 miles away from the nearest airport ("Oxford Airport"). Since Project activities are greater than two miles from the nearest Municipal Airport Runway, a Massachusetts Aeronautics Commission Airspace Review Form is not required. Project activities are greater than four miles from a major airport that has a runway long enough to trigger a Federal Aviation Administration ("FAA") review.

III. Consistency

Describe measures that the proponent will take to comply with municipal, regional, state, and federal plans and policies related to traffic, transit, pedestrian and bicycle transportation facilities and services:

Project construction will not affect transit, pedestrian, or bicycle transportation facilities since work will primarily occur on a cross-country NEP ROW, which is not designated for public

use. The Project is consistent with federal, state, regional and local plans, and policies; minimal, if any, impacts related to roadways or other transportation facilities are anticipated.

TRANSPORTATION SECTION (ROADWAYS AND OTHER TRANSPORTATION FACILITIES)

I. Thresholds

A. Will the project meet or exceed any review thresholds related to roadways or other transportation facilities (see 301 CMR 11.03(6))? ___ Yes _X_ No; **If yes, specify, in quantitative terms:**

B. Does the project require any state permits related to roadways or other transportation facilities? ___ Yes _X_ No; **If yes, specify which permit:**

C. If you answered "No" to both questions A and B, proceed to the Energy Section. If you answered "Yes" to either question A or question B, fill out the remainder of the Roadways Section below.

II. Transportation Facility Impacts

A. Describe existing and proposed transportation facilities in the immediate vicinity of the project site:

B. Will the project involve any

1. **Alteration of bank or terrain (in linear feet)?** _____
2. **Cutting of living public shade trees (number)?** _____
3. **Elimination of stone wall (in linear feet)?** _____

III. Consistency

Describe the project's consistency with other federal, state, regional, and local plans and policies related to traffic, transit, pedestrian and bicycle transportation facilities and services, including consistency with the applicable regional transportation plan and the Transportation Improvements Plan (TIP), the State Bicycle Plan, and the State Pedestrian Plan:

ENERGY SECTION

I. Thresholds / Permits

A. Will the project meet or exceed any review thresholds related to energy (see 301 CMR 11.03(7))? ___ Yes _X_ No; **If yes, specify, in quantitative terms:**

B. Does the project require any state permits related to energy? _X_ Yes ___ No; **If yes, specify which permit:**

- Energy Facility Siting Board ("EFSB"), Approval under M.G.L. c.164 § 69J
- Department of Public Utilities ("DPU"), Approval to Construct under M.G.L. c.164 § 72

C. If you answered "No" to both questions A and B, proceed to the Air Quality Section. If you answered "Yes" to either question A or question B, fill out the remainder of the Energy Section below.

II. Impacts and Permits

A. Describe existing and proposed energy generation and transmission facilities at the project site:

	Existing	Change	Total
Capacity of electric generating facility (megawatts)			
Length of fuel line (in miles)			
Length of transmission lines (in miles)	**~67 Miles**		**~67 Miles**
Capacity of transmission lines (in kilovolts)	**69kV**	**115kV**	**115kV**

B. If the project involves construction or expansion of an electric generating facility, what are:

1. the facility's current and proposed fuel source(s)? N/A

2. the facility's current and proposed cooling source(s)? N/A

C. If the project involves construction of an electrical transmission line, will it be located on a new, unused, or abandoned right of way? ___Yes _X_ No; **If yes, please describe:**

D. Describe the project's other impacts on energy facilities and services:

The Project proposes complete asset refurbishment and system improvements to the Lines. The purpose is to ensure reliable and continuous electricity is provided across the region, meeting current and future predicted energy demands.

NEP will also be installing OPGW, which serves the dual purpose of providing electrical grounding in the event of lightning strikes, while also enabling fast telecommunication along the lines. This is critical for rapidly identifying and responding to problems, such as damage to the infrastructure from storm events. In addition, due to poor access along most of the ROW corridor, access improvements or re-establishment and construction of new access will be undertaken to conduct the proposed work and to support future maintenance of the proposed infrastructure. As such, the Project will result in positive impacts to energy facilities and services, by improving electrical reliability, resilience, and connectivity across the region.

III. Consistency

Describe the project's consistency with state, municipal, regional, and federal plans and policies for enhancing energy facilities and services:

The Project, addressing asset conditions and the need for system improvements, includes refurbishment activities to the existing electrical structures, improvements to access, and the installation of stormwater management features. As a result, the Project will result in the following benefits associated with enhanced energy facilities and services:

- Safe and reliable access and work areas at each transmission structure.
- Reliable and continuous electricity supply for customers, including increased reliability during extreme weather events.
- Rapid telecommunication along the transmission lines and between substations.

These impacts align with the following federal, state, regional, and municipal plans and policies for enhancing energy facilities and services:

Federal

The Project is generally consistent with federal policies related to maintaining reliable energy delivery systems and enhancing energy infrastructure to accommodate alternative energy supply.

State

The Project is generally consistent with important state energy laws and policies, such as the Electric Utility Restructuring Act of 1997 (the “Restructuring Act”), the Green Communities Act (c. 169 of the Acts of 2008), the Global Warming Solutions Act (c. 298 of the Acts of 2008) (the “GWSA”), the Energy Diversity Act (c. 188 of the Acts of 2016), the Clean Energy Act (c. 227 of the Acts of 2018), An Act Creating a Next Generation Roadmap for Massachusetts Climate Policy (c. 8 of the Acts of 2021) (the “Roadmap Act”), and An Act Driving Clean Energy and Offshore Wind (St. 2022, c. 179) (the “Drive Act”).

Regional

Regional Greenhouse Gas Initiative (“RGGI”): In January 2007, Massachusetts joined the RGGI, a cooperative effort by Northeast and Mid-Atlantic States to reduce carbon dioxide (“CO2”) emissions from large fossil-fueled power plants. In 2018, Massachusetts joined eight other states in developing amendments to revise the RGGI, including reductions to the regional cap and other programmatic changes. As the Project will increase capacity for transmission of energy from renewable sources, which do not produce carbon emissions as part of the electricity generation process, the Project is consistent with the RGGI.

New England Energy Vision: In 2020, Massachusetts joined with the five other New England states in forming New England Energy Vision and its respective Vision Statement. The vision is one of a clean, affordable, and reliable regional electric grid, achievable through three core segments: Wholesale Electricity Market Design, Transmission System Planning, and Independent System Operator (“ISO”) New England Governance. Advancements have since been made in all three core segments, including a 2021 “Report to the Governors” and a joint initiative for innovation in design concepts (2022-2023). Given that the Project involves upgrading and replacing existing infrastructure to result in more clean, affordable, and reliable transmission, it aligns with the New England Energy Vision.

New England States Committee on Electricity (“NESCOE”): NESCOE is a not-for-profit entity,

regional committee, recognized by the Federal Energy Regulatory Commission ("FERC"). NESCOE advances the New England states' common interest of reliable, low-cost provision of electricity to consumers through two focus areas: Resource Adequacy, and System Planning and Expansion. This Project strengthens infrastructure, ensuring a reliable and continuous electricity supply for customers, thereby remaining consistent with the NESCOE vision.

Municipal

The Green Communities Act: On July 2, 2008, Massachusetts Governor Deval Patrick signed into law the Green Communities Act. The Green Communities Act is a comprehensive, multi-faceted energy reform bill that encourages energy and building efficiency, promotes renewable energy, creates green communities, implements elements of the RGGI, and provides market incentives and funding for various types of energy generation. The Green Communities Act (as amended and supplemented by St. 2012, c. 209, An Act Relative to Competitively Priced Electricity) can be expected to result in greater renewable supplies and substantial new conservation initiatives in future years. In order to achieve Green Community Designation, municipalities must meet five criteria:

- Criterion 1 is met by passing zoning in designated locations for the as-of-right siting of renewable or alternative energy generating facilities, research and development facilities, or manufacturing facilities;
- Criterion 2 is met by adopting an expedited application and permitting of one year at most, under which facilities interested in locating their facility in a designated renewable zone may be sites within the municipality;
- Criterion 3 is met by (i) establishing an energy baseline inventory for municipal buildings and facilities, and (ii) adopting an Energy Reduction Plan demonstration a reduction of 20% of energy use after five years of implementation;
- Criterion 4 is met if all departments within a Green Community purchase fuel-efficient vehicles for municipal use, whenever such vehicles are commercially available and practicable; and
- Criterion 5 is met if municipalities minimize the life-cycle cost of all newly constructed homes and buildings.

Shelburne, Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, Spencer, Leicester, Auburn and Millbury are all designated Green Communities. The improvements to the transmission system in the region will further the goals of the Green Communities Act by ensuring a reliable, efficient energy supply. The Project also supports the communities' interest in an energy supply from renewable energy sources. The Project, therefore, advances the important policy objectives of the Green Communities Act.

The Massachusetts Municipal Vulnerability Preparedness ("MVP") Grant Program: The MVP Grant Program was created in 2017, as result of Executive Order No. 569, signed by Governor Charlie Baker on September 16, 2016. The Program provides support for cities and towns in Massachusetts to identify climate hazards, assess vulnerabilities, and develop action plans to improve resilience to climate change. Communities that complete the MVP Planning Grant process become designated as an MVP Community and are eligible for MVP Action Grant funding to implement the Priority Actions identified through the planning process. Thirteen of the 16 towns along the Project ROW, including Deerfield, Sunderland,

Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, Spencer, Leicester, Auburn, Conway, and Millbury have all achieved MVP Community designation as a result of going through the MVP planning process, all of which identified power outages as vulnerabilities in their communities. Additionally, some of the plans also addressed transitions to clean energy sources. As the Project will increase reliability and decrease likelihood of outages during extreme weather events, as well as increase capacity for transmission of energy from renewable sources, the Project is consistent with MVP Program. Please see also the Land Section above, which outlines conformance with regional Plans, including those relating to Land Use and Energy/Infrastructure.

AIR QUALITY SECTION

I. Thresholds

A. Will the project meet or exceed any review thresholds related to air quality (see 301 CMR 11.03(8))? ___ Yes _X_ No; **if yes, specify, in quantitative terms:**

B. Does the project require any state permits related to air quality? __ Yes _X_ No; **If yes, specify which permit:**

C. If you answered "No" to both questions A and B, proceed to the Solid and Hazardous Waste Section. If you answered "Yes" to either question A or question B, fill out the remainder of the Air Quality Section below.

II. Impacts and Permits

A. Does the project involve construction or modification of a major stationary source (see 310 CMR 7.00, Appendix A)? ___ Yes ___ No; **If yes, describe existing and proposed emissions (in tons per day) of:**

	Existing	Change	Total
Particulate matter	_____	_____	_____
Carbon monoxide	_____	_____	_____
Sulfur dioxide	_____	_____	_____
Volatile organic compounds	_____	_____	_____
Oxides of nitrogen	_____	_____	_____
Lead	_____	_____	_____
Any hazardous air pollutant	_____	_____	_____
Carbon dioxide	_____	_____	_____

B. Describe the project's other impacts on air resources and air quality, including noise impacts:

III. Consistency

A. Describe the project's consistency with the State Implementation Plan:

B. Describe measures that the proponent will take to comply with other federal, state, regional, and local plans and policies related to air resources and air quality:

SOLID AND HAZARDOUS WASTE SECTION

I. Thresholds / Permits

A. Will the project meet or exceed any review thresholds related to solid or hazardous waste (see 301 CMR 11.03(9))? ___ Yes _X_ No; **If yes, specify, in quantitative terms:**

B. Does the project require any state permits related to solid and hazardous waste? ___ Yes _X_ No; **If yes, specify which permit:**

C. If you answered "No" to both questions A and B, proceed to the Historical and Archaeological Resources Section. If you answered "Yes" to either question A or question B, fill out the remainder of the Solid and Hazardous Waste Section.

II. Impacts and Permits

A. Is there any current or proposed facility at the project site for the storage, treatment, processing, combustion or disposal of solid waste? ___ Yes ___ No; **If yes, what is the volume (in tons per day) of the capacity:**

	Existing	Change	Total
Storage	_____	_____	_____
Treatment, processing	_____	_____	_____
Combustion	_____	_____	_____
Disposal	_____	_____	_____

B. Is there any current or proposed facility at the project site for the storage, recycling, treatment or disposal of hazardous waste? ___ Yes ___ No; **If yes, what is the volume (in tons or gallons per day) of the capacity:**

	Existing	Change	Total
Storage	_____	_____	_____
Treatment, processing	_____	_____	_____
Combustion	_____	_____	_____
Disposal	_____	_____	_____

C. If the project will generate solid waste (ex. during demolition or construction), describe alternatives considered for re-use, recycling, and disposal:

D. If the project involves demolition, do any buildings to be demolished contain asbestos? ___ Yes ___ No

E. Describe the project's other solid and hazardous waste impacts (including indirect impacts):

III. Consistency

Describe measures that the proponent will take to comply with the State Solid Waste Master Plan:

HISTORICAL AND ARCHAEOLOGICAL RESOURCES SECTION

I. Thresholds / Impacts

A. Have you consulted with the Massachusetts Historical Commission? X Yes ___ No; **If yes, attach correspondence.**

Refer to **Attachment E: Correspondence**

For project sites involving lands underwater, have you consulted with the Massachusetts Board of Underwater Archaeological Resources? X Yes __ No; if yes, attach correspondence

Refer to **Attachment E: Correspondence**

B. Is any part of the project site a historic structure, or a structure within a historic district, in either case listed in the State Register of Historic Places or the Inventory of Historic and Archaeological Assets of the Commonwealth?

X Yes ___ No; **If yes, does the project involve the demolition of all or any exterior part of such historic structure?** ___ Yes X No; **If yes, please describe:**

NEP retained The Public Archaeology Laboratory, Inc. ("PAL") to undertake a historic and archaeological review of the Project corridor. PAL conducted a cultural resource due diligence and archaeological sensitivity assessment of the Project ROW in June 2022. PAL reviewed the proposed Project impact areas and prepared a technical proposal to conduct an intensive (locational) archaeological survey for the Project. PAL submitted a State Archaeologist's Permit application to the Massachusetts Historical Commission ("MHC") for the E5/F6 lines on August 1, 2022. On August 8, 2022, the MHC issued Permit #4206 to PAL to conduct the survey .

PAL started the survey in October 2022, which is on-going. PAL will file a survey report with the MHC in the 2nd quarter of 2025. NEP will continue to consult with the MHC and with the Army Corps of Engineers ("USACE") and federal Native American Tribes through the federal Section 106 consultation process.

PAL is in the process of developing a historic architectural reconnaissance survey; the effort began in the fourth quarter of 2024 and is ongoing at the time of the ENF filing. PAL plans to submit a report to the MHC on the results of the survey in the first quarter of 2025.

C. Is any part of the project site an archaeological site listed in the State Register of Historic Places or the Inventory of Historic and Archaeological Assets of the Commonwealth? __ Yes X No; **if yes, does the project involve the destruction of all or any part of such archaeological site?** ___ Yes X No; **If yes, please describe:**

D. If you answered "No" to all parts of both questions A, B and C, proceed to the Attachments and Certifications Sections. If you answered "Yes" to any part of either question A or question B, fill out the remainder of the Historical and Archaeological Resources Section below.

II. Impacts

Describe and assess the project's impacts, direct and indirect, on listed or inventoried historical and archaeological resources:

As noted above, there are no listed or inventoried sites within the Project site and no impacts to listed or inventoried historical or archaeological resources is anticipated at this time.

III. Consistency

Describe measures that the proponent will take to comply with federal, state, regional, and local plans and policies related to preserving historical and archaeological resources:

If, after further assessment by PAL, historical or archaeological resources eligible for listing in the National Register of Historic Places ("NRHP") are discovered that may be impacted by the Project, NEP will consult with both the USACE and MHC on avoidance, minimization and mitigation to the extent required by law. As part of its Section 404 permit review, pursuant to Section 106 of the National Historic Preservation Act ("NHPA"), the USACE will also consult with Native American Tribes that express an interest in historic resources that may be affected by portions of the Project within USACE jurisdiction.

CLIMATE CHANGE ADAPTATION AND RESILIENCY SECTION

This section of the Environmental Notification Form (ENF) solicits information and disclosures related to climate change adaptation and resiliency, in accordance with the MEPA Interim Protocol on Climate Change Adaptation and Resiliency (the "MEPA Interim Protocol"), effective October 1, 2021. The Interim Protocol builds on the analysis and recommendations of the 2018 Massachusetts Integrated State Hazard Mitigation and Climate Adaptation Plan (SHMCAP) and incorporates the efforts of the Resilient Massachusetts Action Team (RMAT), the inter-agency steering committee responsible for implementation, monitoring, and maintenance of the SHMCAP, including the "Climate Resilience Design Standards and Guidelines" project. The RMAT team recently released the RMAT Climate Resilience Design Standards Tool, which is available here.

The MEPA Interim Protocol is intended to gather project-level data in a standardized manner that will both inform the MEPA review process and assist the RMAT team in evaluating the accuracy and effectiveness of the RMAT Climate Resilience Design Standards Tool. Once this testing process is completed, the MEPA Office anticipates developing a formal Climate Change Adaptation and Resiliency Policy through a public stakeholder process. Questions about the RMAT Climate Resilience Design Standards Tool can be directed to rmat@mass.gov.

All Proponents must complete the following section, referencing as appropriate the results of the output report generated by the RMAT Climate Resilience Design Standards Tool and attached to the ENF. In completing this section, Proponents are encouraged, but not required at this time, to utilize the recommended design standards and associated Tier 1/2/3 methodologies outlined in the RMAT Climate Resilience Design Standards Tool to analyze the project design. However, Proponents are requested to respond to a respond to a user feedback survey on the RMAT website or to provide feedback to rmat@mass.gov, which will be used by the RMAT team to further refine the tool. Proponents are also encouraged to consult general guidance and best practices as described in the RMAT Climate Resilience Design Guidelines.

Climate Change Adaptation and Resiliency Strategies

I. Has the project taken measures to adapt to climate change for all of the climate parameters analyzed in the RMAT Climate Resilience Design Standards Tool (sea level rise/storm surge, extreme precipitation (urban or riverine flooding), extreme heat)? X Yes __ No

Note: Climate adaptation and resiliency strategies include actions that seek to reduce vulnerability to anticipated climate risks and improve resiliency for future climate conditions. Examples of climate adaptation and resiliency strategies include flood barriers, increased stormwater infiltration, living shorelines, elevated infrastructure, increased tree canopy, etc. Projects should address any planning priorities identified by the affected municipality through the Municipal Vulnerability Preparedness (MVP) program or other planning efforts, and should consider a flexible adaptive pathways approach, an adaptation best practice that encourages design strategies that adapt over time to respond to changing climate conditions. General guidance and best practices for designing for climate risk are described in the RMAT Climate Resilience Design Guidelines.

A. If no, explain why.

B. If yes, describe the measures the project will take, including identifying the planning horizon and climate data used in designing project components. If applicable, specify the return period and design storm used (e.g., 100-year, 24-hour storm).

NEP has taken steps to promote climate change adaptation and resiliency in the design of the Project. The Project will result in a more climate-ready and resilient transmission system that can withstand more extreme weather events; address existing system capacity shortages and increased demand; and support future interconnections from renewable energy projects. In addition, NEP's preferred solution uses substantial portions of existing ROW, thereby minimizing alteration of new land resources to construct the Project.

C. Is the project contributing to regional adaptation strategies? X Yes __ No; **If yes, describe.**

Of the 16 towns crossed by the Project, 13 have achieved MVP Community designation. All 13 municipalities identified power outages as a vulnerability in their communities during community resilience building workshops and associated summary of findings reports and sought to identify ways to improve power utility resilience. Vulnerability due to high winds, snow and ice loads, and trees were common concerns resulting in frequent and/or long duration power outages. While this Project does not address local distribution, transmission line and structure replacements are intended to result in a more reliable and resilient transmission system supporting these communities.

II. Has the Proponent considered alternative locations for the project in light of climate change risks? ___ Yes X No

A. If no, explain why.

The proposed Project location, within the existing ROW, is the only location that meets the identified Project need and reliability, addresses the various regulatory objectives, minimizes environmental impacts, and provides a cost-effective solution to customers. Also, the Project is located outside of areas identified as vulnerable to sea level rise and coastal flooding.

B. If yes, describe alternatives considered.

III. Is the project located in Land Subject to Coastal Storm Flowage (LSCSF) or Bordering Land Subject to Flooding (BLSF) as defined in the Wetlands Protection Act?
X Yes ___ No

If yes, describe how/whether proposed changes to the site's topography (including the addition of fill) will result in changes to floodwater flow paths and/or velocities that could impact adjacent properties or the functioning of the floodplain. General guidance on providing this analysis can be found in the CZM/MassDEP Coastal Wetlands Manual, available here.

The Project is not located within Land Subject to Coastal Storm Flowage ("LSCSF"); however, it is within areas of BLSF. Where new and improved access is proposed within BLSF, the area will be over excavated resulting in no loss of flood storage. Concrete caisson foundations are proposed within BLSF. NEP will provide compensatory flood storage as required under state and local requirements.

ENVIRONMENTAL JUSTICE SECTION

I. Identifying Characteristics of EJ Populations

A. If an Environmental Justice (EJ) population has been identified as located in whole or in part within 5 miles of the project site, describe the characteristics of each EJ populations as identified in the EJ Maps Viewer (i.e., the census block group identification number and EJ characteristics of "Minority," "Minority and Income," etc.). Provide a breakdown of those EJ populations within 1 mile of the project site, and those within 5 miles of the site.

Within the Designated Geographic Area ("DGA") ("1-mile"), NEP identified 19 Environmental Justice ("EJ") Populations across 13 municipalities in Hampshire, Worcester, and Franklin Counties. Of these, three meet the criteria of "Minority and Income," three meet "Minority," and thirteen meet "Income" criterion. Within a 5-mile radius of the Project, NEP identified 158 EJ Populations across eight municipalities spanning four counties. Of these, 59 meet "Minority and Income" criteria, 55 meet "Minority" criterion, and 30 meet "Income" criterion, with additional populations meeting combinations of criteria such as "Minority, income, and English isolation" and "Minority and English isolation." Refer to **Table 12** for specific census block group identification numbers and EJ characteristics, and **Attachment D: Environmental Justice**, for maps showing EJ block groups.

Table 12: Environmental Justice Population Characteristics Within 1 and 5 Miles from the E5/F6 Lines

Block Group	Census Tract	Municipality	Minority Population (%)	Median Household Income ($)	English Isolation (%)	EJ Criteria Met
Within 1 Mile						
4	401	Charlemont	9.7%	$53,229	0.0%	Income
2	408	Sunderland	23.1%	$47,614	5.7%	Income
3	408	Sunderland	29.2%	$95,230	6.6%	Minority
4	408	Sunderland	24.8%	$41,845	2.3%	Minority and income
3	415.02	Buckland	9.0%	$44,063	0.0%	Income
4	415.02	Shelburne	9.4%	$49,063	4.8%	Income
2	7231	Hardwick	12.3%	$39,205	0.0%	Income
3	7241	West Brookfield	10.8%	$36,913	0.0%	Income
3	7251	North Brookfield	11.9%	$51,053	0.0%	Income
3	7262	Spencer	20.8%	$37,448	0.0%	Income
4	7262	Spencer	17.3%	$28,977	0.0%	Income
3	7352	Leicester	26.5%	$97,821	0.0%	Minority
3	7365	Auburn	10.1%	$44,773	0.0%	Income
1	7372	Millbury	16.7%	$53,875	0.0%	Income
2	7372	Millbury	13.7%	$53,375	0.0%	Income
2	8201	Ware	13.9%	$41,731	0.0%	Income
3	8201	Ware	24.5%	$33,889	2.6%	Minority and income
1	8203	Amherst	28.5%	$118,250	1.6%	Minority
1	8207	Amherst	44.5%	$36,168	2.8%	Minority and income
Within 5 Miles						
1	407.01	Montague	18.4	$40,491	0.0%	Income
2	407.01	Montague	23.1	$25,339	1.5%	Income
4	407.01	Montague	15.7	$54,696	0.0%	Income
1	407.02	Montague	6.9	$40,000	1.9%	Income
1	411	Greenfield	8.7	$52,315	2.4%	Income
1	412	Greenfield	13.0	$54,432	0.0%	Income
3	412	Greenfield	12.1	$51,435	5.3%	Income
1	413.01	Greenfield	21.4	$40,204	3.9%	Income
2	413.01	Greenfield	20.4	$44,091	4.1%	Income
3	413.01	Greenfield	17.5	$43,472	0.0%	Income
1	413.02	Greenfield	14.5	$21,792	0.0%	Income
2	413.02	Greenfield	15.8	$41,146	2.5%	Income
1	414	Greenfield	39.9	$24,688	2.9%	Minority and income

Block Group	Census Tract	Municipality	Minority Population (%)	Median Household Income ($)	English Isolation (%)	EJ Criteria Met
2	414	Greenfield	24.8	$47,404	9.0%	Minority and income
2	7307	Worcester	32.3	$98,269	0.0%	Minority
3	7307	Worcester	34.1	$44,099	0.0%	Minority and income
4	7307	Worcester	36.8	$81,708	5.5%	Minority
2	7308.02	Worcester	29.3	$80,300	7.9%	Minority
2	7309.01	Worcester	28.9	$69,306	15.5%	Minority
1	7309.02	Worcester	26.4	$98,073	0.0%	Minority
2	7309.02	Worcester	35.9	$72,667	11.9%	Minority
3	7309.02	Worcester	24.6	$101,750	0.0%	Minority
1	7310.01	Worcester	48.9	$82,917	8.7%	Minority
1	7310.02	Worcester	47.9	$63,115	5.5%	Minority
2	7310.02	Worcester	57.9	$41,745	10.1%	Minority and income
3	7310.02	Worcester	50.9	$48,705	9.7%	Minority and income
4	7310.02	Worcester	60.5	$0	7.6%	Minority
1	7311.01	Worcester	67.9	$30,238	18.8%	Minority and income
2	7311.01	Worcester	62.1	$53,147	4.6%	Minority and income
3	7311.01	Worcester	33.8	$50,568	1.5%	Minority and income
4	7311.01	Worcester	66.3	$40,847	11.2%	Minority and income
1	7311.02	Worcester	26.4	$118,594	0.0%	Minority
2	7311.02	Worcester	50.7	$46,964	9.6%	Minority and income
3	7311.02	Worcester	36.2	$118,750	0.0%	Minority
1	7312.02	Worcester	27.6	$0	0.0%	Minority
1	7312.03	Worcester	73.7	$14,852	16.8%	Minority and income
2	7312.03	Worcester	59.5	$32,567	5.6%	Minority and income
3	7312.03	Worcester	67.4	$39,276	29.4%	Minority, income and English isolation
4	7312.03	Worcester	66.9	$41,058	0.0%	Minority and income
1	7312.04	Worcester	73.3	$44,784	10.6%	Minority and income
2	7312.04	Worcester	73.9	$31,406	10.1%	Minority and income
1	7313	Worcester	80.8	$16,719	12.1%	Minority and income
2	7313	Worcester	88.6	$37,548	42.6%	Minority, income and English isolation
3	7313	Worcester	78.0	$38,333	19.3%	Minority and income
1	7314	Worcester	84.9	$14,744	25.5%	Minority, income and English isolation
2	7314	Worcester	79.1	$22,778	30.7%	Minority, income and English isolation
3	7314	Worcester	74.8	$47,419	17.2%	Minority and income

Block Group	Census Tract	Municipality	Minority Population (%)	Median Household Income ($)	English Isolation (%)	EJ Criteria Met
4	7314	Worcester	85.4	$46,908	0.0%	Minority and income
5	7314	Worcester	77.7	$27,981	0.0%	Minority and income
1	7315	Worcester	84.3	$16,319	19.4%	Minority and income
2	7315	Worcester	68.9	$14,179	18.1%	Minority and income
3	7315	Worcester	79.9	$39,240	4.2%	Minority and income
4	7315	Worcester	84.9	$0	9.9%	Minority
5	7315	Worcester	62.6	$0	14.9%	Minority
1	7316.01	Worcester	48.4	$17,012	9.9%	Minority and income
2	7316.01	Worcester	65.8	$41,481	7.1%	Minority and income
3	7316.01	Worcester	48.1	$40,984	23.2%	Minority and income
4	7316.01	Worcester	35.1	$25,772	0.0%	Minority and income
2	7316.02	Worcester	34.4	$25,921	25.2%	Minority, income and English isolation
1	7317	Worcester	49.4	$32,813	20.8%	Minority and income
2	7317	Worcester	46.1	$34,856	11.6%	Minority and income
3	7317	Worcester	61.0	$40,993	9.1%	Minority and income
2	7318.01	Worcester	50.4	$15,176	29.2%	Minority, income and English isolation
1	7318.02	Worcester	60.9	$43,583	23.2%	Minority and income
2	7318.02	Worcester	91.9	$11,543	33.9%	Minority, income and English isolation
4	7318.02	Worcester	69.2	$33,203	51.1%	Minority, income and English isolation
2	7322.01	Worcester	47.6	$76,250	12.2%	Minority
1	7322.02	Worcester	41.9	$51,163	23.5%	Minority and income
2	7322.02	Worcester	38.9	$92,344	9.1%	Minority
1	7322.03	Worcester	56.7	$75,401	25.9%	Minority and English isolation
2	7322.03	Worcester	51.8	$68,902	33.4%	Minority and English isolation
3	7322.03	Worcester	68.8	$39,732	14.6%	Minority and income
1	7323.01	Worcester	42.7	$61,607	4.6%	Minority
2	7323.01	Worcester	35.1	$68,795	4.7%	Minority
1	7323.02	Worcester	56.1	$39,207	14.8%	Minority and income
2	7323.02	Worcester	46.0	$77,561	21.7%	Minority
1	7324	Worcester	64.5	$60,851	4.3%	Minority
2	7324	Worcester	64.7	$66,250	14.1%	Minority
3	7324	Worcester	76.3	$37,964	29.2%	Minority, income and English isolation
4	7324	Worcester	75.7	$52,621	14.8%	Minority and income
5	7324	Worcester	82.5	$31,406	34.6%	Minority, income and English isolation

Block Group	Census Tract	Municipality	Minority Population (%)	Median Household Income ($)	English Isolation (%)	EJ Criteria Met
6	7324	Worcester	73.0	$35,217	8.7%	Minority and income
1	7325	Worcester	60.4	$29,886	8.7%	Minority and income
2	7325	Worcester	75.3	$32,845	10.9%	Minority and income
1	7326	Worcester	72.9	$22,578	33.5%	Minority, income and English isolation
2	7326	Worcester	71.4	$51,458	19.1%	Minority and income
3	7326	Worcester	60.7	$58,958	0.0%	Minority
4	7326	Worcester	64.1	$60,047	2.6%	Minority
5	7326	Worcester	71.9	$37,839	43.5%	Minority, income and English isolation
1	7327	Worcester	60.8	$24,044	14.8%	Minority and income
2	7327	Worcester	68.4	$53,750	3.0%	Minority and income
3	7327	Worcester	68.0	$47,788	9.4%	Minority and income
4	7327	Worcester	67.5	$28,997	0.0%	Minority and income
1	7328.01	Worcester	32.9	$77,821	1.7%	Minority
2	7328.01	Worcester	42.8	$70,766	5.4%	Minority
1	7328.02	Worcester	41.8	$63,676	10.4%	Minority
2	7328.02	Worcester	57.4	$73,250	8.7%	Minority
3	7328.02	Worcester	64.5	$0	13.1%	Minority
1	7329.01	Worcester	51.4	$32,768	8.8%	Minority and income
2	7329.01	Worcester	51.8	$63,737	7.6%	Minority
3	7329.01	Worcester	54.5	$71,458	14.7%	Minority
4	7329.01	Worcester	39.5	$64,798	5.4%	Minority
5	7329.01	Worcester	59.0	$12,080	17.7%	Minority and income
1	7329.02	Worcester	31.1	$0	0.0%	Minority
1	7330	Worcester	77.9	$41,667	0.0%	Minority and income
2	7330	Worcester	64.7	$41,369	6.7%	Minority and income
3	7330	Worcester	81.2	$33,799	14.5%	Minority and income
1	7331.01	Worcester	46.5	$57,500	6.5%	Minority
2	7331.01	Worcester	37.3	$66,369	0.0%	Minority
1	7331.02	Worcester	57.3	$43,696	8.3%	Minority and income
2	7331.02	Worcester	41.9	$74,712	7.6%	Minority
1	7352	Leicester	26.0	$103,021	0.0%	Minority
2	7381	Grafton	28.0	$67,273	0.0%	Minority
3	7381	Grafton	35.8	$127,619	0.0%	Minority
2	7391.01	Shrewsbury	32.1	$72,425	0.0%	Minority

Block Group	Census Tract	Municipality	Minority Population (%)	Median Household Income ($)	English Isolation (%)	EJ Criteria Met
3	7391.01	Shrewsbury	44.4	$131,200	2.8%	Minority
1	7391.02	Shrewsbury	57.2	$148,523	0.0%	Minority
2	7391.02	Shrewsbury	58.2	$100,313	11.8%	Minority
1	7601	Brookfield	7.4	$34,779	0.0%	Income
1	7611	Warren	10.5	$50,128	0.0%	Income
3	7611	Warren	12.8	$48,711	0.0%	Income
2	8102	Palmer	10.2	$47,163	2.3%	Income
3	8201.01	Ware	13.9	$41,731	0.0%	Income
2	8203	Amherst	51.4	$37,500	5.7%	Minority and income
3	8203	Amherst	58.4	$67,778	3.9%	Minority
4	8203	Amherst	33.4	$75,882	3.8%	Minority
5	8203	Amherst	45.1	$61,429	4.9%	Minority
1	8204	Amherst	39.5	$2,500	0.0%	Minority and income
1	8205	Amherst	28.9	$54,609	0.0%	Minority and income
2	8205	Amherst	24.8	$106,190	5.0%	Minority
3	8205	Amherst	36.9	$22,936	0.0%	Minority and income
4	8205	Amherst	25.9	$16,226	0.0%	Minority and income
5	8205	Amherst	30.7	$74,018	1.2%	Minority
6	8205	Amherst	41.9	$40,956	2.3%	Minority and income
1	8206	Amherst	52.4	$0	0.0%	Minority
2	8207	Amherst	40.0	$62,321	9.1%	Minority
3	8207	Amherst	27.7	$140,000	3.6%	Minority
3	8208.01	Amherst	60.3	$47,435	5.6%	Minority and income
4	8208.01	Amherst	40.5	$89,712	14.7%	Minority

Source: Executive Office of Energy and Environmental Affairs (“EEA”) Geographic Information Systems (“MassGIS”), Massachusetts 2020 Environmental Justice Populations. Updated November 12, 2022.

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B. Identify all languages identified in the "Languages Spoken in Massachusetts" tab of the EJ Maps Viewer as spoken by 5 percent or more of the EJ population who also identify as not speaking English "very well." The languages should be identified for each census tract located in whole or in part within 1 mile and 5 miles of the project site, regardless of whether such census tract contains any designated EJ populations.

There are no census tracts with languages spoken by 5 percent or more of the population who also identify as not speaking English "very well" or "at all" within the 1-mile DGA of the Project ROW. **Table 13** below shows languages spoken by at least 5 percent of the census Tract population within 5 miles of the Project ROW.

Table 13: Languages Spoken By At Least 5 Percent Of The Census Tract Population

Census Tract	Municipality	Language Spoken (%)
7327	Worcester	Spanish or Spanish Creole: 7.5%
7311.02	Worcester	Spanish or Spanish Creole: 6.3%, Other IndoEuropean language: 11.6%
7316	Worcester	Chinese: 6%
7323.02	Worcester	Spanish or Spanish Creole: 6.9%
7324	Worcester	Spanish or Spanish Creole: 11.2%
7310.02	Worcester	Spanish or Spanish Creole: 4.5%, Vietnamese: 7.8%
7317	Worcester	Spanish or Spanish Creole: 9.1%
7330	Worcester	Spanish or Spanish Creole: 17.4%, Vietnamese: 5.5%
7310.01	Worcester	Spanish or Spanish Creole: 8.8%, Other IndoEuropean language: 8.3%
7312.03	Worcester	Spanish or Spanish Creole: 16.6%, Vietnamese: 6.1%
7313	Worcester	Spanish or Spanish Creole: 23.4%, Vietnamese: 8.5%
7314	Worcester	Spanish or Spanish Creole: 24.2%, Other Indic language: 6.5%
8208.01	Amherst	Chinese: 7.8%
7322.03	Worcester	Spanish or Spanish Creole: 7.5%, Vietnamese: 4.5%, Other Asian language: 4.8%
7325	Worcester	Spanish or Spanish Creole: 18.5%
7331.01	Worcester	Spanish or Spanish Creole: 5%, Vietnamese: 7%
7315	Worcester	Spanish or Spanish Creole: 31.3%
7331.02	Worcester	Spanish or Spanish Creole: 8.5%, Vietnamese: 7.1%
7311.01	Worcester	Spanish or Spanish Creole: 8.4%
7318	Worcester	Spanish or Spanish Creole: 15.9%
7326	Worcester	Spanish or Spanish Creole: 11.5%
7312.04	Worcester	Spanish or Spanish Creole: 21.5%, Vietnamese: 8.3%

Source: Executive Office of Energy and Environmental Affairs ("EEA") Geographic Information Systems ("MassGIS"), Massachusetts 2020 Environmental Justice Populations. Updated November 12, 2022.

C. If the list of languages identified under Section I.B. has been modified with approval of the EEA EJ Director, provide a list of approved languages that the project will use to provide public involvement opportunities during the course of MEPA review. If the list has been expanded by the Proponent (without input from the EEA EJ Director), provide a list of the additional languages that will be used to provide public involvement opportunities during the course of MEPA review as required by Part II of the MEPA Public Involvement Protocol for Environmental Justice Populations ("MEPA EJ Public Involvement Protocol"). If the project is exempt from Part II of the protocol, please specify.

Not Applicable

II. Potential Effects on EJ Populations

A. If an EJ population has been identified using the EJ Maps Viewer within 1 mile of the project site, describe the likely effects of the project (both adverse and beneficial) on the identified EJ population(s).

The Project will occur within the existing ROW, thereby minimizing adverse environmental impacts. Due to the nature of the Project, outage constraints in the region, and NEP's efforts to reduce impacts to the natural and human environment, Project activities will be sequenced in both the mainline and Tap Lines. No long-term impacts on soil, bedrock, vegetation, surface water, groundwater, wetland resources or air quality will occur.

The Project is anticipated to have temporary and short-term impacts on the air quality, water quality, land protection and open space, noise, and traffic related to construction; however, following implementation of BMPs, there are no anticipated adverse effects on the identified EJ populations.

B. If an EJ population has been identified using the EJ Maps Viewer within 5 miles of the project site, will the project: (i) meet or exceed MEPA review thresholds under 301 CMR 11.03(8)(a)-(b) __ Yes X No; **or (ii) generate 150 or more new average daily trips (adt) of diesel vehicle traffic, excluding public transit trips, over a duration of 1 year or more.** ___ Yes X No

C. If you answered "Yes" to either question in Section II.B., describe the likely effects of the project (both adverse and beneficial) on the identified EJ population(s).

Not Applicable.

III. Public Involvement Activities

A. Provide a description of activities conducted prior to filing to promote public involvement by EJ populations, in accordance with Part II of the MEPA EJ Public Involvement Protocol. In particular:

1. If advance notification was provided under Part II.A., attach a copy of the Environmental Justice Screening Form and provide list of CBOs/tribes contacted (with dates). Copies of email correspondence can be attached in lieu of a separate list.

Refer to **Attachment D: Environmental Justice**

2. State how CBOs and tribes were informed of ways to request a community meeting, and if any meeting was requested. If public meetings were held, describe any issues of concern that were raised at such meetings, and any steps taken (including modifications to the project design) to address such concerns.

All contacts on the EJ Reference List were provided Advanced Notification of the Project via the EJ Screening Form, which contained information on how to request a meeting or additional Project materials. The EJ Reference List and municipality administrators were also notified by email of a virtual community meeting held on December 19th, and the community was notified via meeting advertisements in three newspapers: the Worcester Telegram and Gazette, the Greenfield Reporter, and the Republican.

3. If the project is exempt from Part II of the protocol, please specify.

N/A

B. Provide below (or attach) a distribution list (if different from the list in Section III.A. above) of CBOs and tribes, or other individuals or entities the Proponent intends to maintain for the notice of the MEPA Site Visit and circulation of other materials and notices during MEPA review.

Refer to **Attachment B: ENF Distribution List**

C. Describe (or submit as a separate document) the Proponent's plan to maintain the same level of community engagement throughout the MEPA review process, as conducted prior to filing.

NEP will maintain the distribution list of contacts from the EJ Reference List and any additional contacts that are identified during the virtual meetings and public engagement process. Contacts will receive notifications of the MEPA site visit, summaries of supplemental information submitted to the MEPA office and any other relevant notices or materials issued during the course of the MEPA review. NEP will continue to host a Project website. A Project video will be created and made available on the Project website post-ENF filing.

CERTIFICATIONS:

1. **The Public Notice of Environmental Review has been/will be published in the following newspapers in accordance with 301 CMR 11.15(1):**

Worcester Telegram and Gazette	**12/16/2024**
Greenfield Recorder	**12/16/2024**
The Republican	**12/16/2024**

2. **This form has been circulated to Agencies and Persons in accordance with 301 CMR 11.16(2).**

Signatures:





Date Signature of Responsible Officer or Proponent	**Date Signature of person preparing ENF (if different from above)**
Mike Tyrrell	**Priyanka Shrestha**
Name (print or type)	**Name (print or type)**
New England Power Company (NEP)	**BSC Group Inc.**
Firm/Agency	**Firm/Agency**
170 Data Drive	**1 Mercantile Street**
Street	**Street**
Waltham, MA, 02451	**Worcester/MA/01608**
Municipality/State/Zip	**Municipality/State/Zip**
603-801-4140	**617-896-4570**
Phone	**Phone**

Appendix A - Figures

Environmental Notification Form (ENF)

Central To Western Massachusetts Energy Improvement Project

Figure 1 – Locus map

Figure 2 – MEPA ER Map

Figure 3 – Water Supply Protection Areas

Figure 4 – Cross Section

Appendix A – Figures
Figure 1 USGS Site Location Map

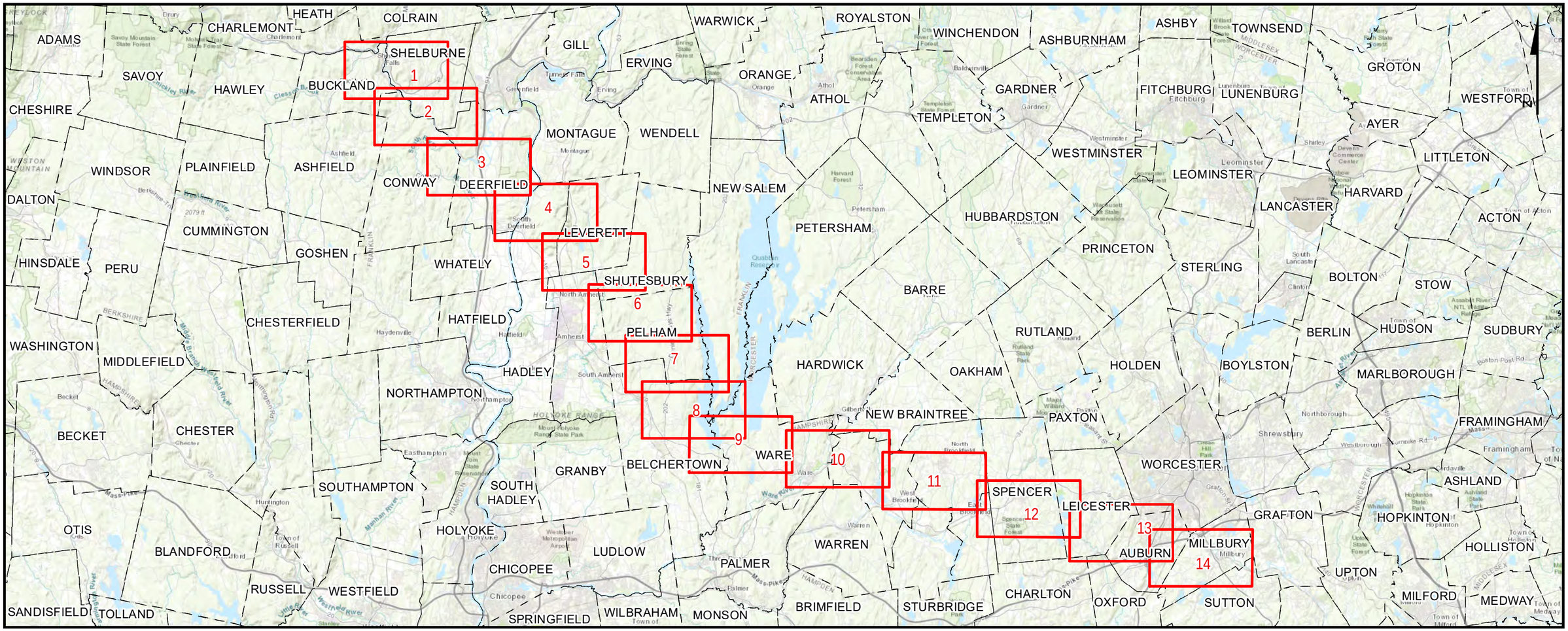
BSC Project Number: 100181.00

Central to Western Massachusetts Energy Improvement Project

USGS Site Location Map

Shelburne, Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn & Millbury, MA

December 18, 2024



PREPARED FOR:

nationalgrid

170 Data Drive
Waltham, MA 02451

INDEX OF FIGURES

T1 - TITLE SHEET
1 - 14 - MAP SHEETS

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PREPARED BY:

BSC GROUP

1 Mercantile Street Suite 601
Worcester, MA 01608

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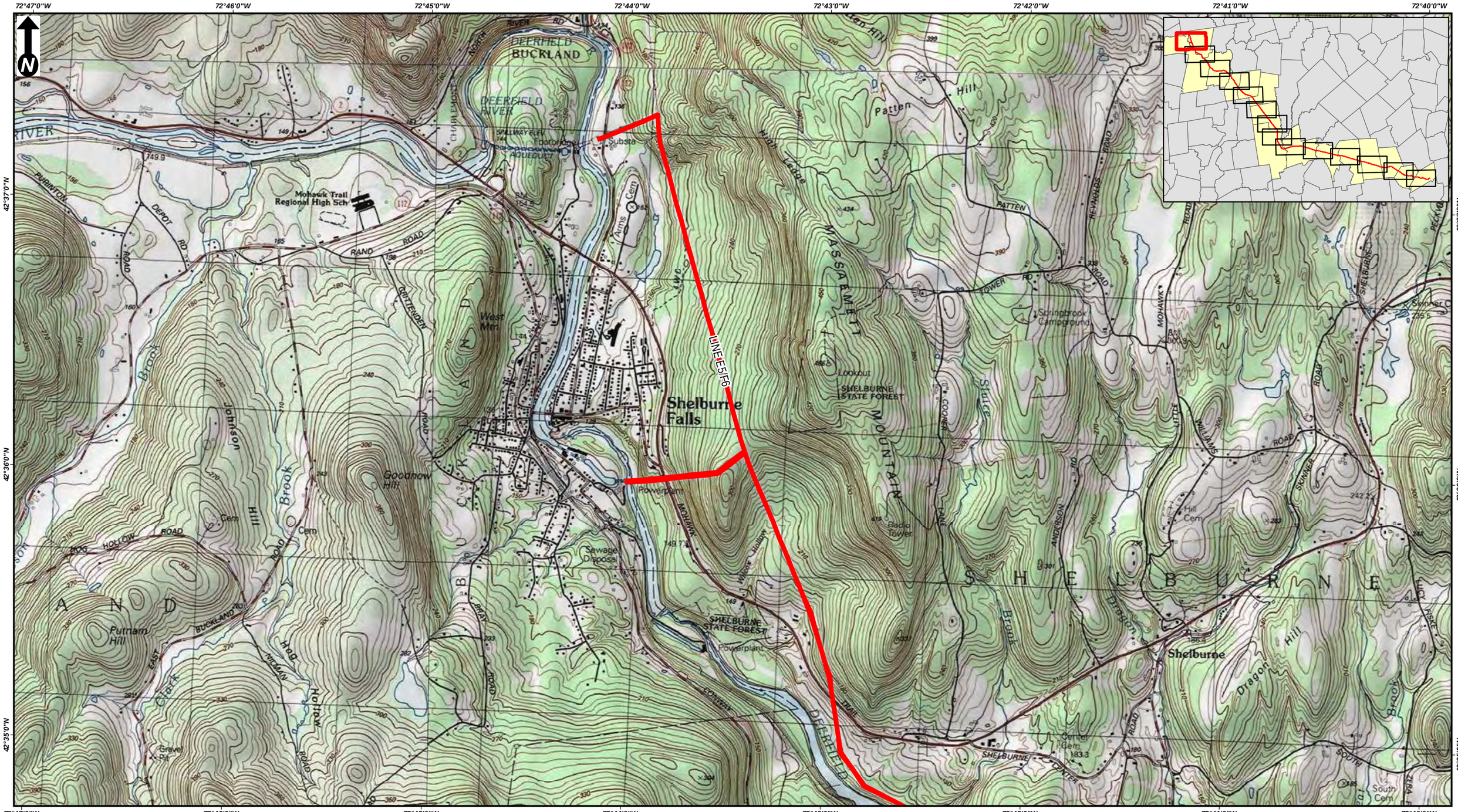

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT
USGS Site Location Map
Shelburne, MA
Page 1 of 14

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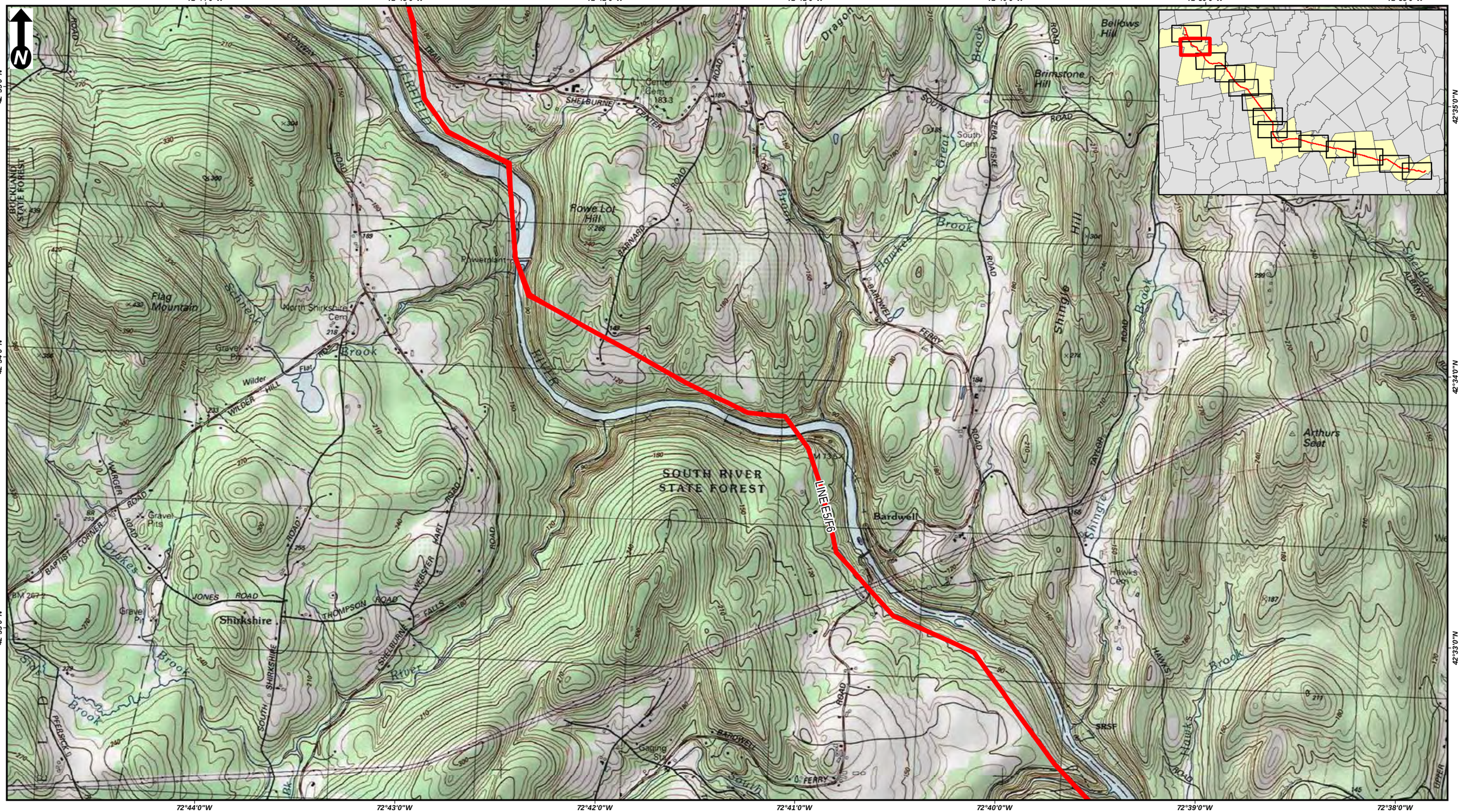

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT
USGS Site Location Map
Shelburne & Conway, MA
Page 2 of 14

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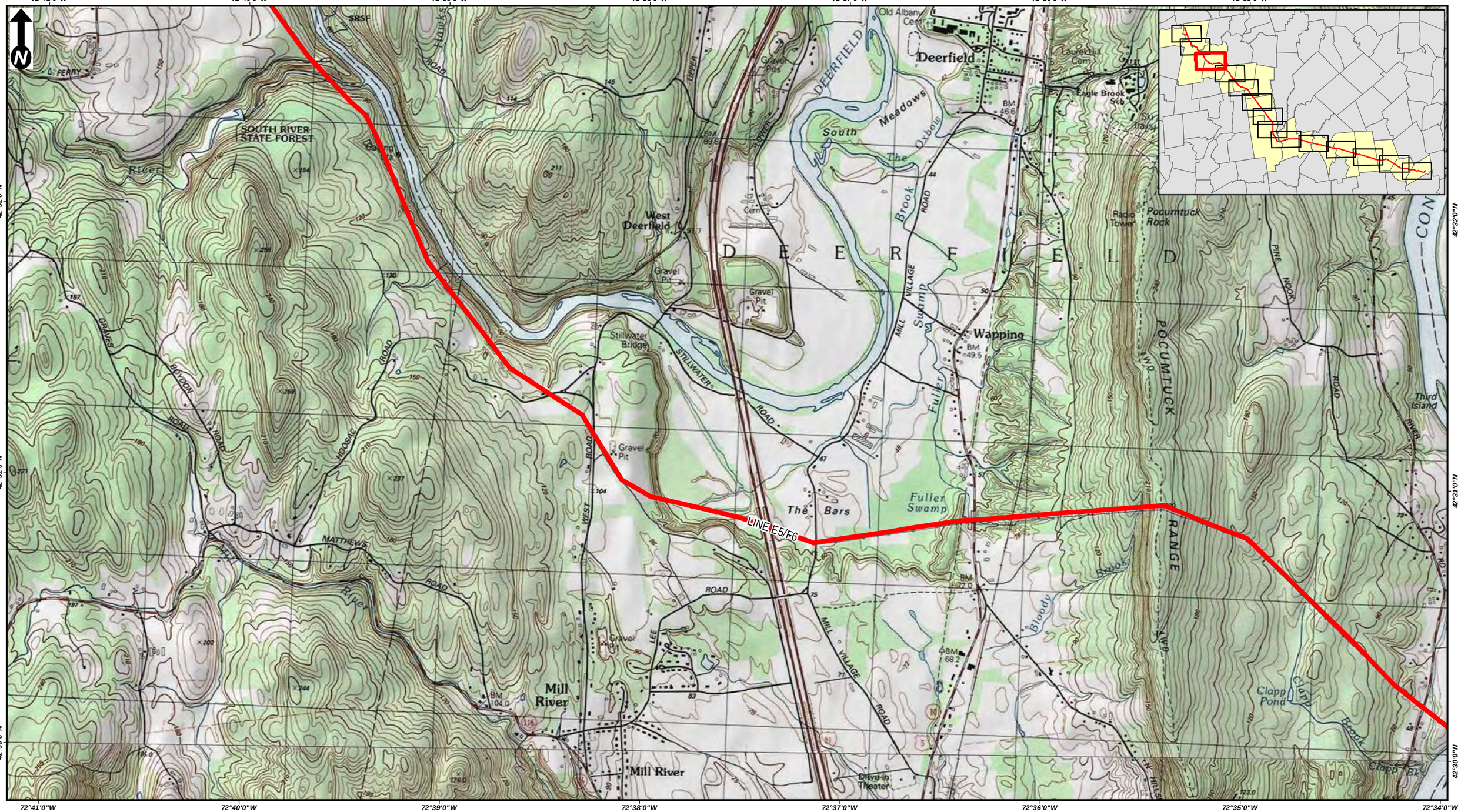

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT
USGS Site Location Map
Conway & Deerfield, MA
Page 3 of 14

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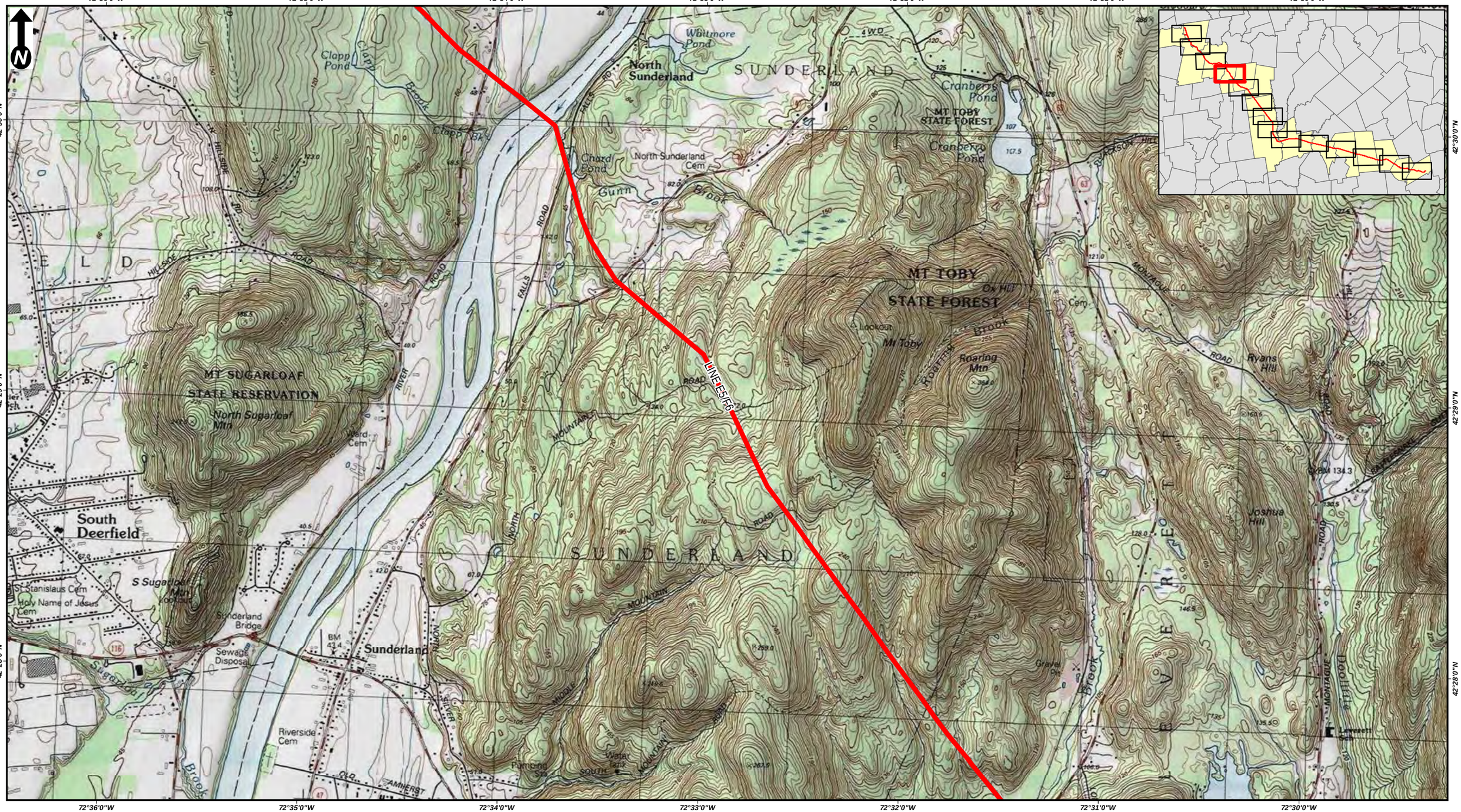

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT
USGS Site Location Map
Deerfield, Sunderland, & Leverett, MA
Page 4 of 14

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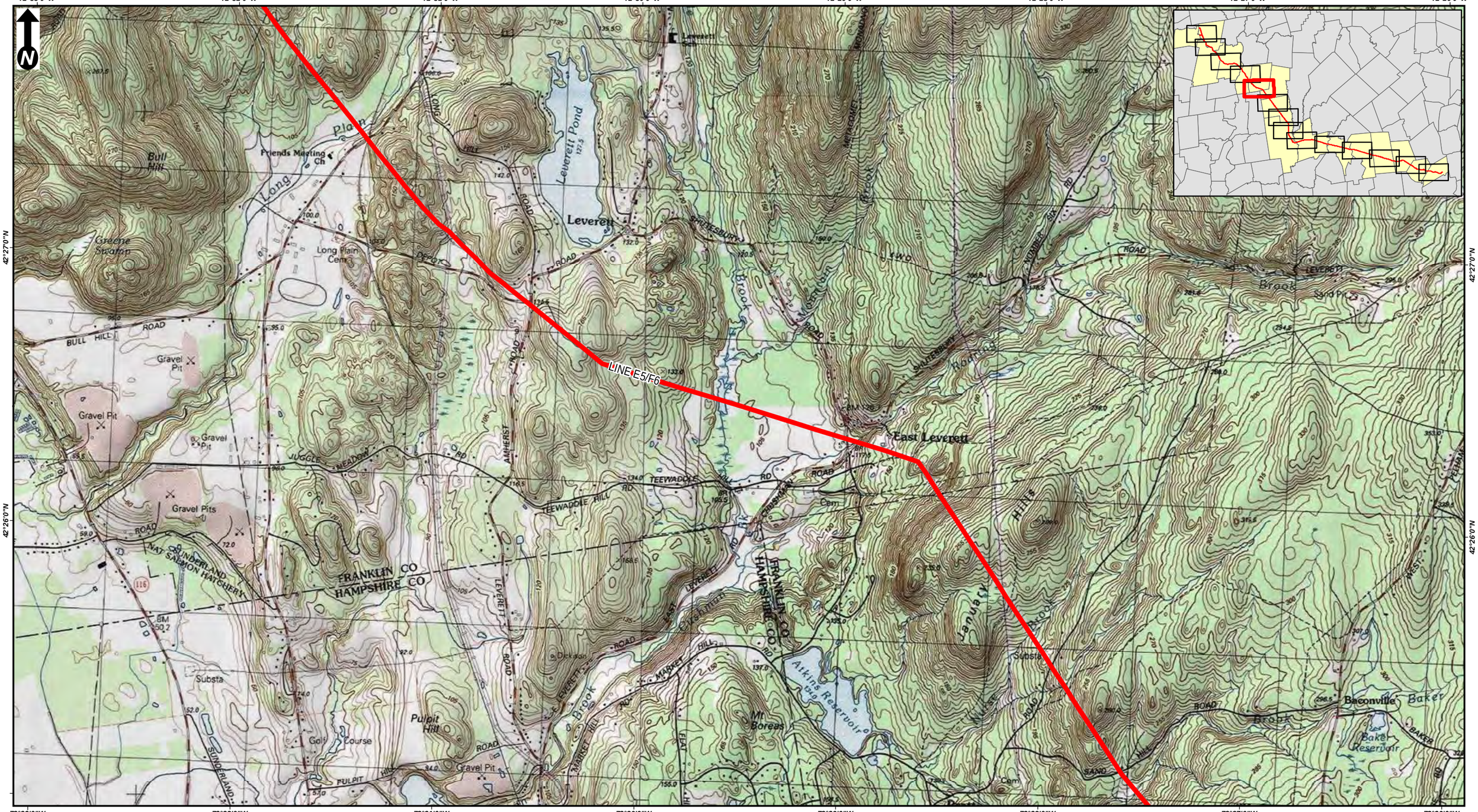

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42°25'0"N

42°24'0"N

42°23'0"N

LINE E5/F6

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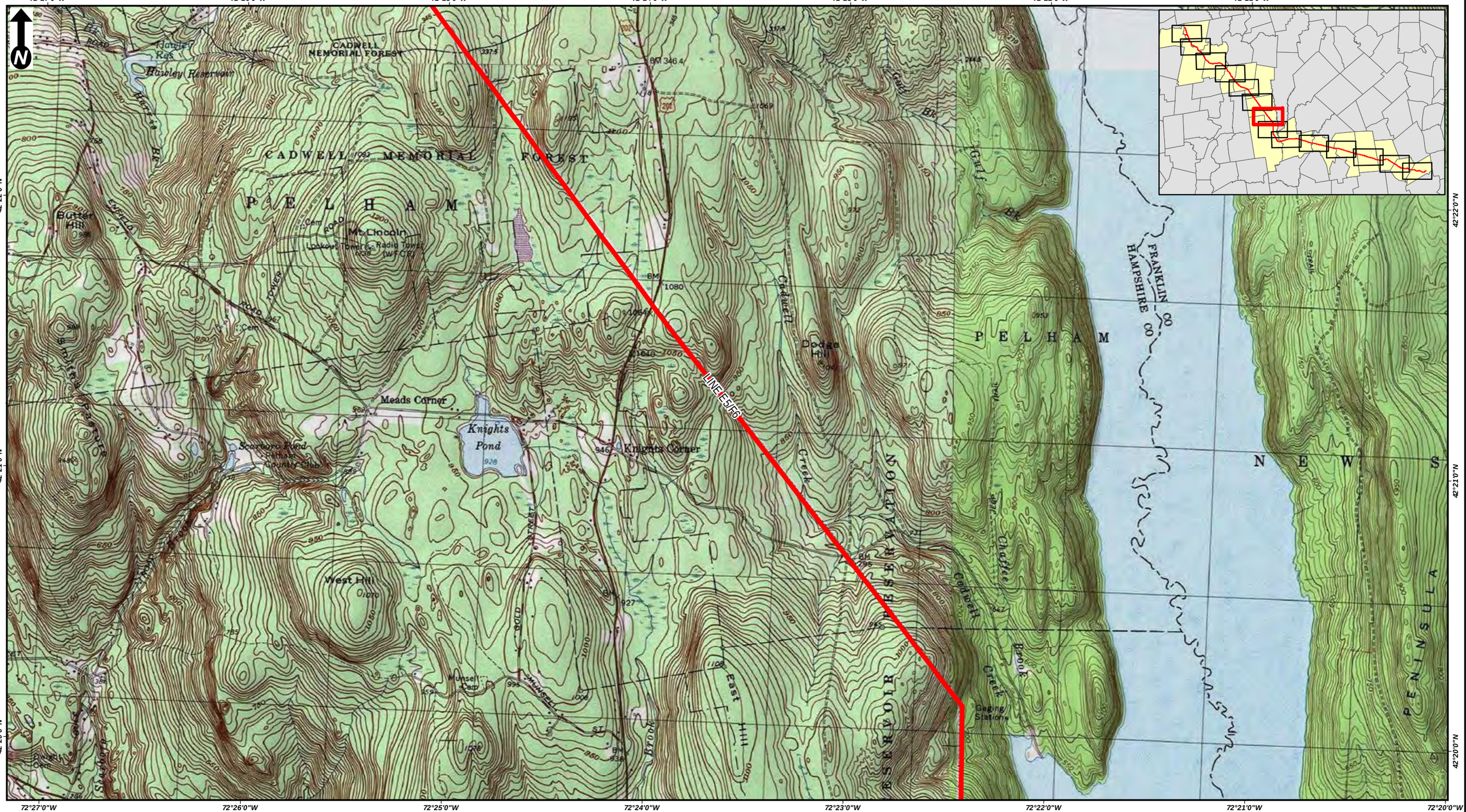
42°20'0"N



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USGS Site Location Map
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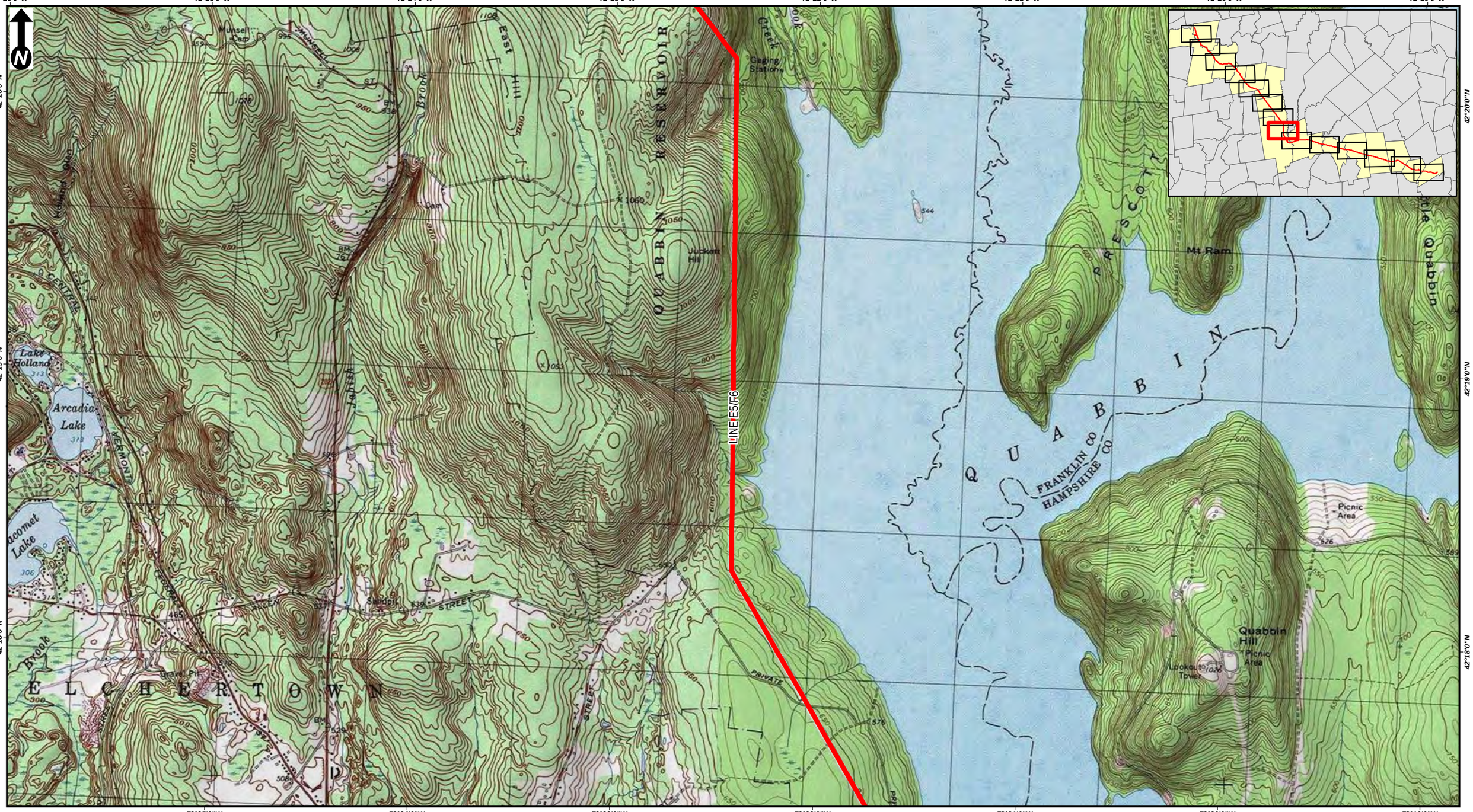

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT
USGS Site Location Map
Belchertown, MA
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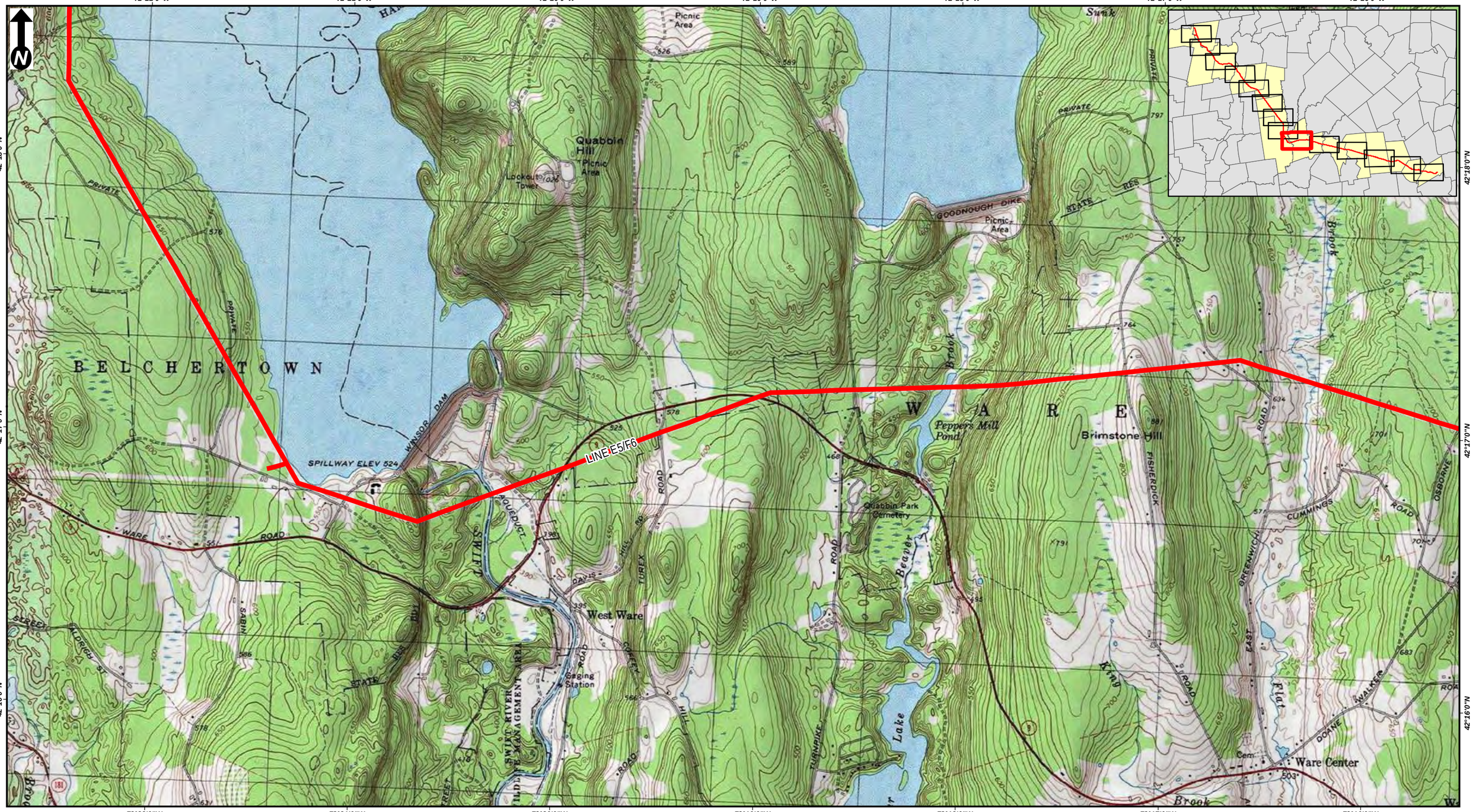

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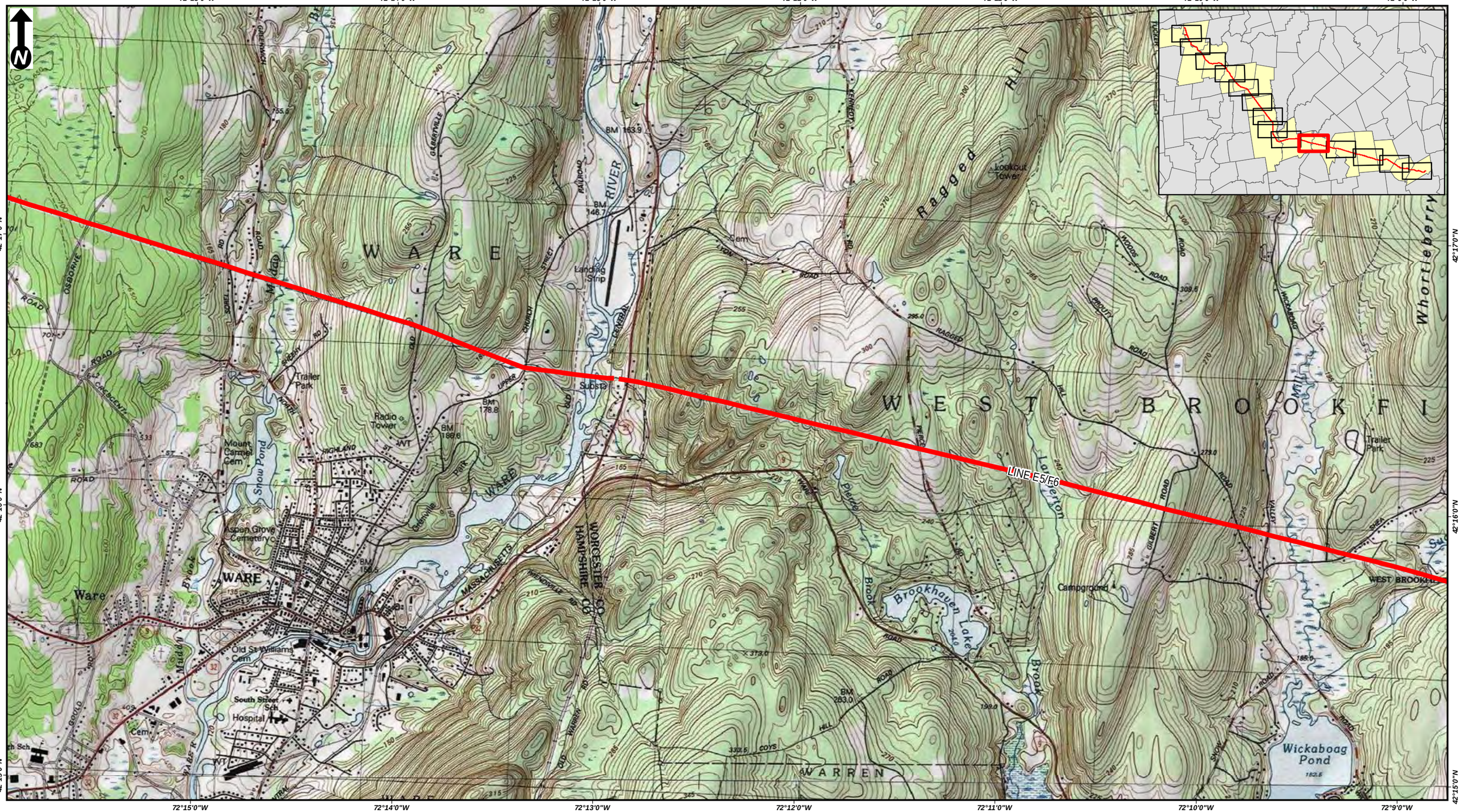

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT
USGS Site Location Map
Ware & West Brookfield, MA
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42°14'0"N

LINE E5/F6

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT
USGS Site Location Map
West Brookfield, North Brookfield, & East Brookfie
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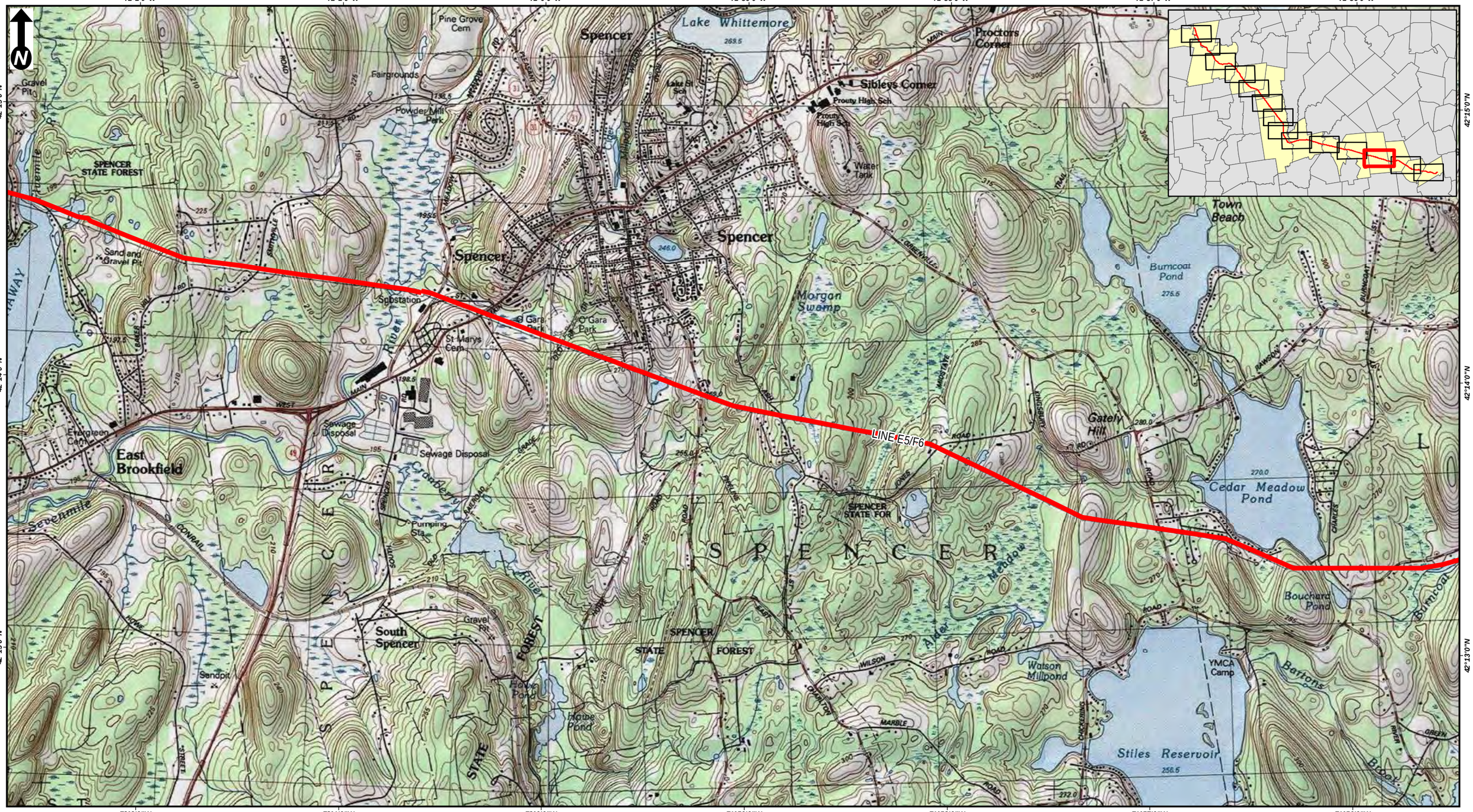

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT
USGS Site Location Map
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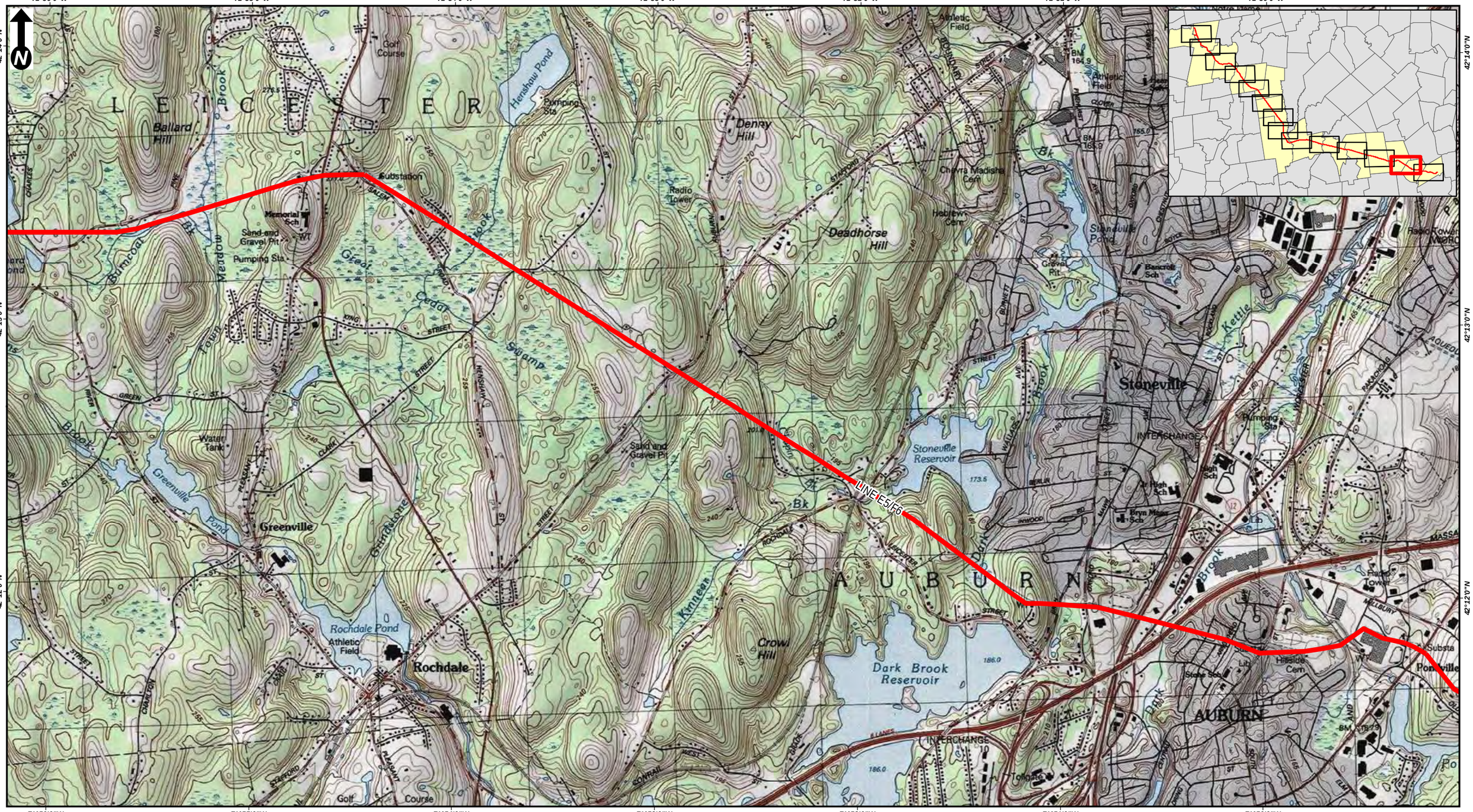

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT
USGS Site Location Map
Leicester & Auburn, MA
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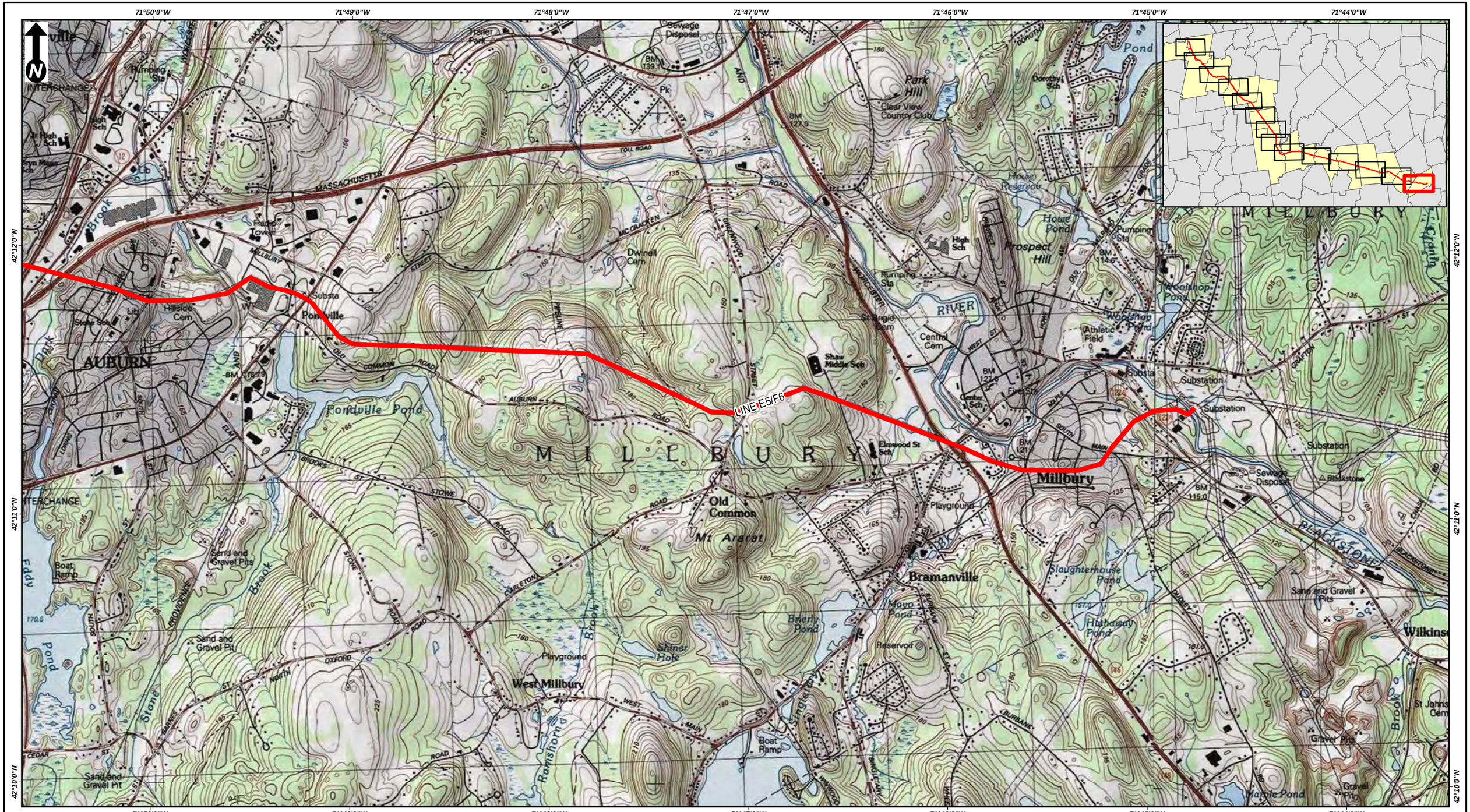

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT
USGS Site Location Map
Auburn & Millbury, MA
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Appendix A – Figures and Plans
Figure 2 MEPA ER Map

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BSC Project Number: 100181.00

Central to Western Massachusetts Energy Improvement Project

Shelburne, Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn & Millbury, MA

MEPA General Purpose Plans - 75% Design

December 20, 2024



PREPARED FOR:

nationalgrid

170 Data Drive
Waltham, MA 02451

INDEX OF FIGURES

T1 - TITLE SHEET
1 - 240 - MAP SHEETS
5A - 231A - OFF ROW ACCESS SHEETS

ISSUED FOR PERMITTING
NOT CONSTRUCTION

PREPARED BY:

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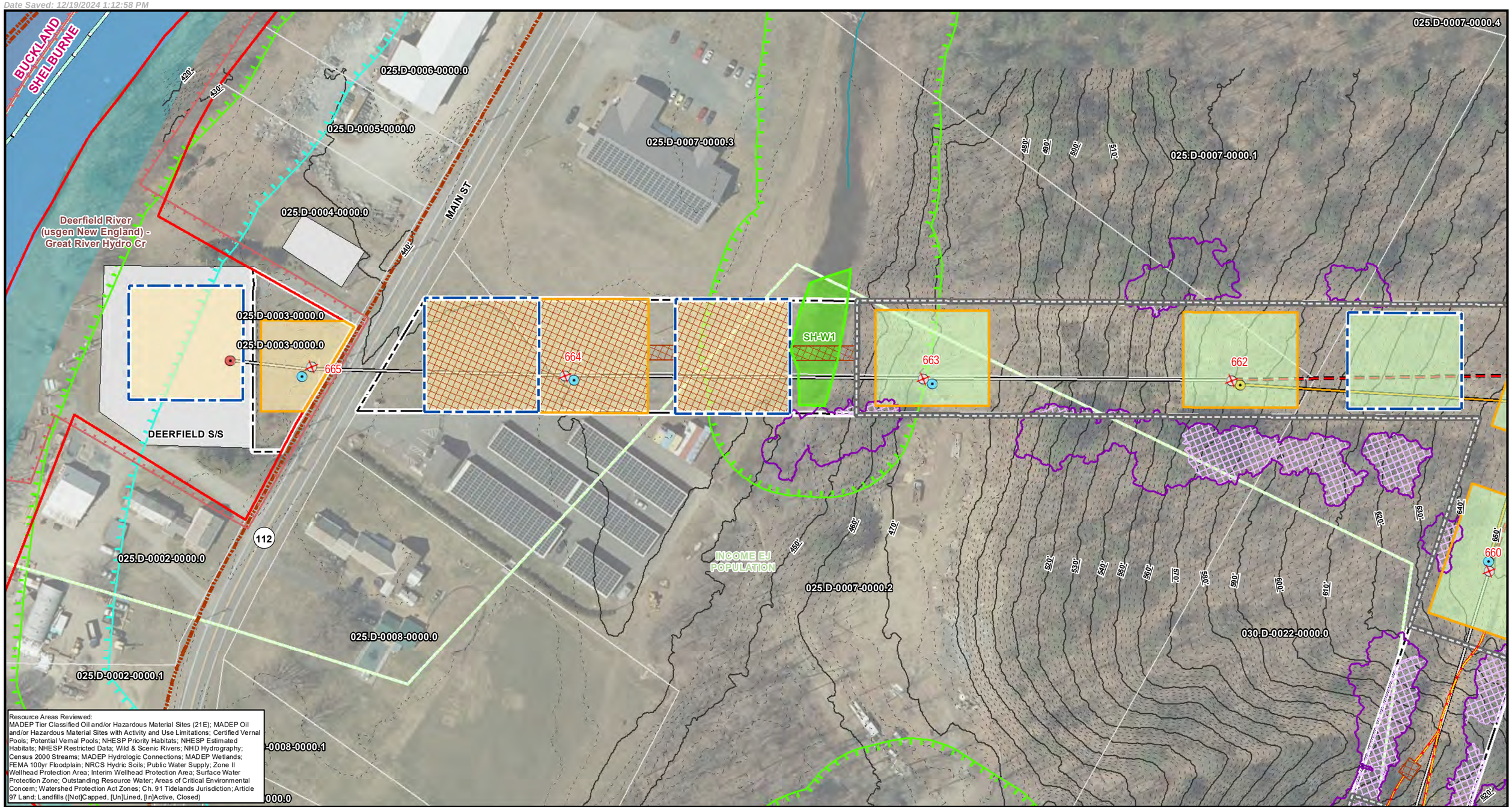
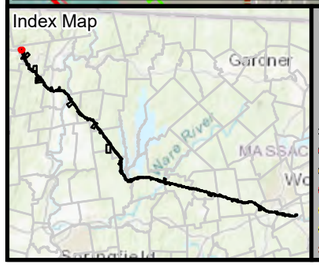
1 Mercantile Street Suite 601
Worcester, MA 01608



Resource Areas Reviewed:
MADEP Tier Classified Oil and/or Hazardous Material Sites (21E); MADEP Oil and/or Hazardous Material Sites with Activity and Use Limitations; Certified Vernal Pools; Potential Vernal Pools; NHESP Priority Habitats; NHESP Estimated Habitats; NHESP Restricted Data; Wild & Scenic Rivers; NHD Hydrography; Census 2000 Streams; MADEP Hydrologic Connections; MADEP Wetlands; FEMA 100yr Floodplain; NRCS Hydric Soils; Public Water Supply; Zone II Wellhead Protection Area; Interim Wellhead Protection Area; Surface Water Protection Zone; Outstanding Resource Water; Areas of Critical Environmental Concern; Watershed Protection Act Zones; Ch. 91 Tidelands Jurisdiction; Article 97 Land; Landfills ([Not]Capped, [Un]Lined, [In]Active, Closed)

Index Map



Legend

*Indicates Layers Set to Transparency

- Existing Structure
- Install Structure (Concrete Caisson)
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- Install Structure (Foundation TBD)
- Remove Structure
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- Type S Access
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- Work Envelope
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- Pull Pad
- Specialized Equipment Required
- Edge of ROW
- National Grid Owned Property
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- Field Delineated Wetlands*
- Field Delineated Vernal Pool*
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- Stonewall
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- Selective Tree Removal
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- Town Boundary
- Parcel Boundaries

Article 97 Lands
- Private

Environmental Justice Populations 2020
- Income

N

1 inch = 100 feet
0 50 100
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Shelburne, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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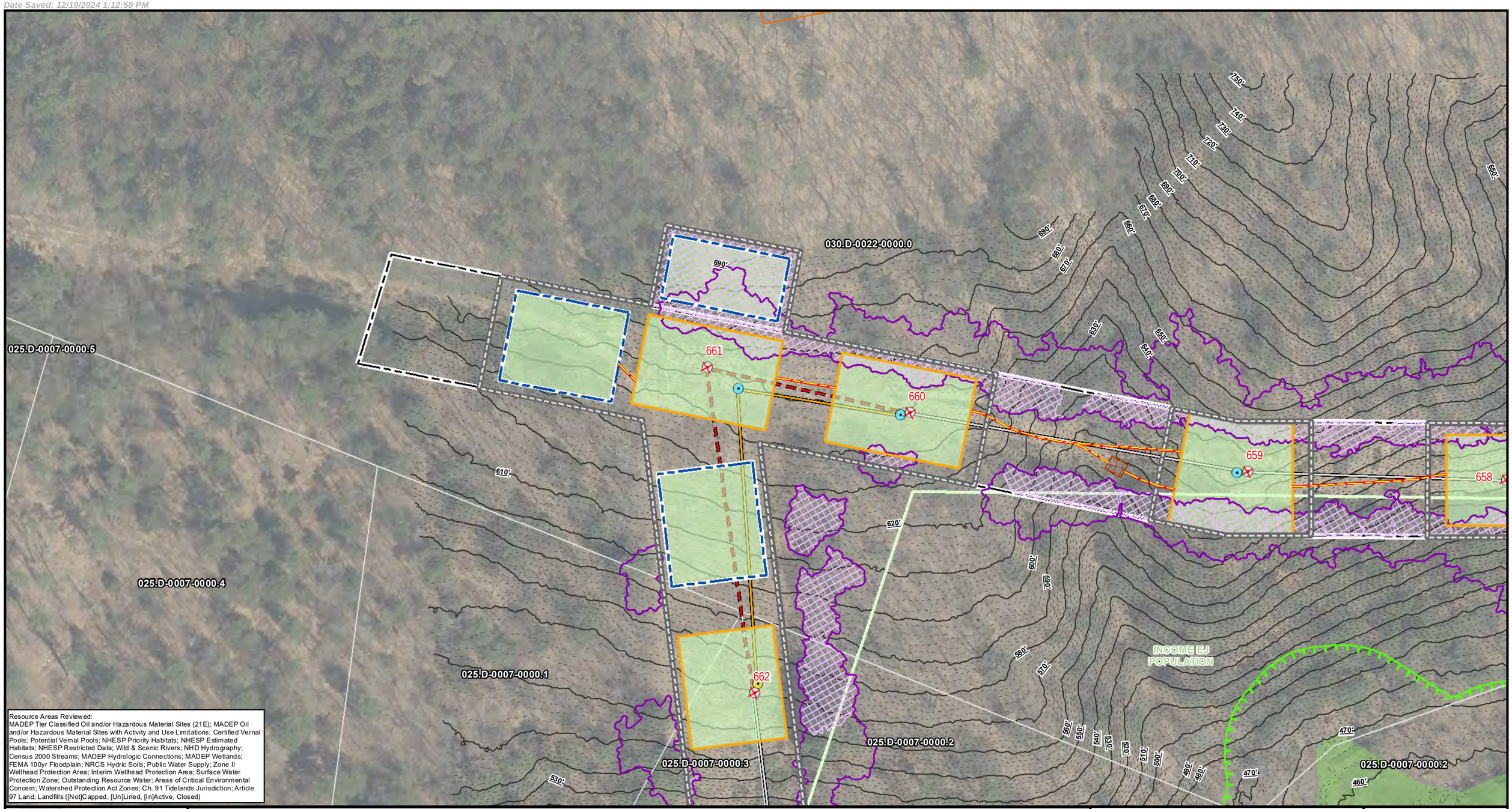

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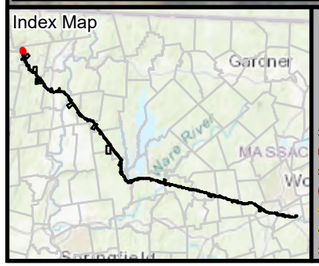

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SH-W1

SH-W2

SH-W3

SH-W4

SH-S2

SPAN STREAM

SPAN STREAM

INCOME EJ POPULATION

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Index Map

Gardner

Springfield

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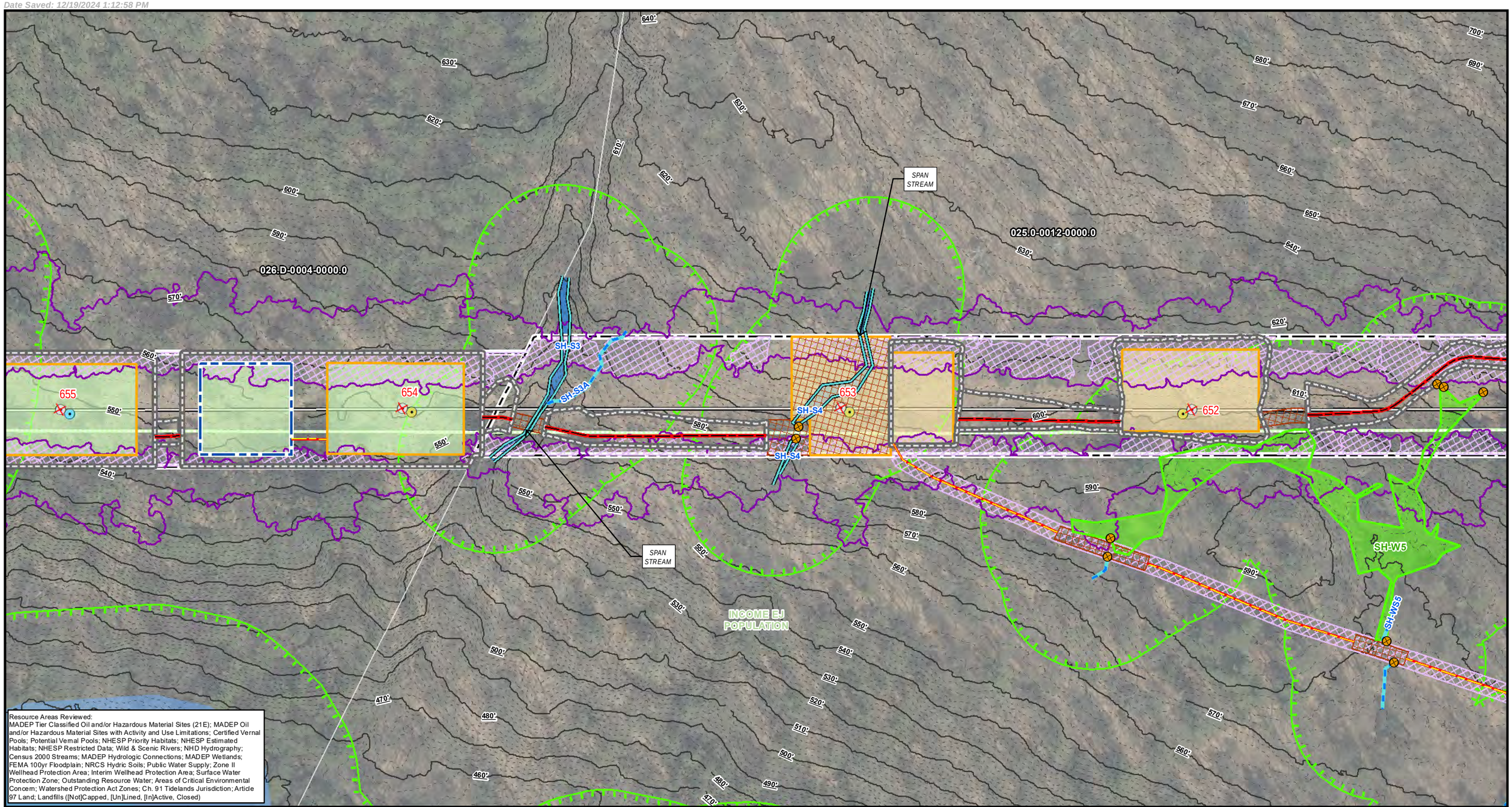

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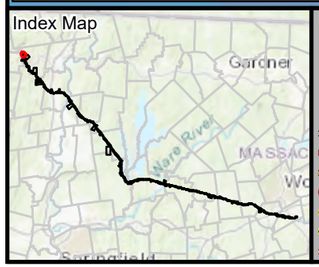

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Shelburne, MA

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SH-S5
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Shelburne, MA

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Shelburne, MA
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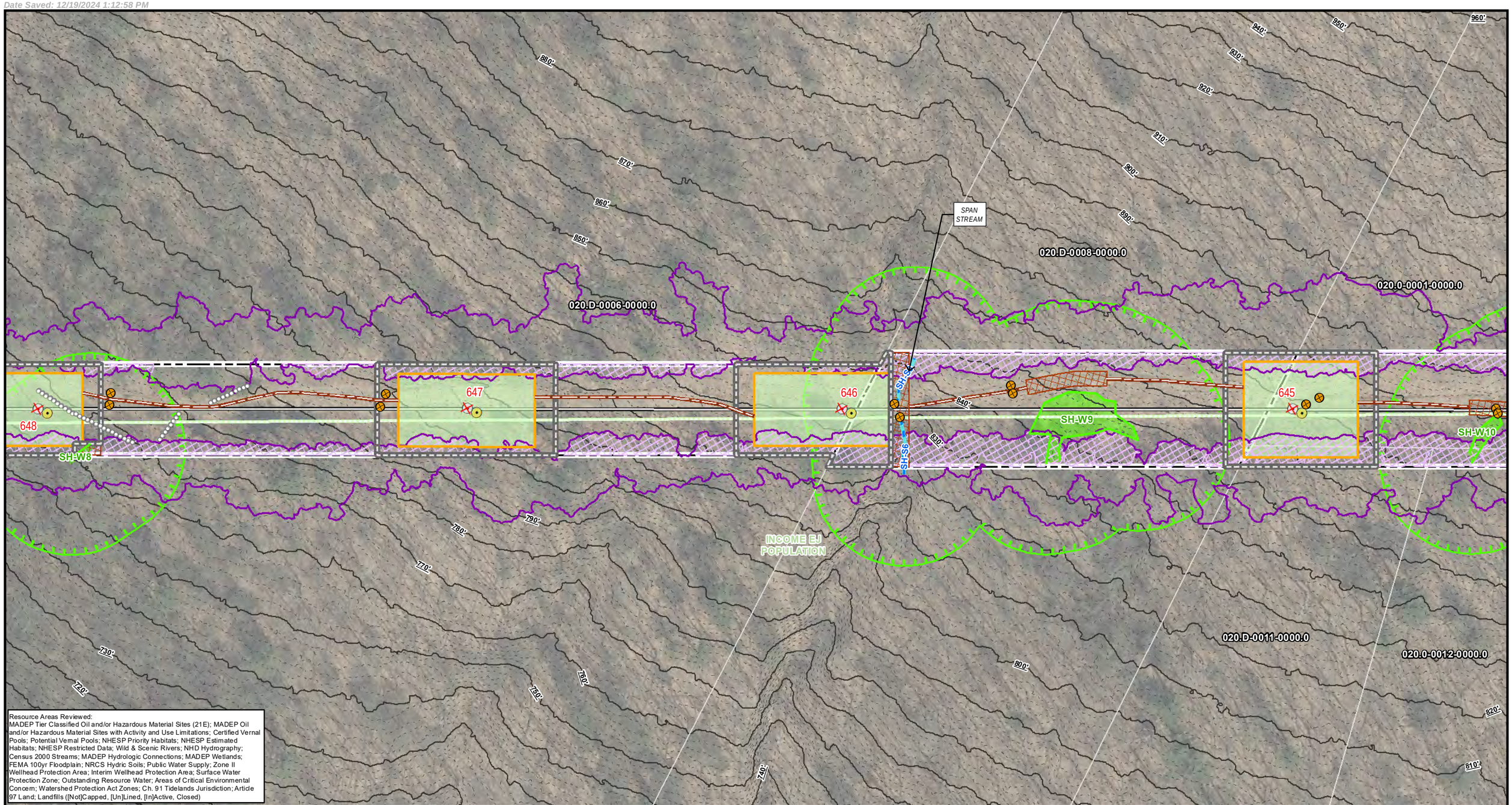

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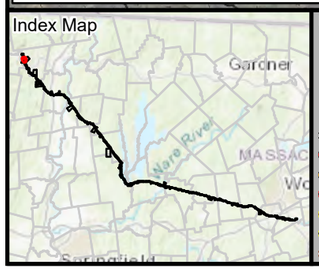

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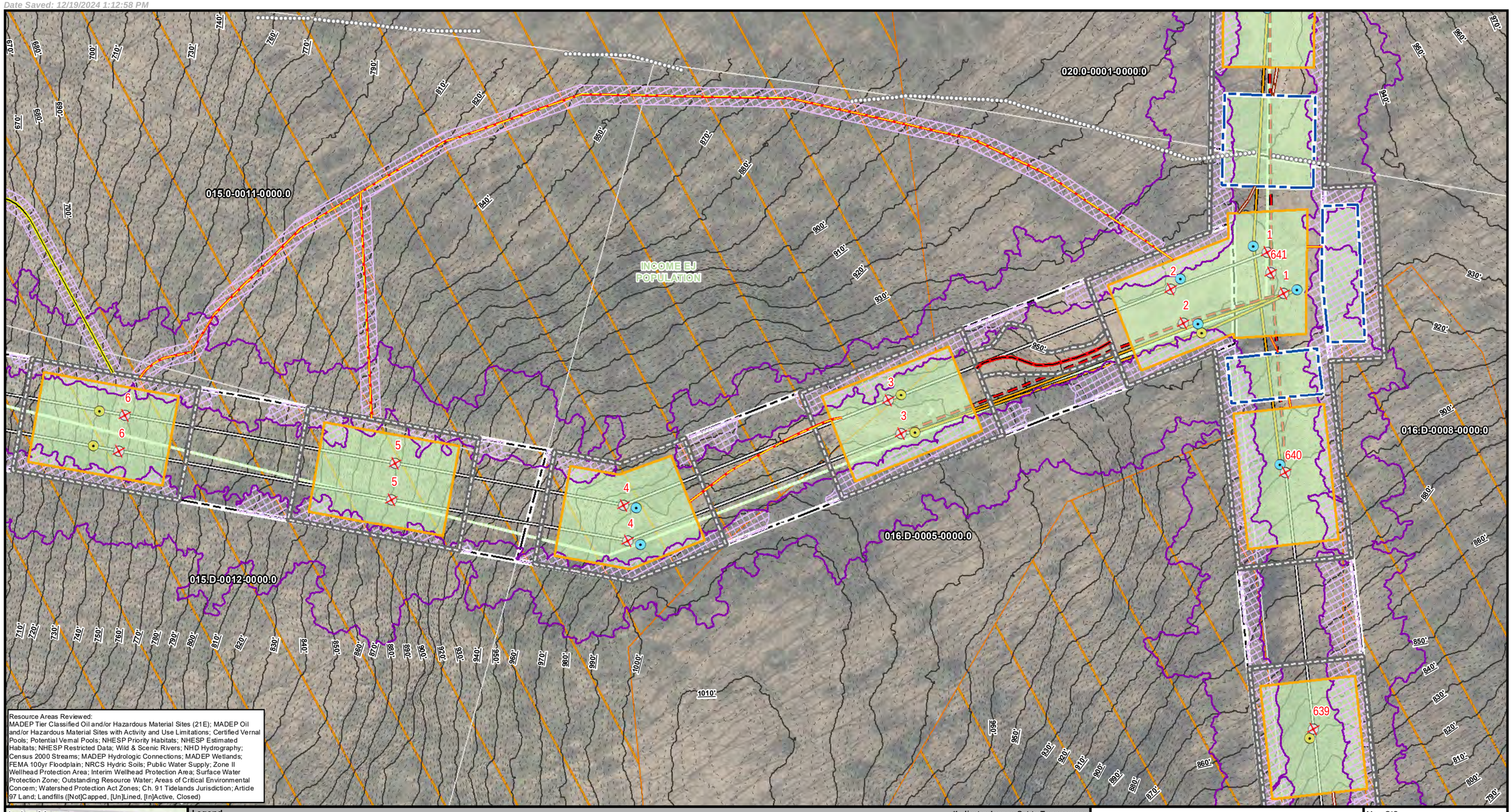

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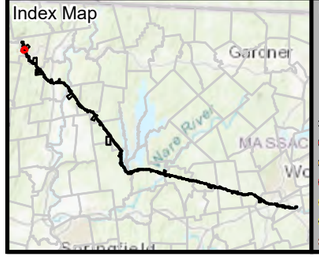

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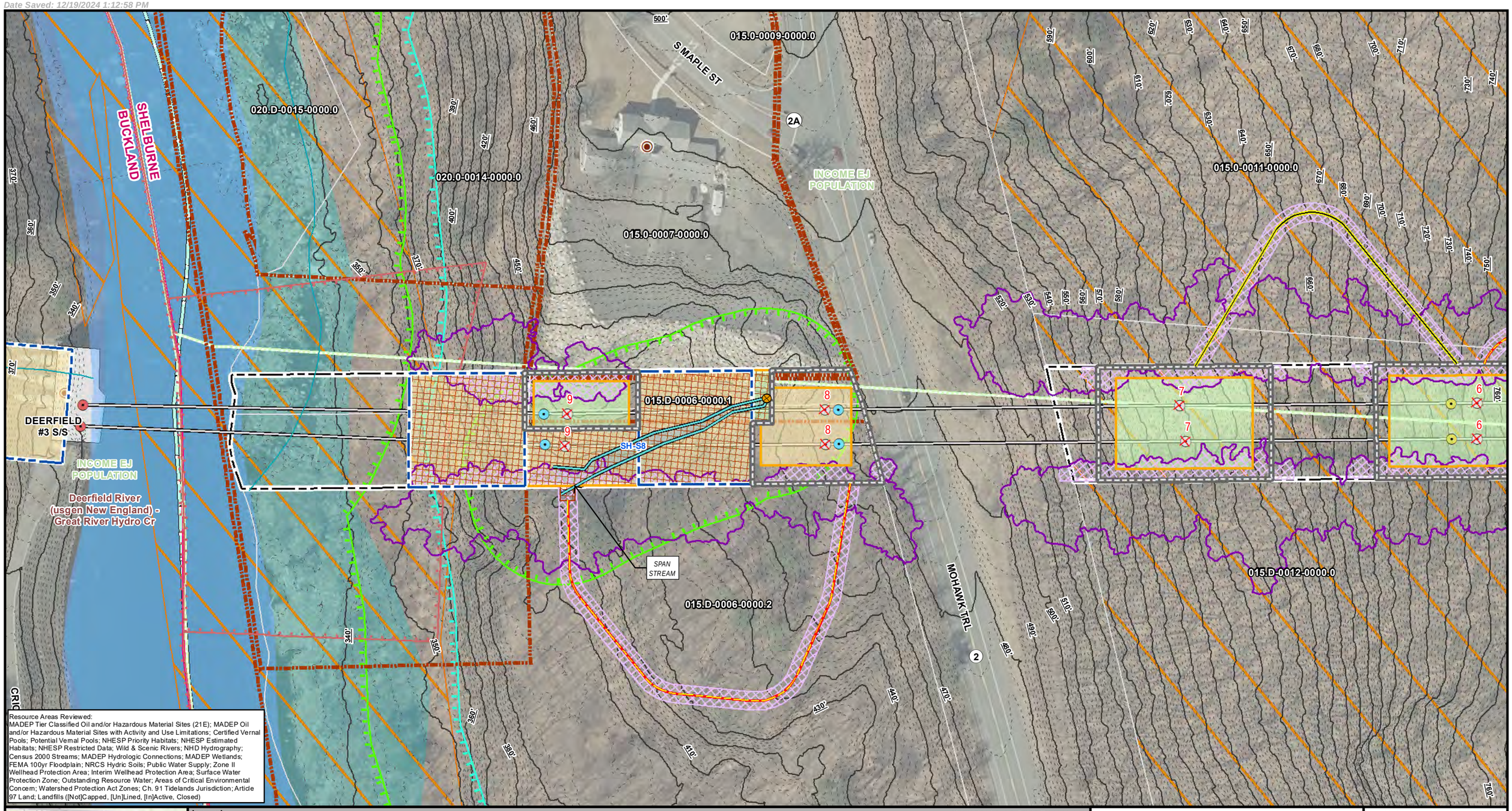

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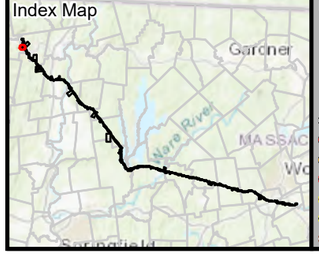

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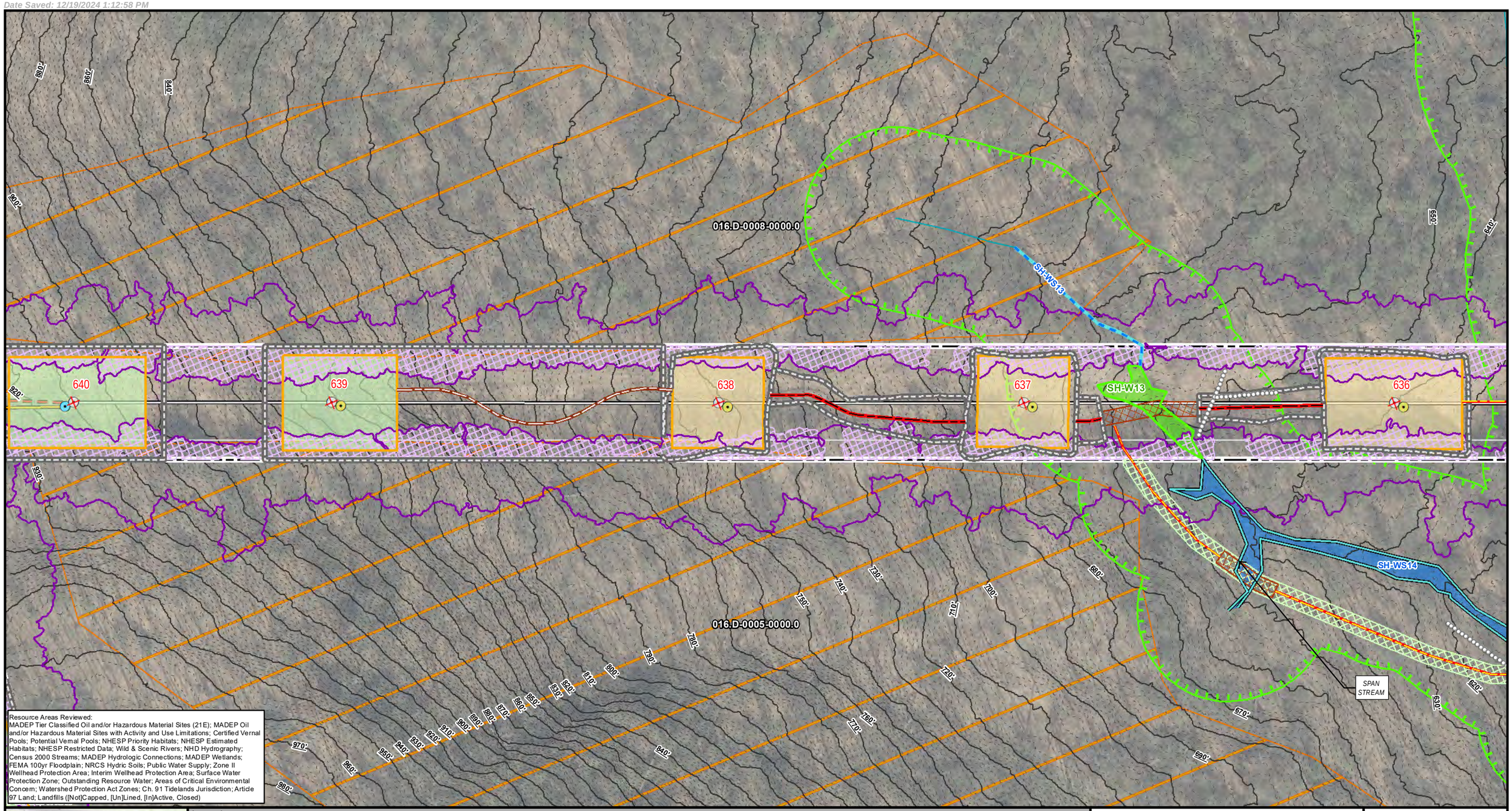

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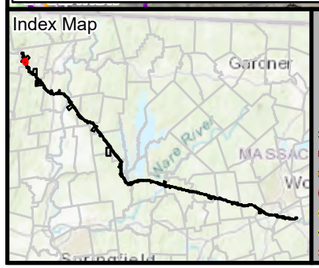
Index Map



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- Temporary Work Area
- Pull Pad
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- Edge of ROW
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- Field Delineated Wetlands*
- Field Delineated Vernal Pool*
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- Watershed Protection Act Secondary Zone
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- Approximate Pipeline
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- 10ft Contour
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- Guardrail
- Stonewall
- Existing Treeline
- Tree Removal
- Selective Tree Removal
- Pruning

*Indicates Layers Set to Transparency

- Town Boundary
- Parcel Boundaries

Environmental Justice Populations 2020

- Income

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Shelburne, MA

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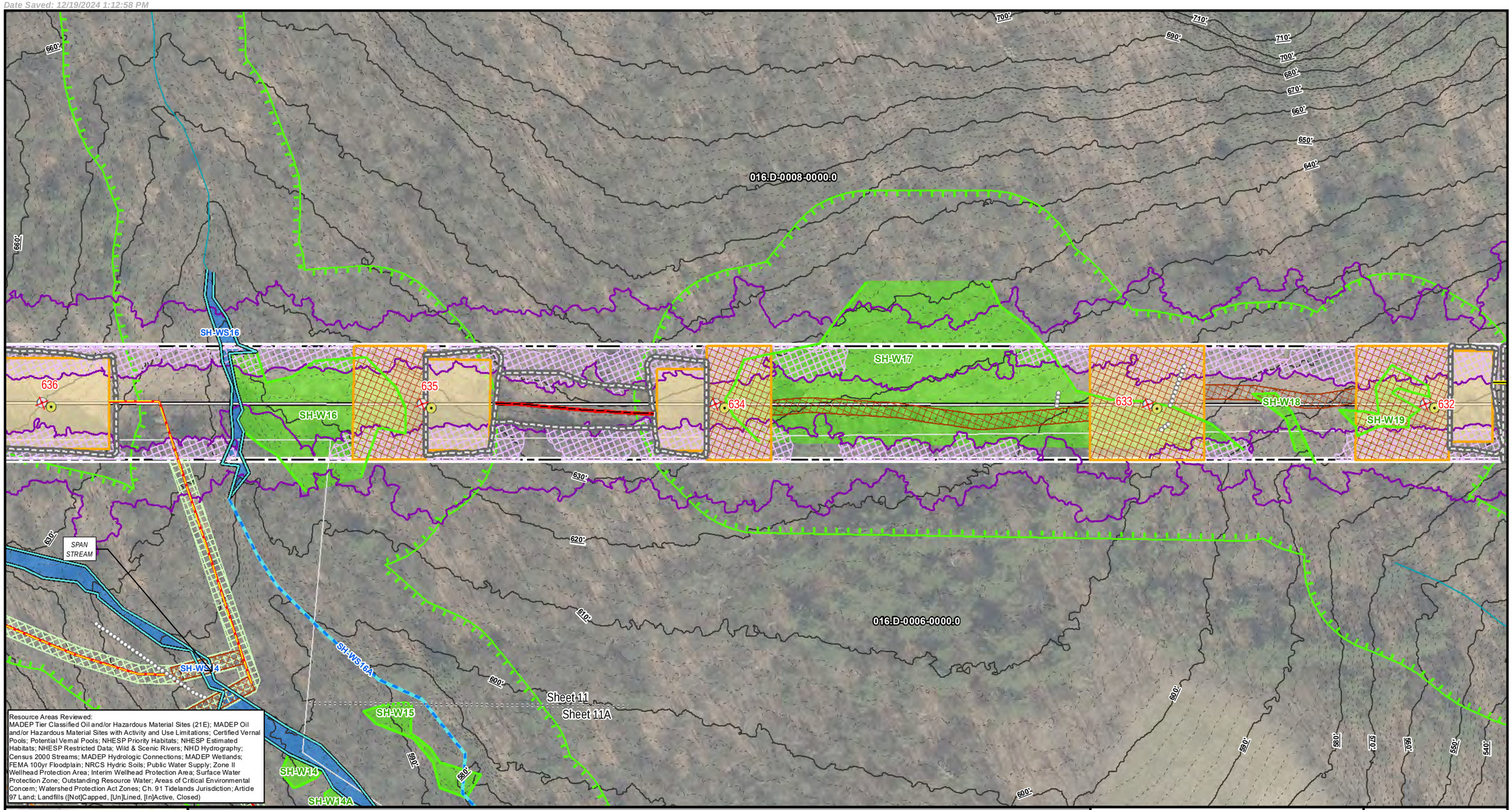

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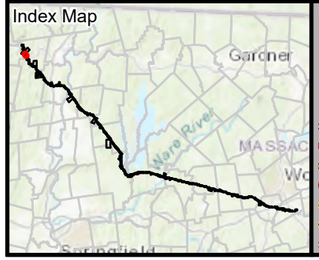

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Shelburne State Forest
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SH-W14
SH-W14A
SH-WS16A
SPAN STREAM
SPAN STREAM
ROUTE 2 MOHAWK TRAIL
MOHAWK TRL
016.D-0005-0000.0
016.D-0004-0000.2
540'
530'
480'
470'
550'
610'
620'
630'
640'
650'
660'
670'
680'
700'
710'
720'
690'
580'
590'
600'
570'
560'
550'
540'
530'
520'
510'
500'
490'

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Gardner
Springfield

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Article 97 Lands

- DCR-State Parks & Recreation

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Shelburne, MA
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MassGIS
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Sheet 12A
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016.D-0008-0000.0
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011.D-0006-0000.1
011.D-0006-0000.3
011.D-0005-0000.2

SPAN STREAM
SPAN STREAM
SPAN STREAM

SH-WS20
SH-WS20A
SH-WS20A
SH-WS20A
SH-WS20
SH-WS20B

SH-W19
SH-W20
SH-W20
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MOHAWK TRL
ROUTE 2:MOHAWK TRAIL
WILCOX HOLLOW ROAD

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016.D-0008-0000.0

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SH-WS20

SPAN STREAM

SPAN STREAM

SH-S9

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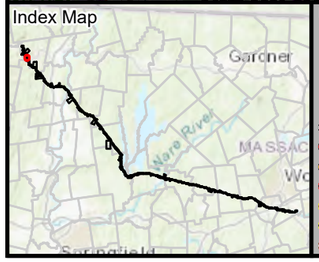

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Environmental Resources Map

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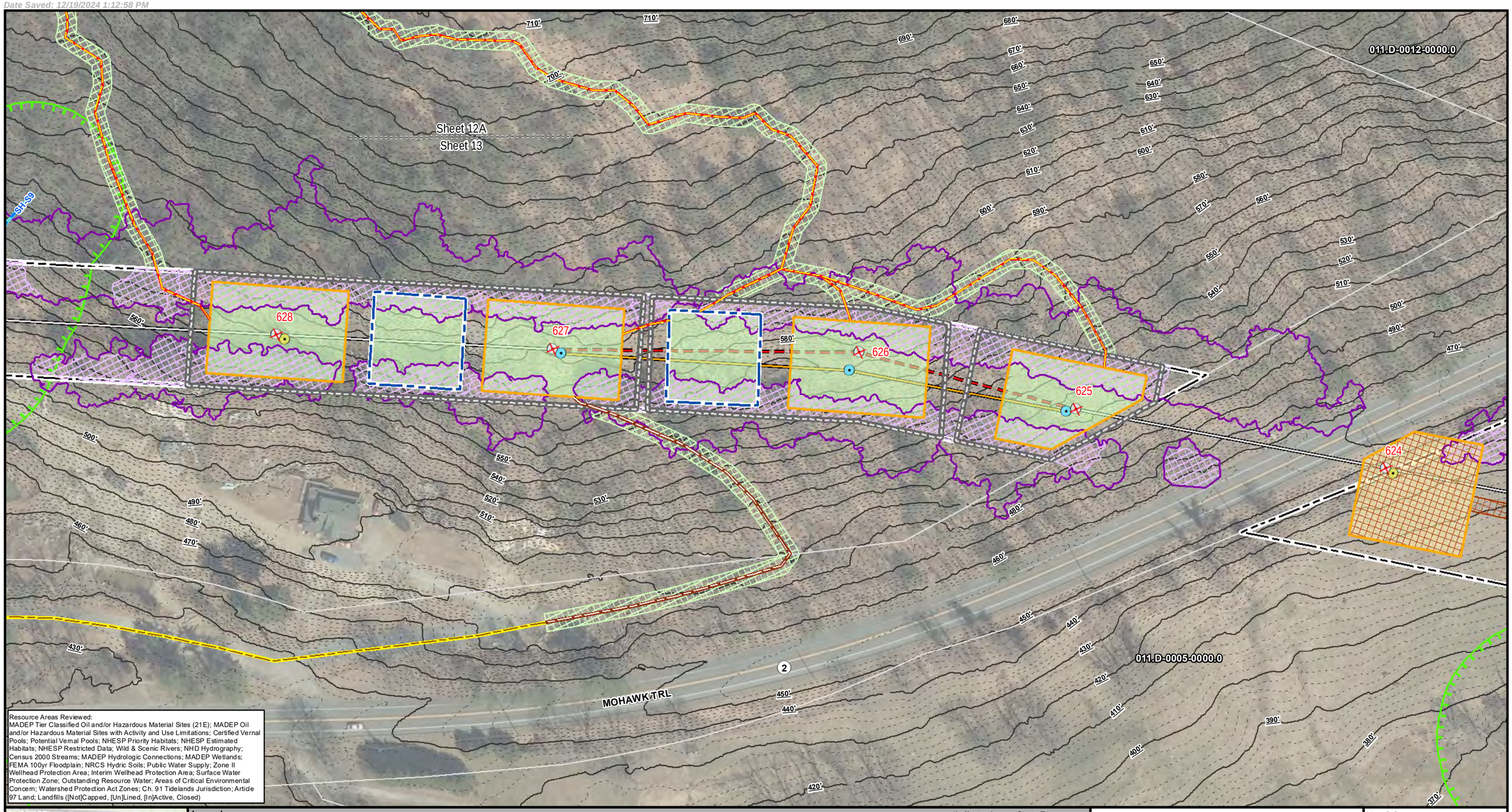

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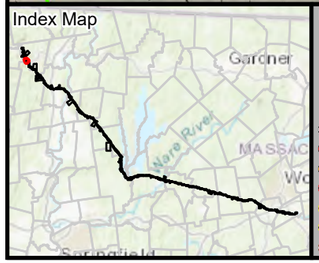

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MAHICAN-MOHAWK TRAIL
Deerfield River
(usgen New England) -
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- 10ft Contour
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- Selective Tree Removal
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N
1 inch = 100 feet
0 50 100
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Shelburne, MA

MassGIS
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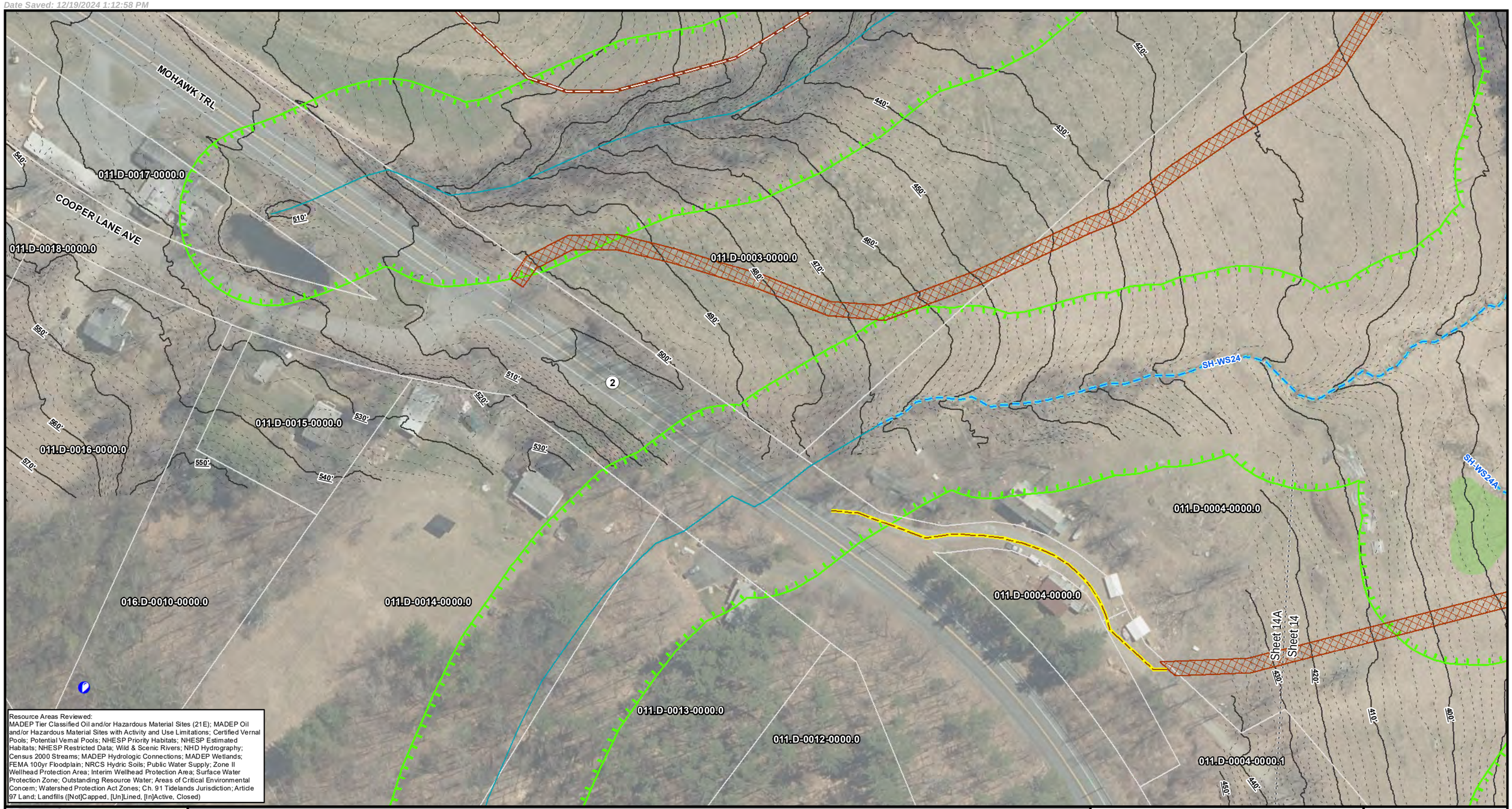

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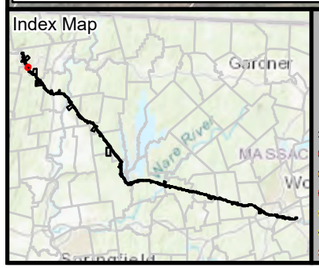

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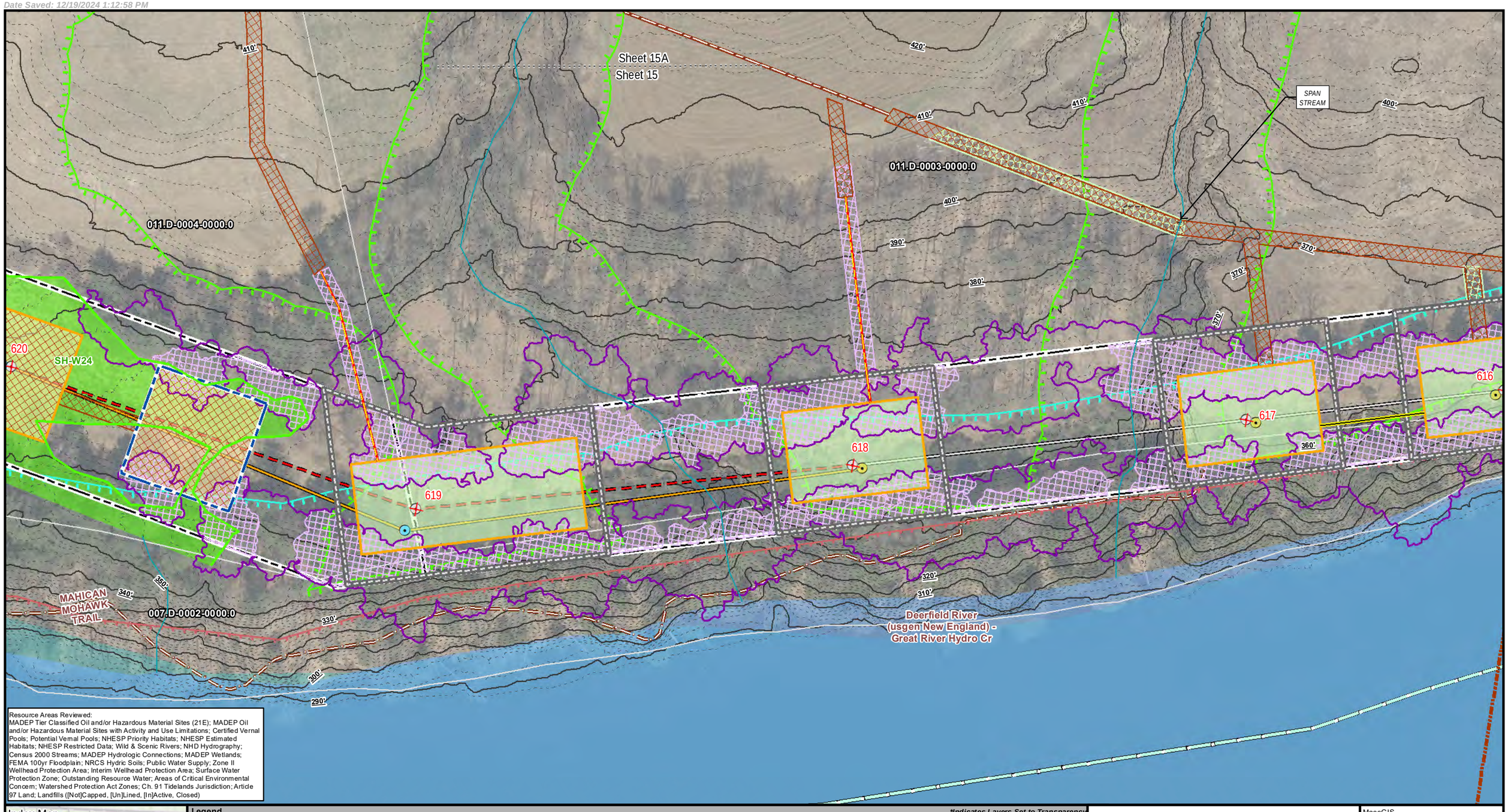

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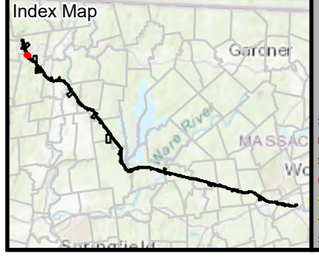

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MOHAWK TRL
COOPER LANE AVE
Sheet 15
Sheet 15A
SH-WS24
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390'
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430'
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460'
470'
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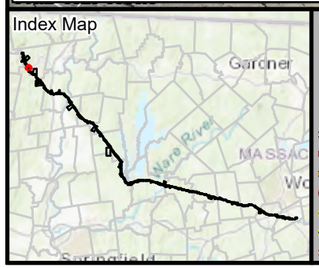

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Environmental Resources Map

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008.D-0004-0000.1
Sluice Brook
MAHICAN-MOHAWK TRAIL
Sheet 16A
Sheet 16
011.D-0003-0000.0
615
614
616
068/401.0-0006-0006.0
068/401.0-0006-0000.0
068/401.0-0010-0003.0
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SHELBURNE
CONWAY
PATRIOT CORRIDOR
068/401.0-0015-0000.0
068/401.0-0006-0005.0
068/401.0-0010-0002.0
SPAN
Deerfield River
(usgen New England) -
Great River Hydro Cr

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Springfield

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SHELBURNE CENTER RD
COOPER LANE AVE
MOHAWK TRL
011.D-0021-0000.0
011.D-0001-0000.0
011.D-0002-0000.0
011.D-0003-0000.0
Sluice Brook
Sheet 16
Sheet 16A
2
460'
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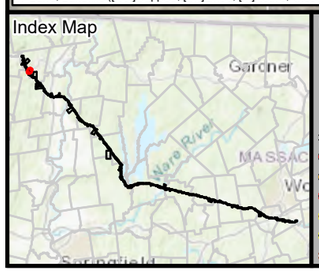

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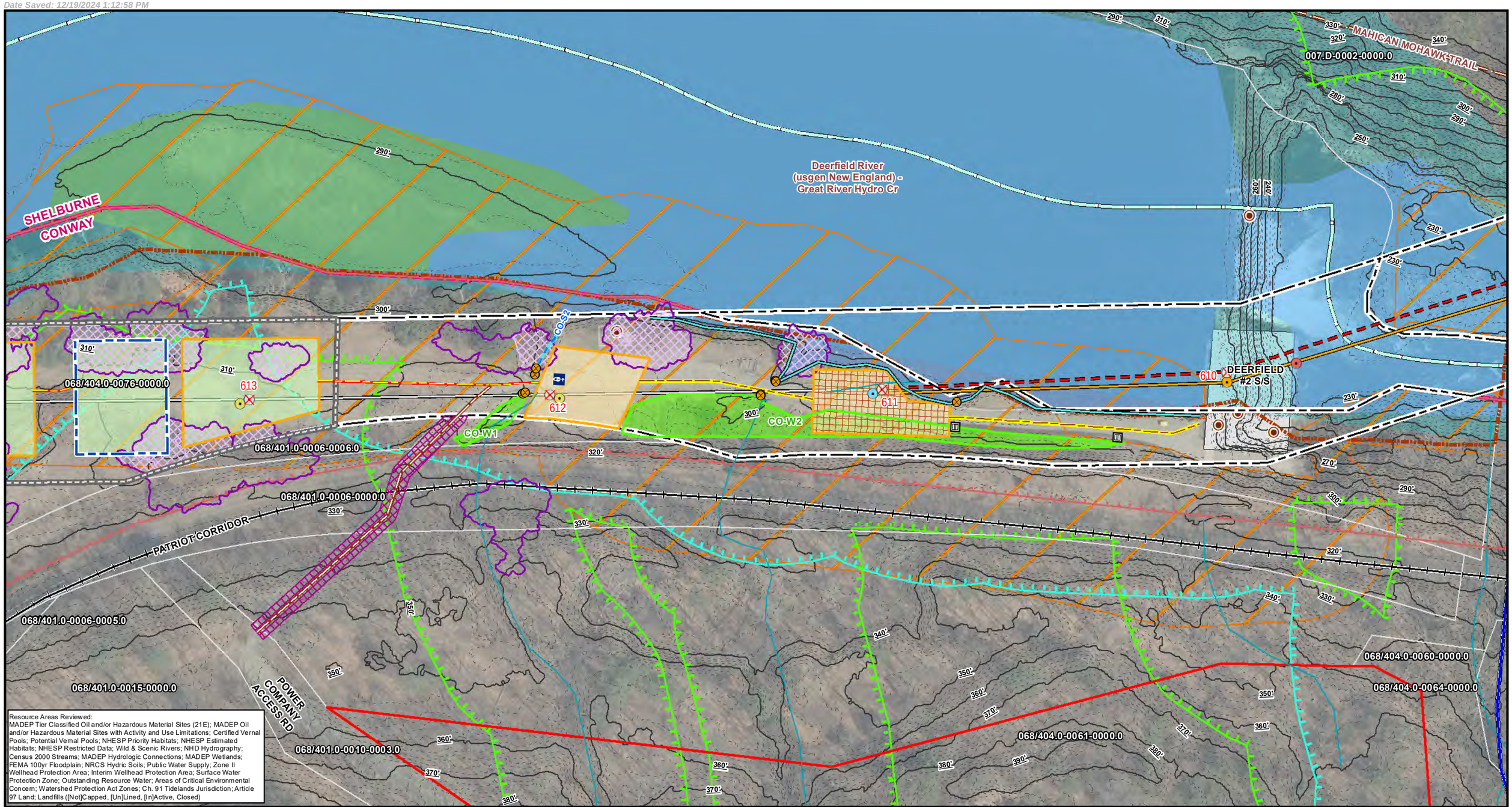

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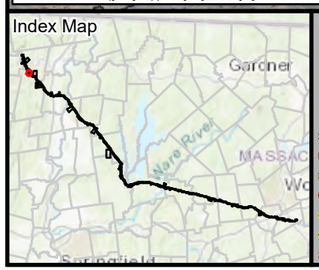

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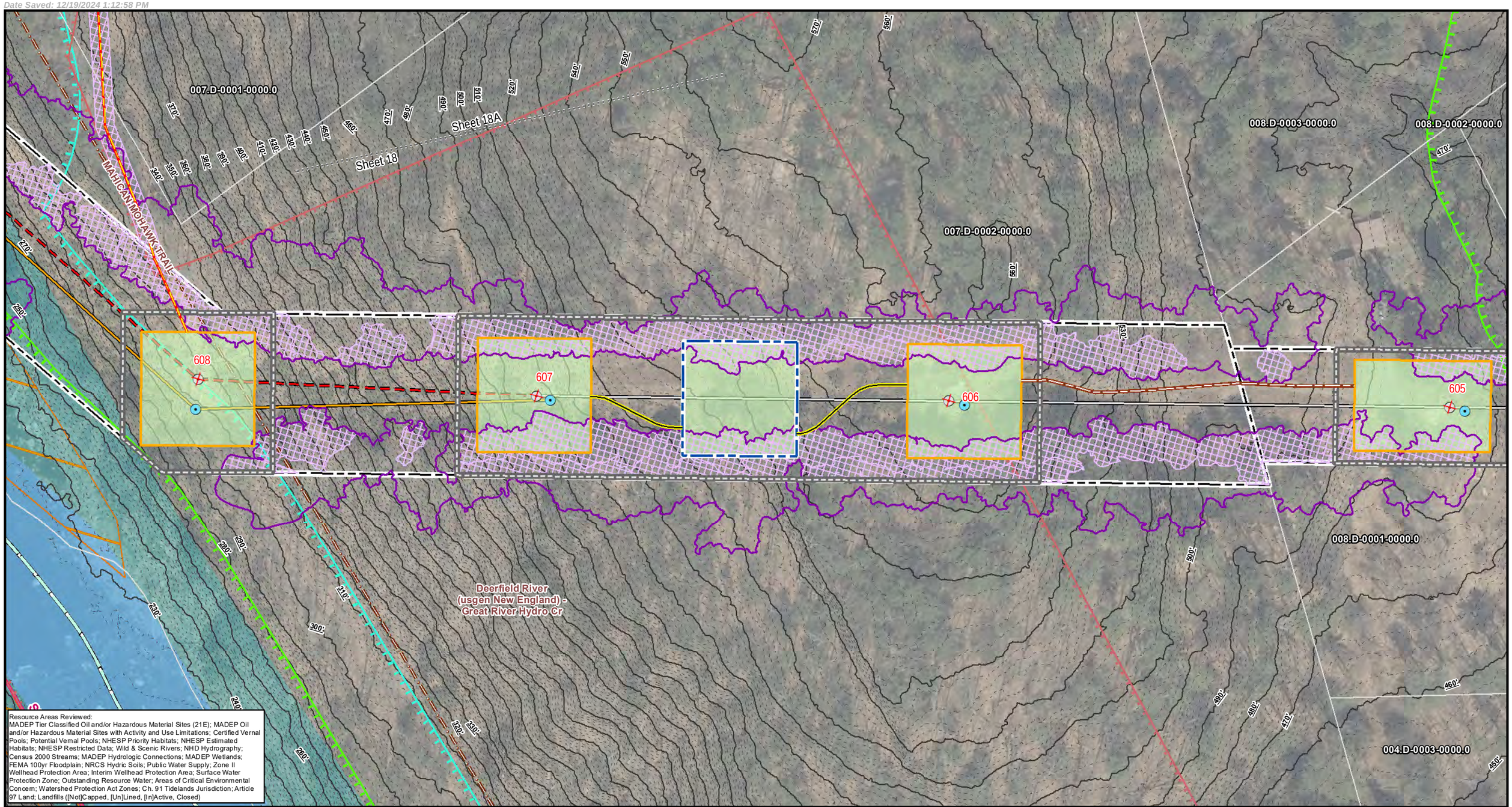

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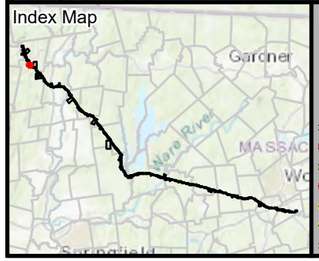

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Article 97 Lands

- Private

N

1 inch = 100 feet
0 50 100
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Shelburne, MA

MassGIS
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CONWAY
Schneck Brook
Sluice Brook
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068/401.0-0006-0000.0
068/404.0-0076-0000.0

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MAHICAN MOHAWK TRAIL
Deerfield River (usgen New England) - Great River Hydro Cr
410'
400'
380'
310'

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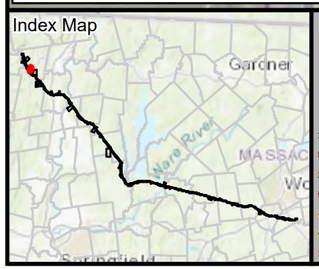

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Shelburne & Conway, MA
Page 18B of 240

MassGIS
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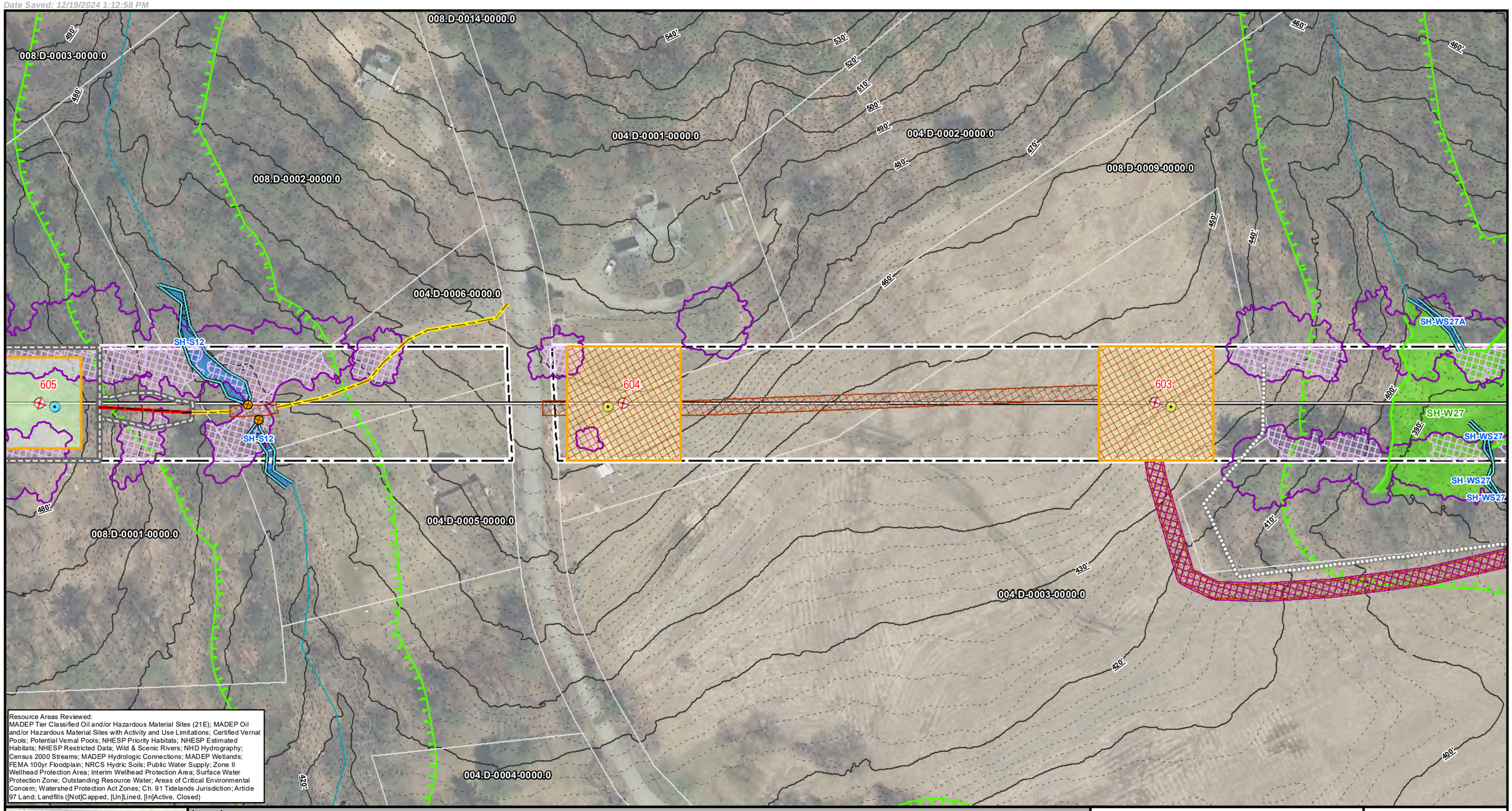

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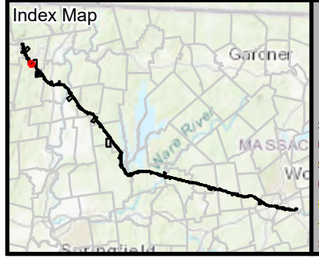

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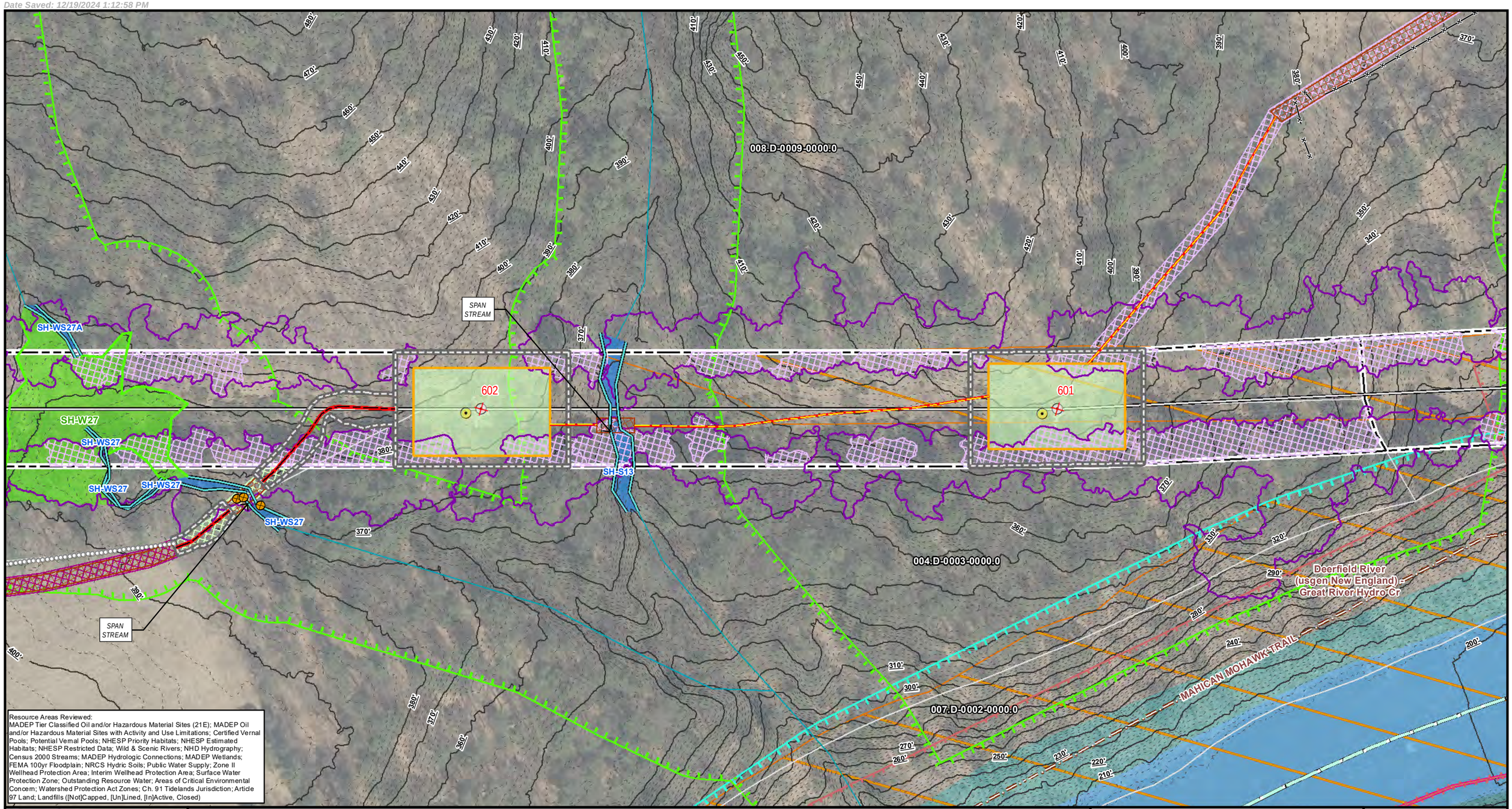

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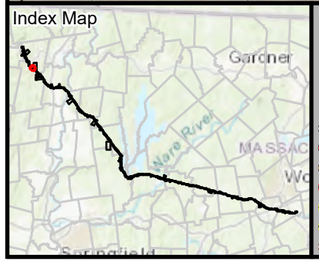

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SPAN STREAM
SPAN STREAM

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598

MAHICAN-MOHAWK TRAIL

Deerfield River
(usgen New England) -
Great River Hydro Cr

SHELBURNE
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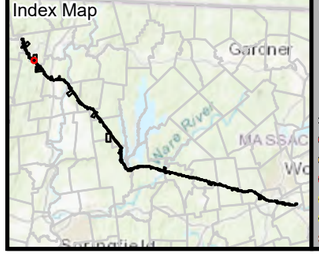

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ORCHARD RD

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SPAN STREAM

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Deerfield River (usgen New England) - Great River Hydro Cr

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- Private

N

1 inch = 200 feet
0 100 200
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Shelburne, MA
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MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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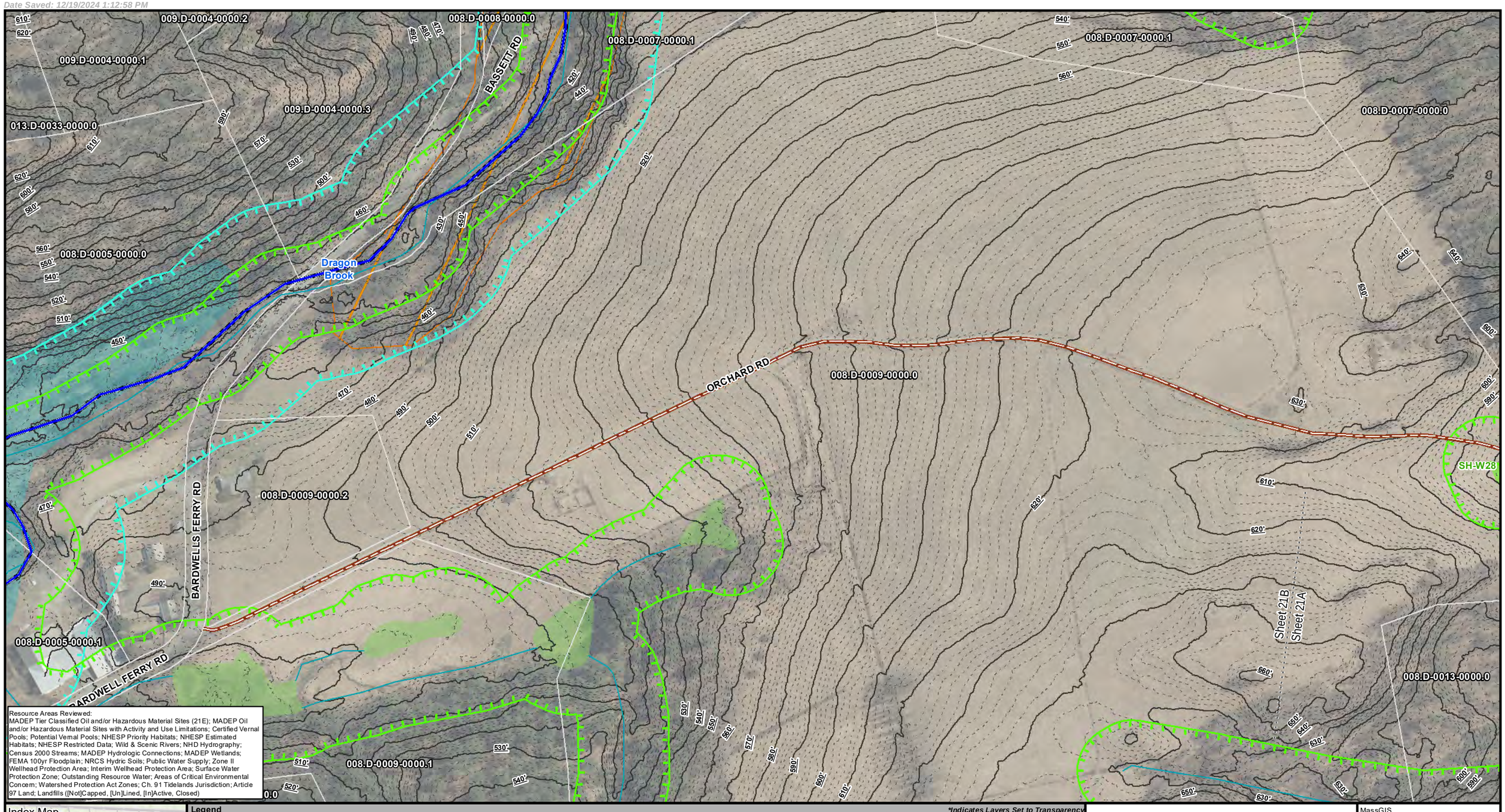

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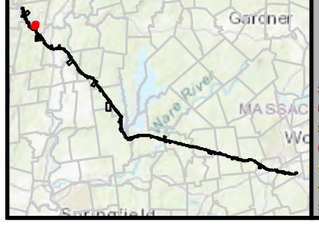

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008.D-0007-0000.0
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Deerfield River (usgen New England) - Great River Hydro Cr
PATRIOT CORRIDOR
MAHICAN MOHAWK TRAIL
SHELBURNE
CONWAY
South River State Forest
SPAN STREAM
596
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597

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Shelburne & Conway, MA

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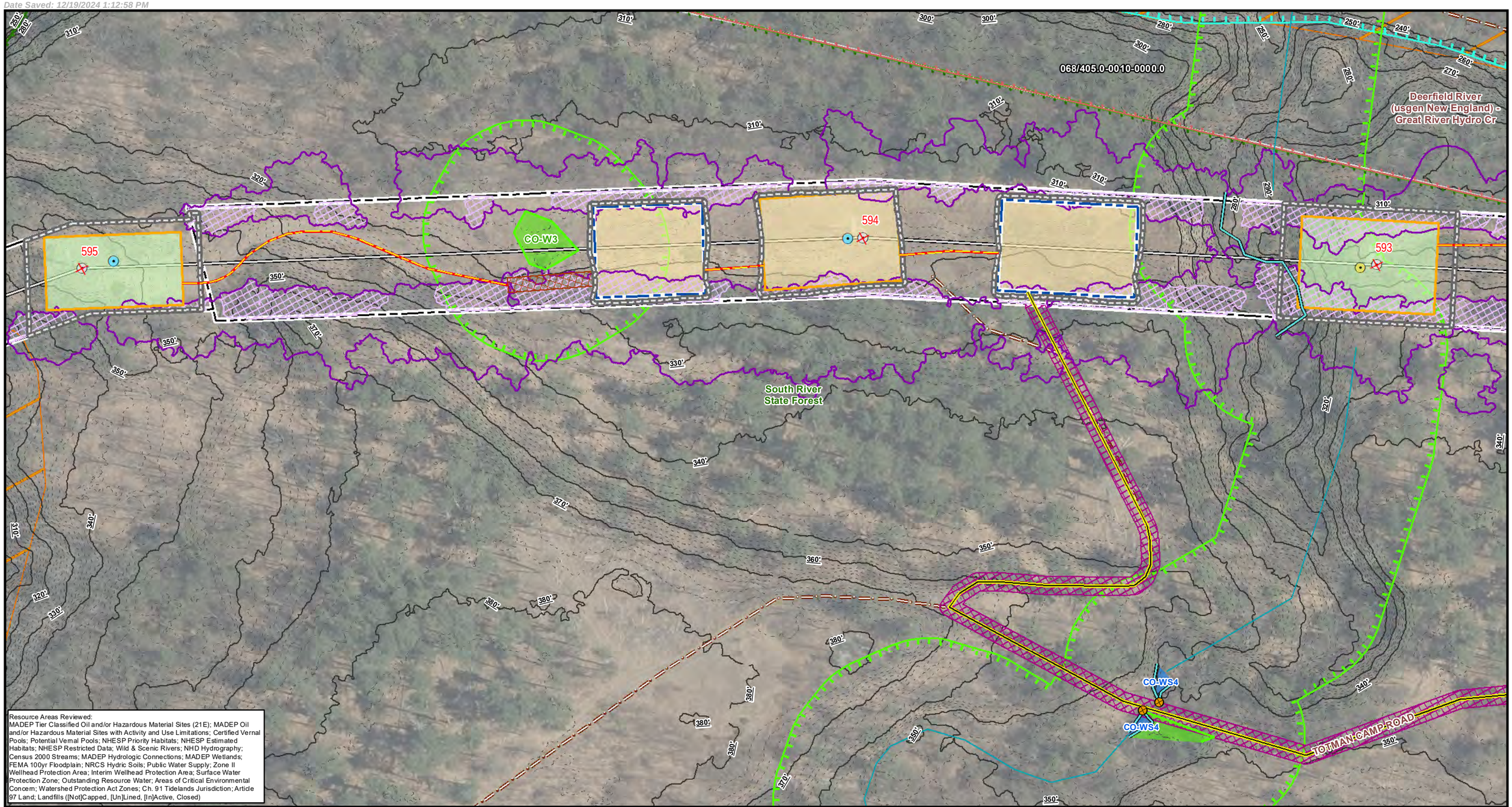

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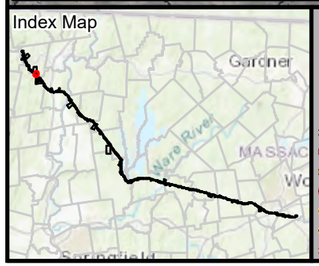

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Conway, MA

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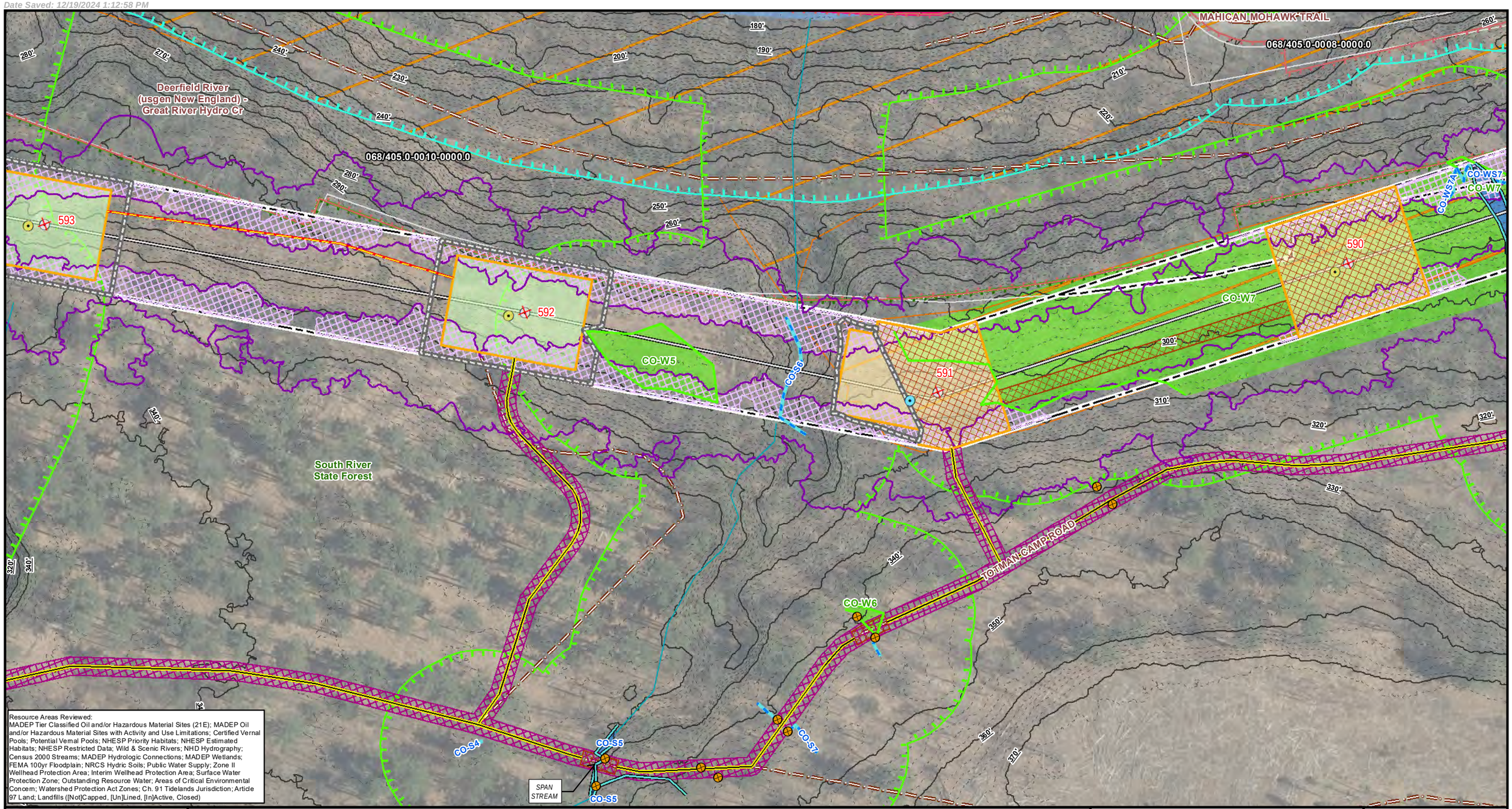

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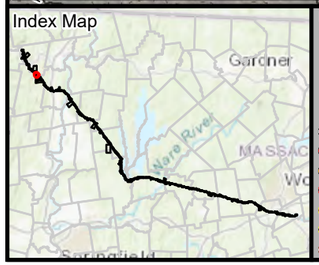

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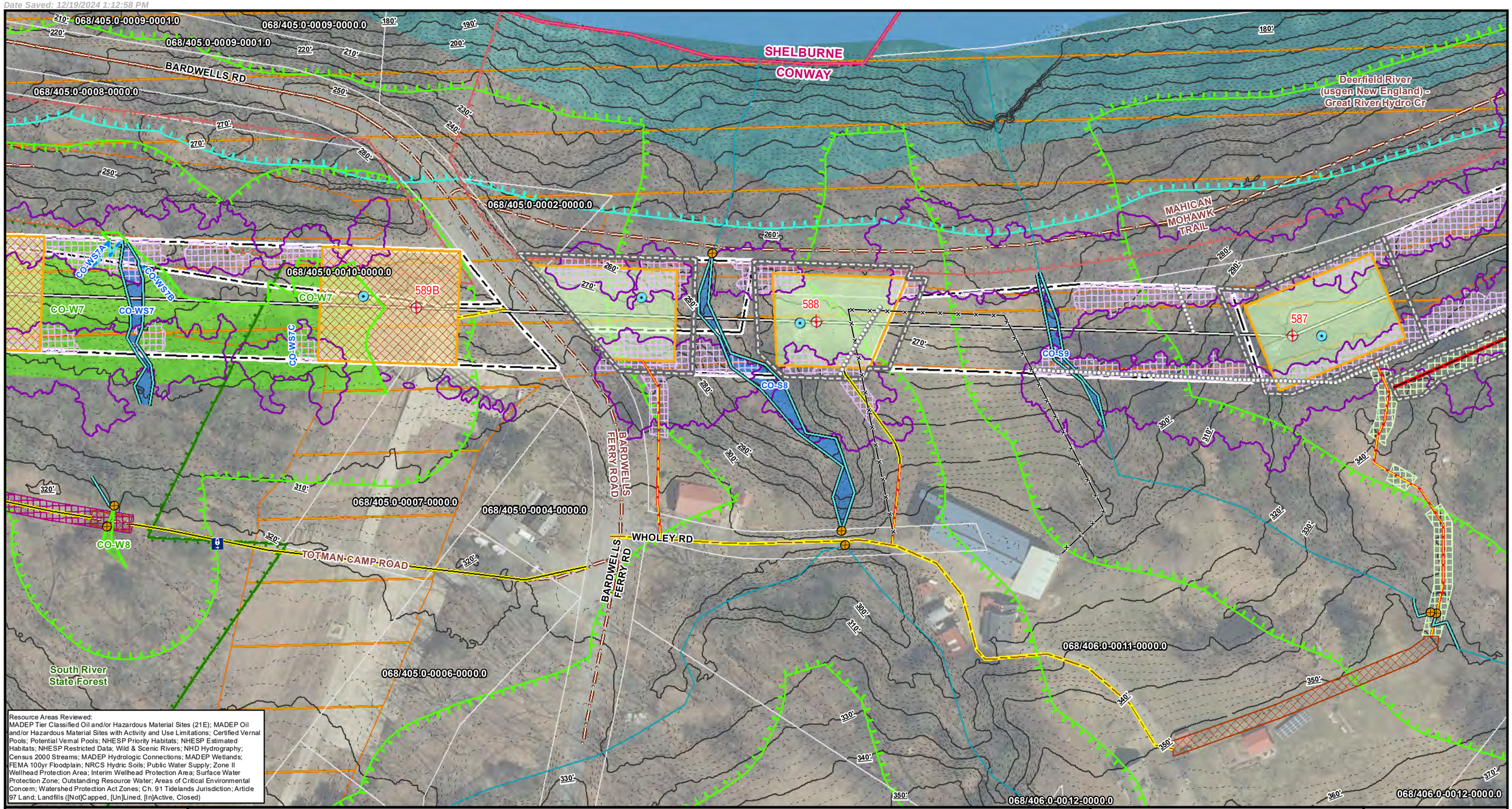

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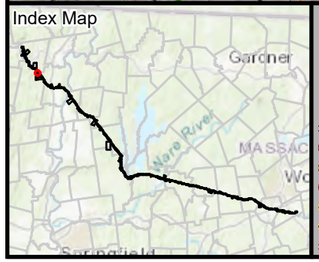

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DEERFIELD
CONWAY

Deerfield River (usgen New England) - Great River Hydro Cr

MAHICAN MOHAWK TRAIL

Totman Farm Apr

586
585
584
CO-W9
CO-S10
CO-S10
CO-S11

068/406.0-0011-0000.0
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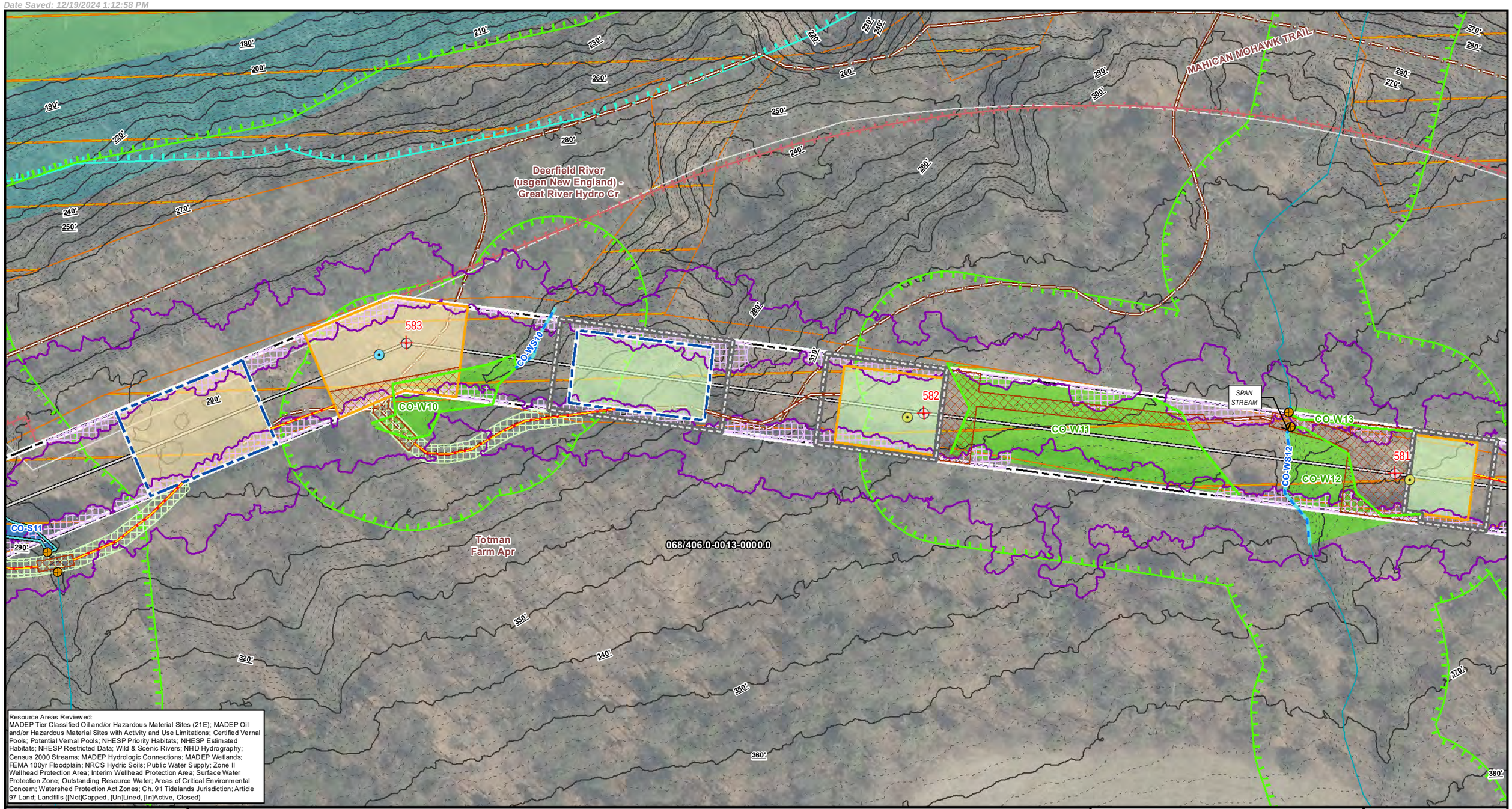

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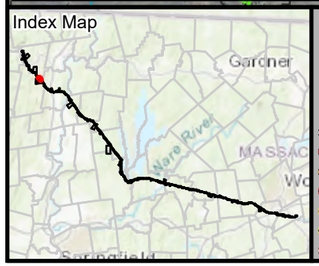

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Conway, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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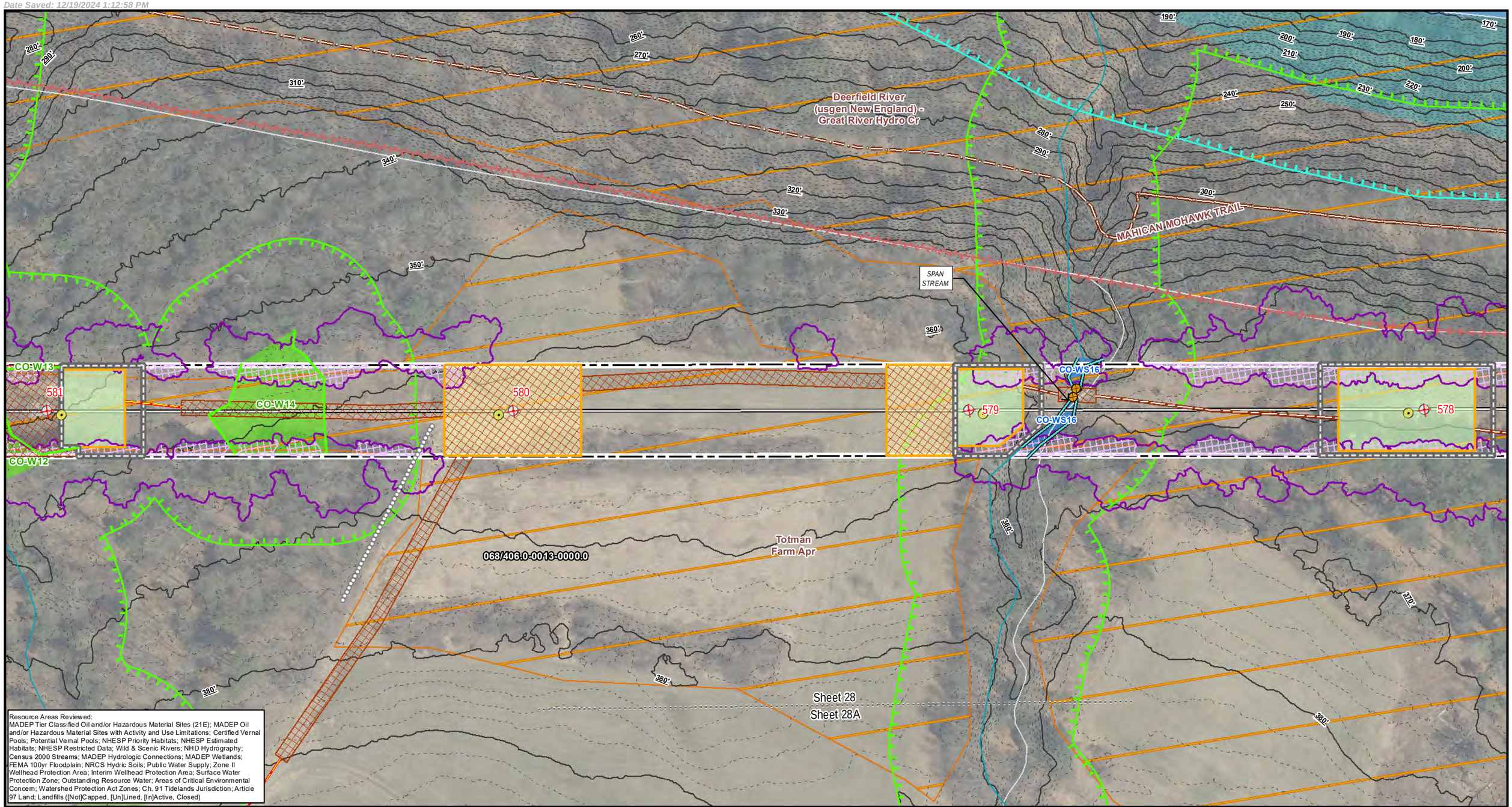

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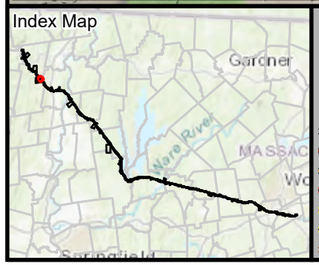

Legend

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- Field Delineated Wetland Lines
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- Guardrail
- Stonewall
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- Tree Removal
- Selective Tree Removal
- Pruning

*Indicates Layers Set to Transparency

- Town Boundary
- Parcel Boundaries

Article 97 Lands

- Private

1 inch = 100 feet
0 50 100
Feet

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068/406.0-0003-0000.0
068/406.0-0015-0000.0
068/406.0-0016-0000.0
068/406.0-0019-0000.0
BARDWELLS FERRY RD
MAHICAN MOHAWK TRAIL
SPAN STREAM
SPAN STREAM
CO-W11
CO-W12
CO-W13
CO-W14
CO-W15
CO-W16
CO-WS16
CO-WS16
CO-WS16
582
581
580
579
578
Totman Farm Apr
South River State Forest
Deerfield River (usgen New England) - Great River Hydro Cr
CONWAY STATION ROAD
STATION RD
Sheet 28
Sheet 28A

Resource Areas Reviewed:
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Conway, MA
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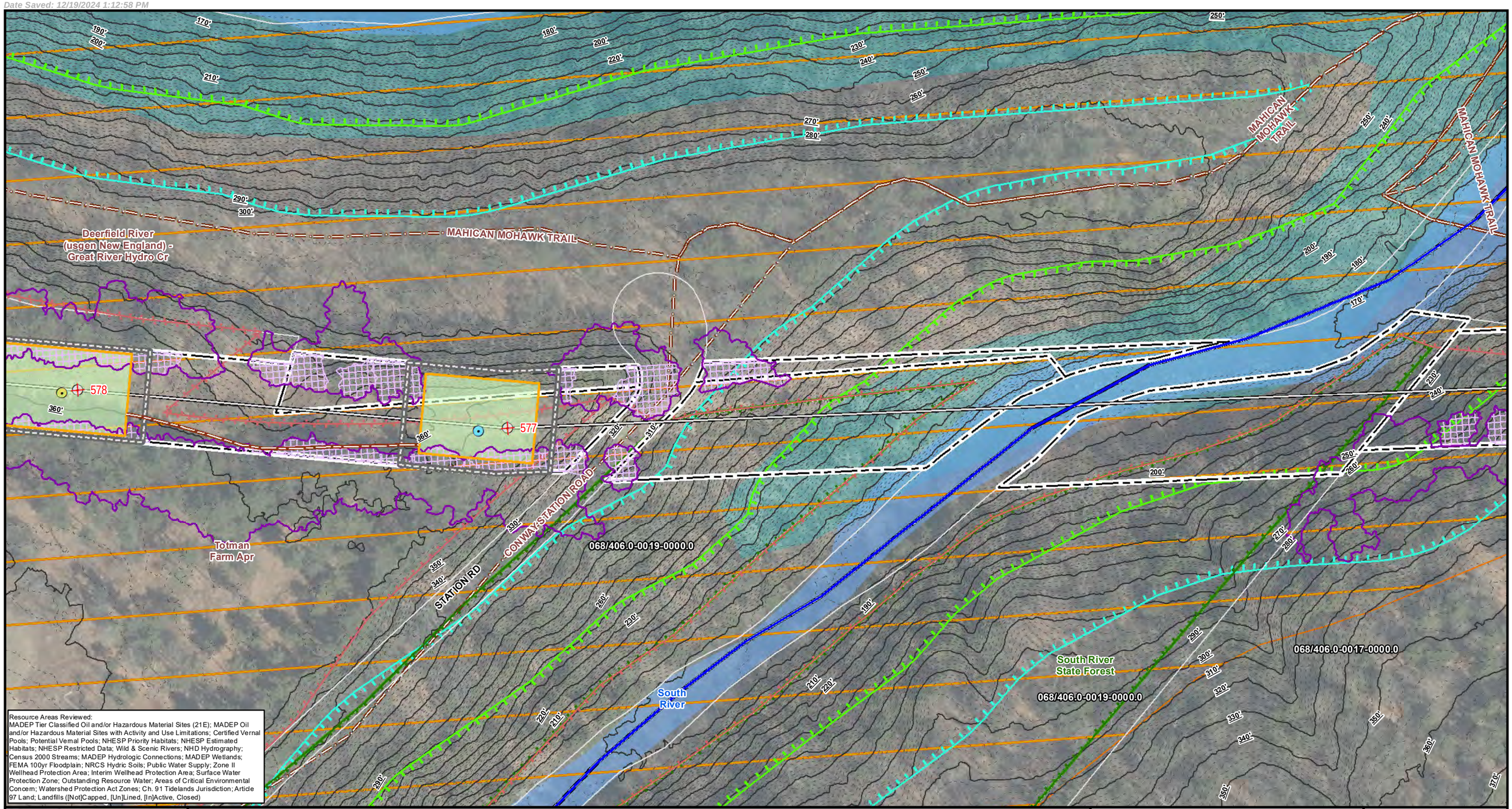

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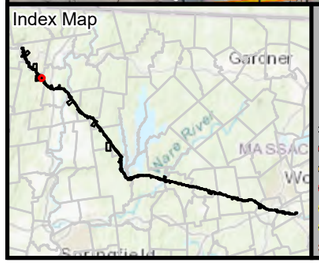

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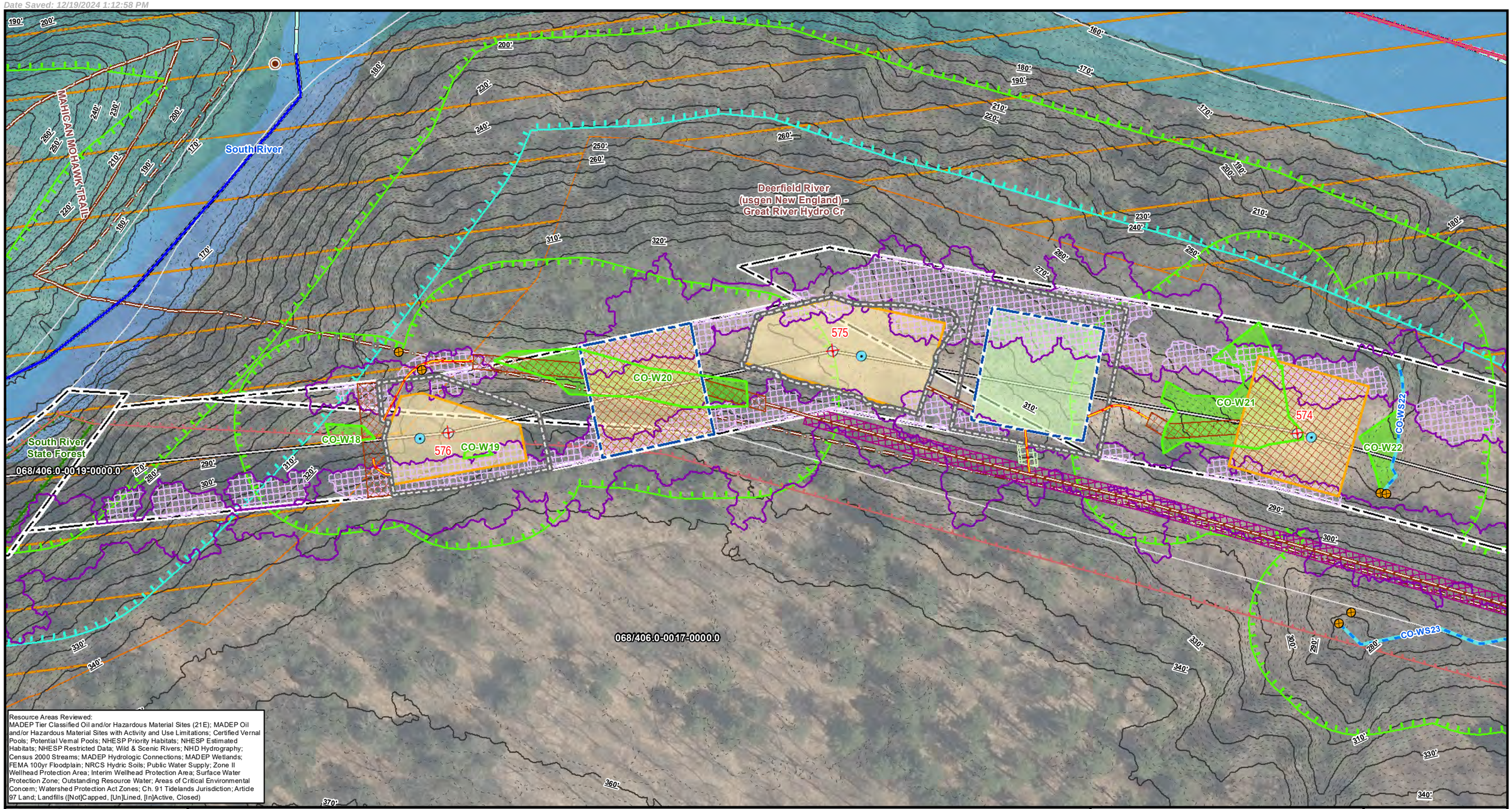

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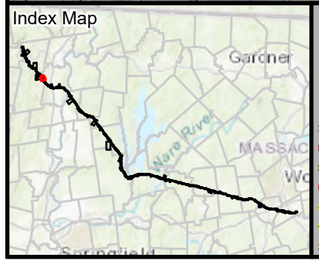

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DEERFIELD
CONWAY

CO-WS22
CO-W22
CO-W23
CO-WS23
CO-S13
CO-S13A
CO-S14
573
572
571
Deerfield River
(usgen New England) -
Great River Hydro Cr
MAHICAN MOHAWK TRAIL
068/406.0-0017-0000.0

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CONWAY
MAHICAN MOHAWK TRAIL
CO-S14
CO-S15
CO-S15A
CO-S16
CO-S18
570
569
568
SPAN STREAM
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068/406.0-0017-0000.0
068/411.0-0068-0000.0
160'
170'
180'
190'
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250'
260'
270'
280'
290'
300'
310'
320'
330'
340'
350'
360'
370'
380'

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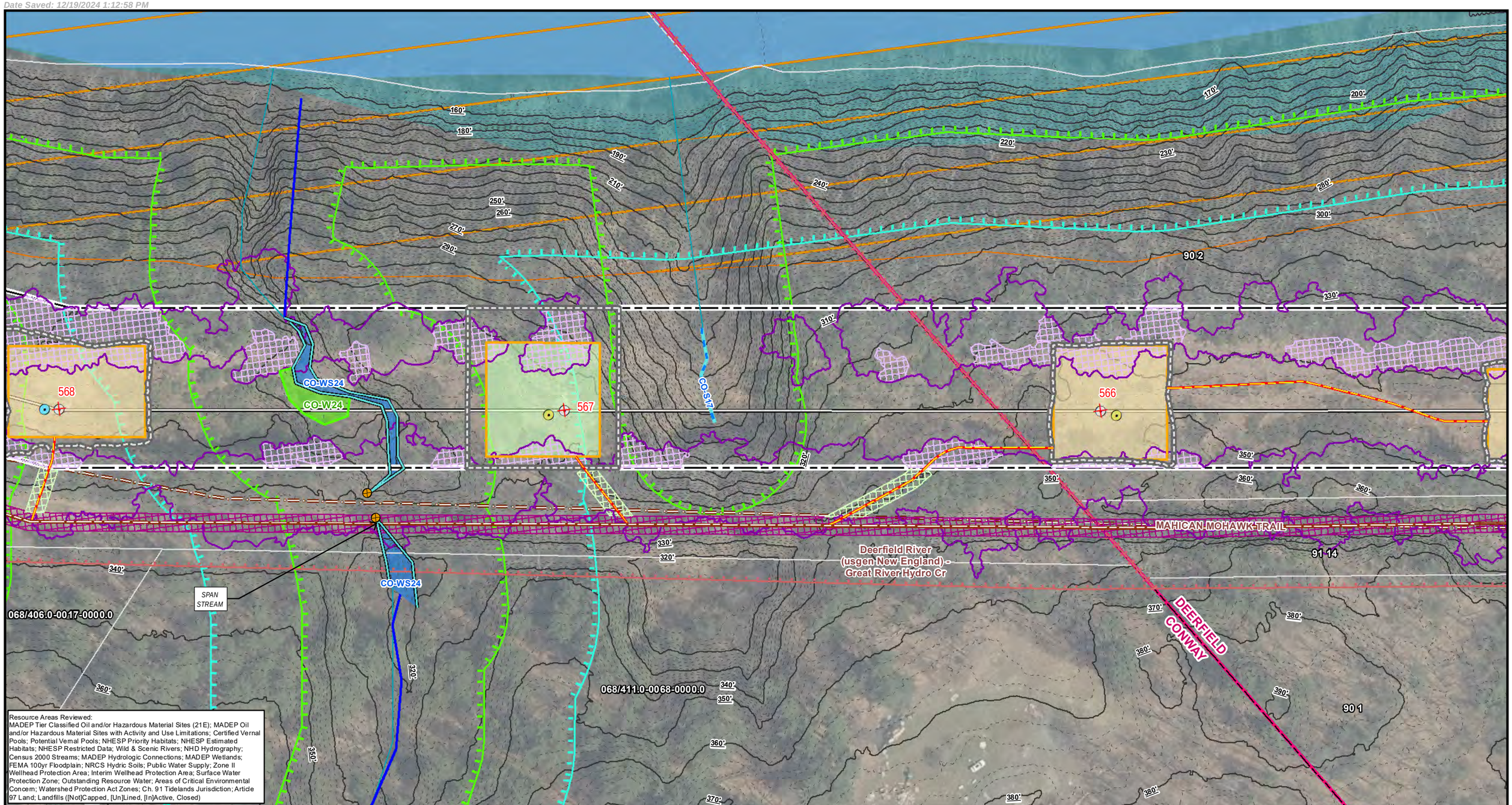

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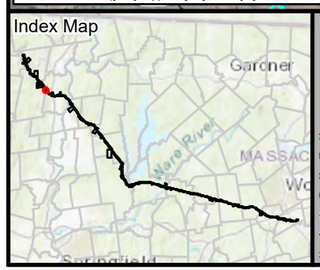

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- MHC Historic Area
- DCR Owned Property
- Culvert
- Catch Basin
- Access Gate
- Railroad
- Hiking Trails
- Approximate Pipeline
- 2ft Contour
- 10ft Contour
- Fenceline
- Guardrail
- Stonewall
- Existing Treeline
- Tree Removal
- Selective Tree Removal
- Pruning

*Indicates Layers Set to Transparency

- Town Boundary
- Parcel Boundaries

Article 97 Lands

- Private

N

1 inch = 100 feet

0 50 100

Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Conway & Deerfield, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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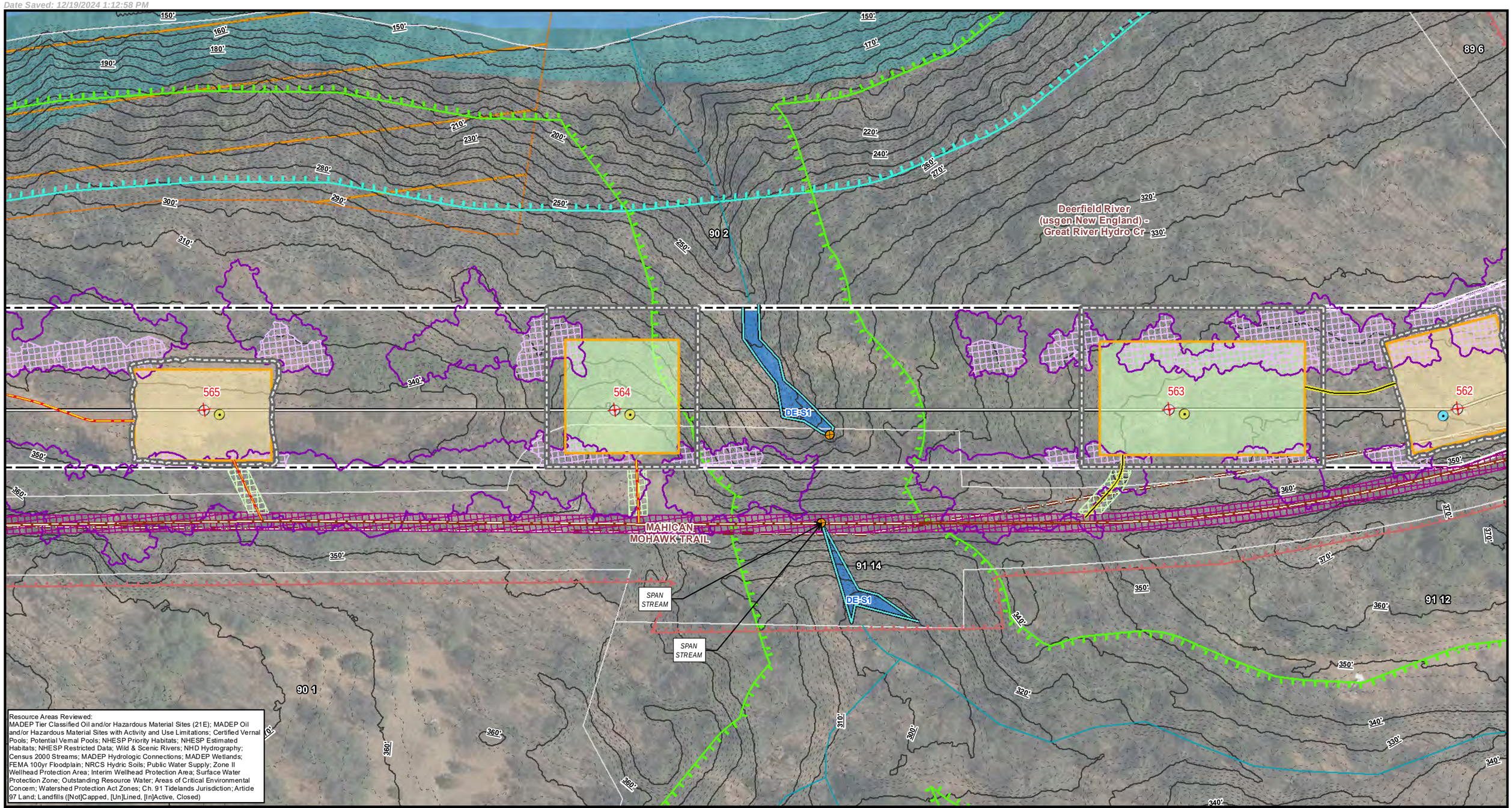

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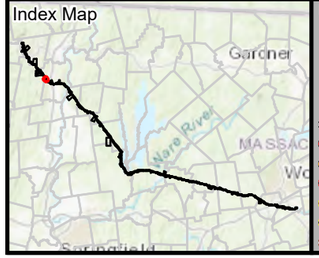
Index Map



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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Deerfield, MA

MassGIS
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Deerfield River (usgen New England) - Great River Hydro Cr

SPAN STREAM

DE-W1

DE-W2

562

561

560

559

MAHICAN MOHAWK TRAIL

HOOSAC RD

89 6

90 2

91 15

91 14

91 12

91 13

91 2

91 1

92 6

92 5

92 3.1

92 2.1

92 4

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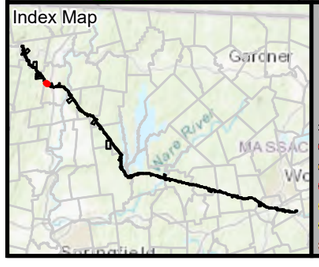

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Article 97 Lands

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

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Deerfield, MA

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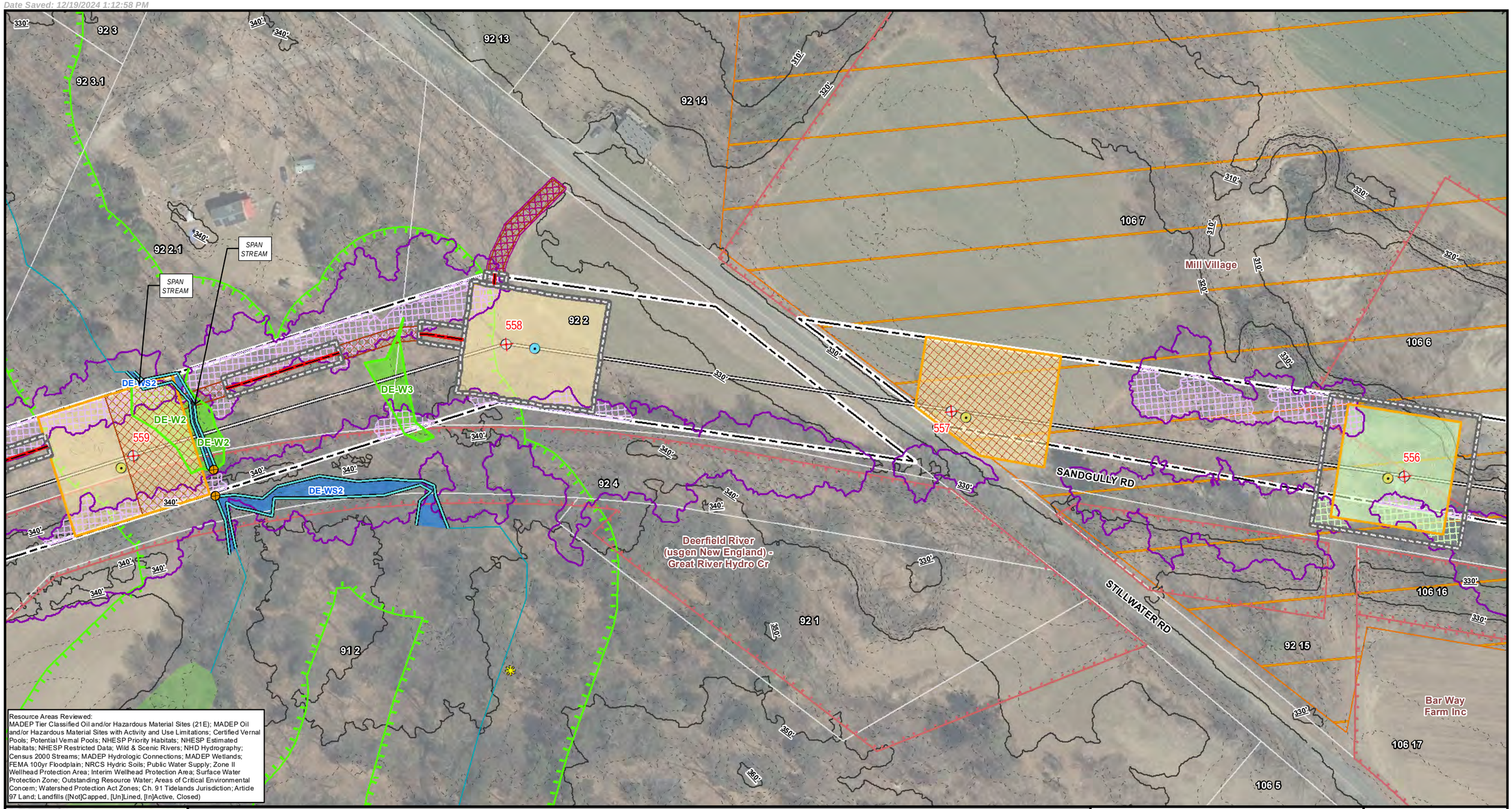

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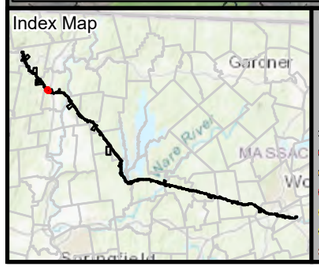

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Deerfield, MA

MassGIS
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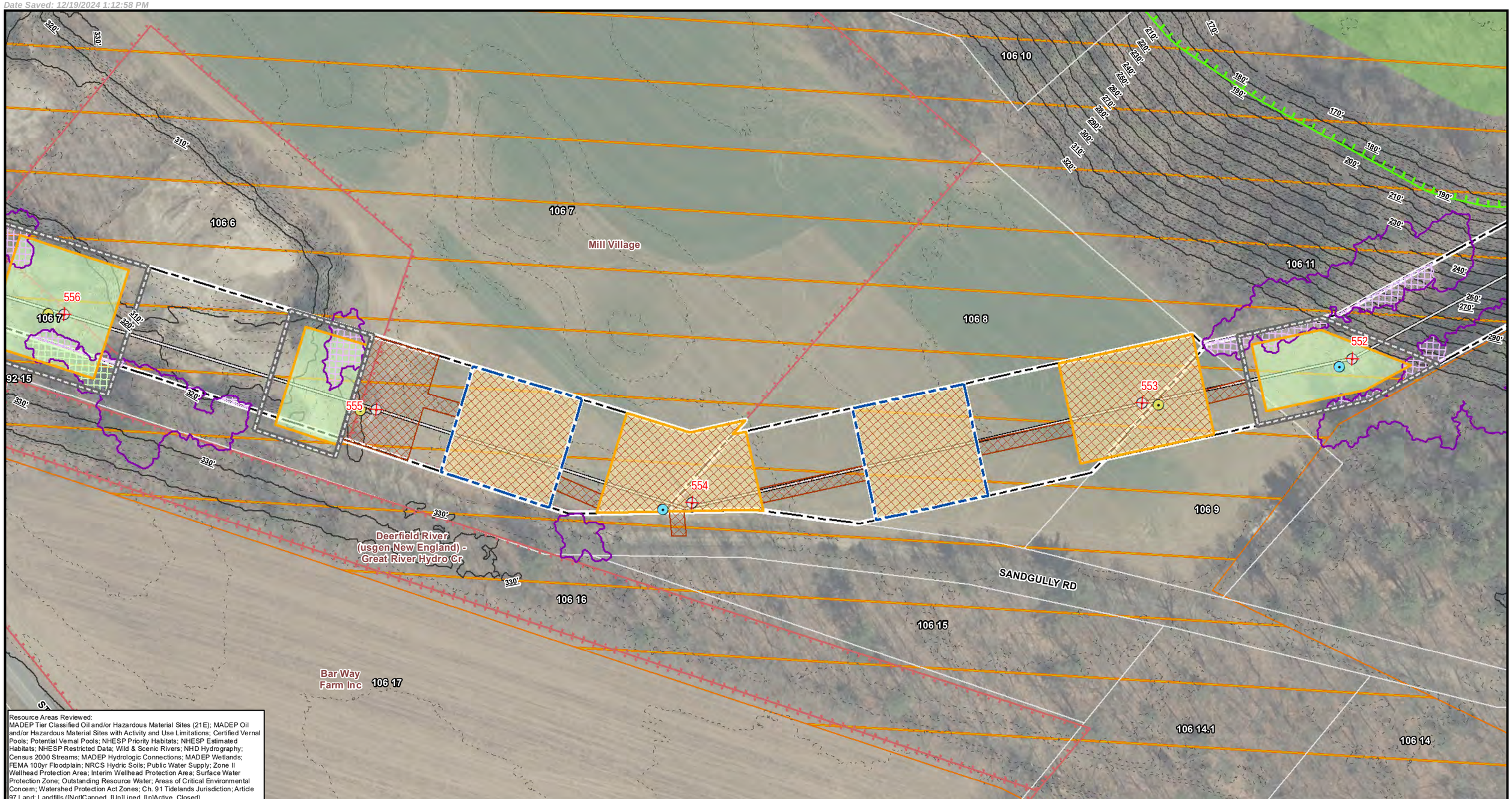

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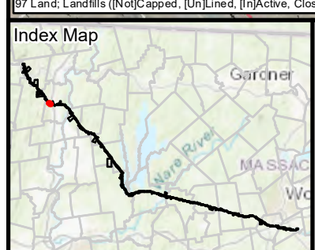

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Article 97 Lands

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0 50 100

Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Deerfield, MA
Page 37 of 240

MassGIS
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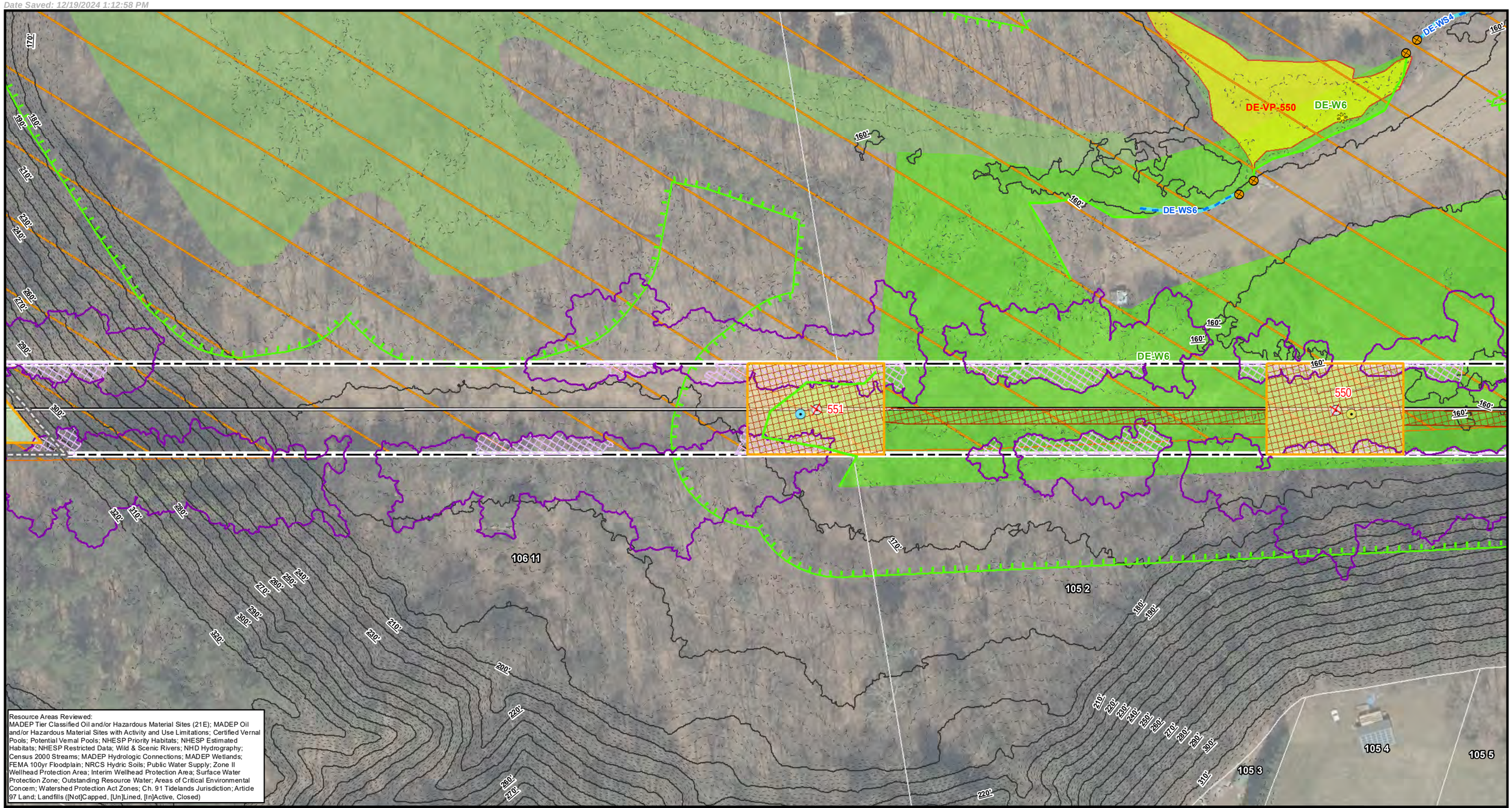

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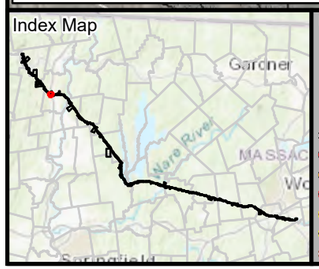

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DE-WS4
DE-VP-550
DE-W6
Sheet 39A
Sheet 39
DE-WS5
DE-WS7
DE-WS7A
DE-W7
DE-WS7A
DE-W6
549
548
DE-W8
547
DE-W9
DE-W10
91
105 6
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111 53
111 53
111 55
I-91
160'
170'
150'
190'
200'
210'
220'
230'
240'
250'
260'
270'
280'
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300'
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Index Map
Gardner
Ware River
MASSAC
Springfield

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Deerfield River (usgen New England) - Great River Hydro Cr

Deerfield River Access

I- 91

STILLWATER RD

DE-W5

DE-W4

DE-W6

DE-VP-550

DE-WS5

DE-WS4

DE-WS6

DE-W7

Sheet 39A

Sheet 39

550

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- Field Delineated Stream Area*
- Approximate Water Line
- Perennial Stream
- Coldwater Fisheries Resources
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- MADEP Wetlands*
- MADEP Open Water*
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- FEMA 100yr Floodplain*
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- Stonewall
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- Tree Removal
- Selective Tree Removal
- Pruning
- Town Boundary
- Parcel Boundaries

Article 97 Lands

- Dept. of Fish & Game
- Private

*Indicates Layers Set to Transparency

N

1 inch = 200 feet

0 100 200

Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Deerfield, MA
Page 39A of 240

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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105 8
105 7
104 1
94 19
Mill Village
105 6
111 64
111 63
MILL VILLAGE RD
DE-W10
DE-W9
DE-W11
DE-WS11
DE-S2
547
546
545
160'
180'
190'
200'
210'
220'
230'
240'
250'
260'
170'

Resource Areas Reviewed:
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Index Map

Gardner
Springfield

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- Private

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Environmental Resources Map

Deerfield, MA

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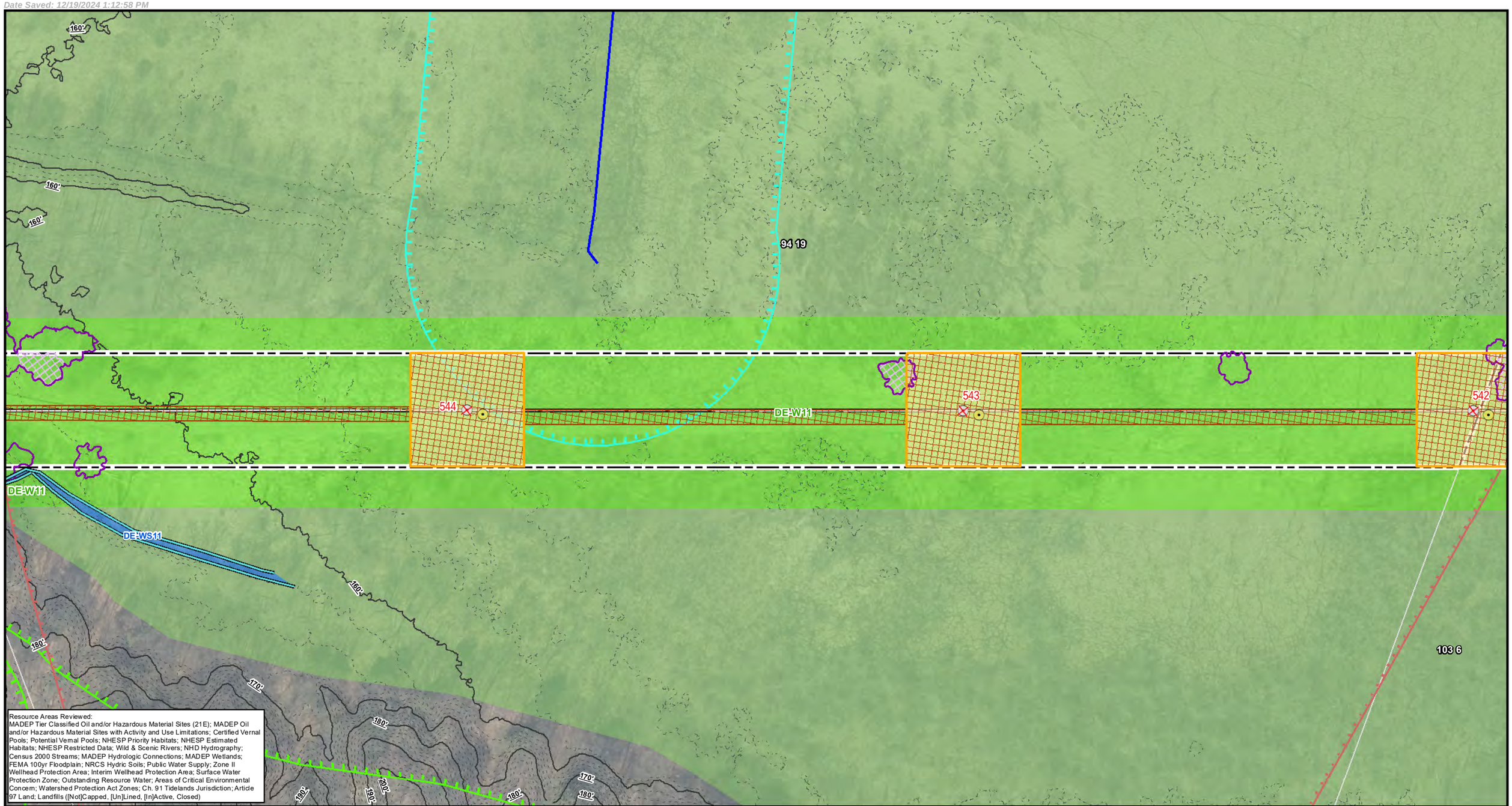

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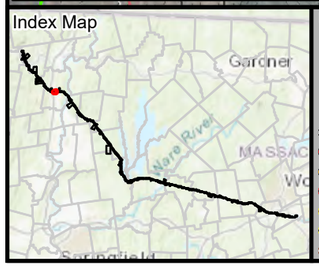

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Mill Village
94 19
542
541
540
DE-W11
DE-S3
DE-S3
GREENFIELD RD
5
103 8
103 9
103 2
103 1
103 6
113 8
113 7.1
113 9
Sheet 42
Sheet 42A
DE-W12
160'
170'
180'
190'
200'
210'
220'
230'

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Deerfield, MA

MassGIS
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GREENFIELD RD

CLARK CROSS RD

Mill Village

Sheet 42

Sheet 42A

113 9 | 113 17 | 113 10 | 113 11 | 103 1 | 113 7 | 113 7.1 | 113 4 | 113 3 | 103 2 | 113 6 | 113 5 | 113 2 | 103 6 | 113 8 | 123 26 | 123 28

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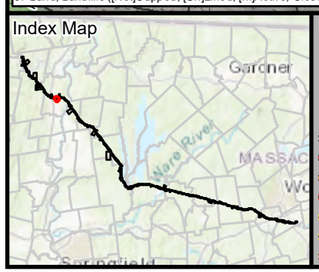

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Article 97 Lands

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0 50 100
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Deerfield, MA
Page 42A of 240

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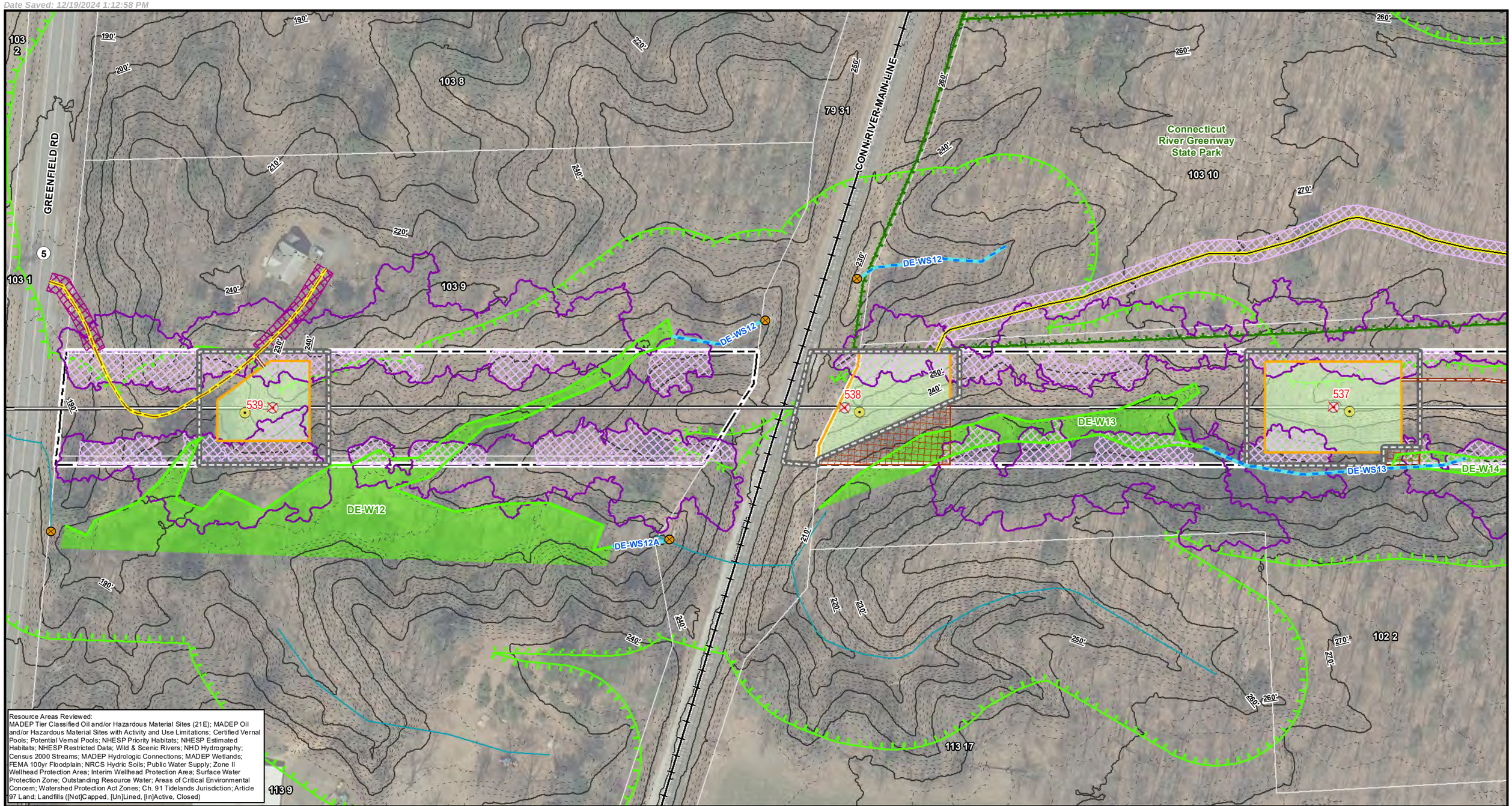

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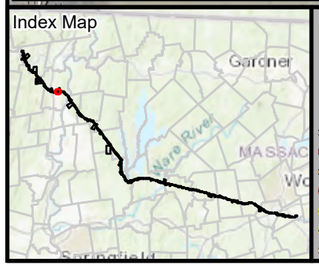

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Sheet 44A
Sheet 44

Connecticut River Greenway State Park

103 10

102 2

102 1

113 17

STEAM MILL RD

DE-S5
DE-WS14
DE-WS15
DE-W14
DE-W15
DE-WS13

536
535
534

SPAN STREAM
SPAN STREAM

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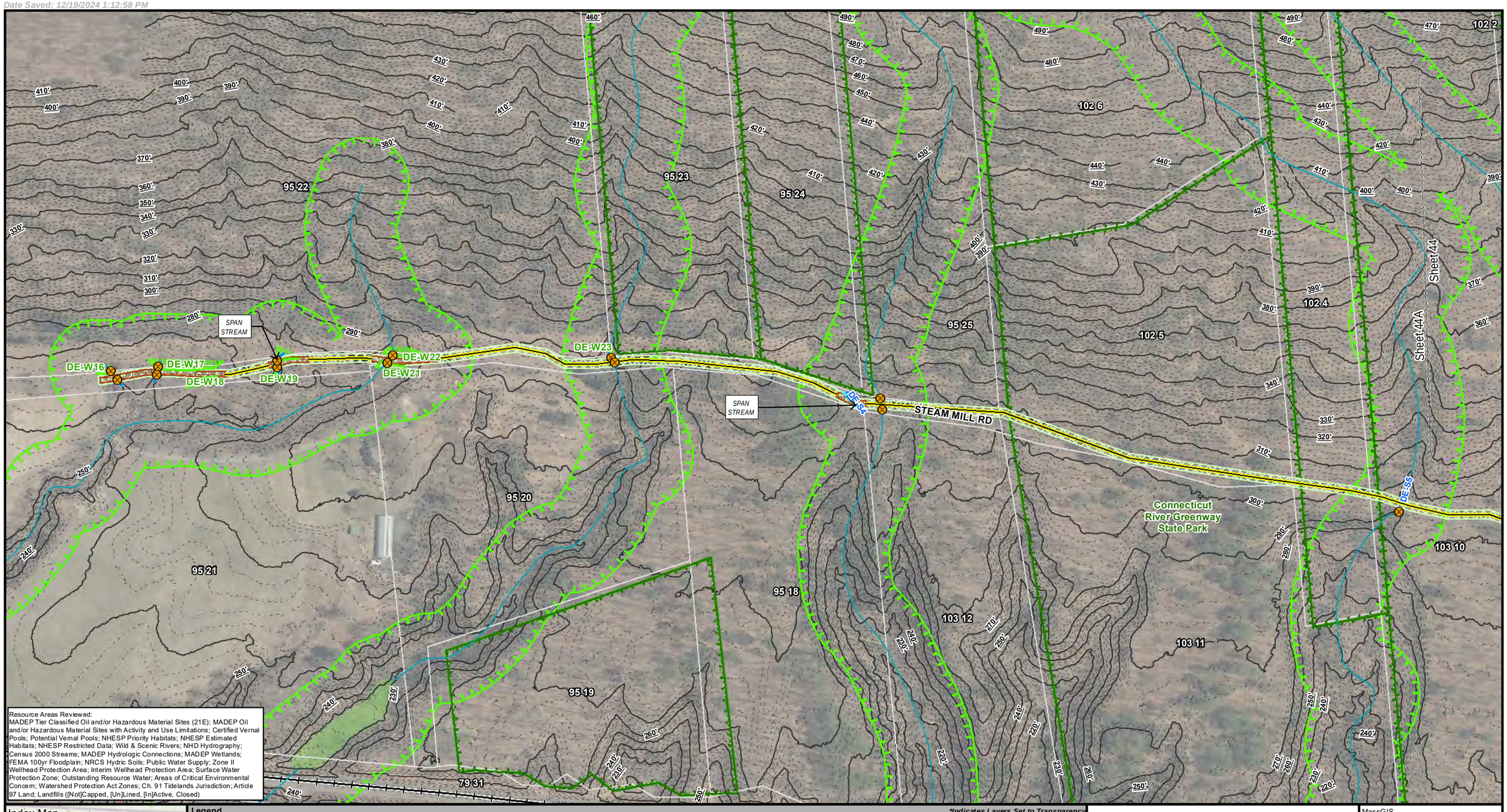

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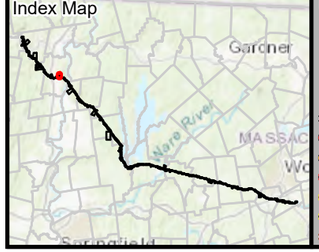

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Article 97 Lands

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- Private

*Indicates Layers Set to Transparency

N

1 inch = 200 feet
0 100 200
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Deerfield, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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103 10

Connecticut River Greenway State Park

102 2

102 7

102 1

113 17

HIKING TRL

DE-S6

531

532

533

534

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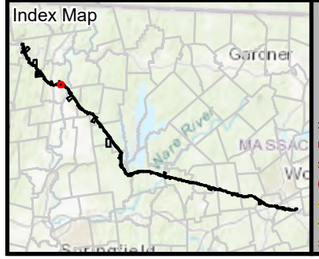

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530
529
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102 7
115 1
SPAN STREAM
DE-ST
Connecticut River Greenway State Park

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Deerfield, MA

MassGIS
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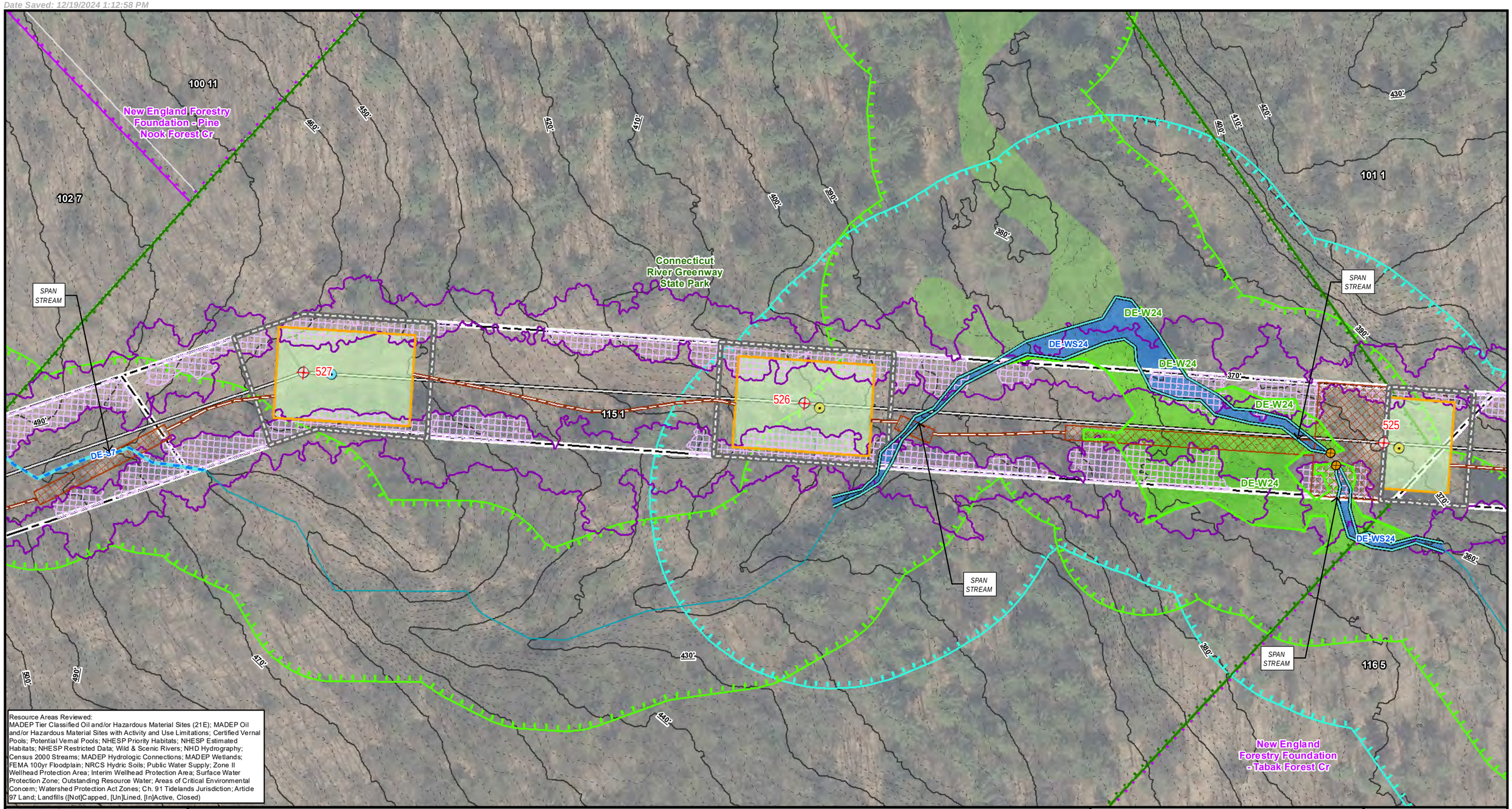

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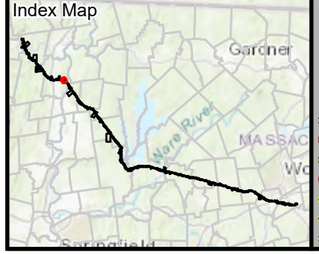

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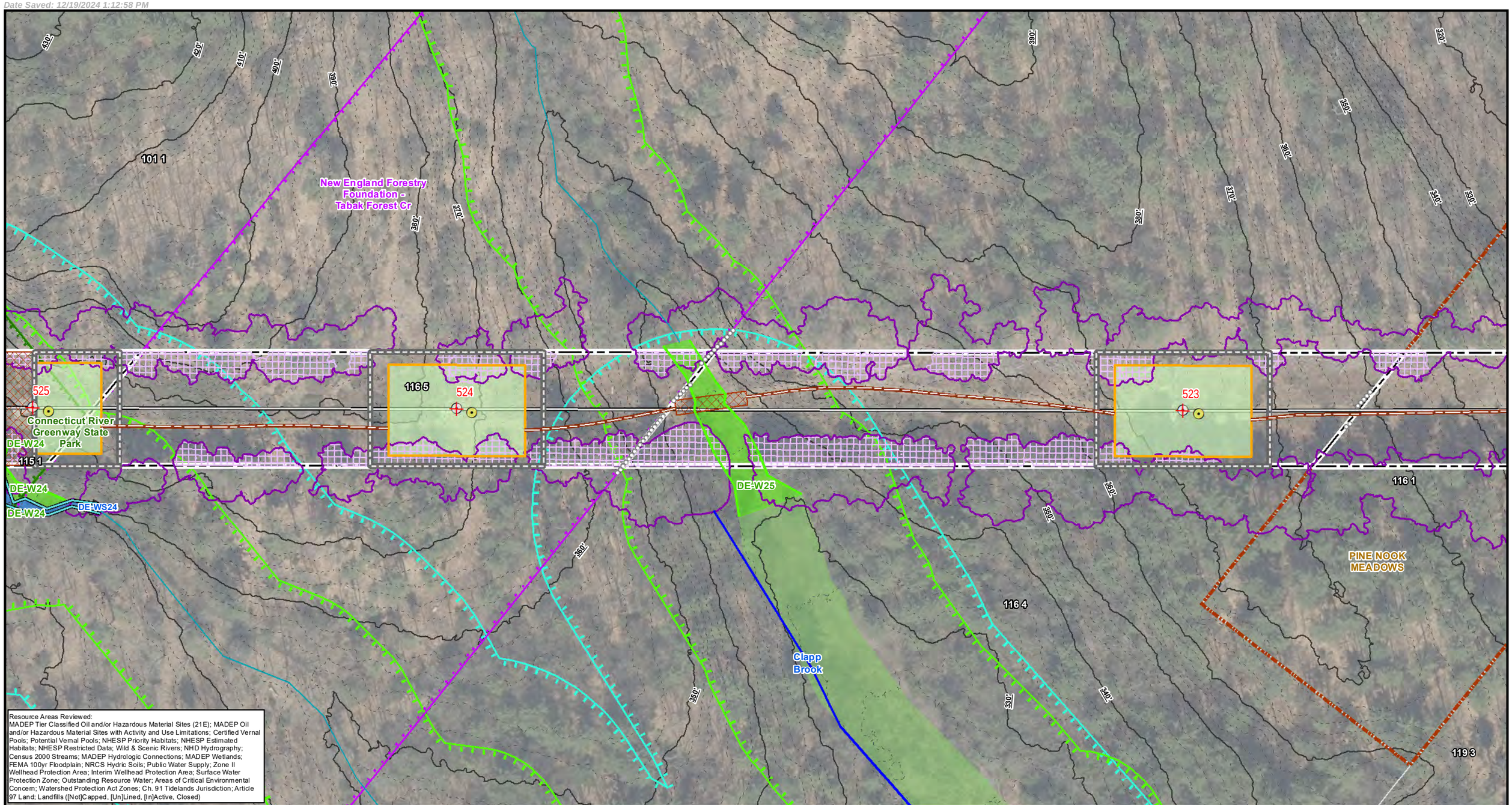

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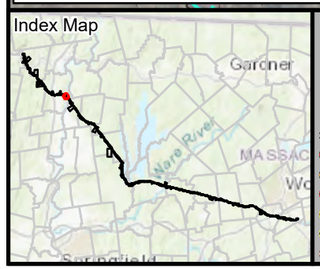

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Article 97 Lands

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1 inch = 100 feet

0 50 100

Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Deerfield, MA

MassGIS
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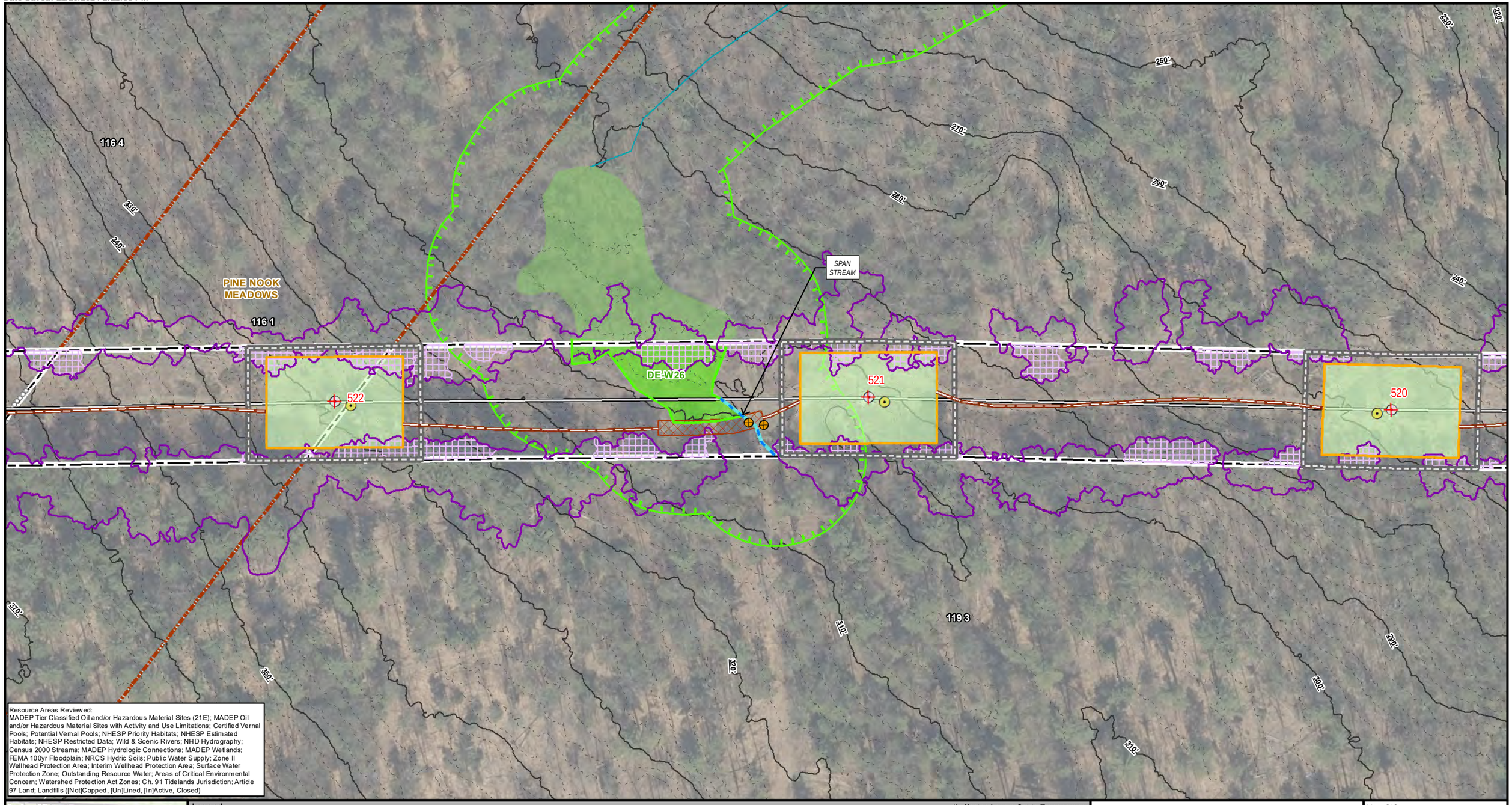

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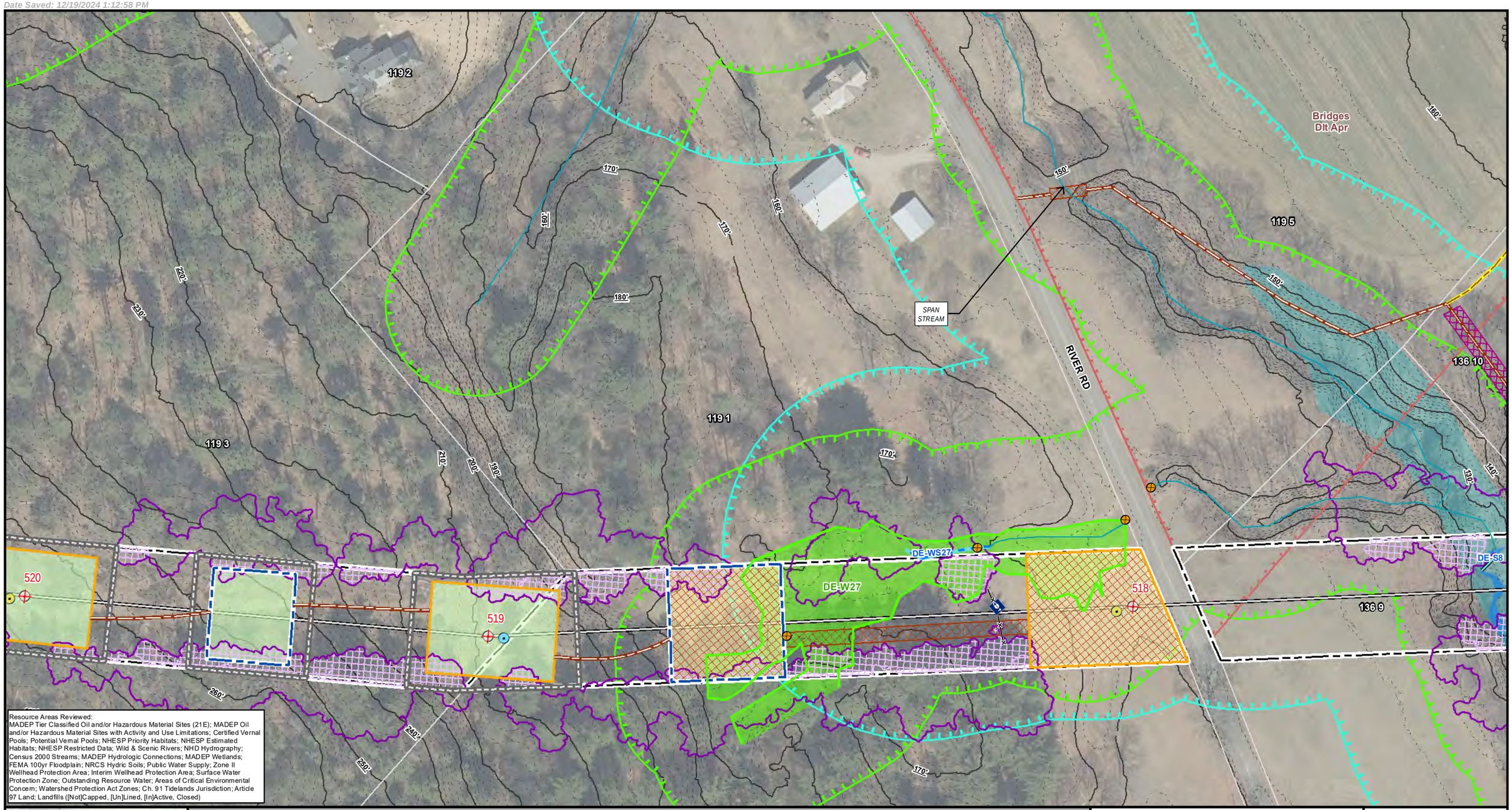

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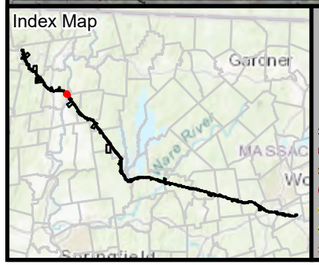

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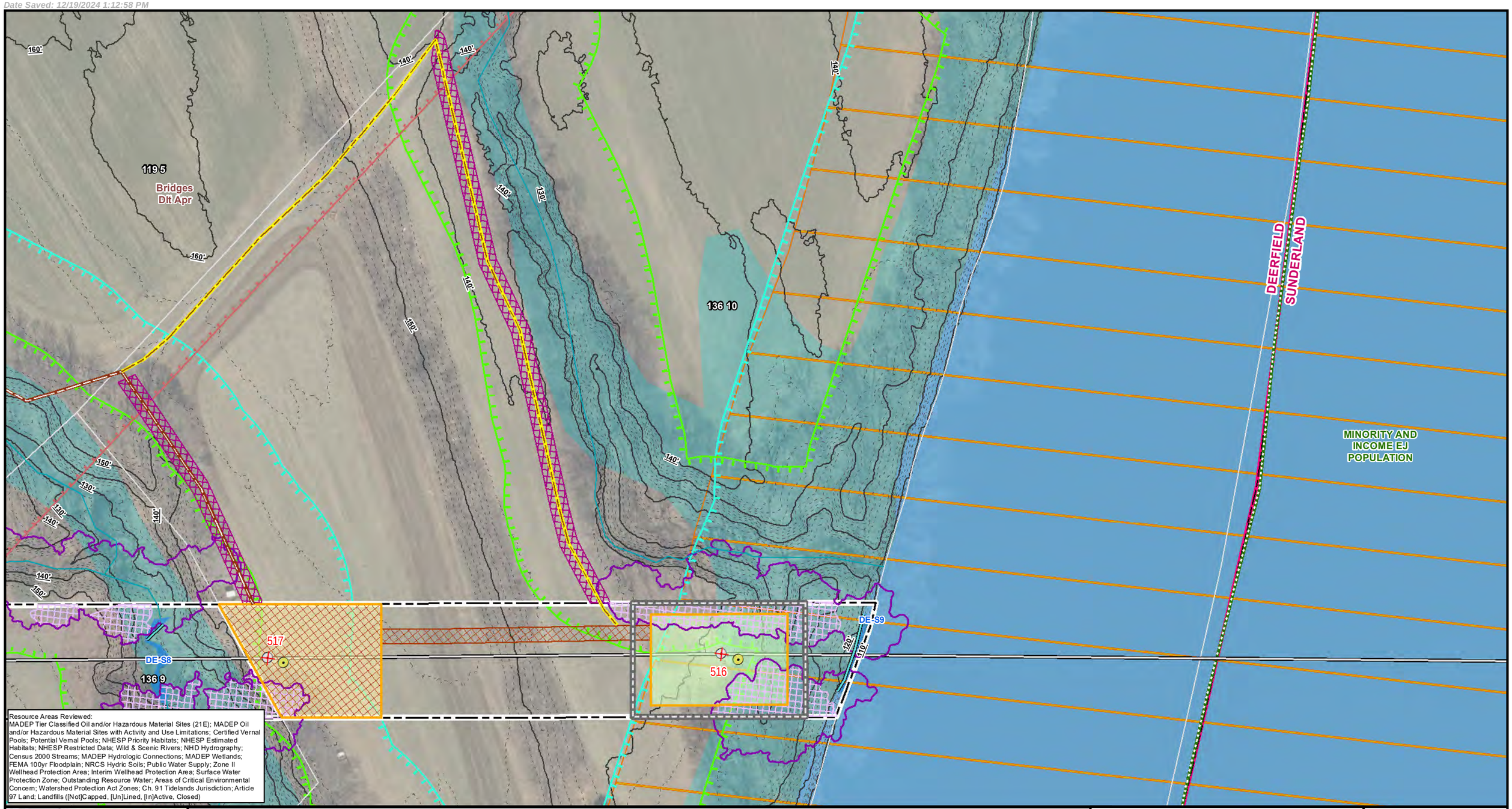

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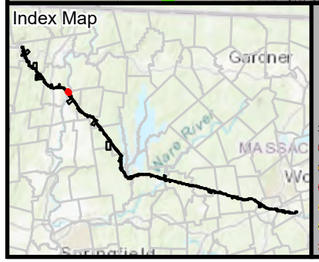

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Environmental Justice Populations 2020

- Minority and Income

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Deerfield & Sunderland, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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ENTIRE MAP PAGE IS WITHIN MINORITY AND INCOME ENVIRONMENTAL JUSTICE POPULATIONS

Connecticut River Greenway State Park

GUNN CROSS RD

1067 1066 1076 1068 1069 1075 1070

Gunn Brook

515 514

DE-S9

SU-W1 SU-W1 SU-WS1 SU-W2 SU-WS2

MINORITY AND INCOME EJ POPULATION

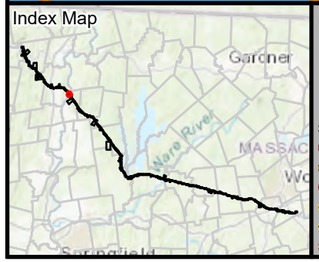
Sheet 52
Sheet 52A

Shilling

FALLS RD

Resource Areas Reviewed:
MADEP Tier Classified Oil and/or Hazardous Material Sites (21E); MADEP Oil and/or Hazardous Material Sites with Activity and Use Limitations; Certified Vernal Pools; Potential Vernal Pools; NHESP Priority Habitats; NHESP Estimated Habitats; NHESP Restricted Data; Wild & Scenic Rivers; NHD Hydrography; Census 2000 Streams; MADEP Hydrologic Connections; MADEP Wetlands; FEMA 100yr Floodplain; NRCS Hydric Soils; Public Water Supply; Zone II Wellhead Protection Area; Interim Wellhead Protection Area; Surface Water Protection Zone; Outstanding Resource Water; Areas of Critical Environmental Concern; Watershed Protection Act Zones; Ch. 91 Tidelands Jurisdiction; Article 97 Land; Landfills ([Not]Capped, [Un]Lined, [In]Active, Closed)

Index Map



Legend

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- Selective Tree Removal
- Pruning
- Town Boundary
- Parcel Boundaries

Article 97 Lands

- DCR-State Parks & Recreation
- Private

Environmental Justice Populations 2020

- Minority and Income

1 inch = 100 feet
0 50 100
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Sunderland, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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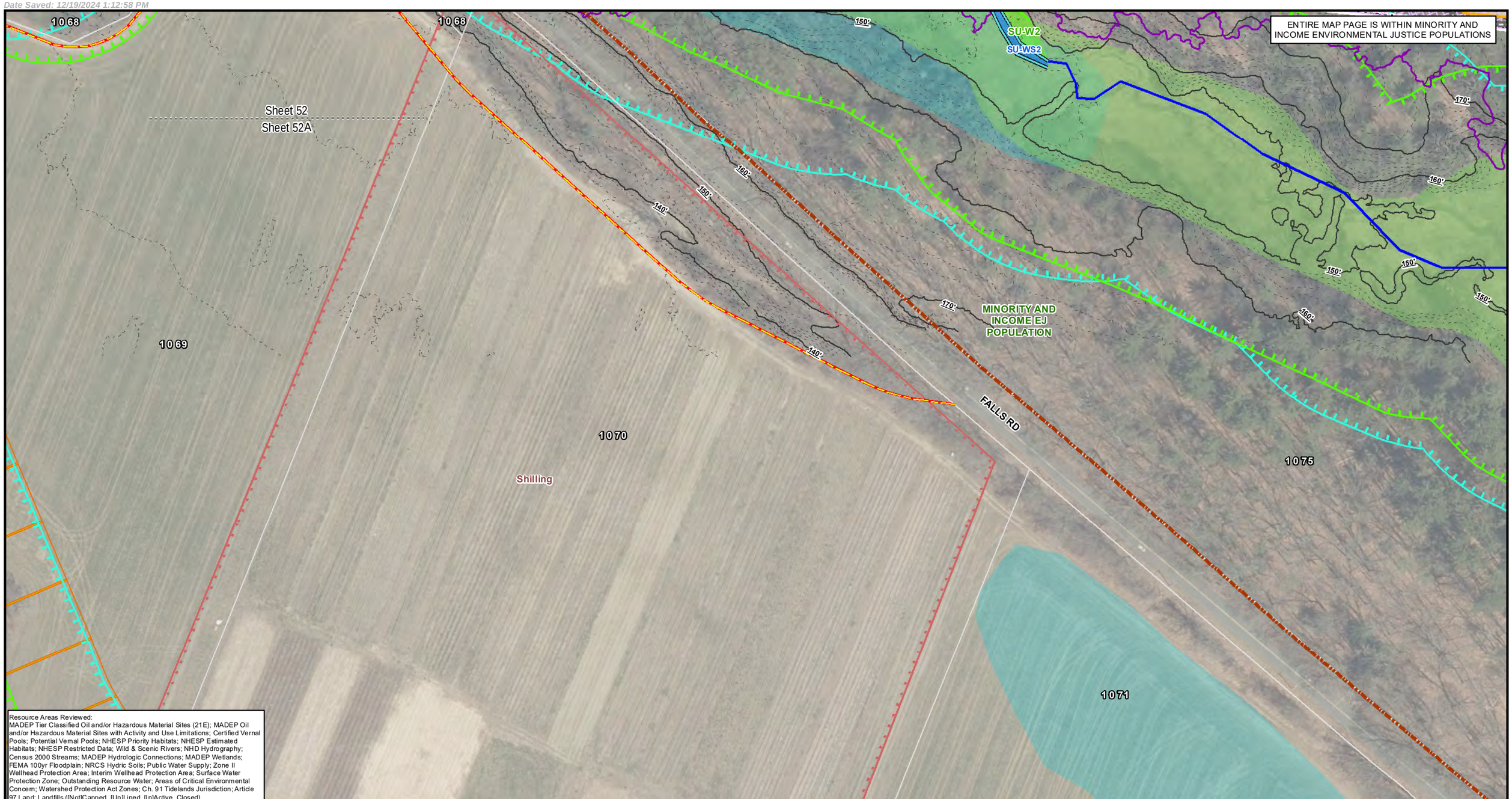

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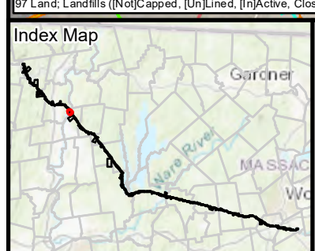

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Article 97 Lands

- Private

Environmental Justice Populations 2020

- Minority and Income

**Indicates Layers Set to Transparency*

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Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Sunderland, MA
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MassGIS
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10134
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Resource Areas Reviewed:
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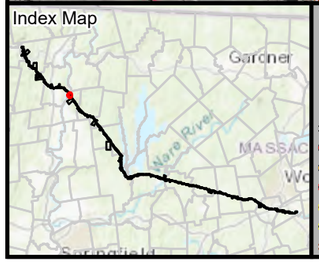

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- Town Boundary
- Parcel Boundaries

Article 97 Lands

- Private

Environmental Justice Populations 2020

- Minority and Income

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0 50 100
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Sunderland, MA
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MassGIS
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Patterson Donald F Jr Apr

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SPAN STREAM

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SU-WS3

SPAN STREAM

SU-W3A

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MINORITY AND INCOME EJ POPULATION

2063

205

2013

MONTAGUE RD

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10 112

10 157

GUNN MTN RD

Resource Areas Reviewed:
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Gardner

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Article 97 Lands

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Environmental Justice Populations 2020

- Minority and Income

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Sunderland, MA
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- Town Boundary
- Parcel Boundaries

Article 97 Lands

- Dept. of Fish & Game
- Private

Environmental Justice Populations 2020

- Minority and Income

1 inch = 100 feet
0 50 100
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Sunderland, MA
Page 54 of 240

MassGIS
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MINORITY AND INCOME EJ POPULATION

MONTAGUE RD

47

SU-WS5
SU-WS5
SU-W5
SU-W6

Patterson Donald F Jr Apr

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270'
280'
290'
300'
310'
320'
330'
340'
250'

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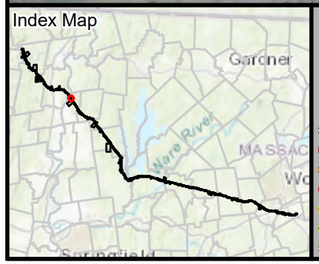

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- Railroad
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N

1 inch = 100 feet
0 50 100
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Sunderland, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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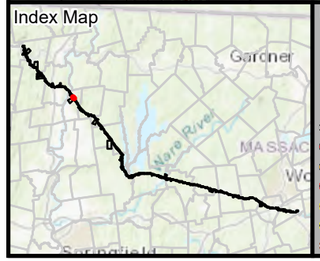

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SU-S25
SU-S27
SU-VP-502-3
SPAN STREAM
SPAN STREAM
N MOUNTAIN RD
Mt. Toby Wma
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UNKNOWN
UNKNOWN
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MINORITY AND INCOME EJ POPULATION

UNKNOWN

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SU-VP-502-3

SU-S27
SU-WS26
SU-W26
SU-WS26
SU-W24
SU-WS24
SU-W24
SU-WS24
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N BEARS DEN DR
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PARK RD
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CLAYBROOK RD
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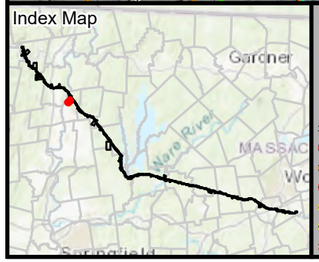

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Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Sunderland, MA
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MassGIS
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3031
MINORITY AND INCOME EJ POPULATION
SPAN STREAM
SPAN STREAM
SU-W13
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SU-W14
SU-WS13
SU-WS13A
SU-S2
501
500
N MOUNTAIN RD
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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

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3010
3011
3032
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3013
209
Mt. Toby Wma
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499
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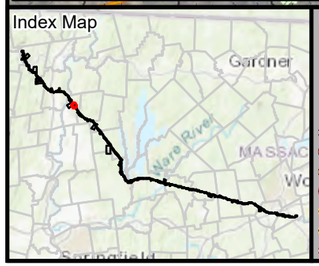

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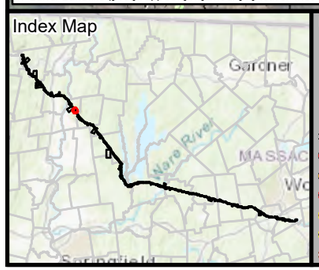

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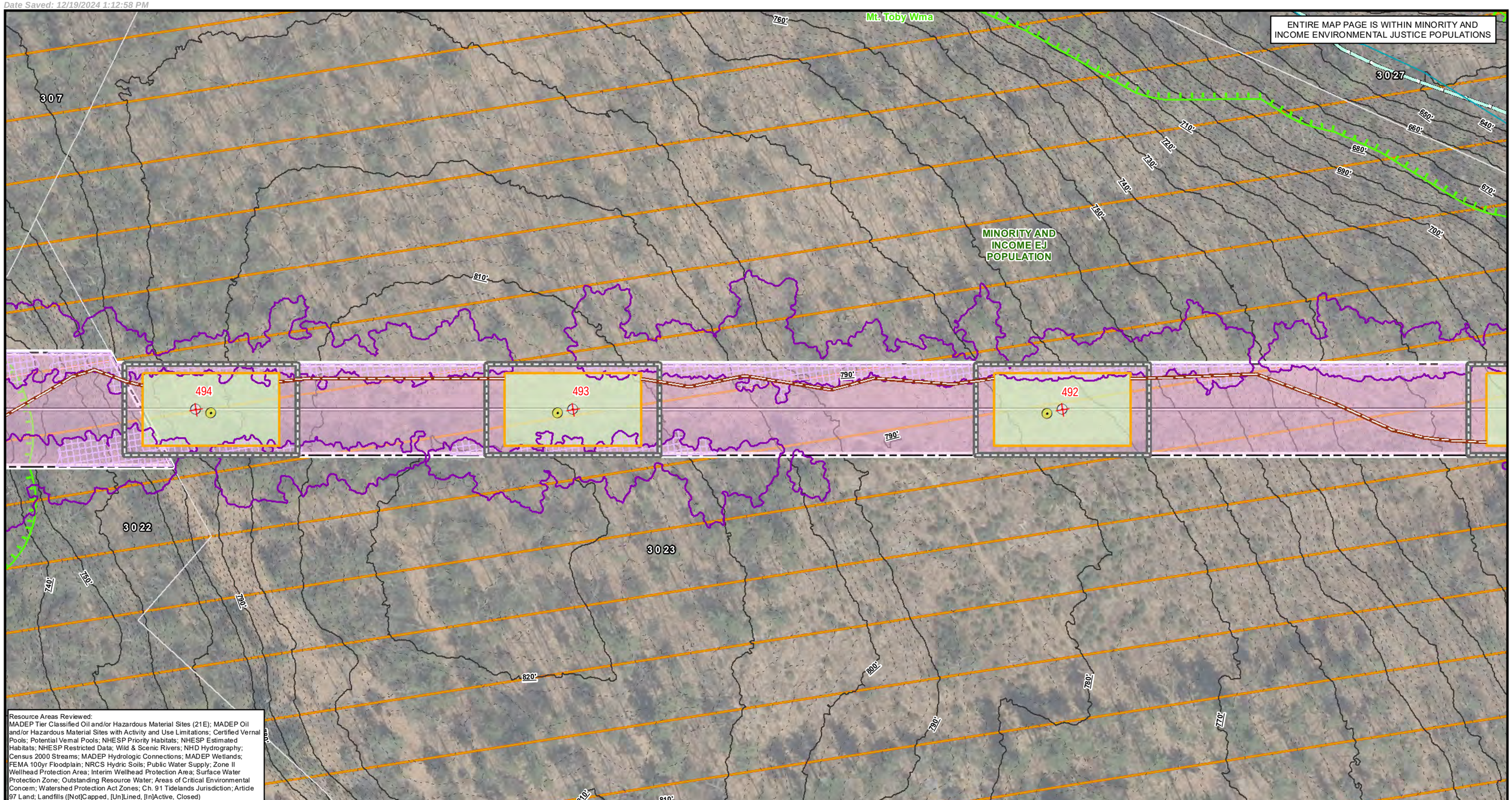

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- Catch Basin
- Access Gate
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- Approximate Pipeline
- 2ft Contour
- 10ft Contour
- Fenceline
- Guardrail
- Stonewall
- Existing Treeline
- Tree Removal
- Selective Tree Removal
- Pruning
- Town Boundary
- Parcel Boundaries

Article 97 Lands

- Dept. of Fish & Game

Environmental Justice Populations 2020

- Minority and Income

**Indicates Layers Set to Transparency*

N

1 inch = 100 feet

0 50 100

Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Sunderland, MA
Page 60 of 240

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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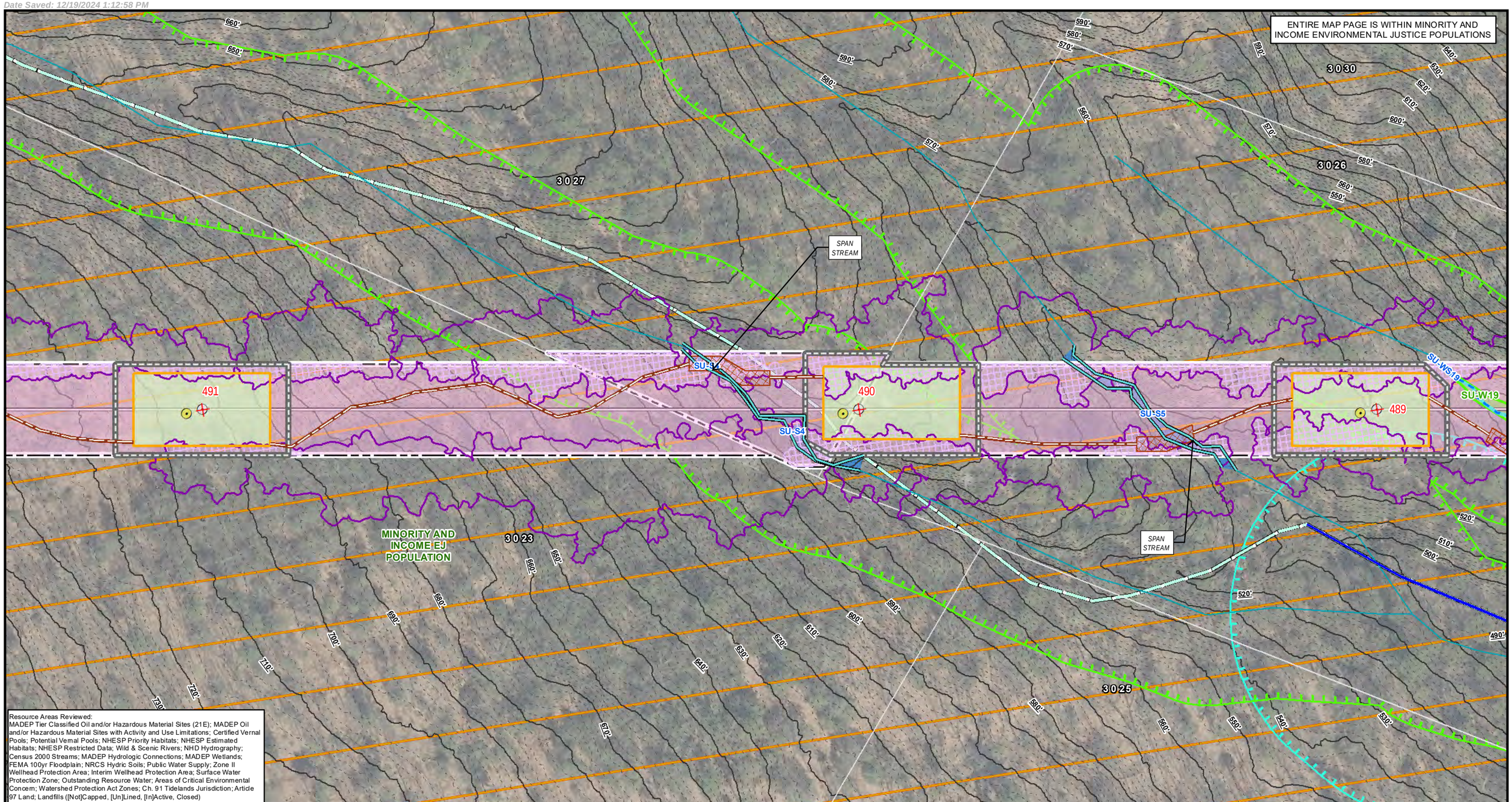

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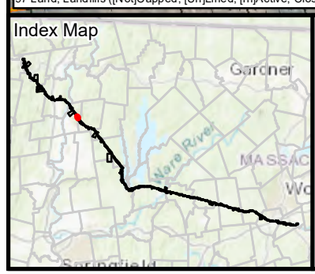

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Environmental Resources Map

Sunderland, MA

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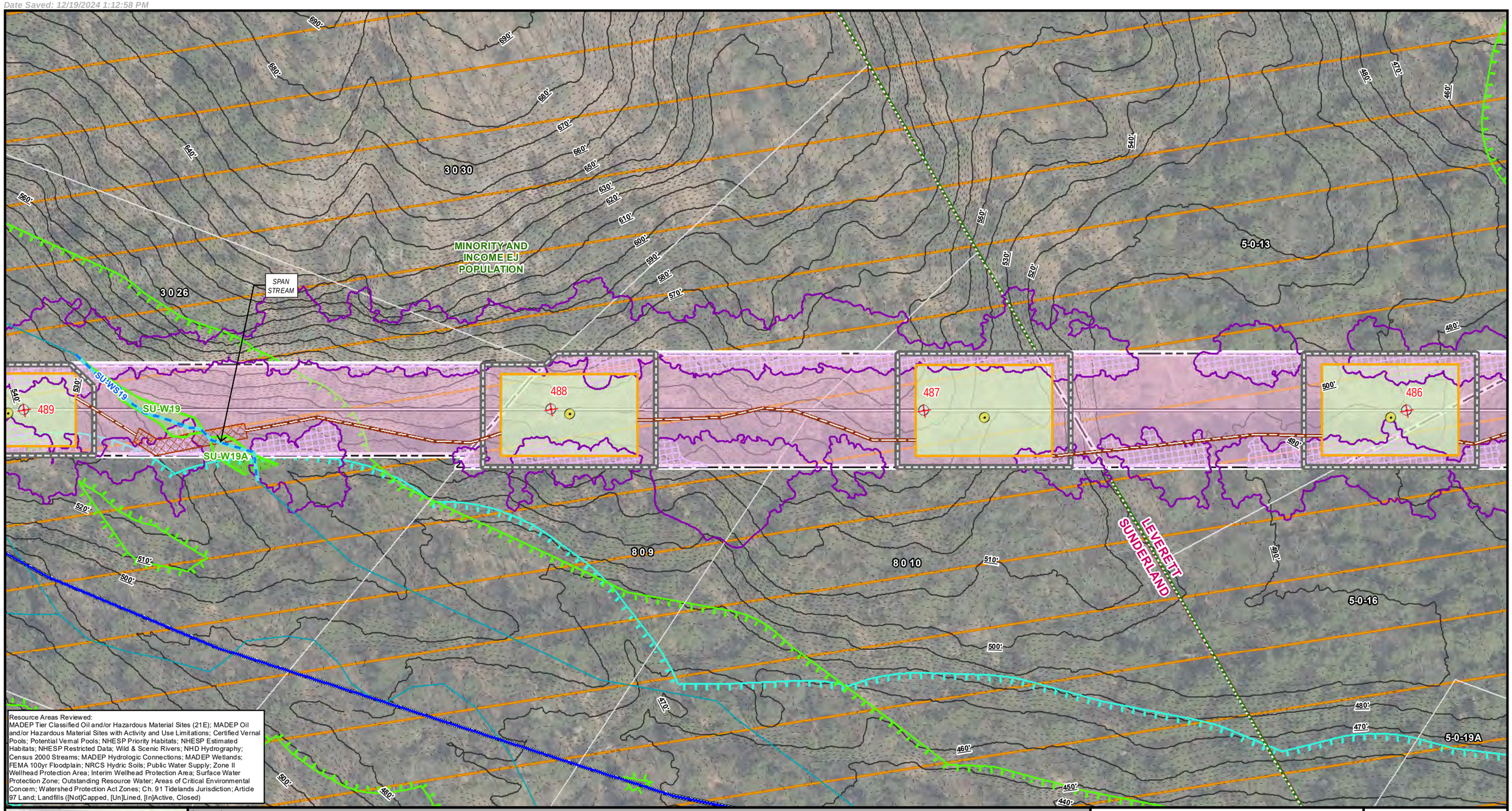

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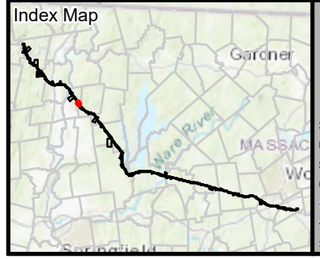

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Sunderland & Leverett, MA
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SPAN STREAM

LE-S1

LE-W1

LE-W1

LE-WS1

5-0-13

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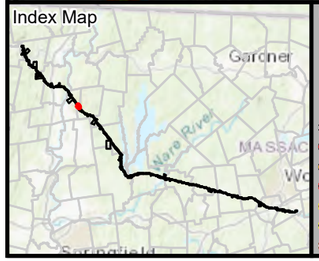

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Leverett, MA

MassGIS
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SPAN STREAM
SPAN STREAM
SPAN STREAM
SPAN STREAM
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LE-W4
LE-S2
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Gardner
Springfield

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Environmental Justice Populations 2020

- Minority and Income

1 inch = 200 feet
0 100 200
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Deerfield, MA
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MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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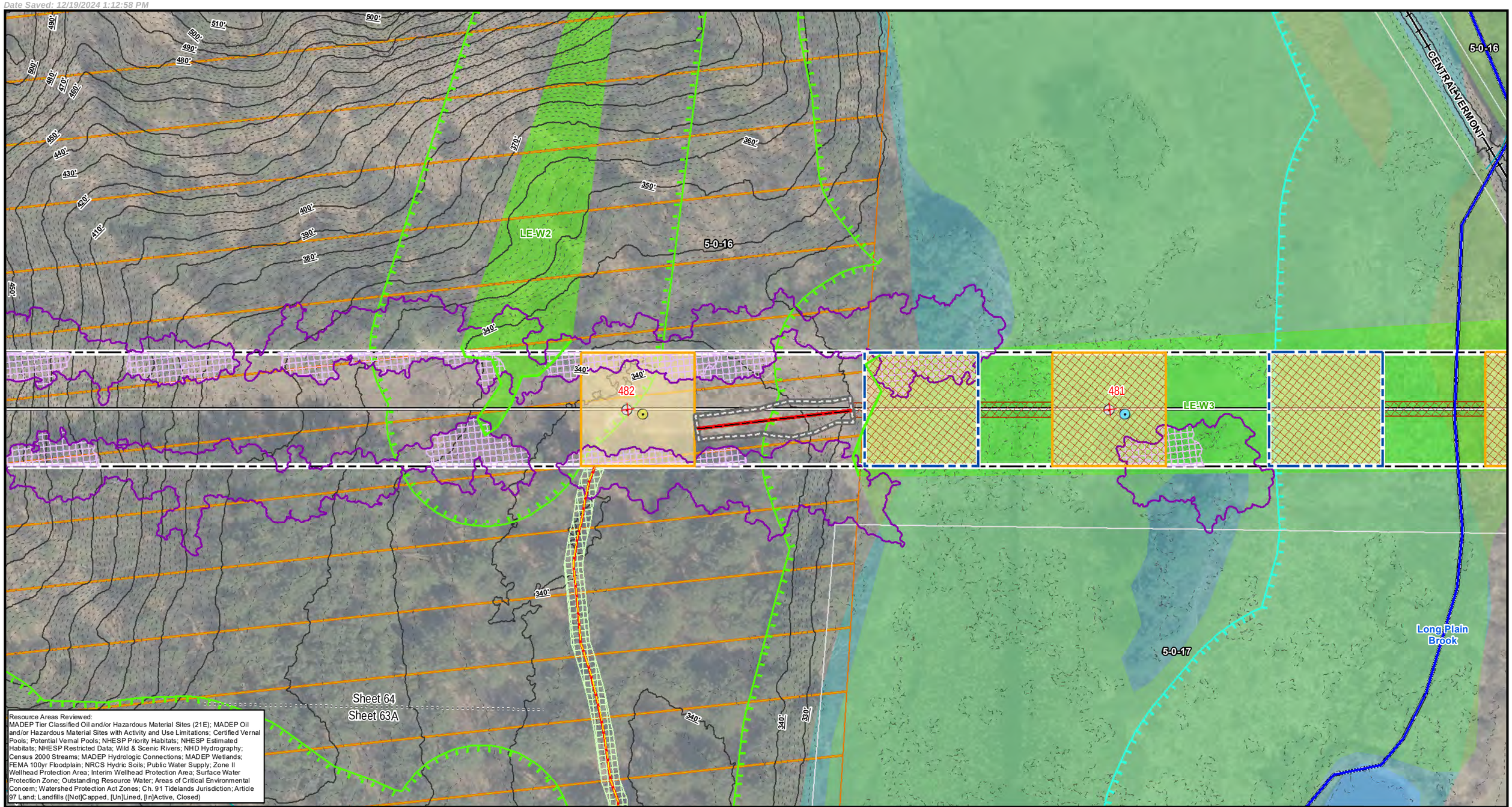

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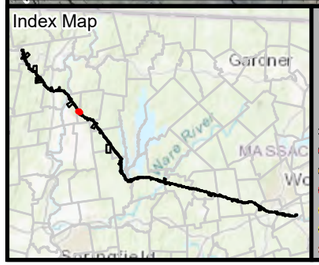

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Leverett, MA
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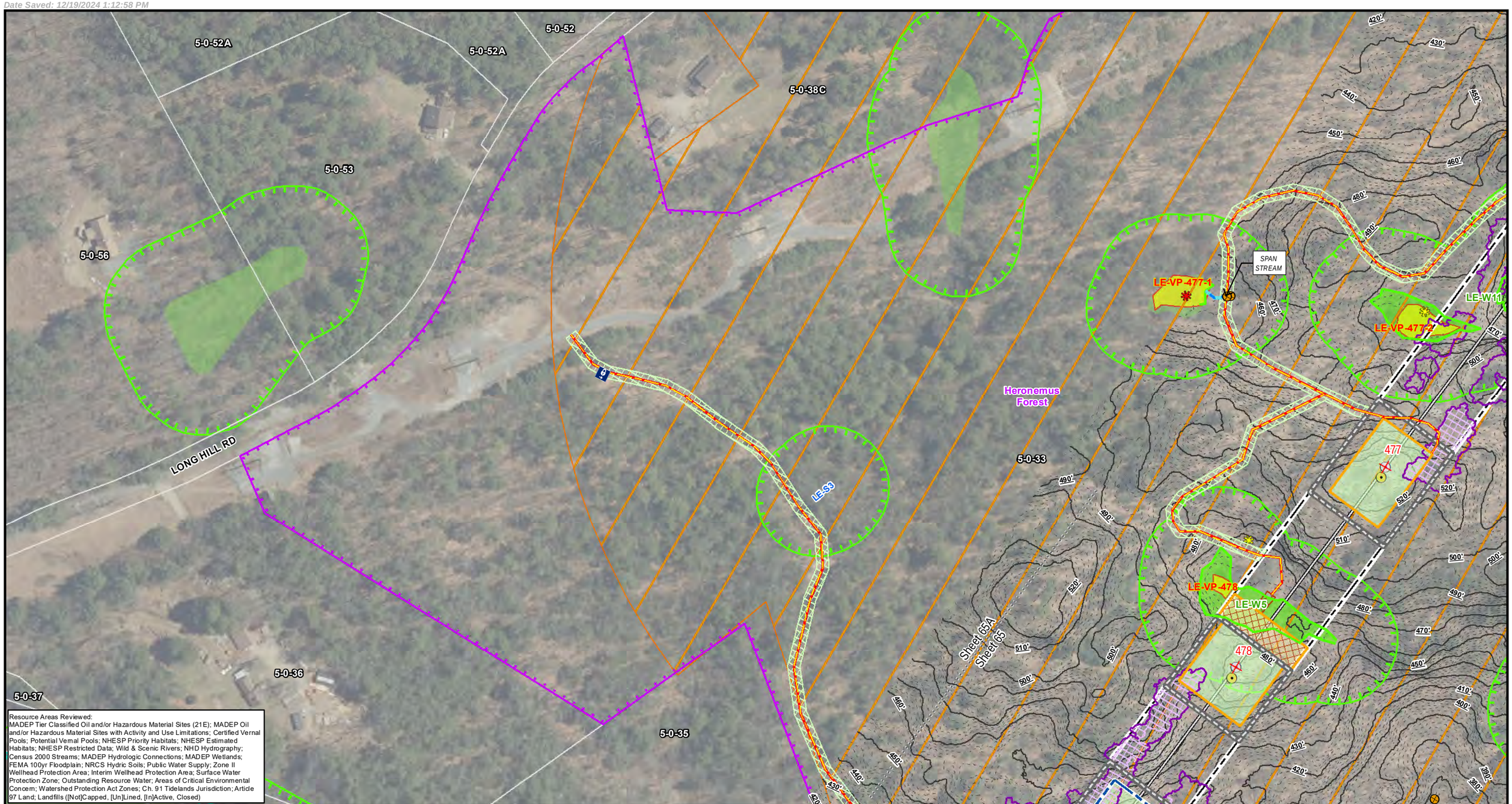

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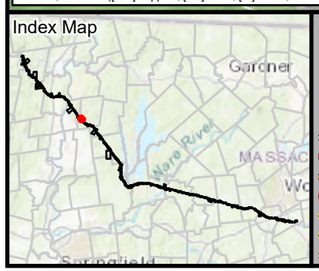

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- Field Delineated Vernal Pool*
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*Indicates Layers Set to Transparency

1 inch = 150 feet
0 75 150
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

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MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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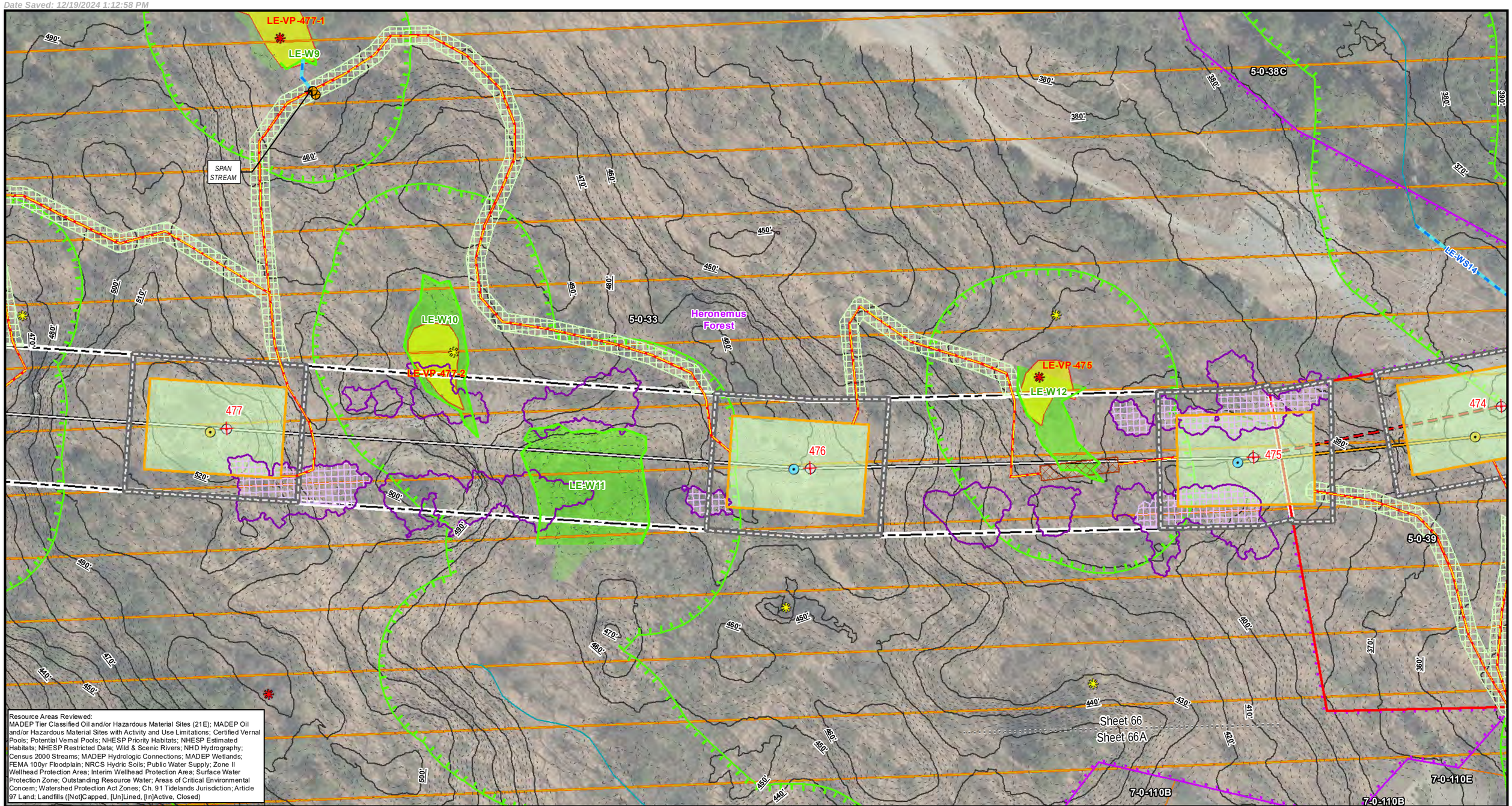

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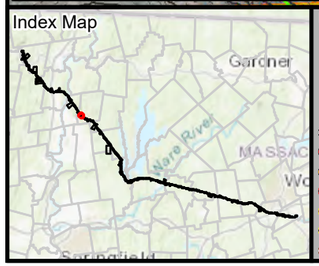
Index Map



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Environmental Resources Map

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Sheet 67
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LE-W13
7-0-110
7-0-110A
7-0-110B
7-0-110C
7-0-110D
7-0-110E
7-0-111
7-0-115D
7-0-116
7-0-118
7-0-118C
DEPOT RD
Ruth Mcintire Conservation Area

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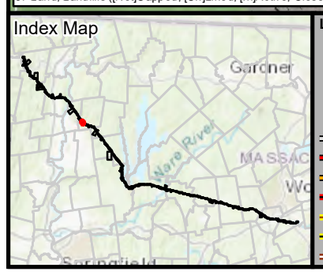

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Environmental Resources Map

Leverett, MA
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Index Map
Gardner
Springfield

Legend

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Leverett, MA

MassGIS
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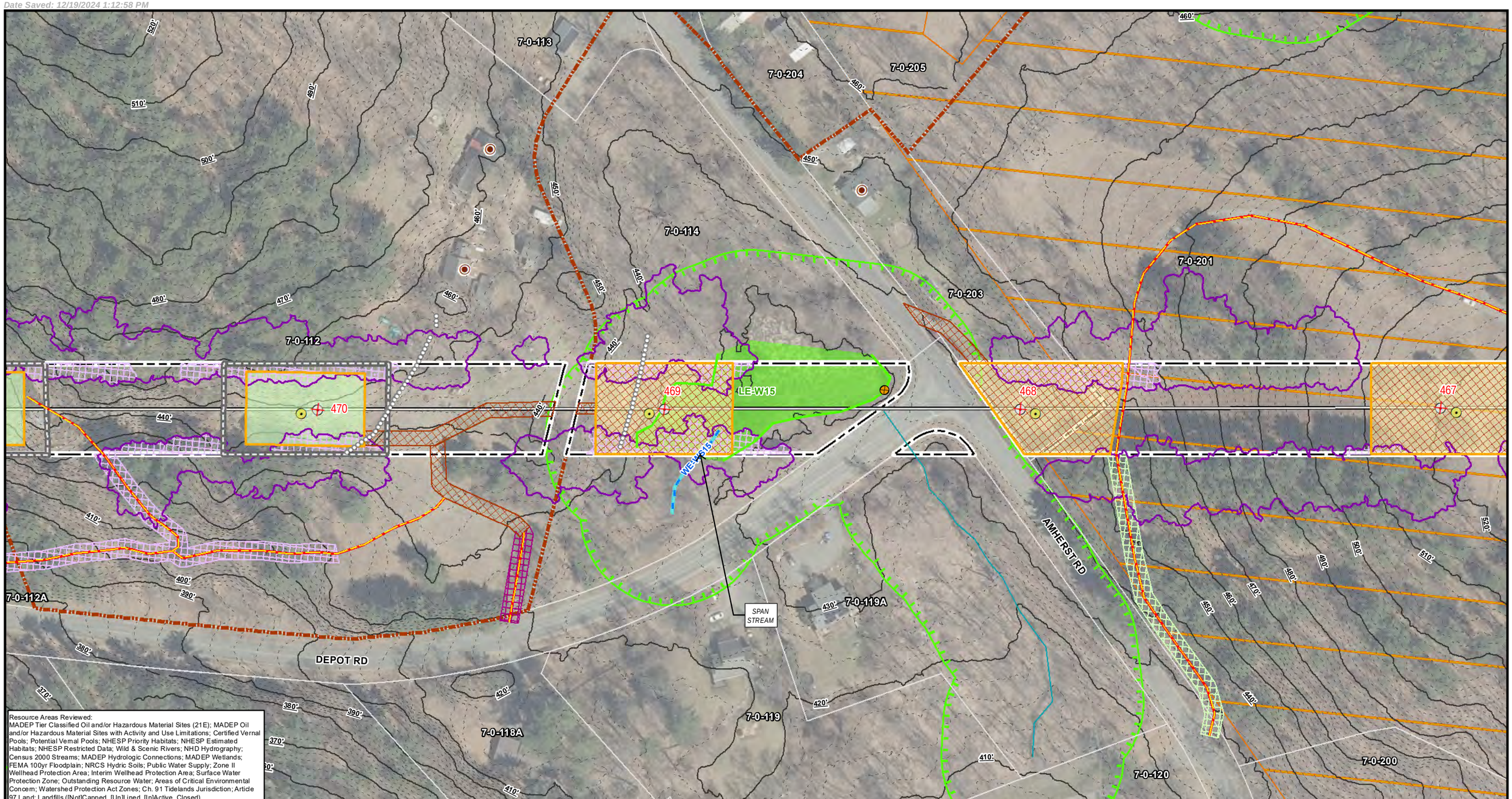

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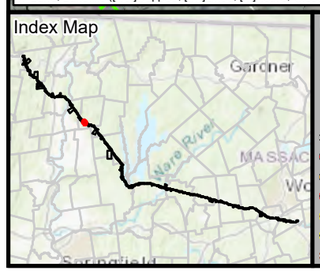
Index Map



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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

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MassGIS
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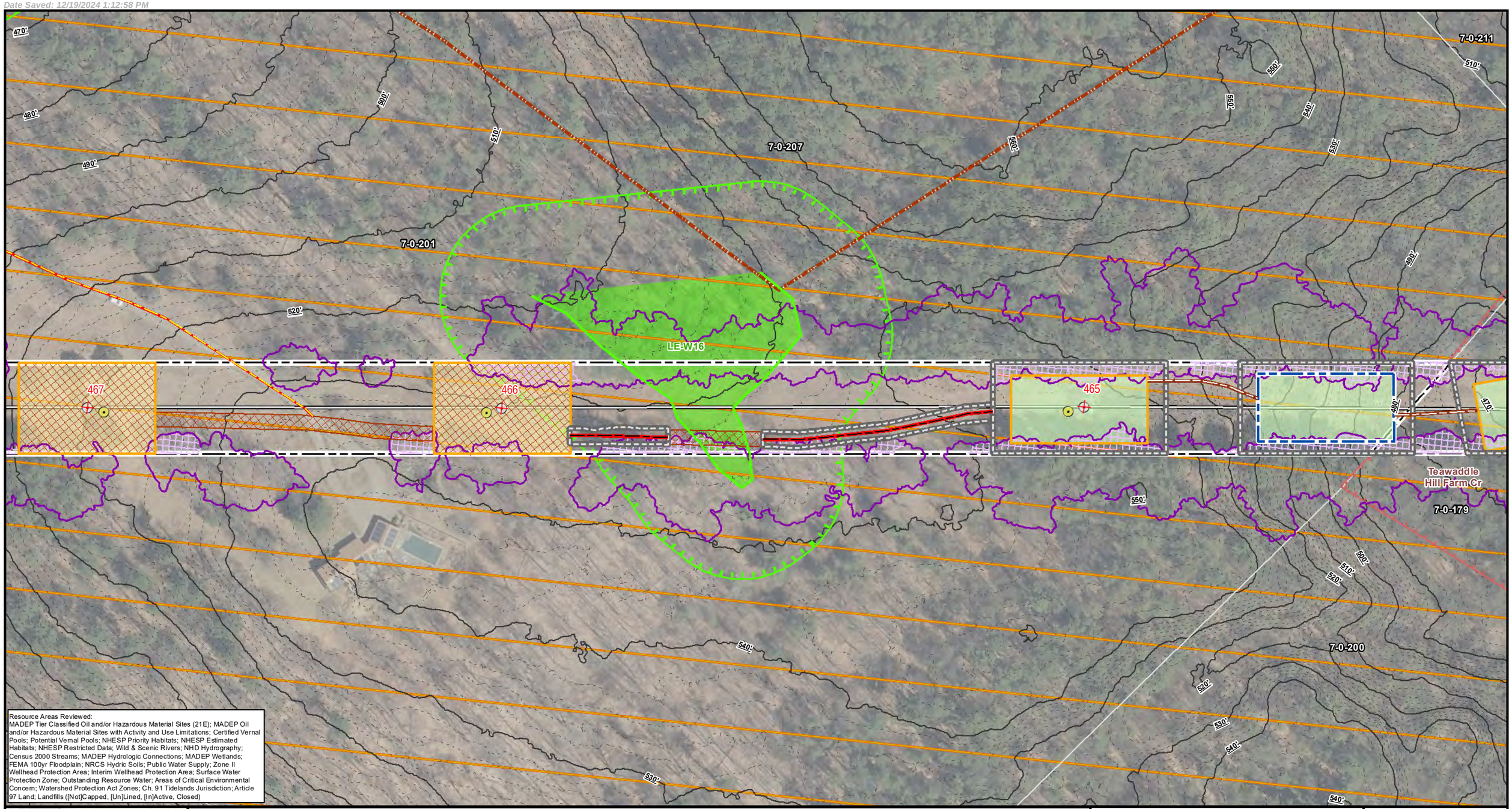

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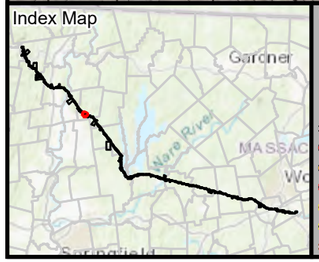

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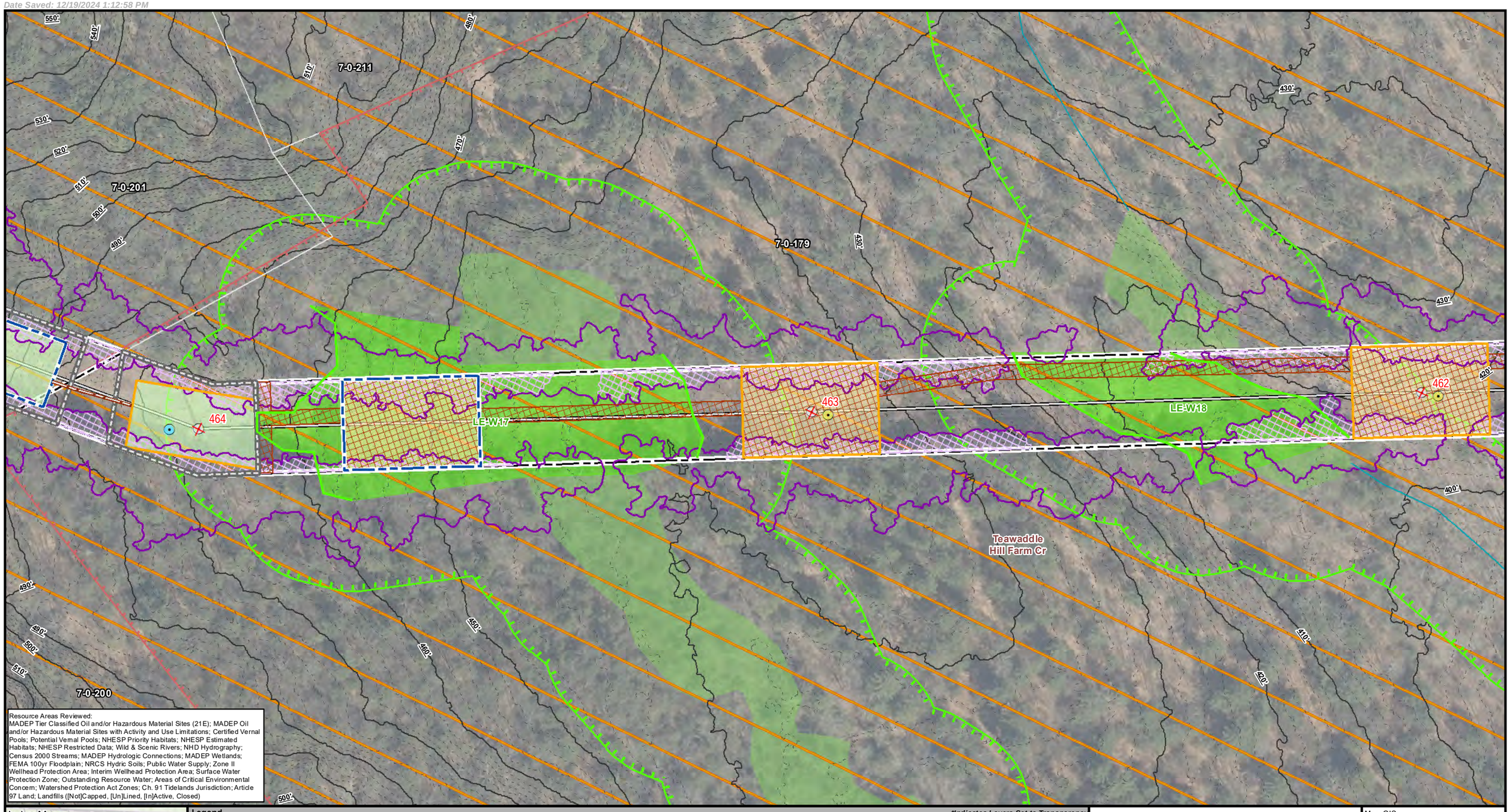

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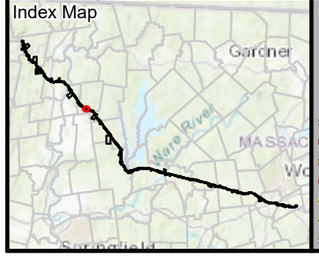

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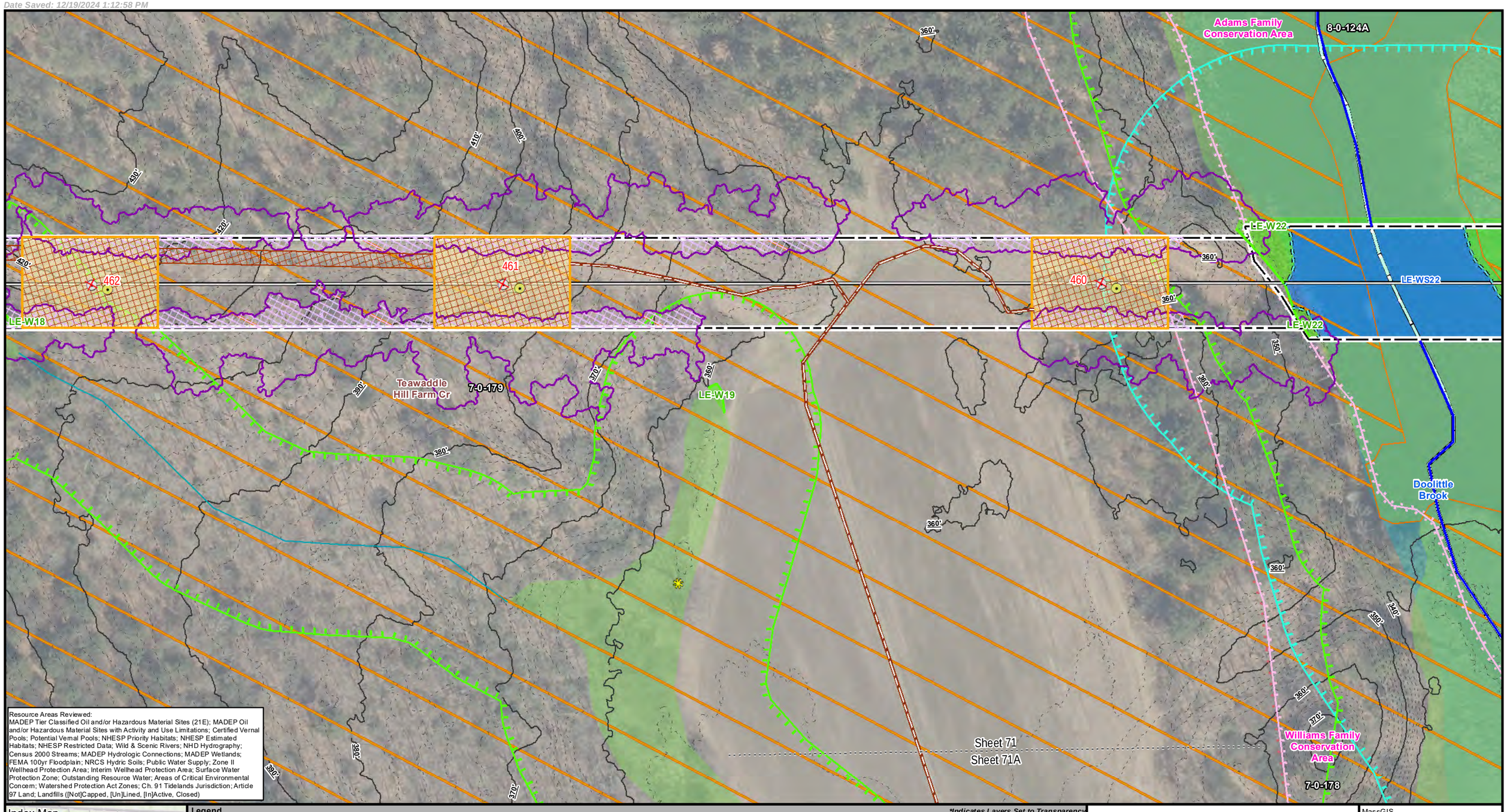

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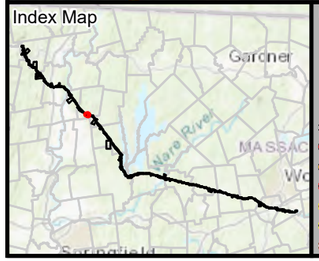

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Article 97 Lands

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1 inch = 100 feet

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Leverett, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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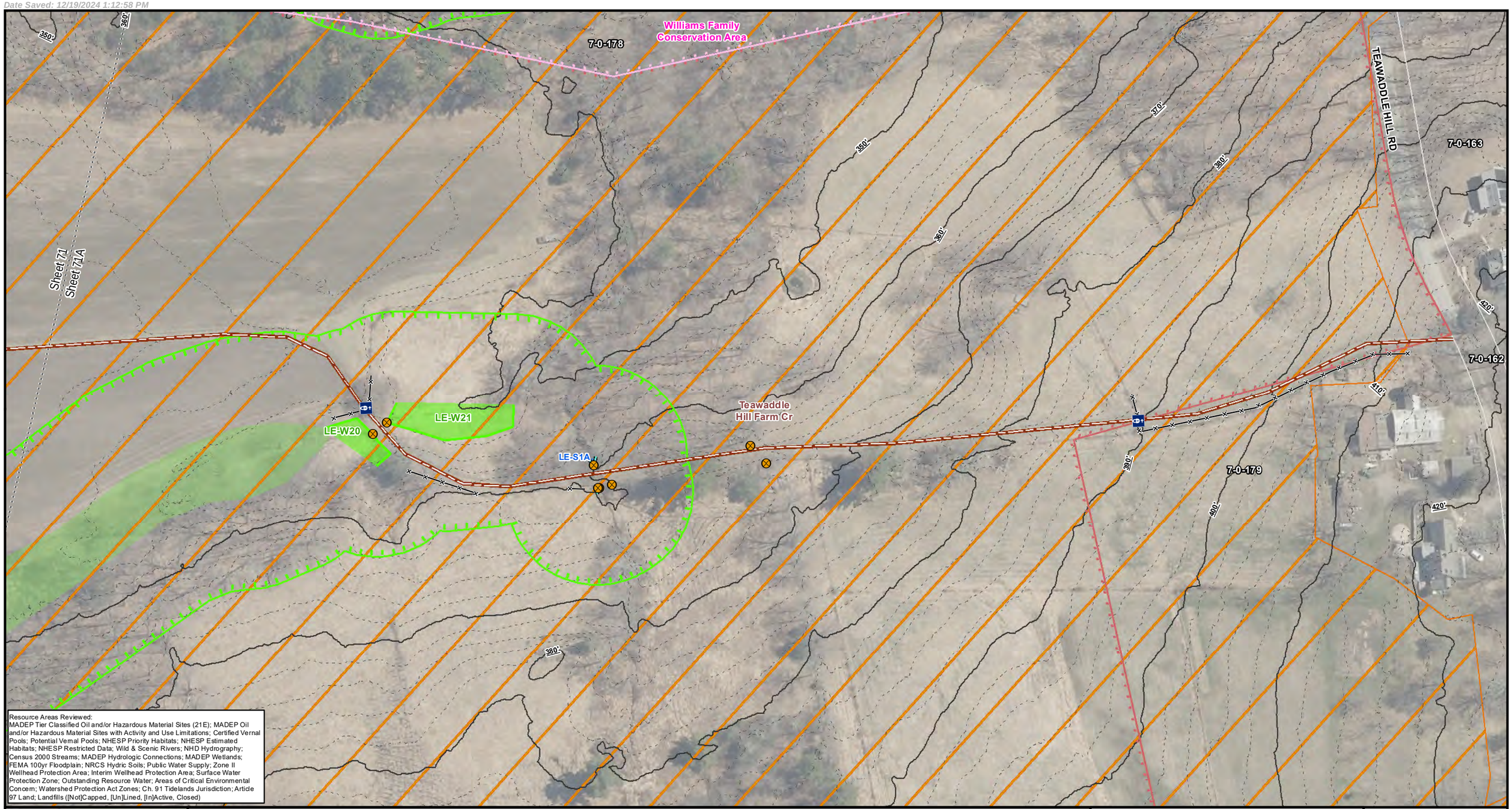

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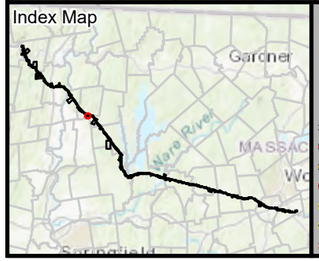

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Environmental Resources Map

Leverett, MA
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MassGIS
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Adams Family Conservation Area
8-0-124
LE-W23
LE-W25
LE-W24
LE-W22
LE-WS22
LE-WS23
459
458
457
350'
SPAN STREAM
Doolittle Brook
8-0-124A
8-0-125
7-0-175
340'

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Springfield

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Environmental Resources Map

Leverett, MA

MassGIS
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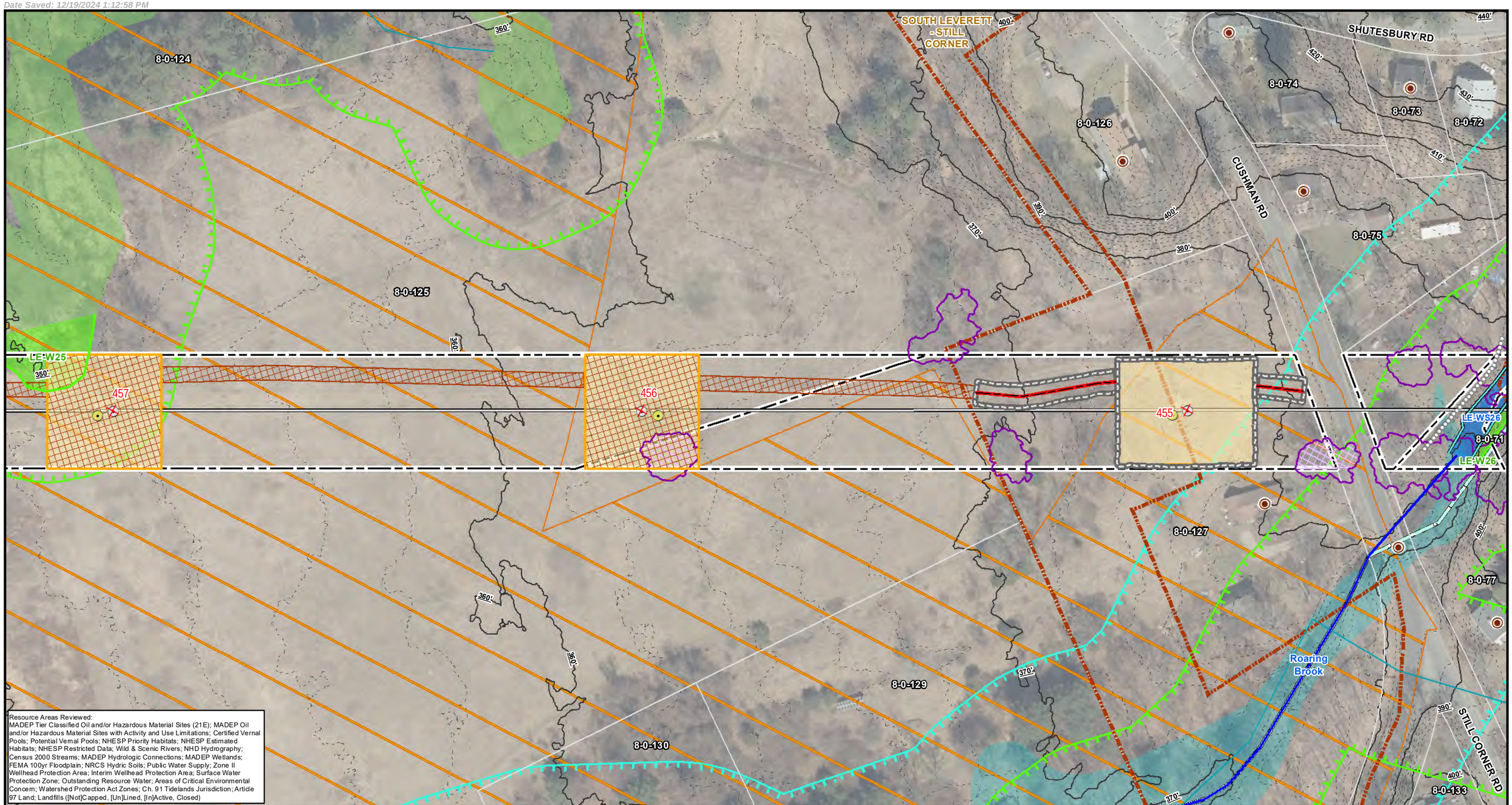

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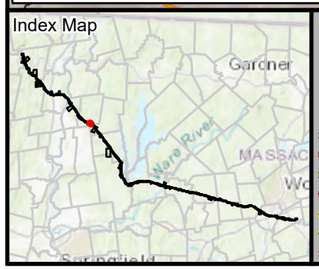

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Leverett, MA

MassGIS
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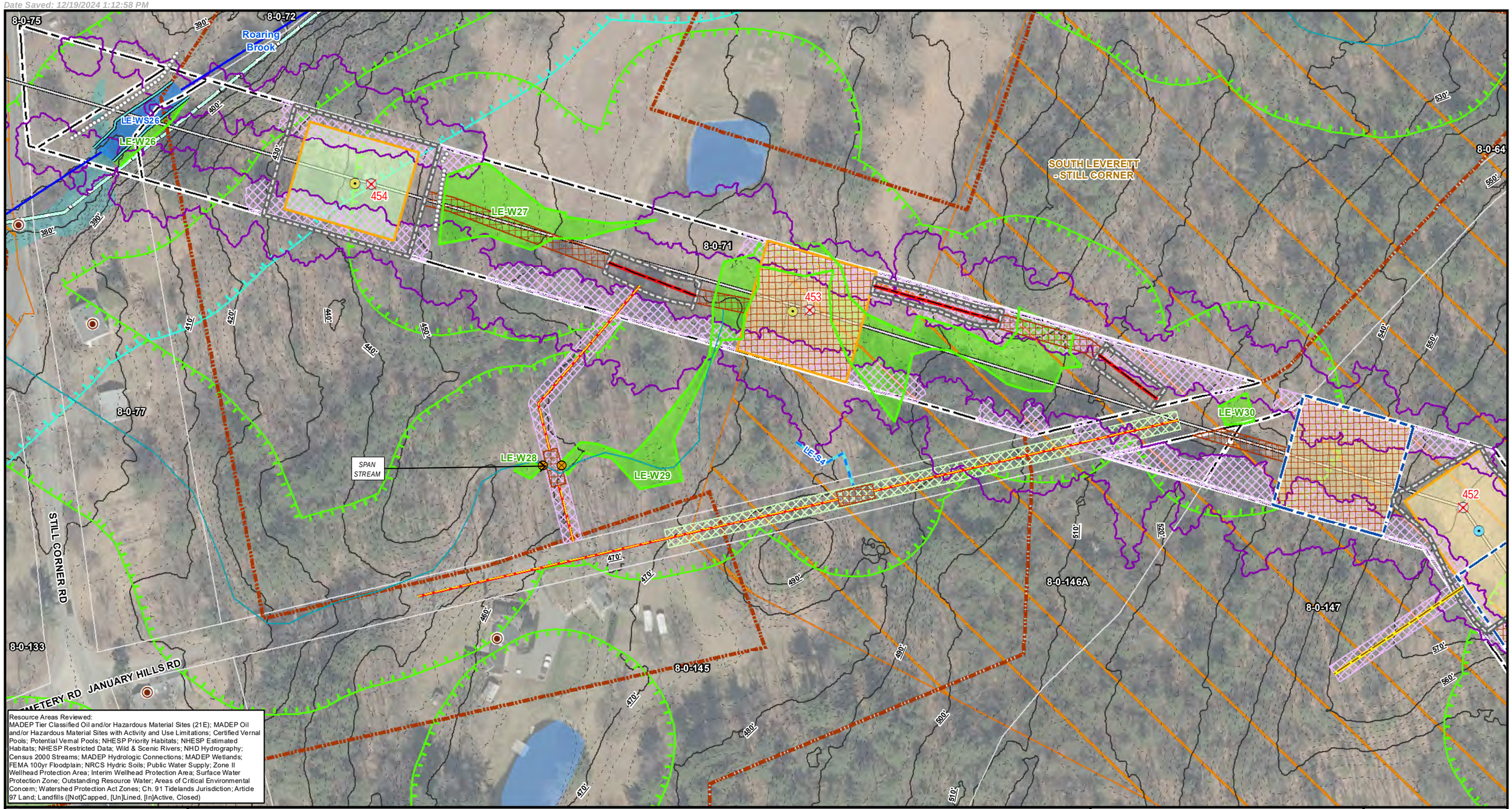

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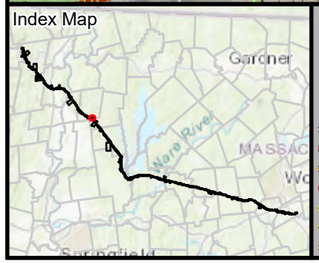

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OLD JANUARY HILL RD

LEVERETT
SHUTESBURY

SPAN STREAM

8-0-147

SPAN STREAM

Walter Cowls Jones Working Forest Wce

452

451

450

LE-W31

LE-WS32

LE-W32

SHU-W1

SHU-W1

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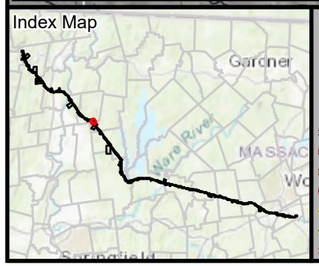

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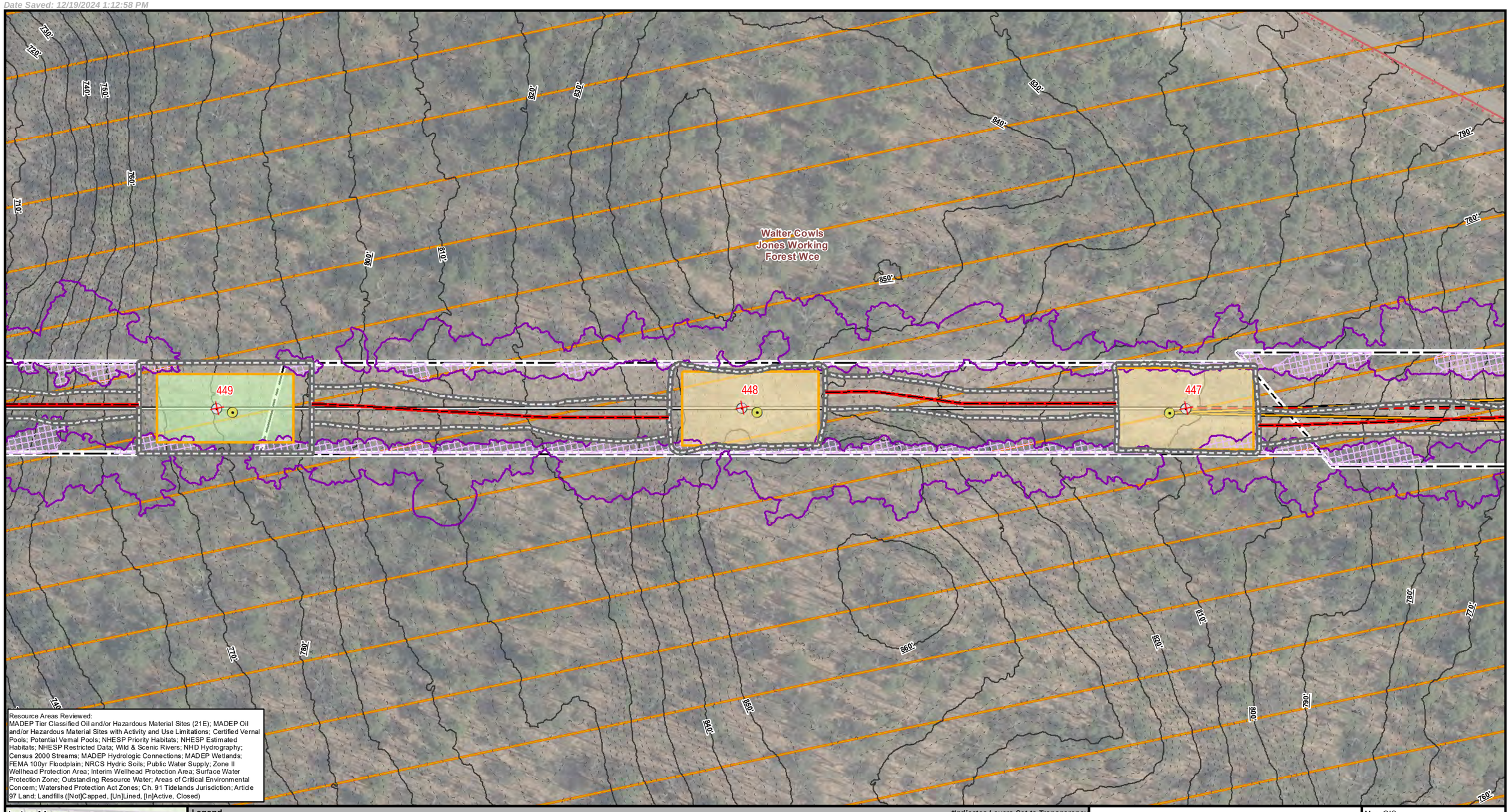

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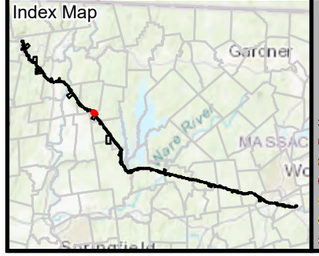

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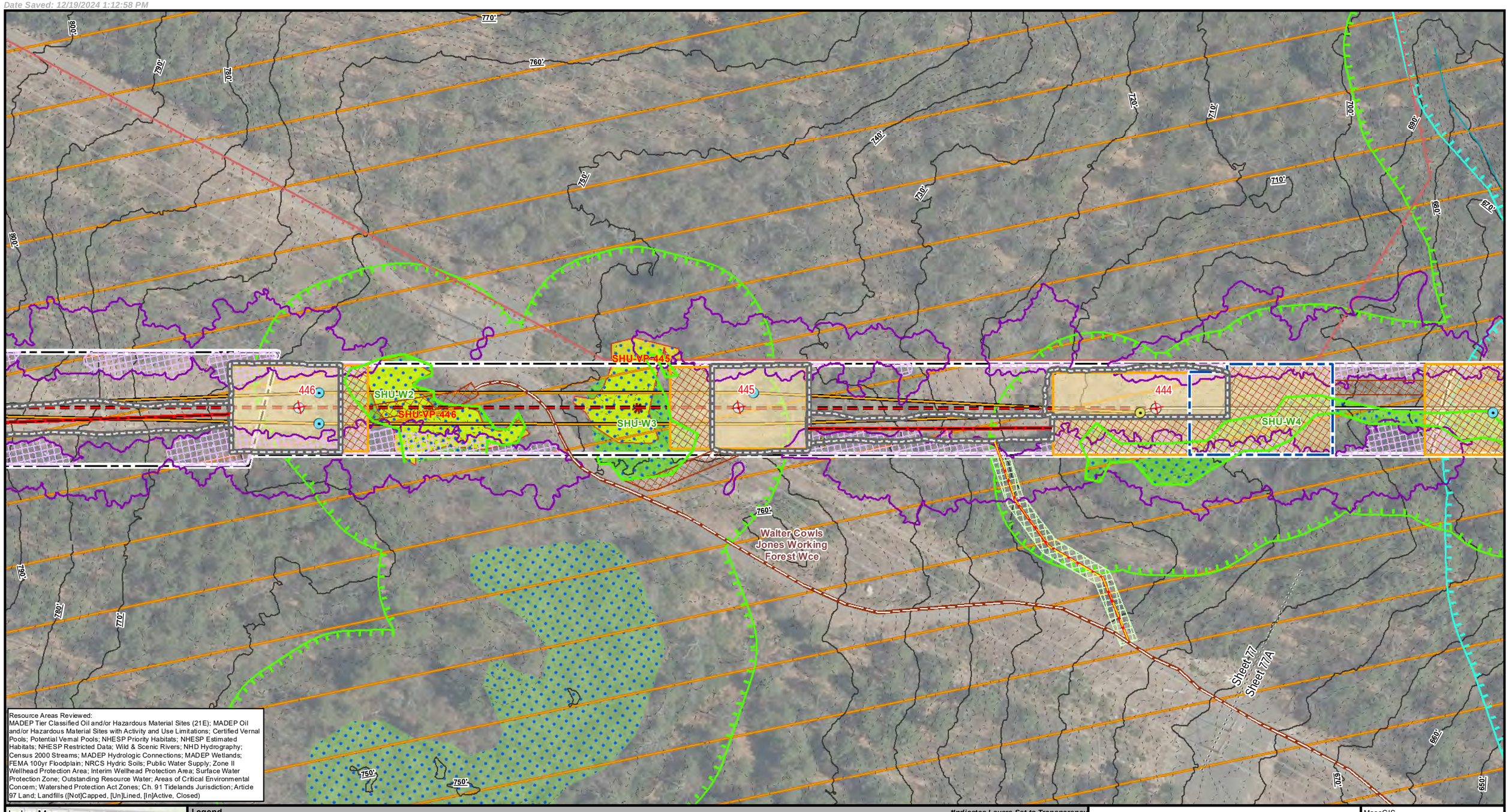

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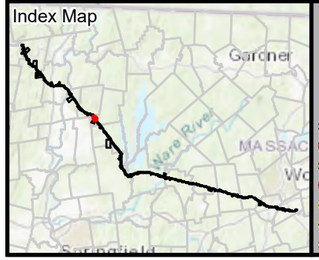

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1 inch = 100 feet
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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Shutesbury, MA

MassGIS
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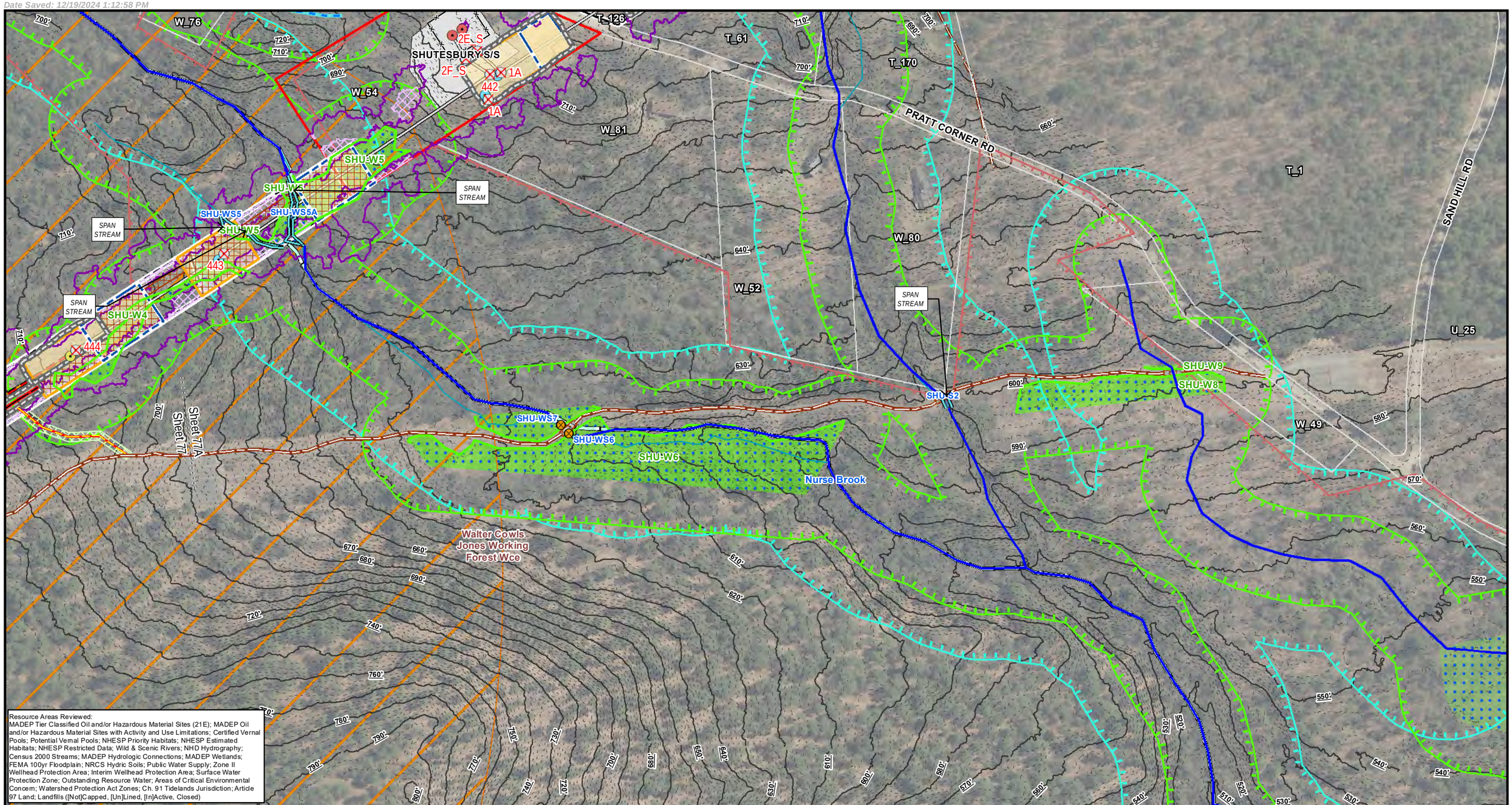

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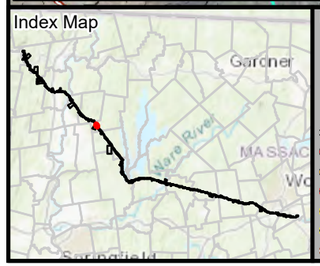

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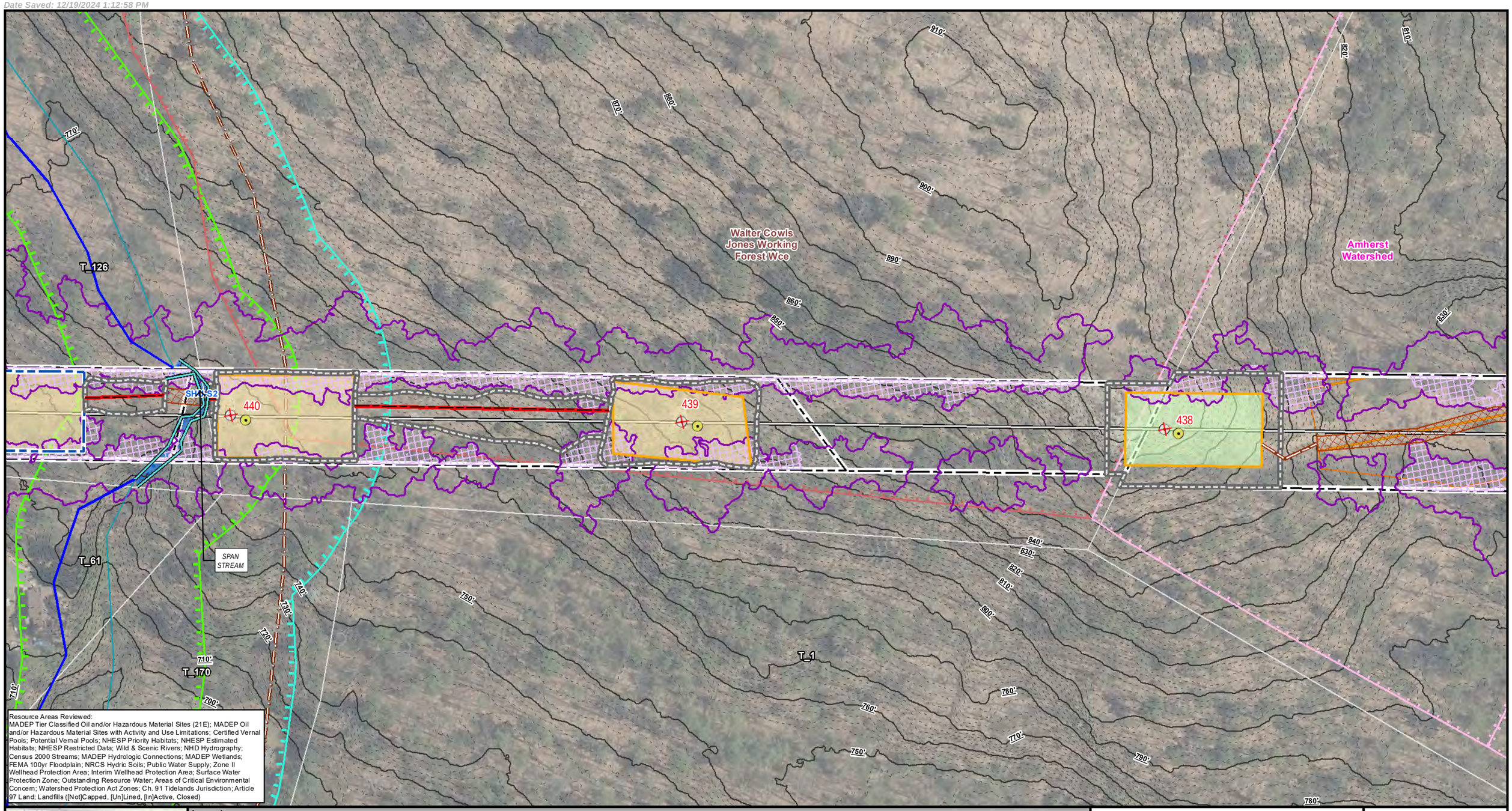

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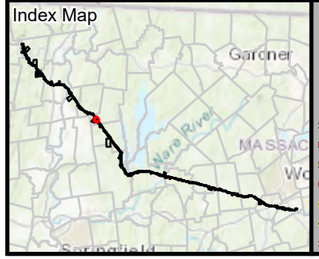

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Walter Cowls Jones Working Forest Wce

SAND HILL RD

Dean Brook

T_6

SHU-WS10

SHU-W10

SHU-S3

SHU-W11

437

436

SPAN STREAM

U_8

Amherst Watershed

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Gardner

Springfield

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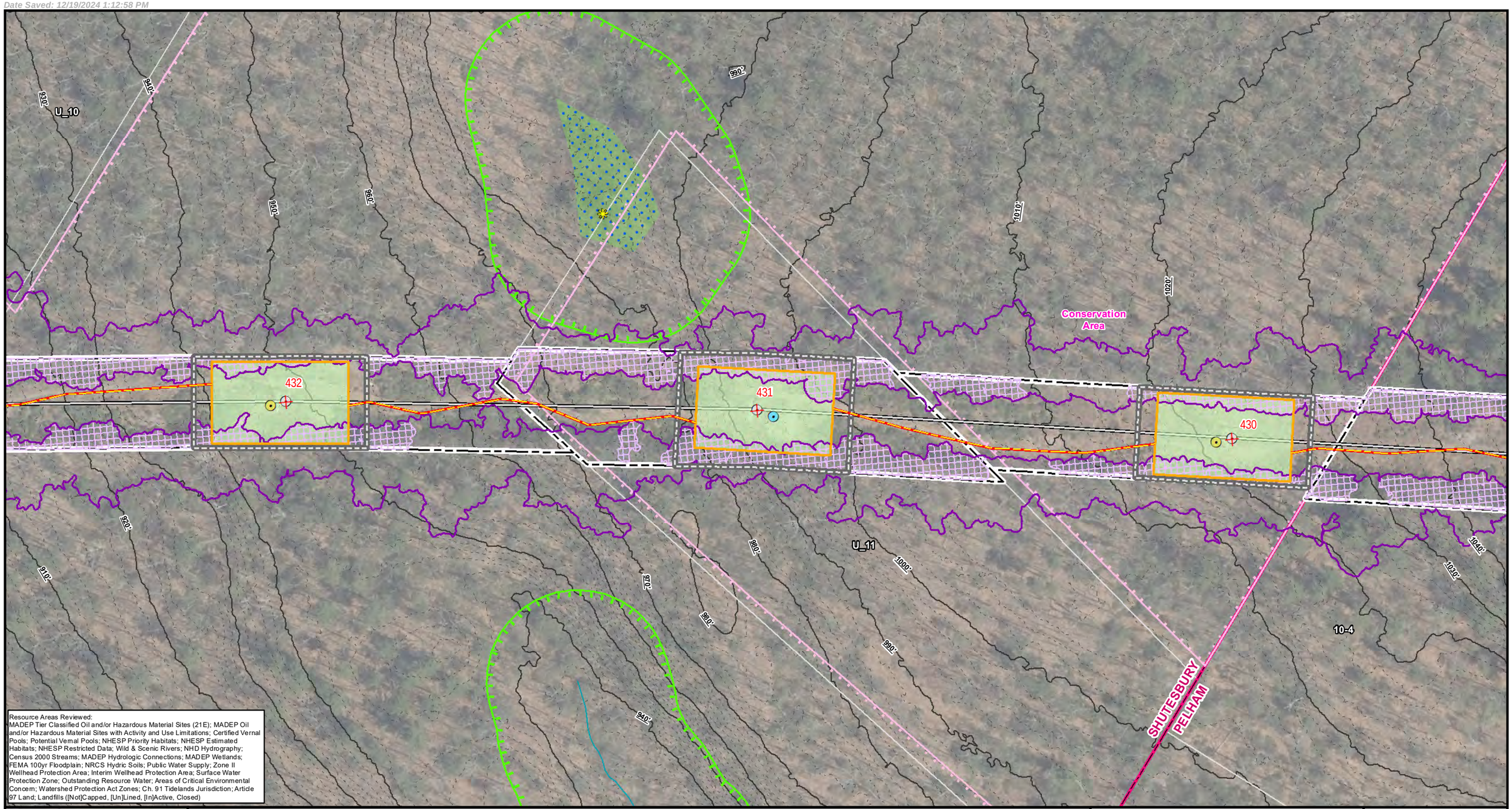

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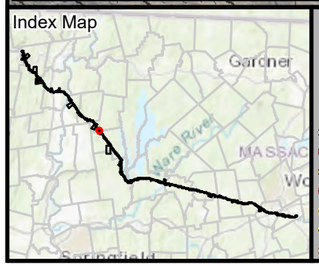

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Conservation Area

SHUTESBURY

PELHAM

10-5-6

10-4

429

428

427

PE-W1

1100'

1080'

1090'

1070'

1060'

1050'

1040'

1030'

1020'

1099'

Resource Areas Reviewed:
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Gardner

Springfield

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Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Shutesbury & Pelham, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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Environmental Resources Map

Pelham, MA

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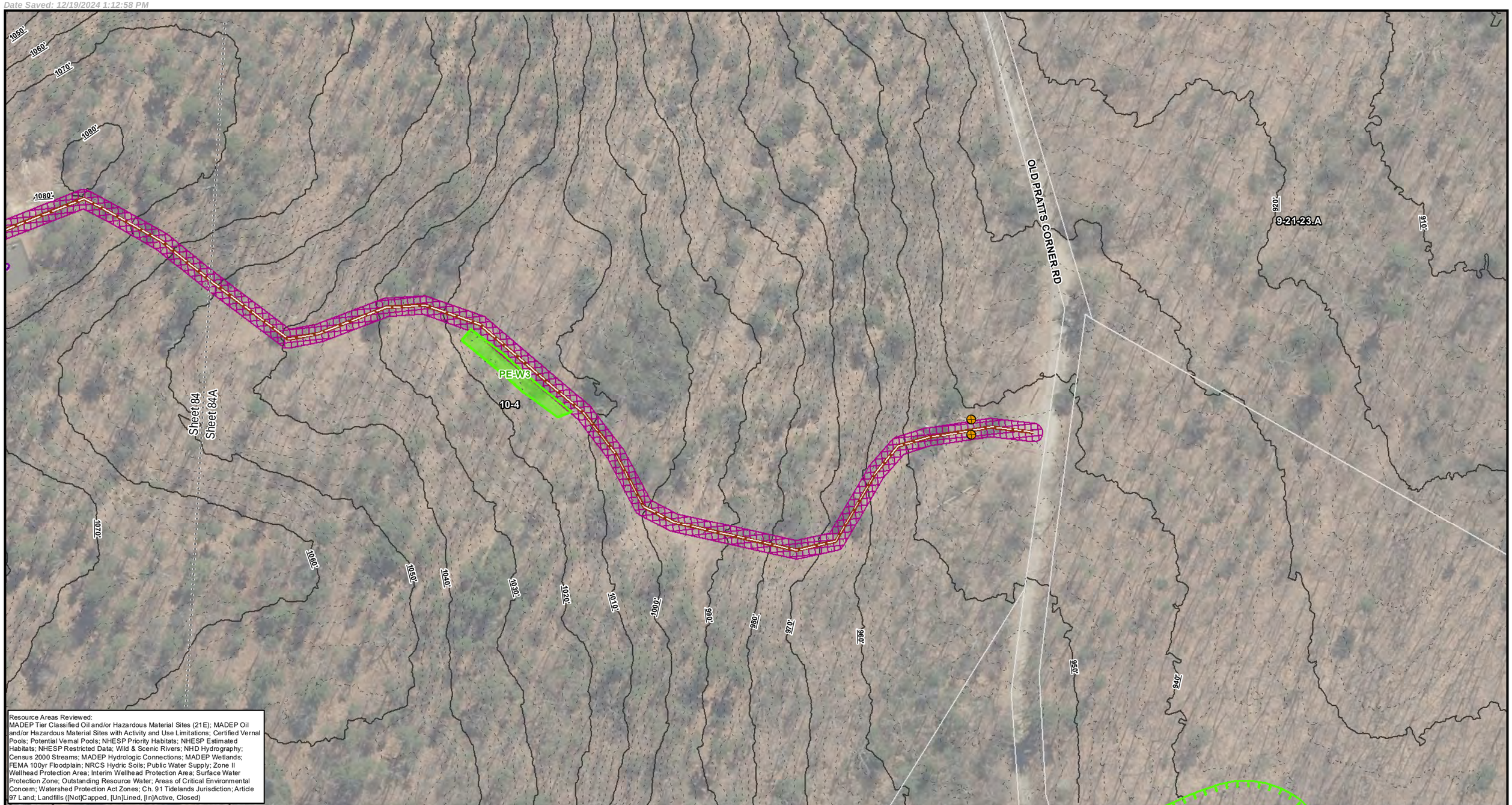

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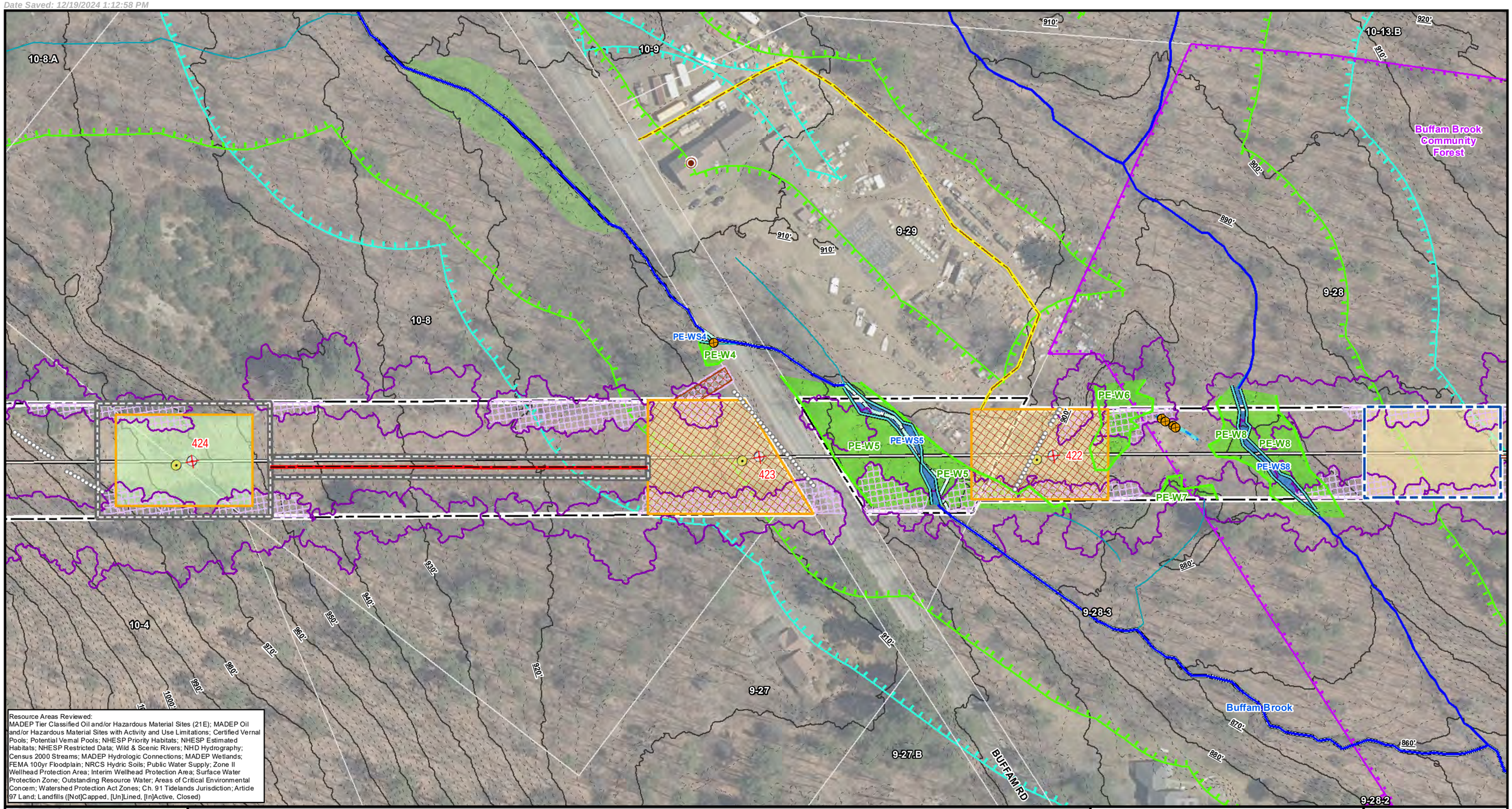

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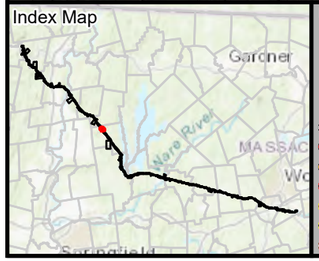

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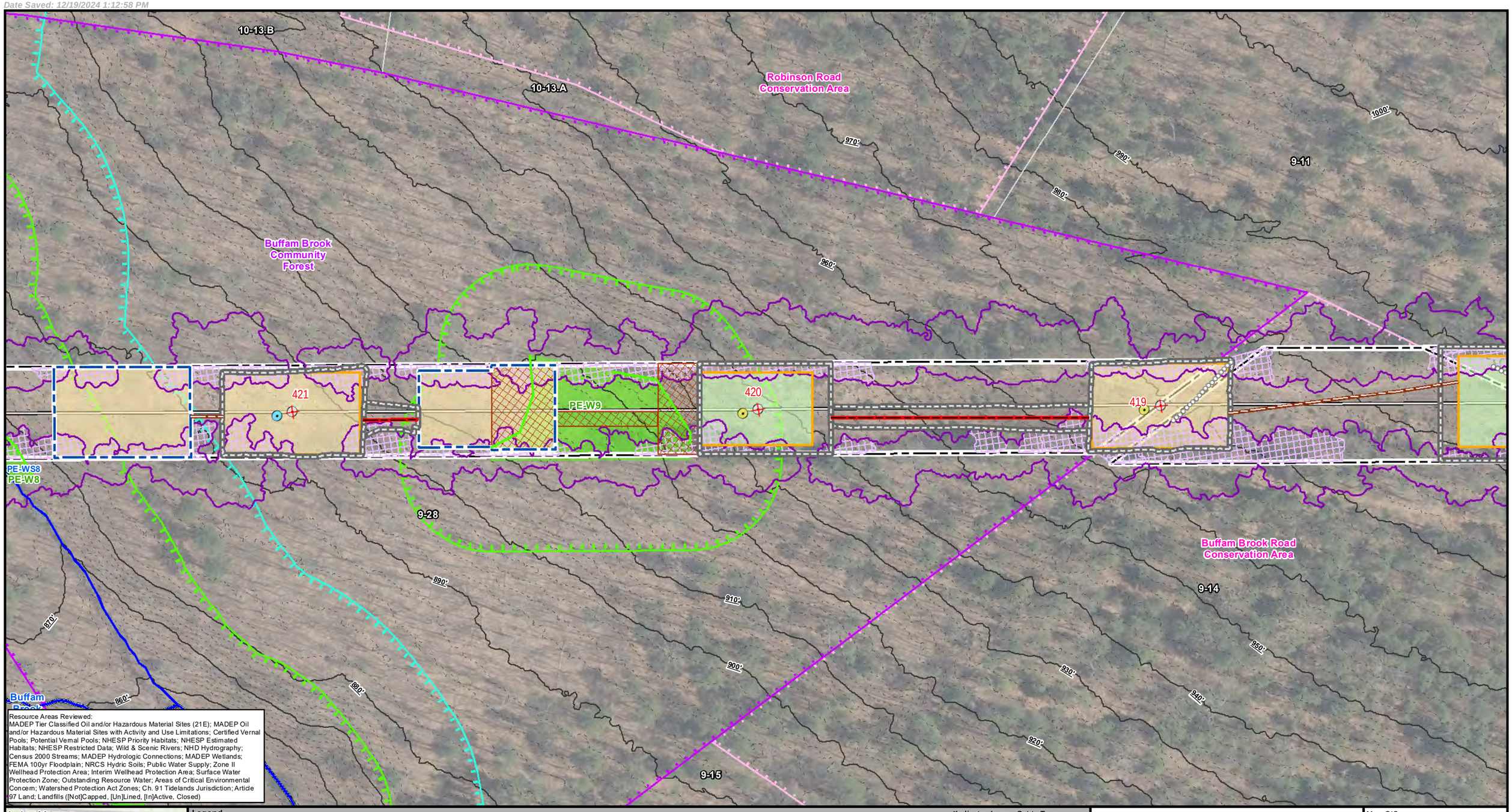

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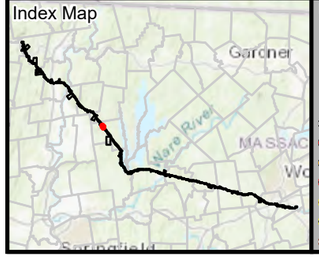

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Buffam Brook Community Forest
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416
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1000'
990'
980'
970'
960'
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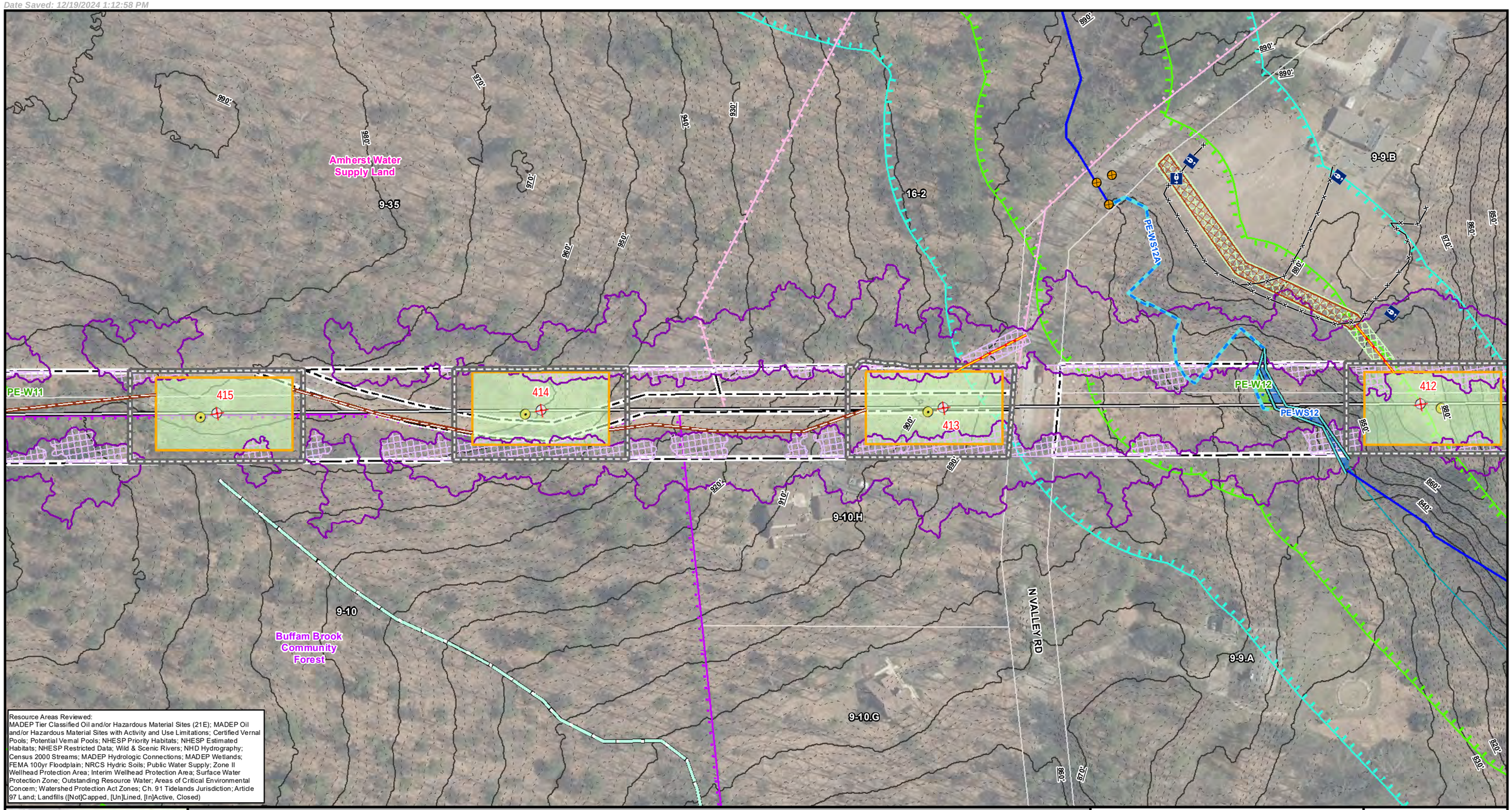

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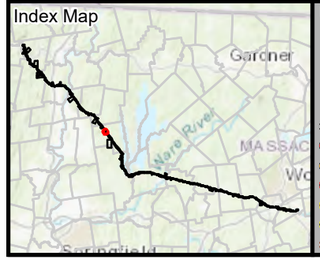

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- Town Boundary
- Parcel Boundaries

Article 97 Lands

- Municipal

1 inch = 100 feet
0 50 100
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Pelham, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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Amherst Water Supply Land
16-1
16-2
16-1
BREWER RD
N VALLEY RD
NEW ENGLAND TRAIL
970'
960'
950'
940'
930'
920'
910'
900'
890'
880'
870'
860'
850'
840'
830'
820'
810'
9-9.B
8-21.A
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Sheet 89A
Sheet 89

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Springfield

Legend

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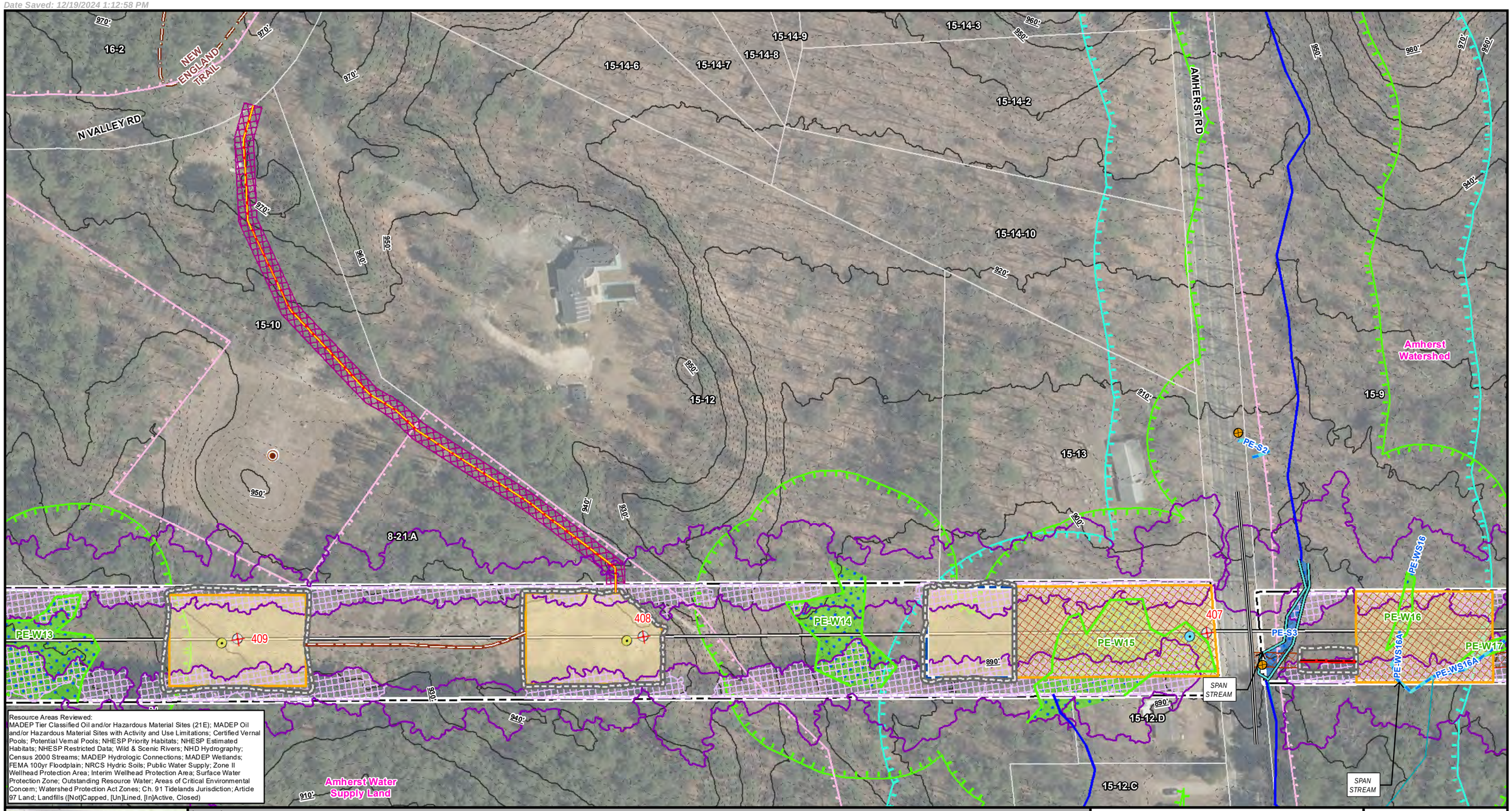

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Pelham, MA

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Amherst Watershed

Dunlop Brook

SPAN STREAM

SPAN STREAM

PE-S3

PE-W16

PE-WS16

PE-WS16A

PE-W17

PE-WS17

PE-WS16A

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PE-WS18

PE-WS18A

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PE-W19

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Indicates Layers Set to Transparency

- Town Boundary
- Parcel Boundaries

Article 97 Lands

- Municipal

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Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Pelham, MA

MassGIS
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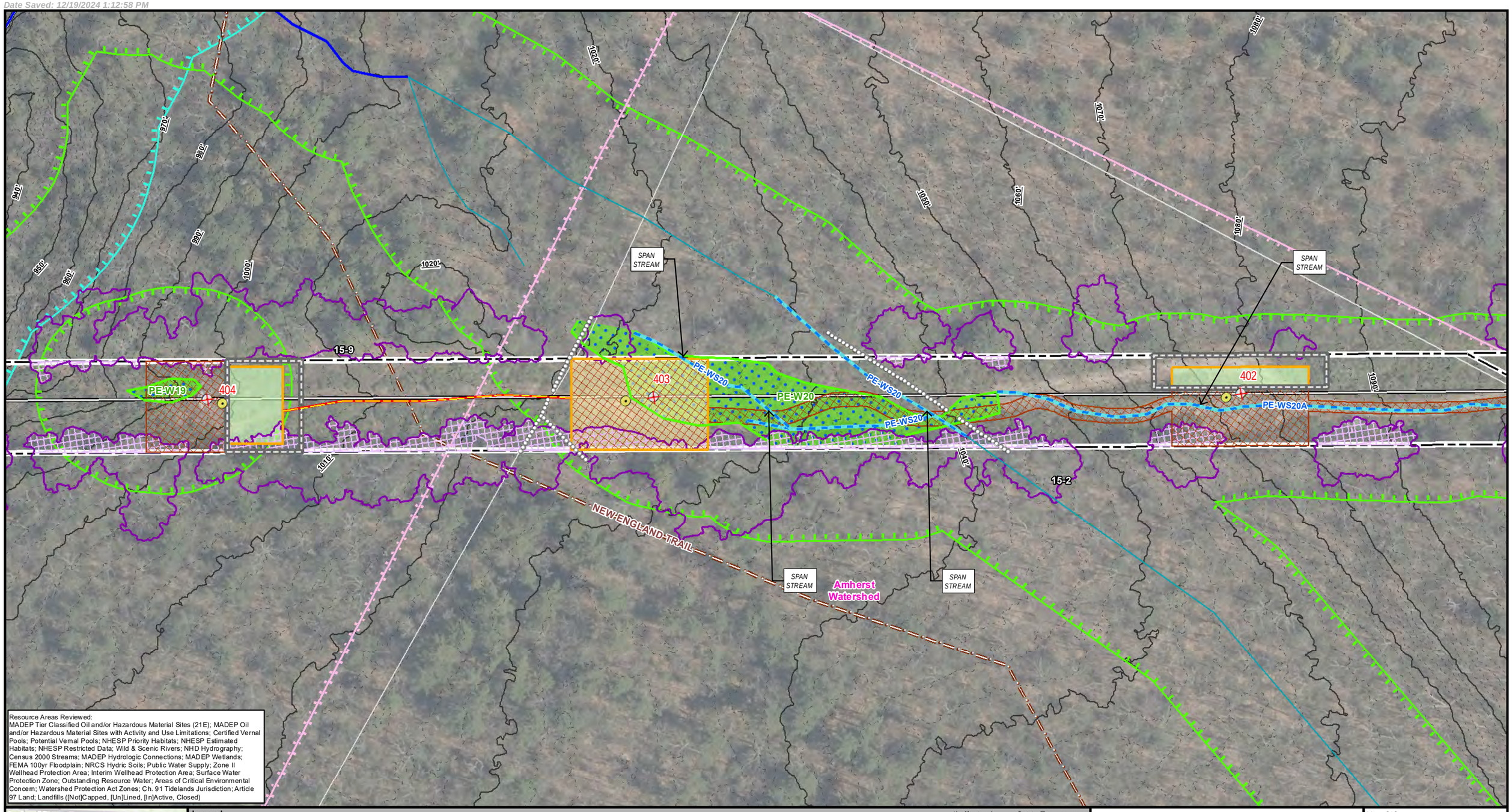

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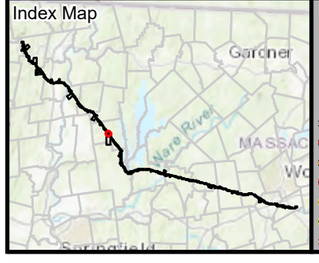

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Article 97 Lands

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

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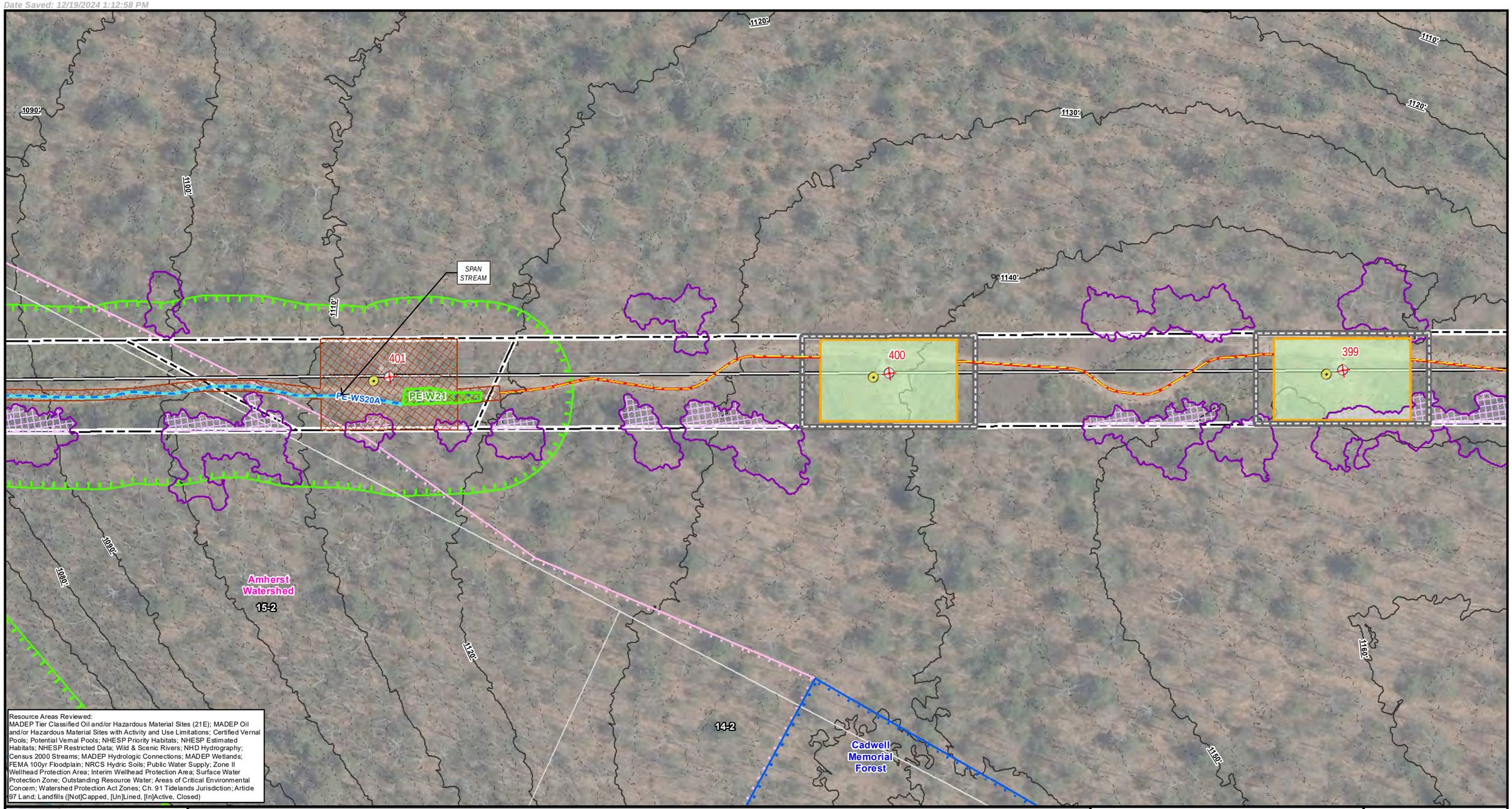

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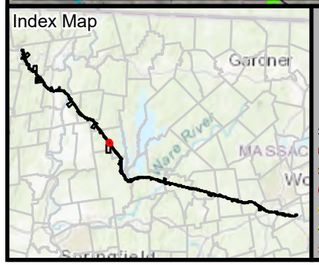

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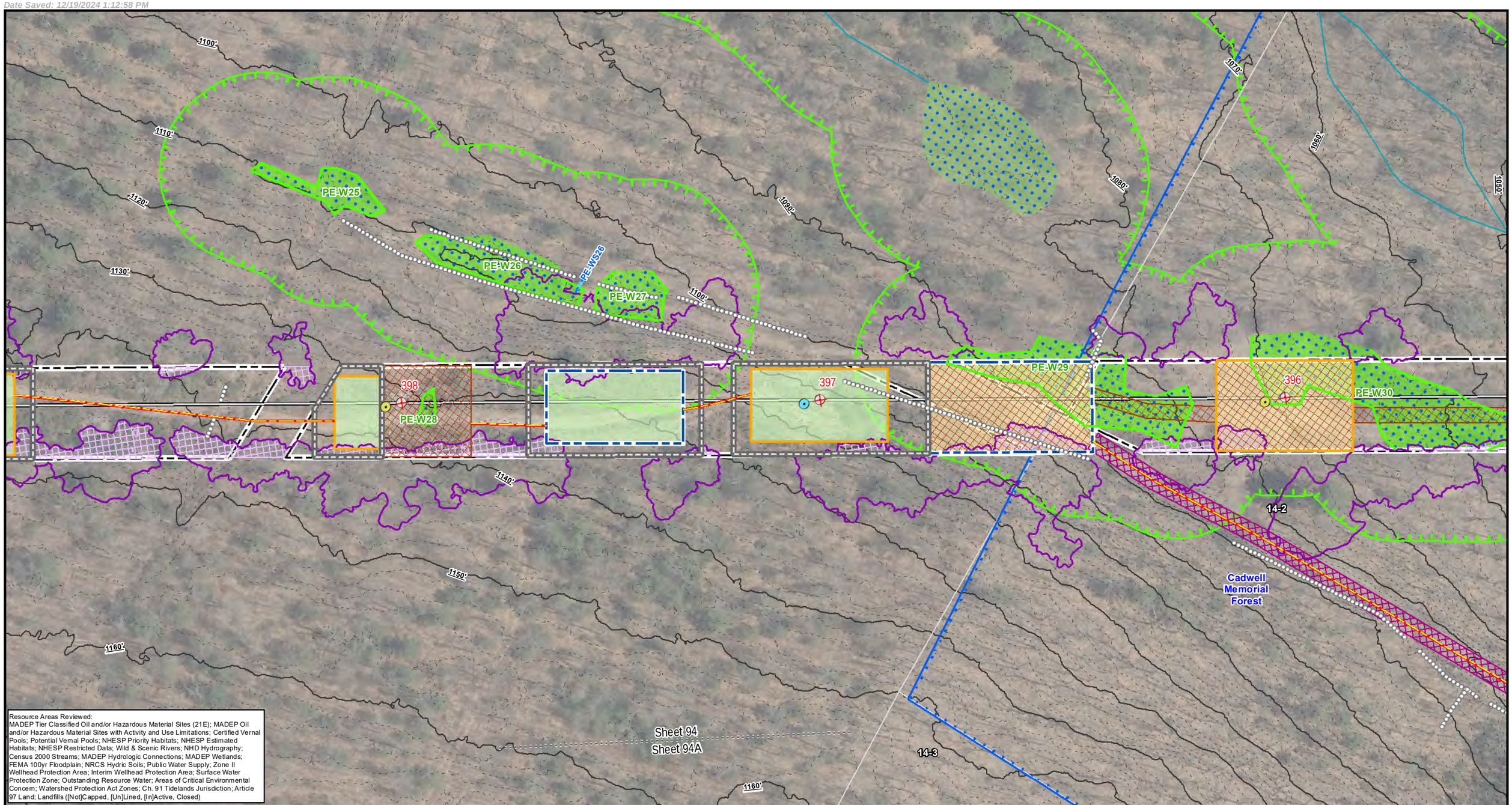

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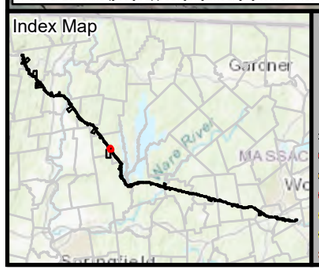

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SPAN STREAM
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Sheet 94A

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- Parcel Boundaries

Article 97 Lands

- Commonwealth of Massachusetts
- Municipal

1 inch = 500 feet
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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Belchertown & Pelham, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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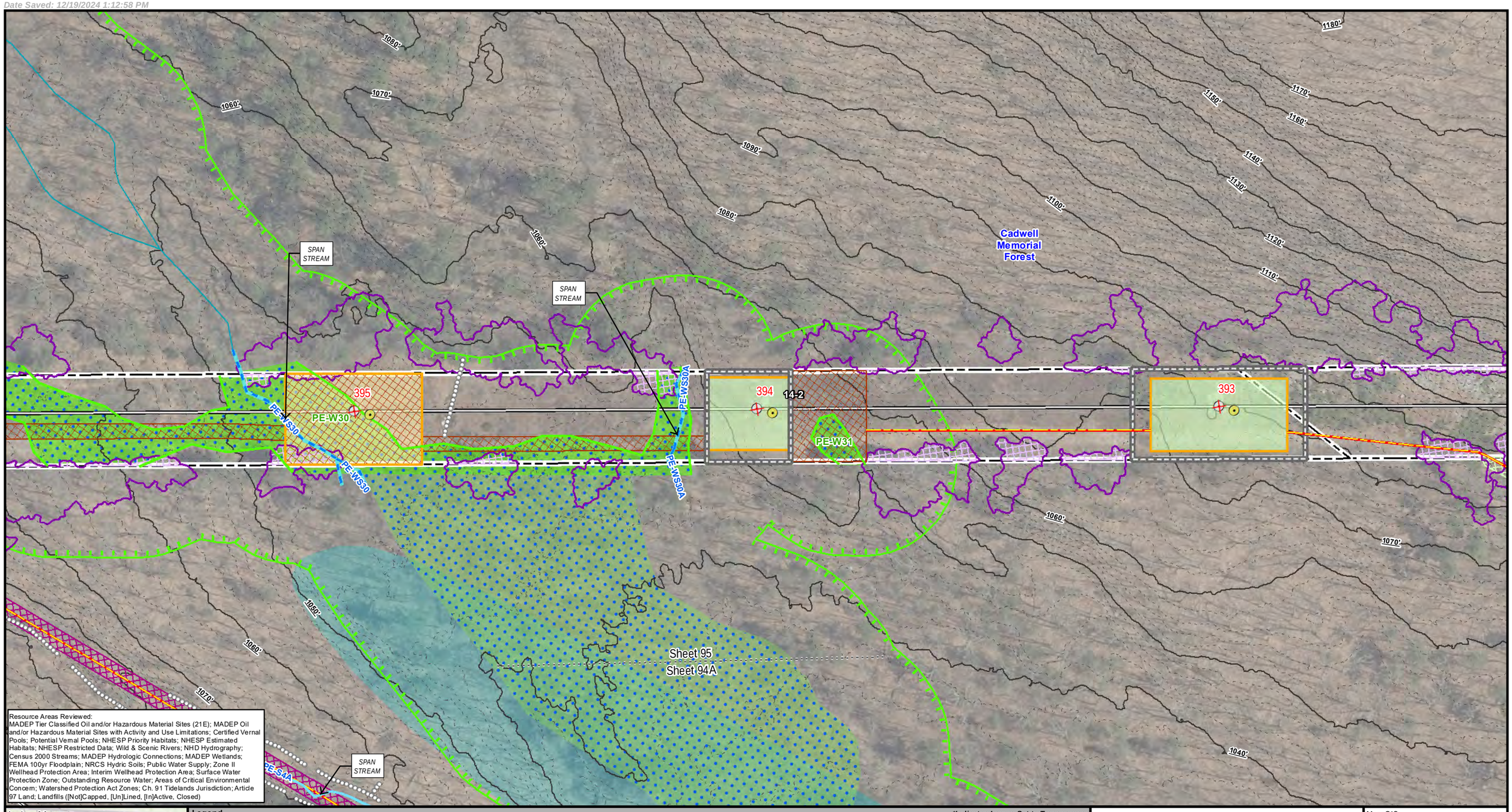

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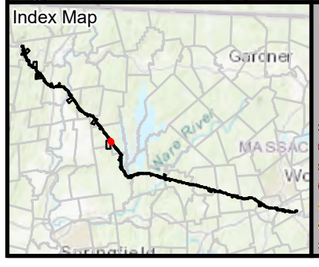

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Pelham, MA

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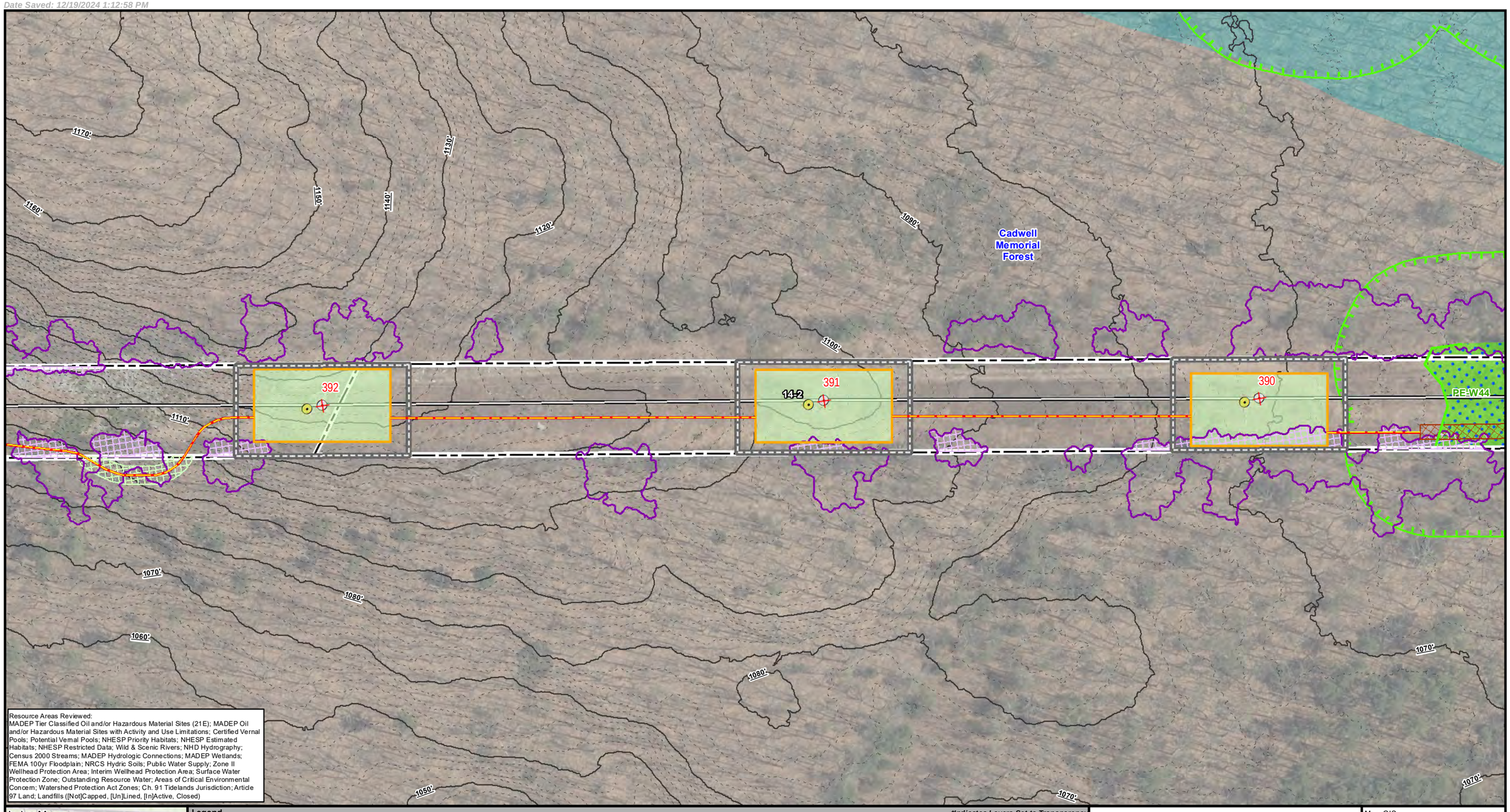

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Pelham, MA

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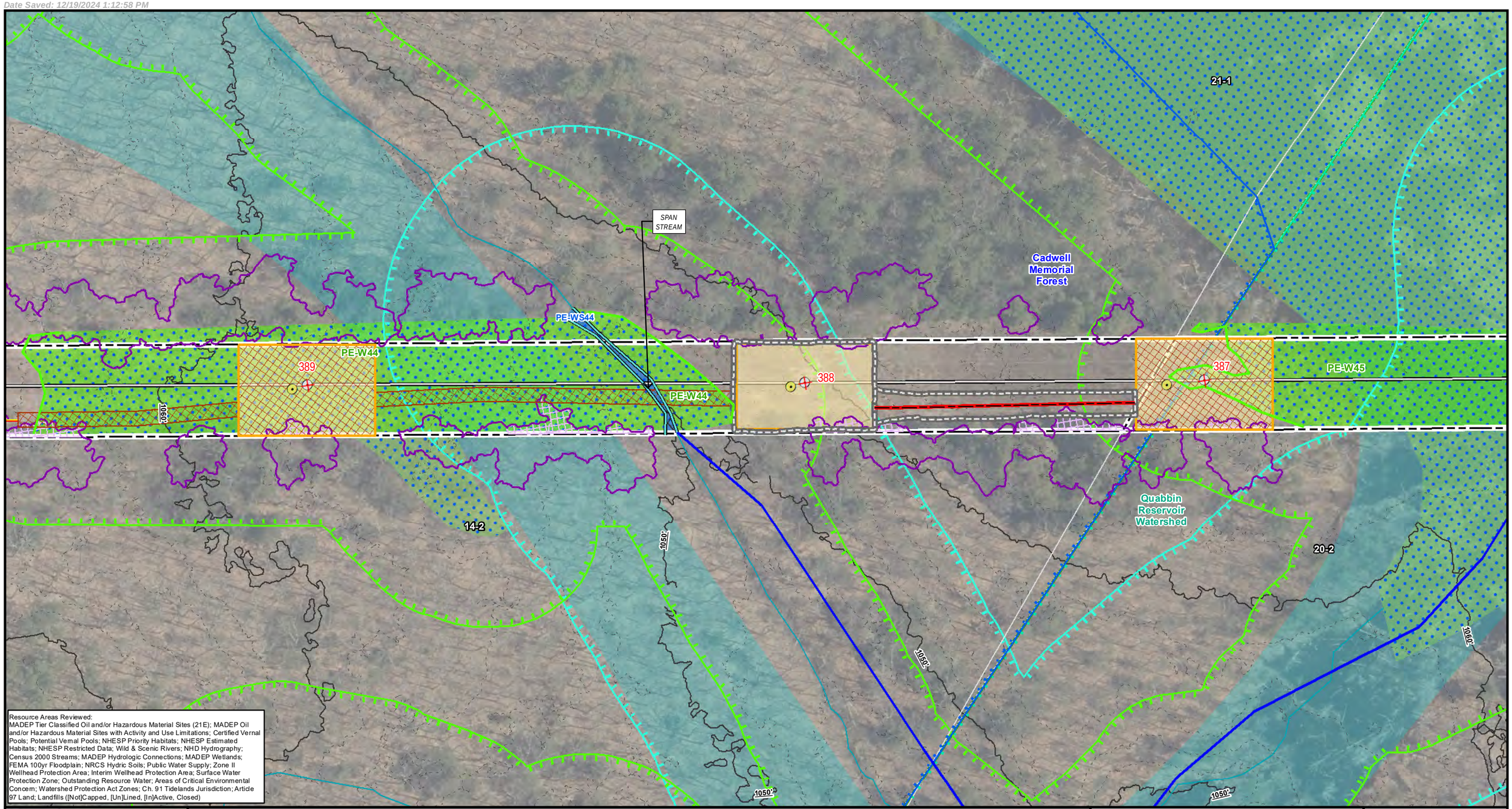

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Environmental Resources Map

Pelham, MA

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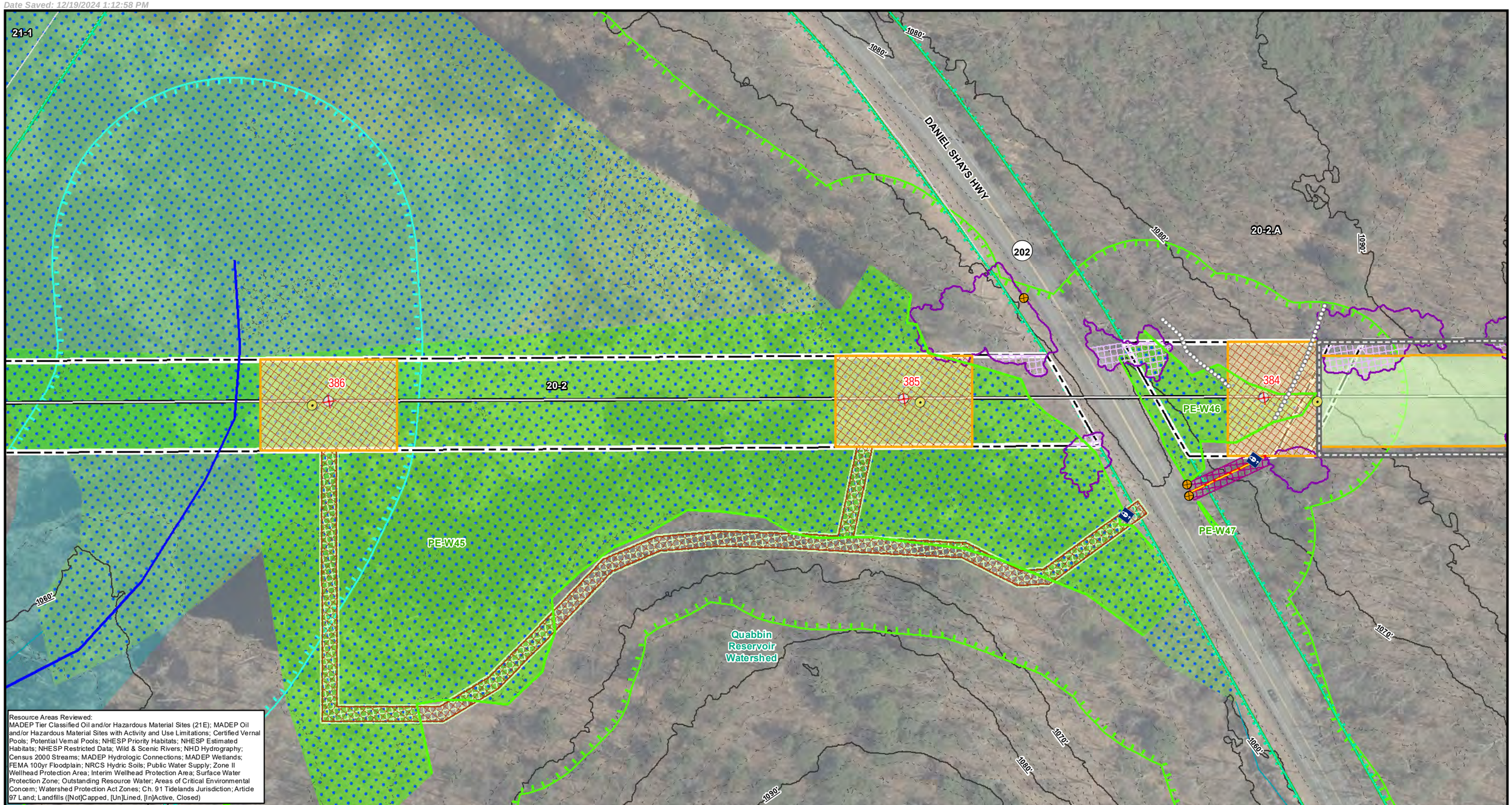

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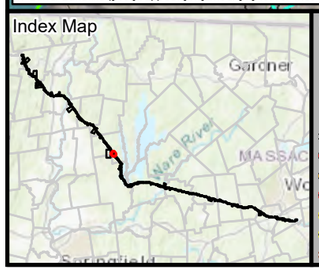

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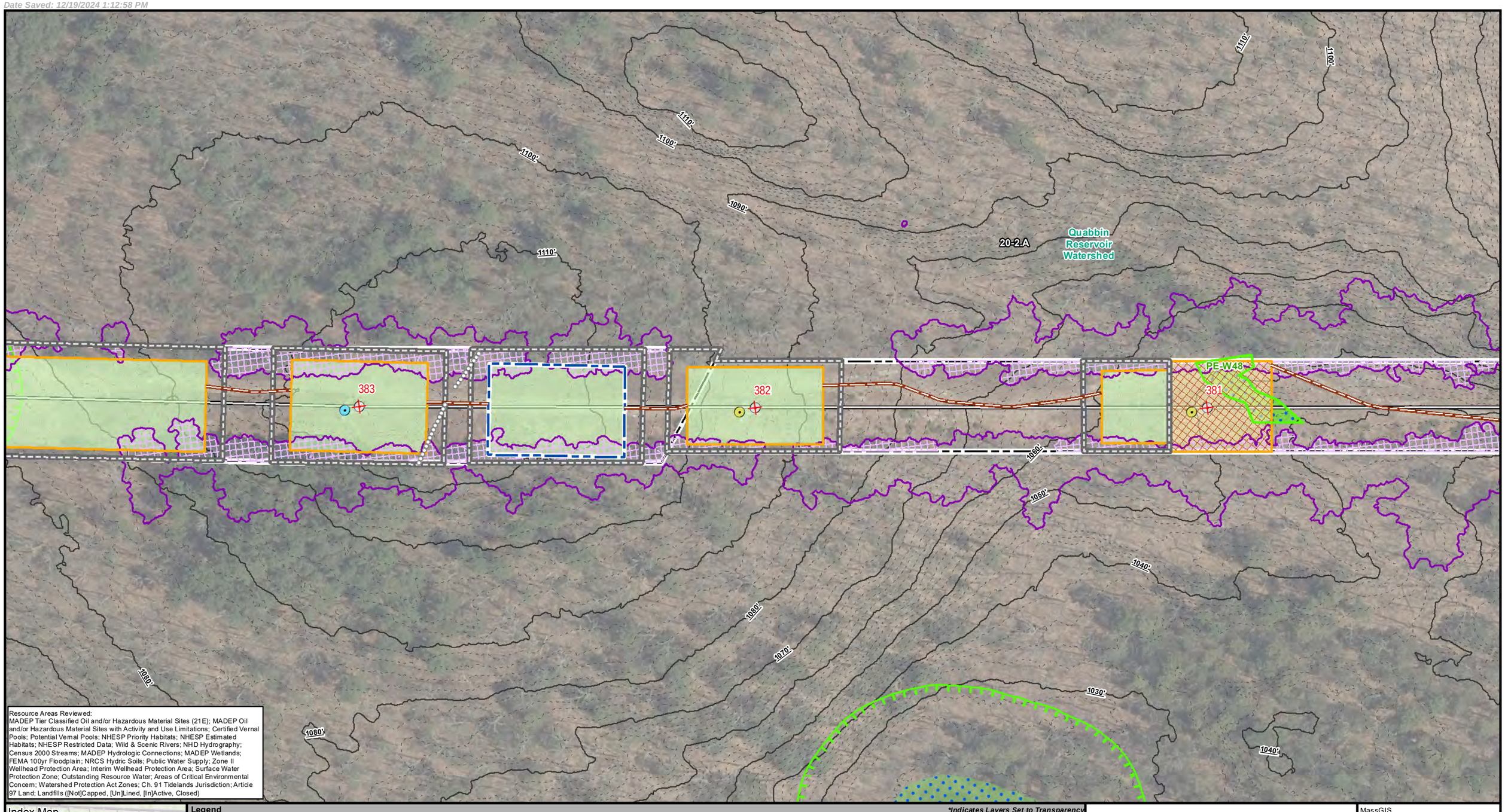

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Pelham, MA

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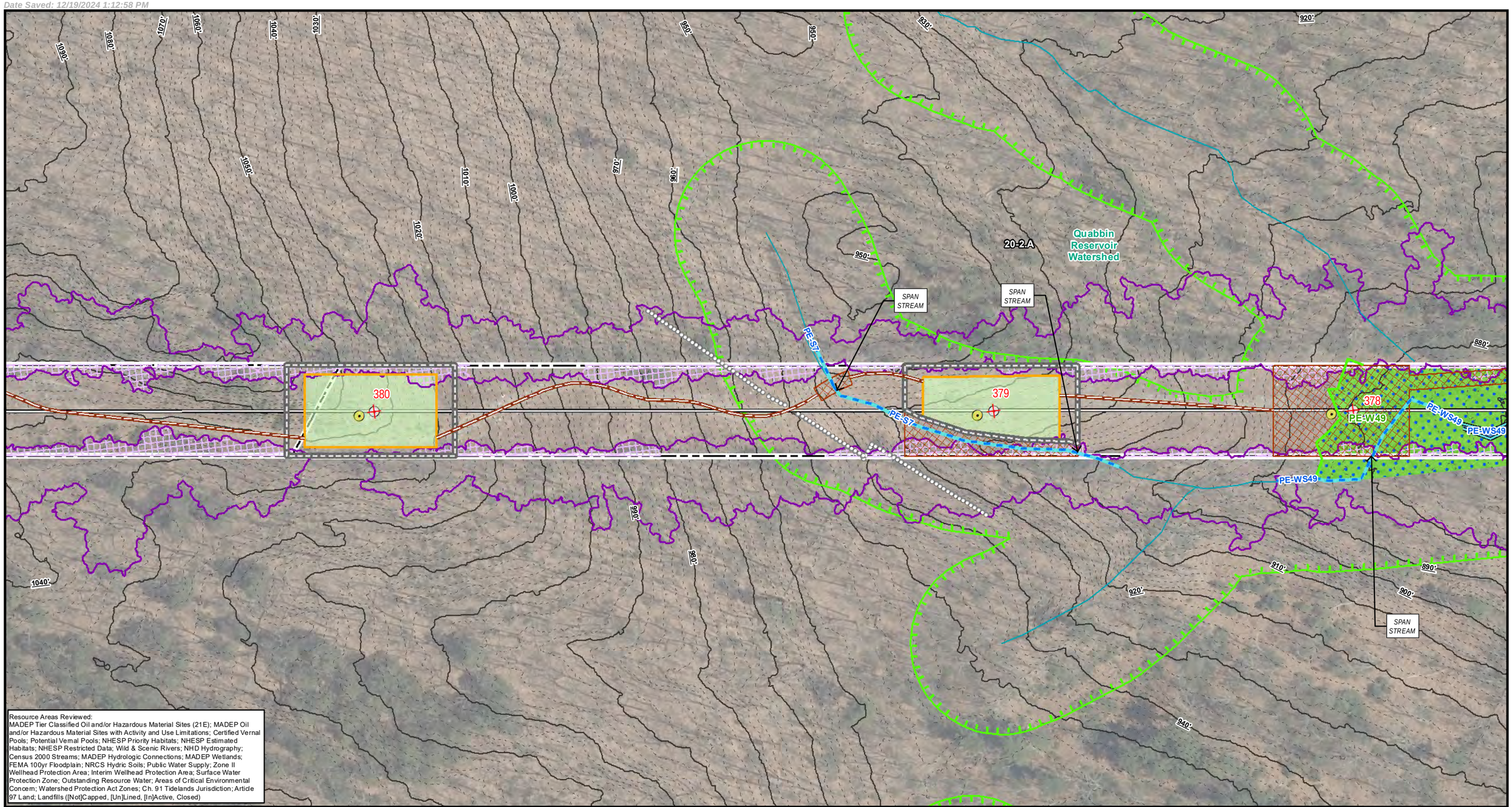

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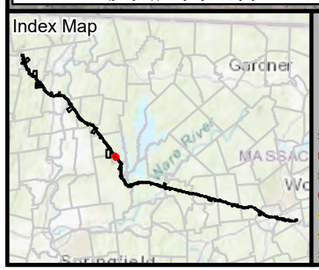

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Cadwell Creek

SPAN STREAM

SPAN STREAM

SPAN STREAM

20-2.A

Quabbin Reservoir Watershed

377

376

375

PE-W49

PE-WS49

PE-WS49C

910'

900'

890'

880'

870'

860'

840'

820'

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Resource Areas Reviewed:
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Index Map

Gardner

Springfield

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*Indicates Layers Set to Transparency

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Article 97 Lands

- DCR-Water Supply Protection

1 inch = 100 feet
0 50 100
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Pelham, MA

MassGIS
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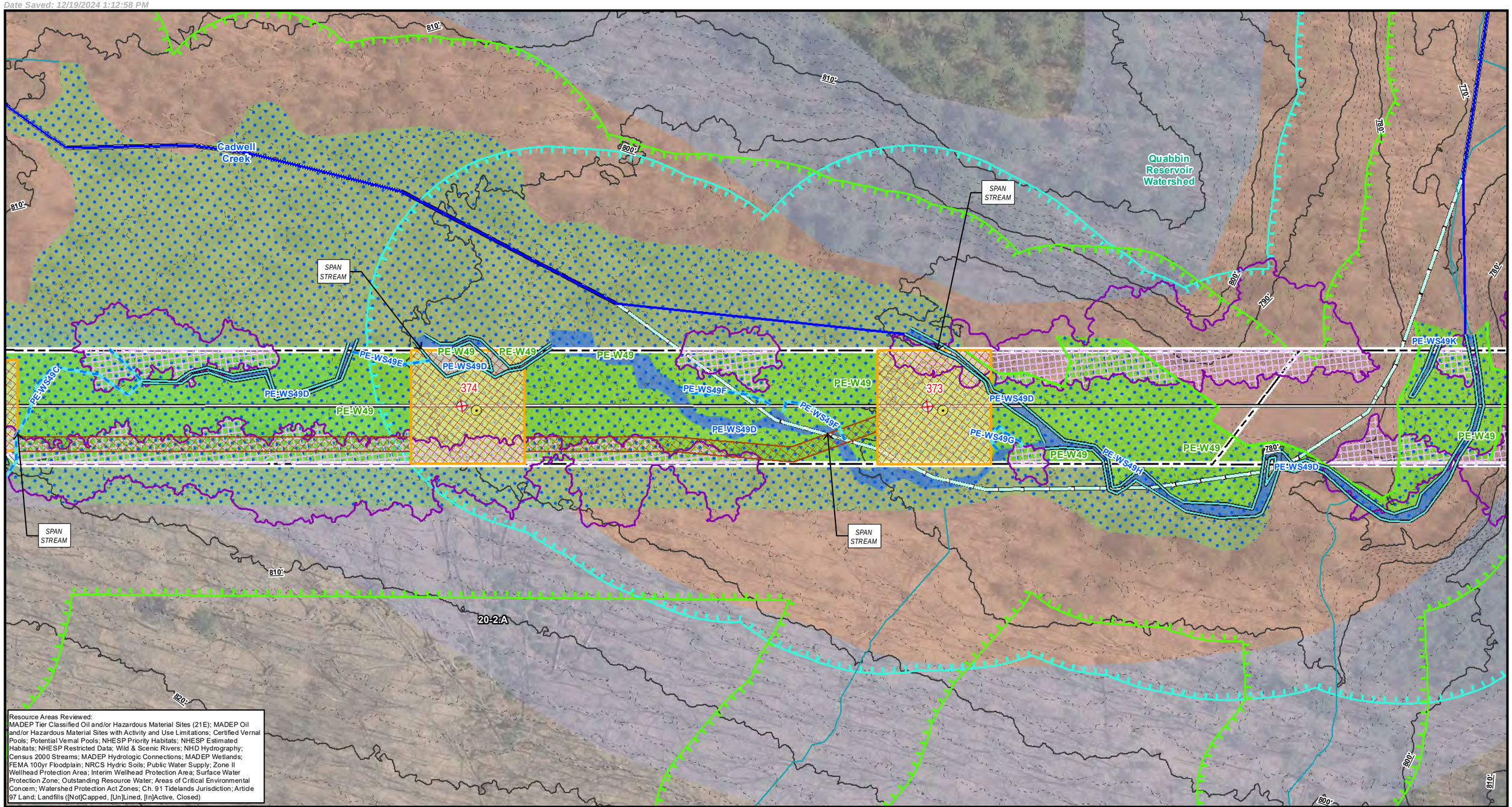

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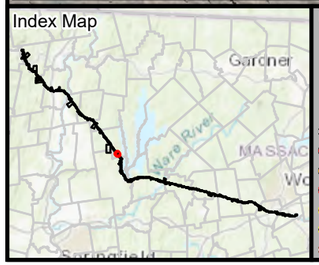

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Cadwell Creek
JUCKETT HILL RD
Quabbin Reservoir Watershed
20-2.A
PE-W51
PE-WS51
PE-WS49K
PE-W49
PE-WS49D
372
371
370
PE-WS50
PE-W50
PE-W52
PE-WS52
PE-WS52B
PE-WS52A
PE-W53
SPAN STREAM
SPAN STREAM
PACKARDVILLE RD
770'
780'
790'
800'
810'
820'
840'
850'

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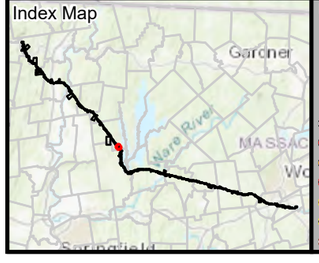

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Environmental Resources Map

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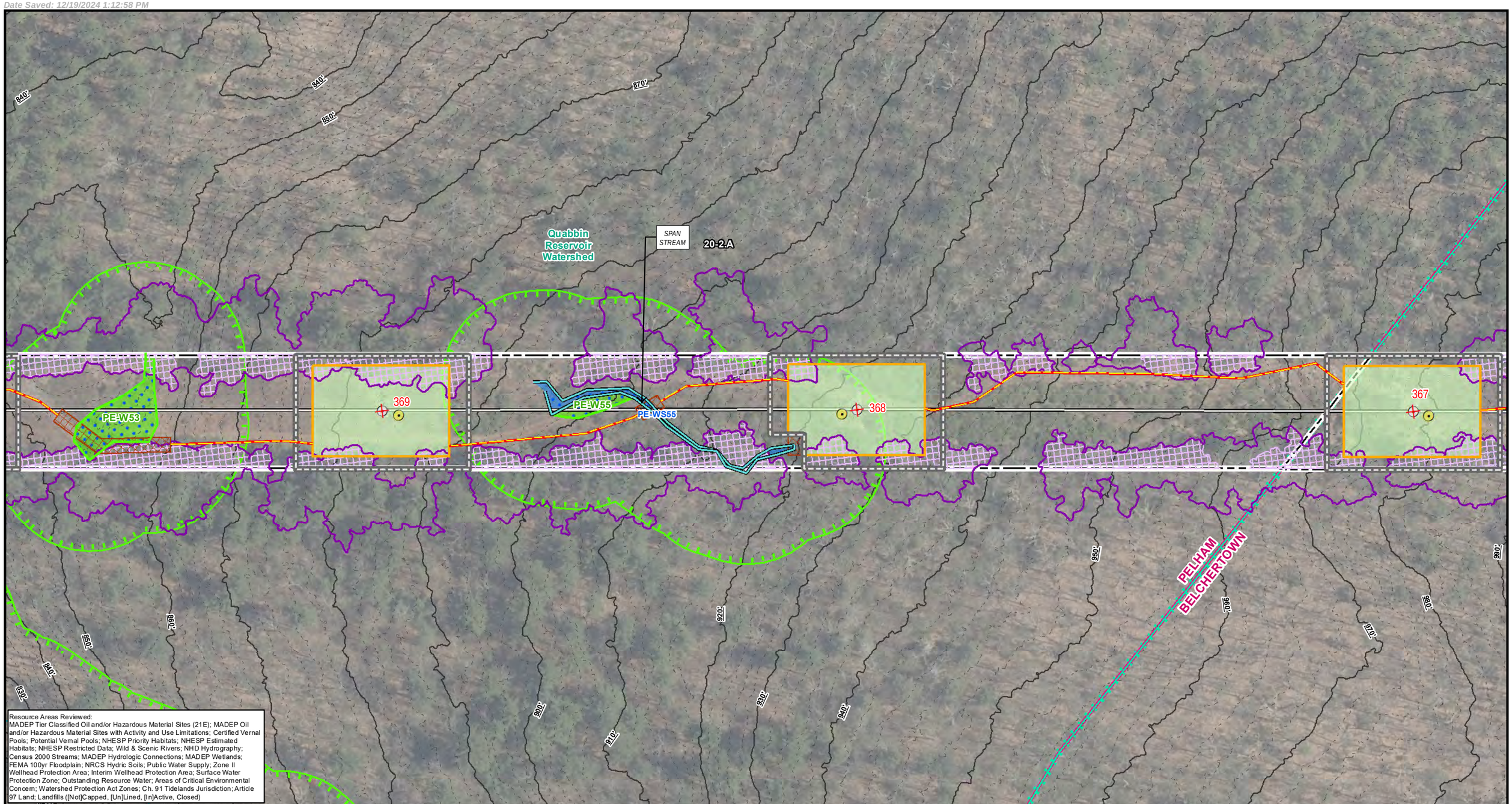

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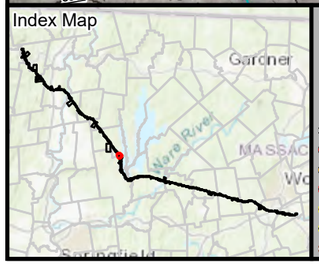

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Pelham & Belchertown, MA

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20-2.A

PELHAM
BELCHERTOWN

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Quabbin Reservoir Watershed

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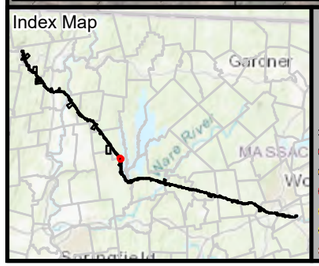

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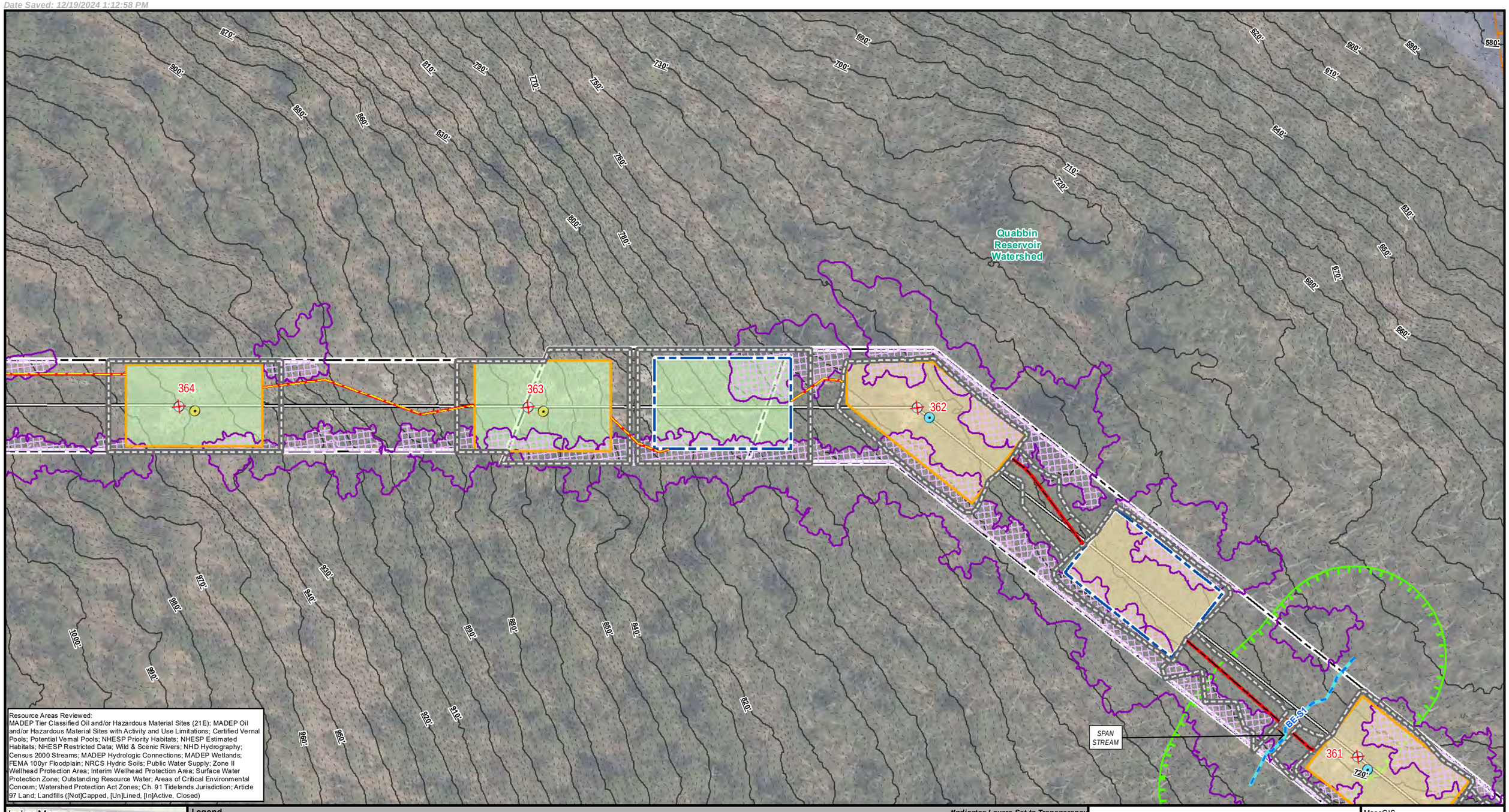

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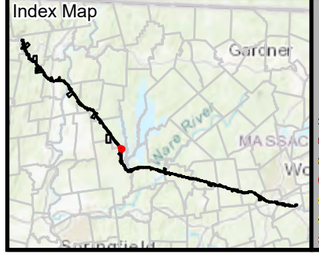

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Quabbin Reservoir Watershed

SPAN STREAM

SPAN STREAM

362

361

360

BE-S1

BE-W1

BE-WS1

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Quabbin Reservoir Watershed

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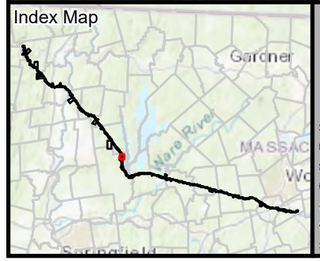

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Indicates Layers Set to Transparency

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Article 97 Lands

- DCR-Water Supply Protection

N

1 inch = 100 feet

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Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Belchertown, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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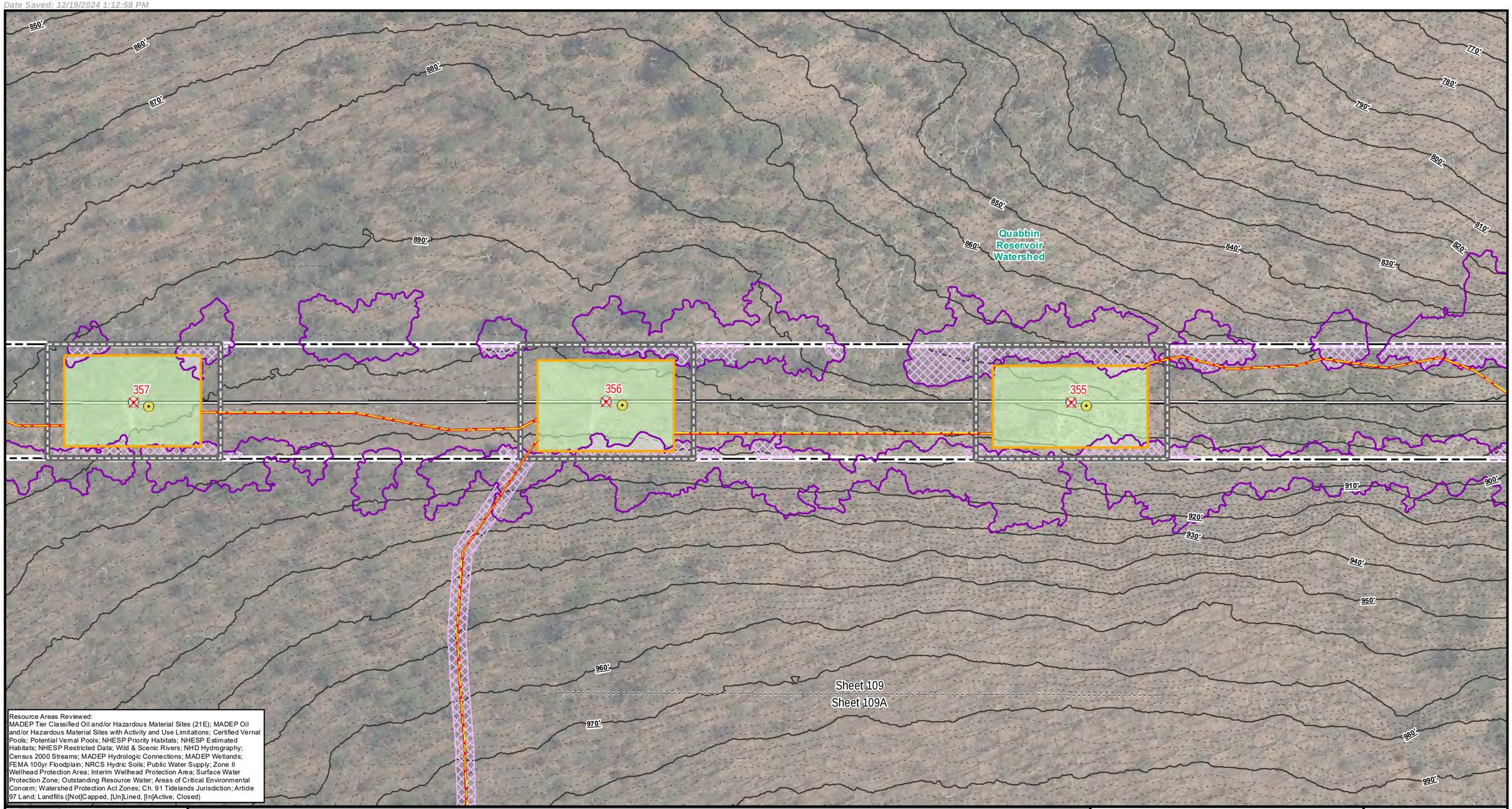

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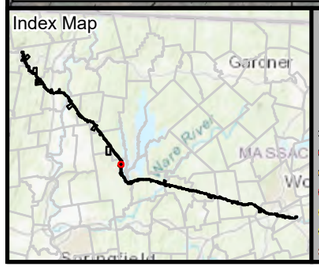

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Sheet 109

Sheet 109A

Quabbin Reservoir Watershed

BE-W3

BE-W4

JUCKETT RD

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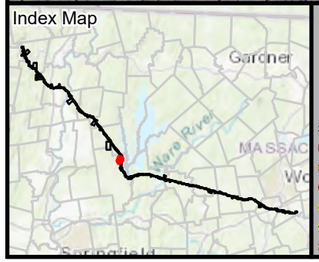

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Belchertown, MA
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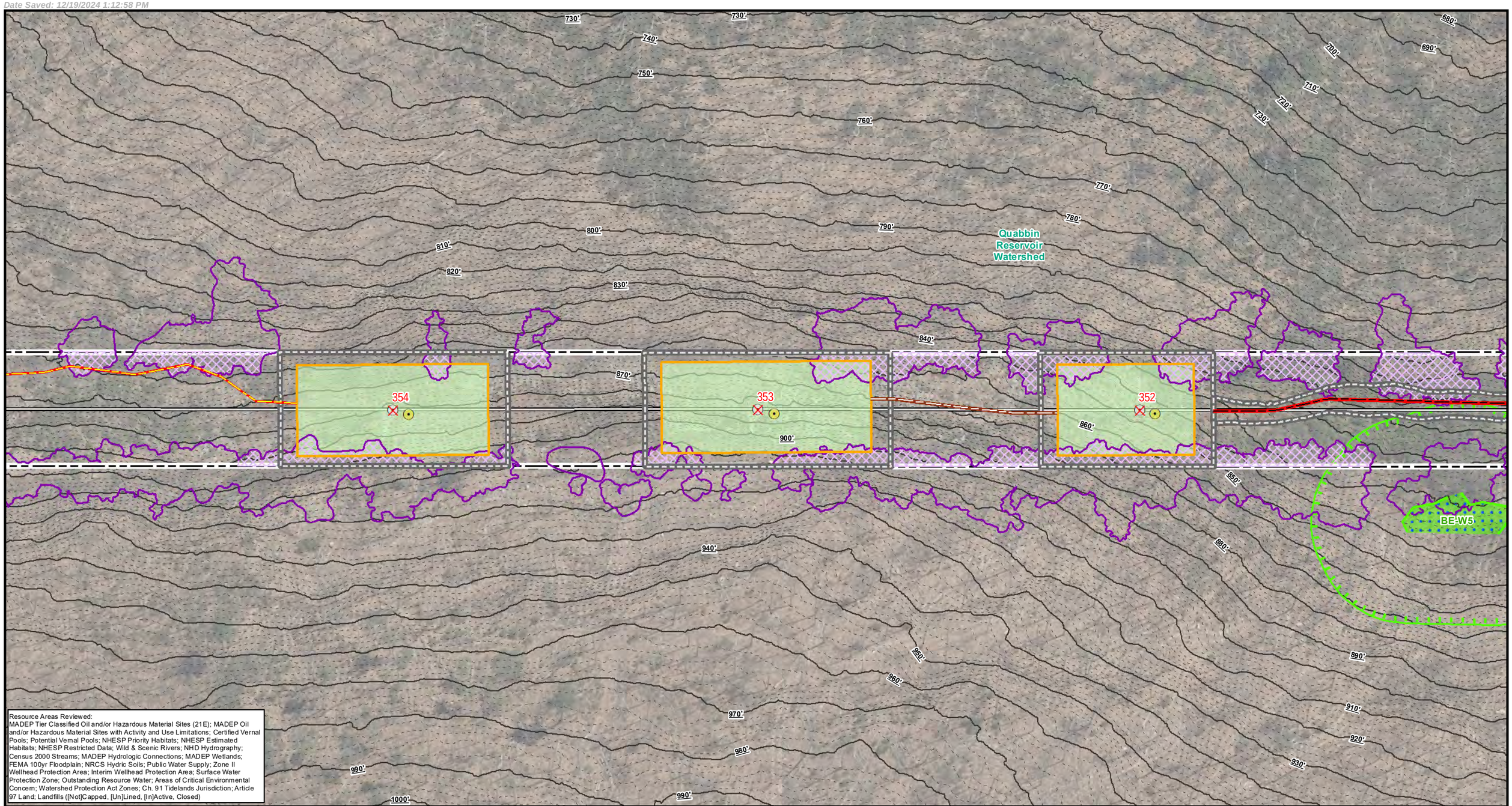

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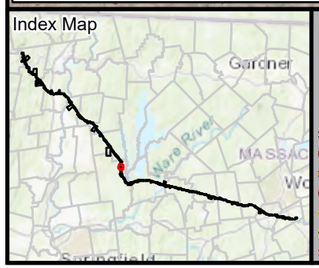

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Article 97 Lands

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Belchertown, MA
Page 110 of 240

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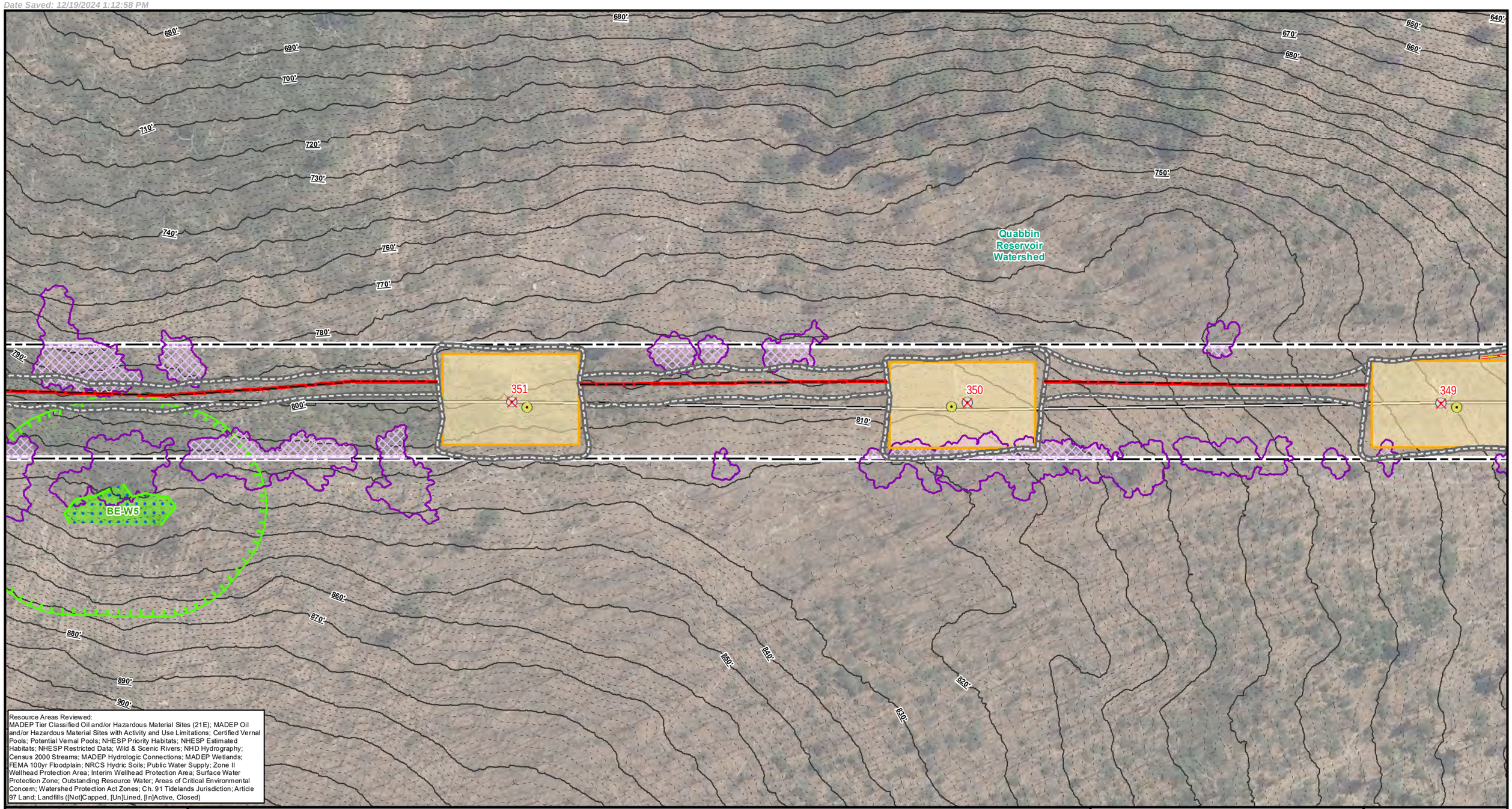

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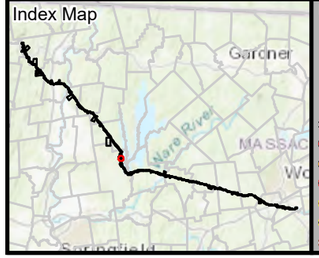

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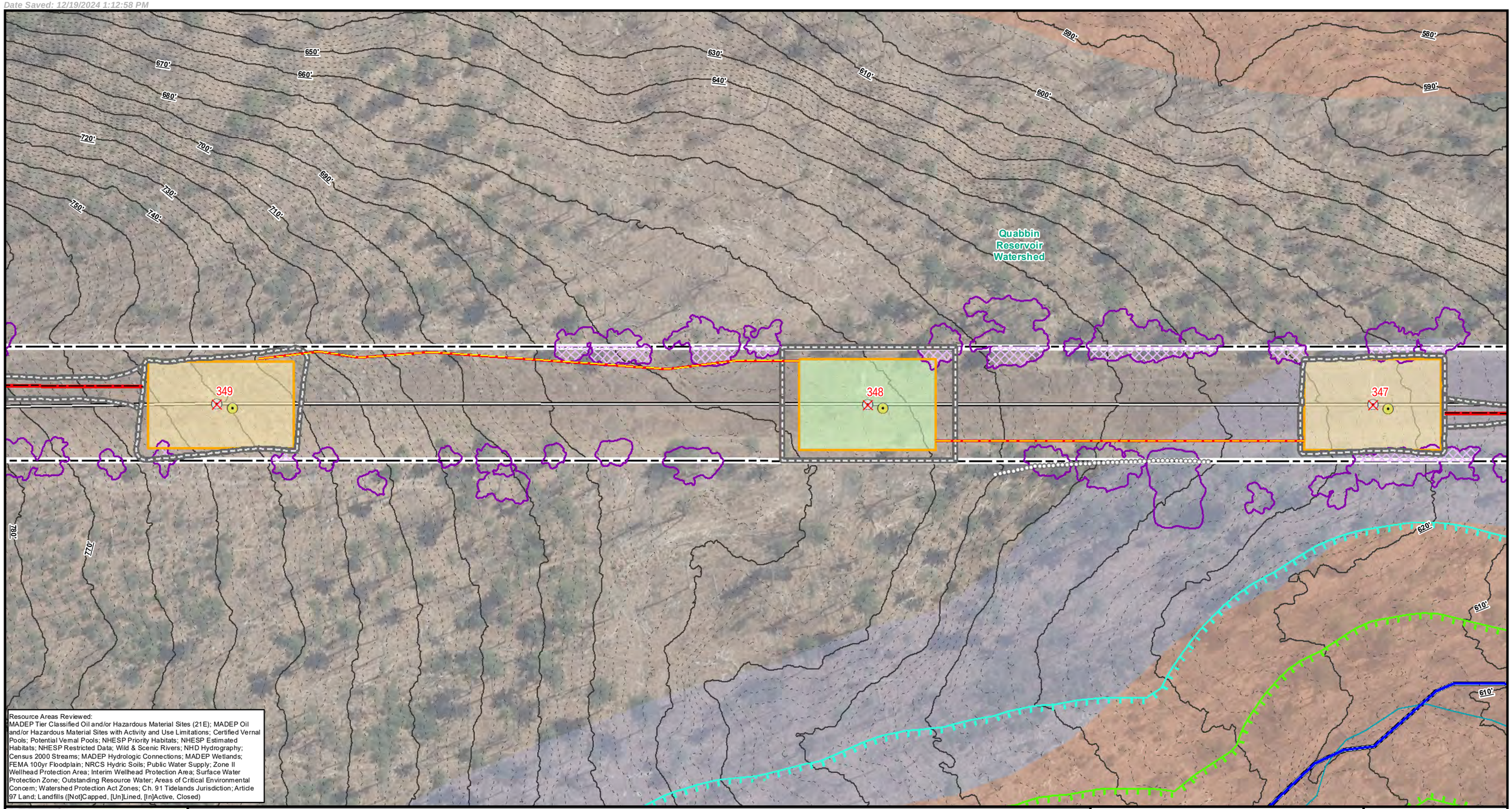

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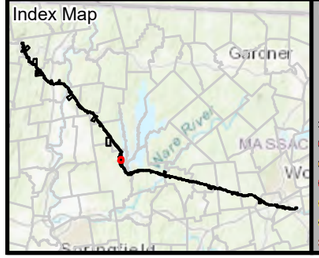

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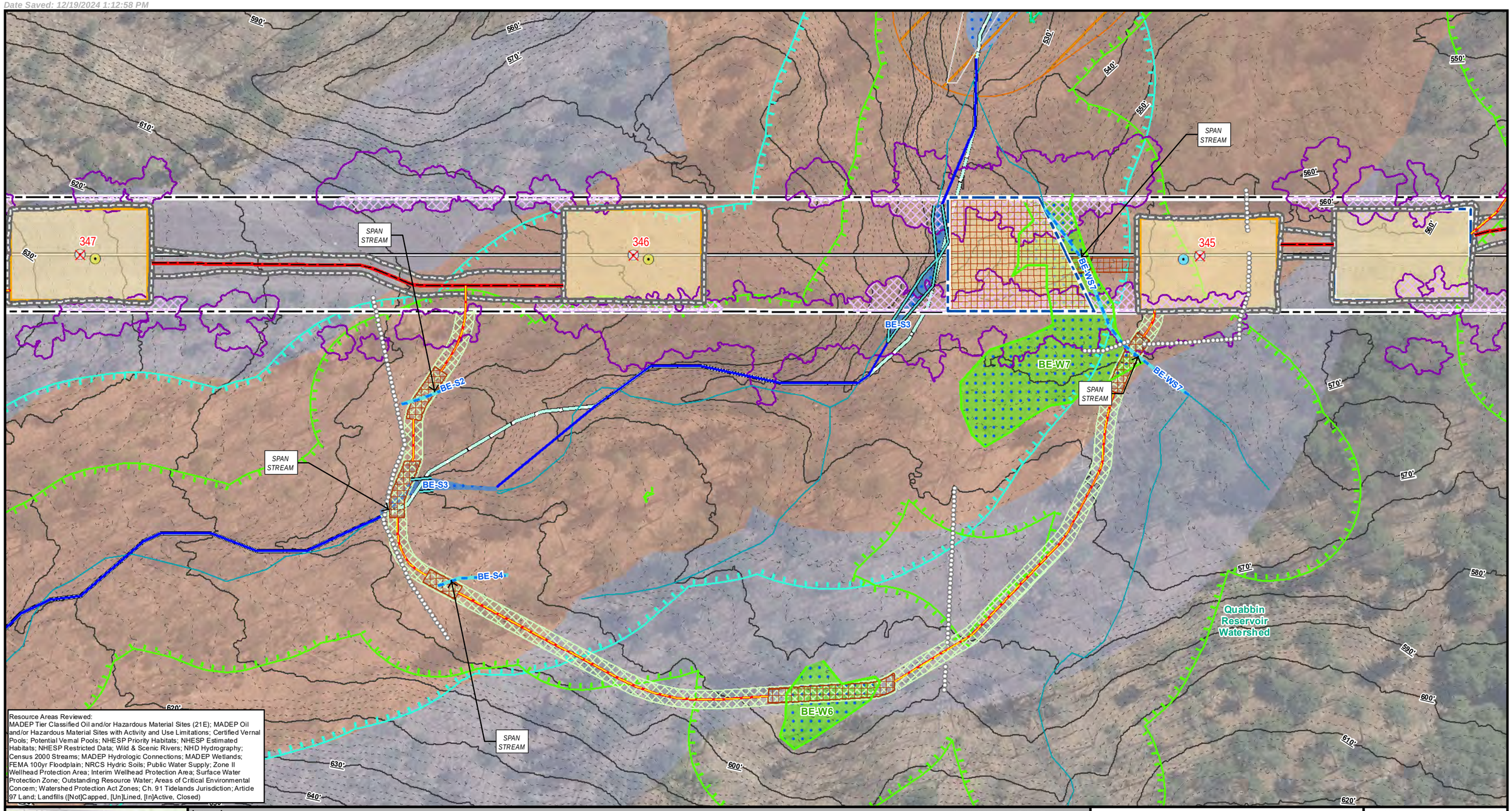

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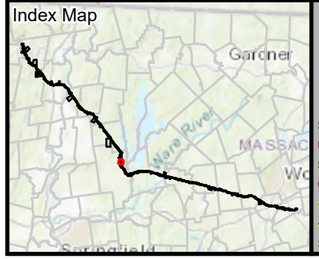

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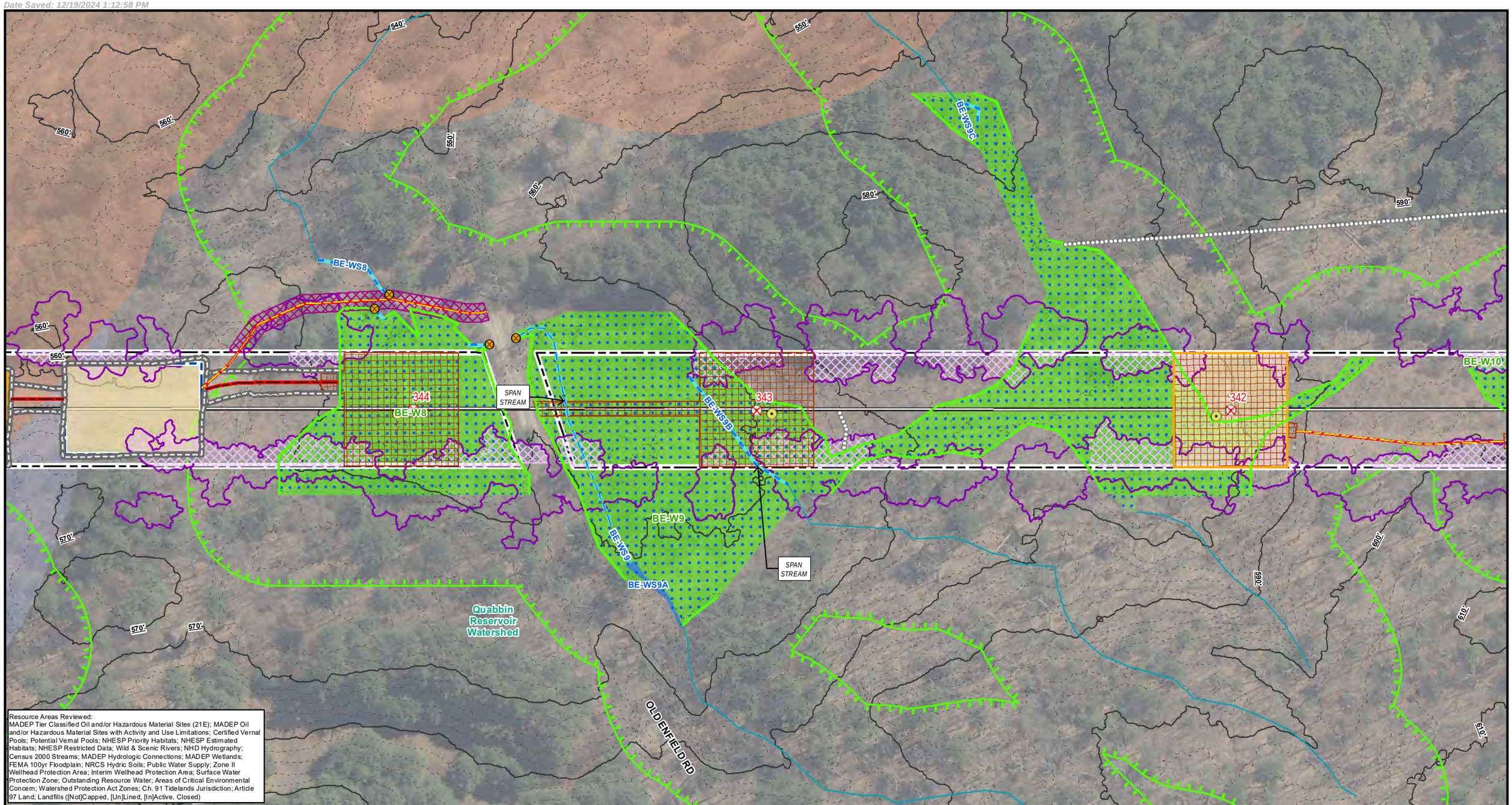

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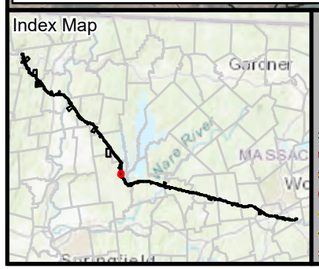

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- Selective Tree Removal
- Pruning

*Indicates Layers Set to Transparency

- Town Boundary
- Parcel Boundaries

Article 97 Lands

- DCR-Water Supply Protection

N

1 inch = 100 feet

0 50 100

Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Belchertown, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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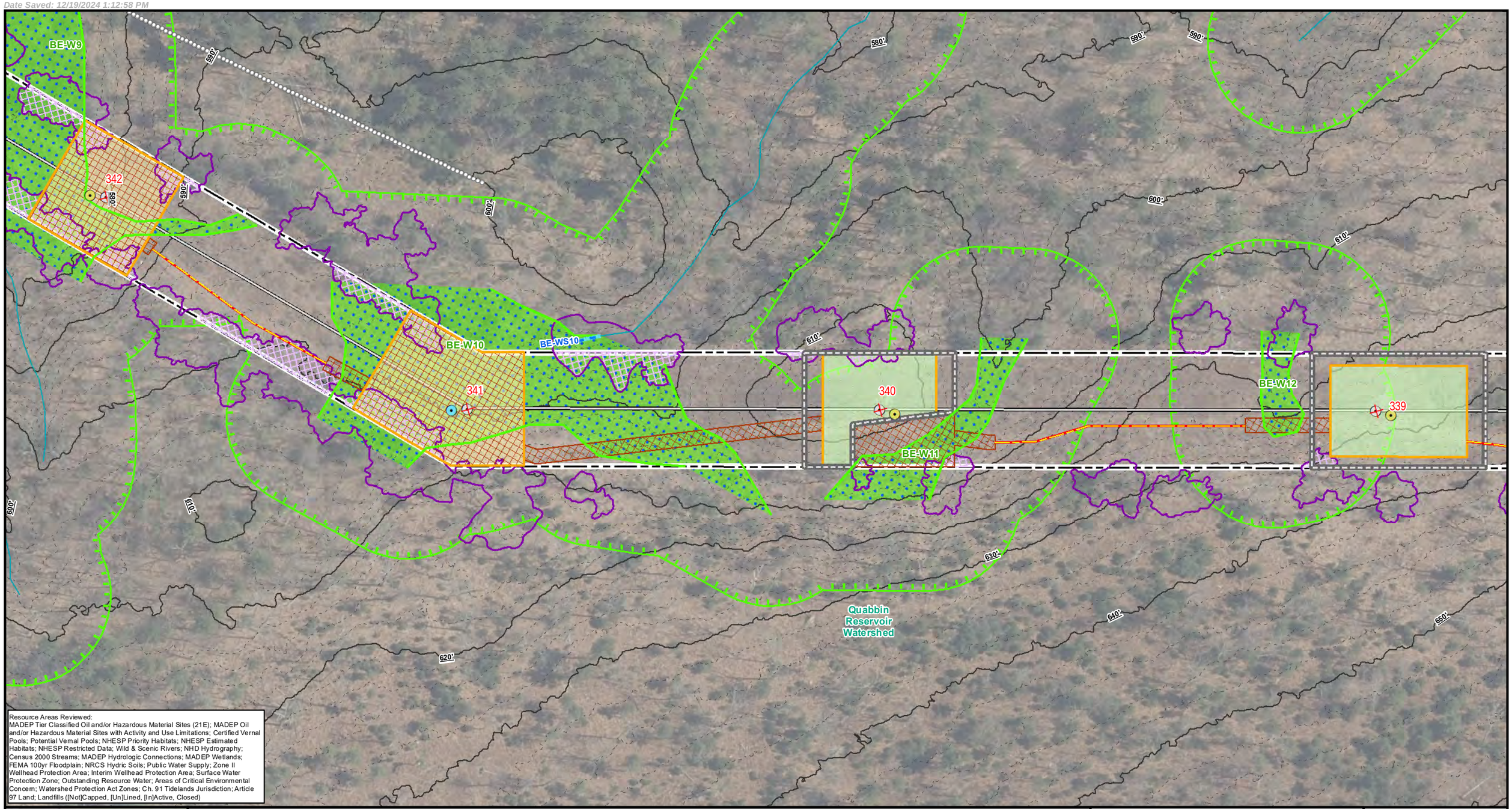

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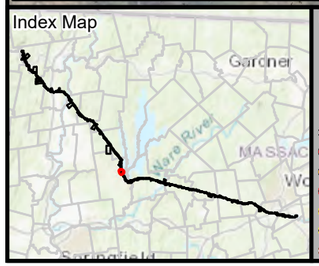

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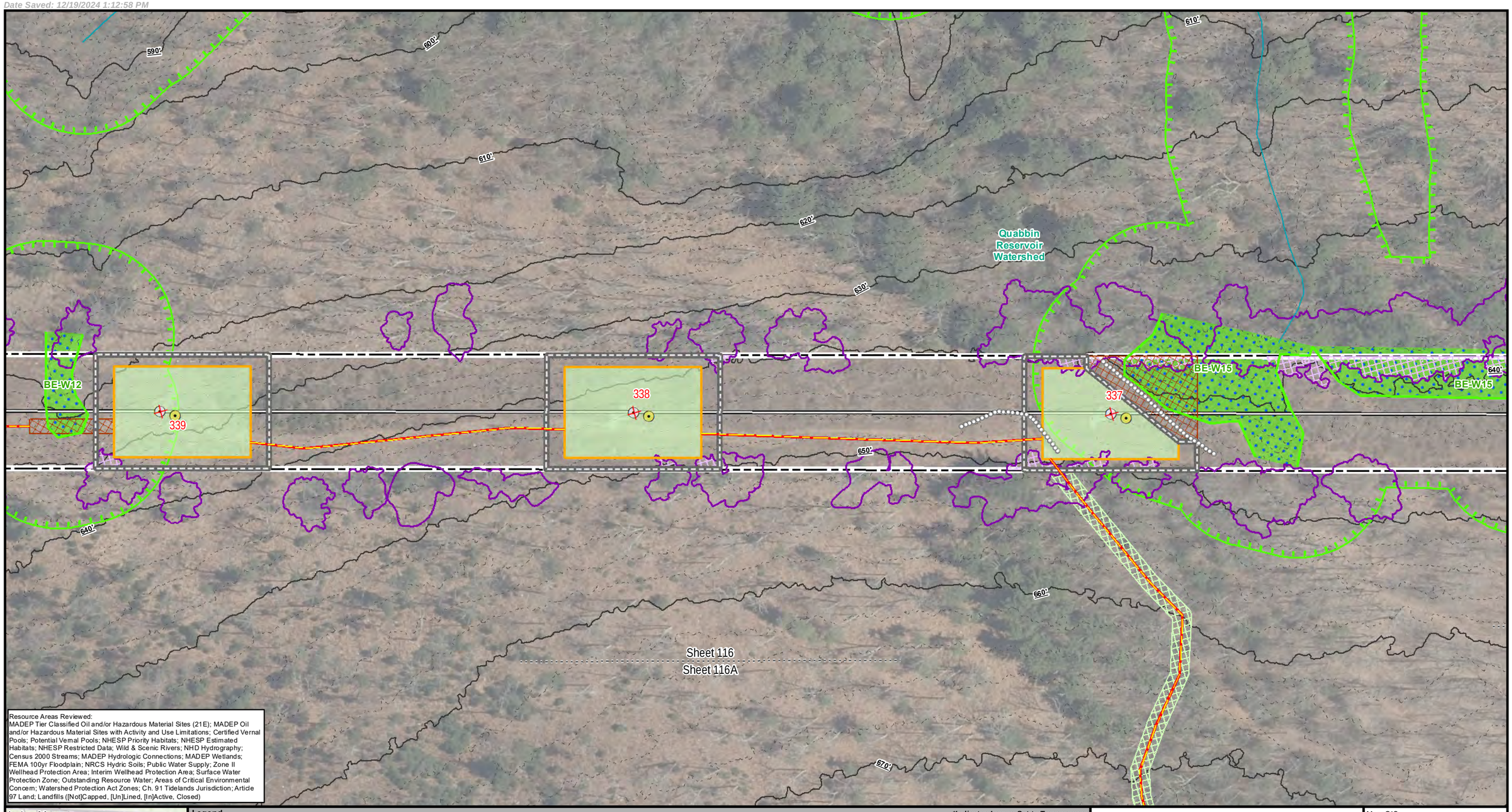

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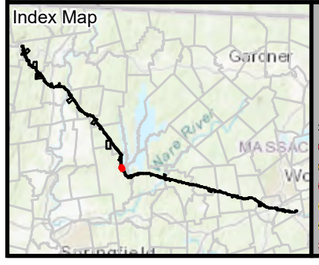

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Belchertown, MA
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BE-W14
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Gardner
Springfield

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0 100 200
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Belchertown, MA
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620'
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EARLEY ST
336
335
334
BE-W15
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Quabbin Reservoir Watershed

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Belchertown, MA

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333
332
331

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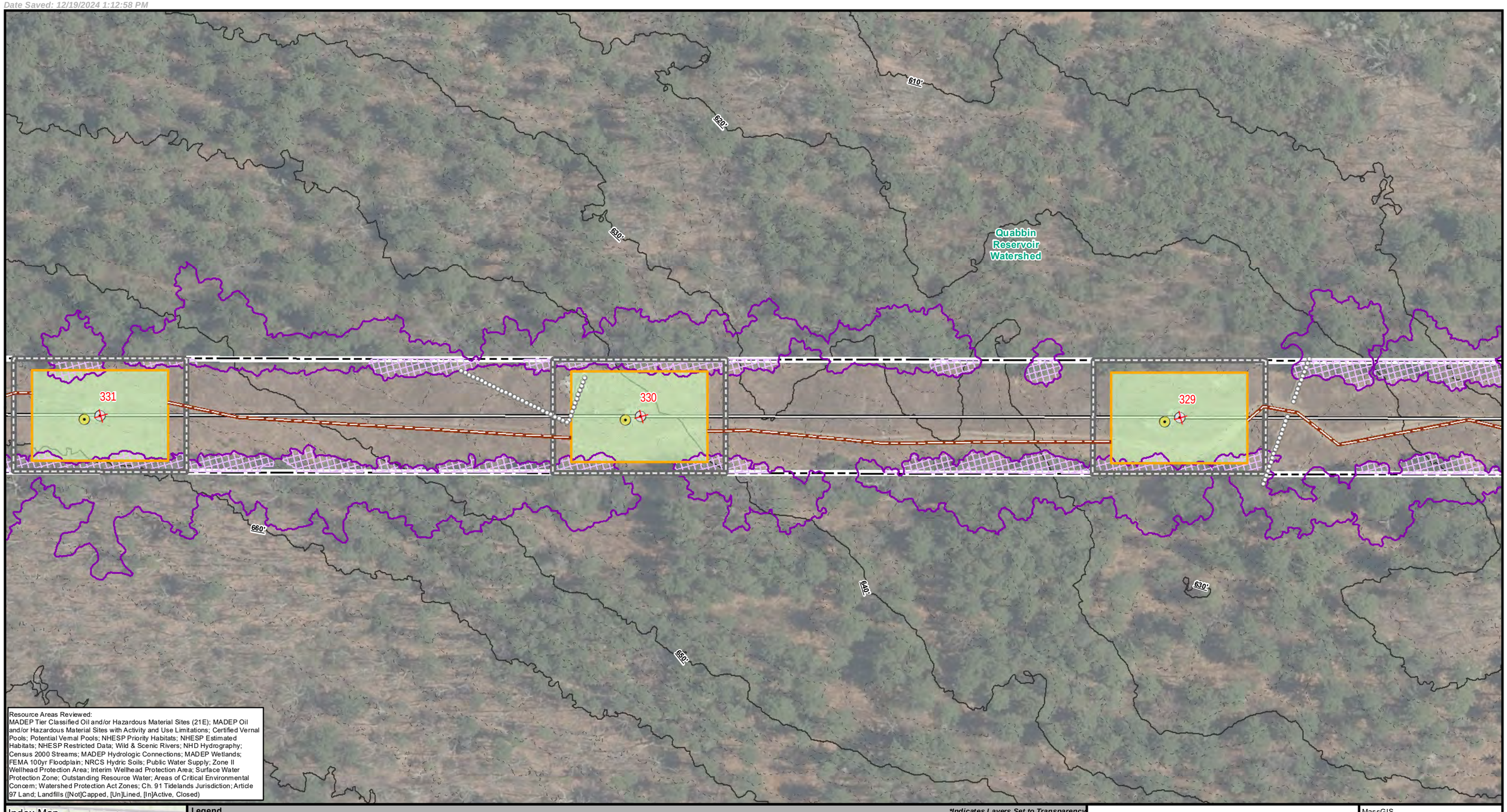

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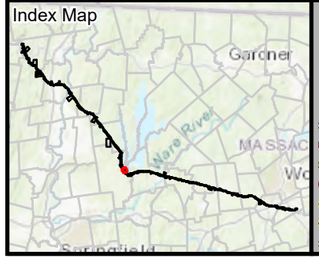

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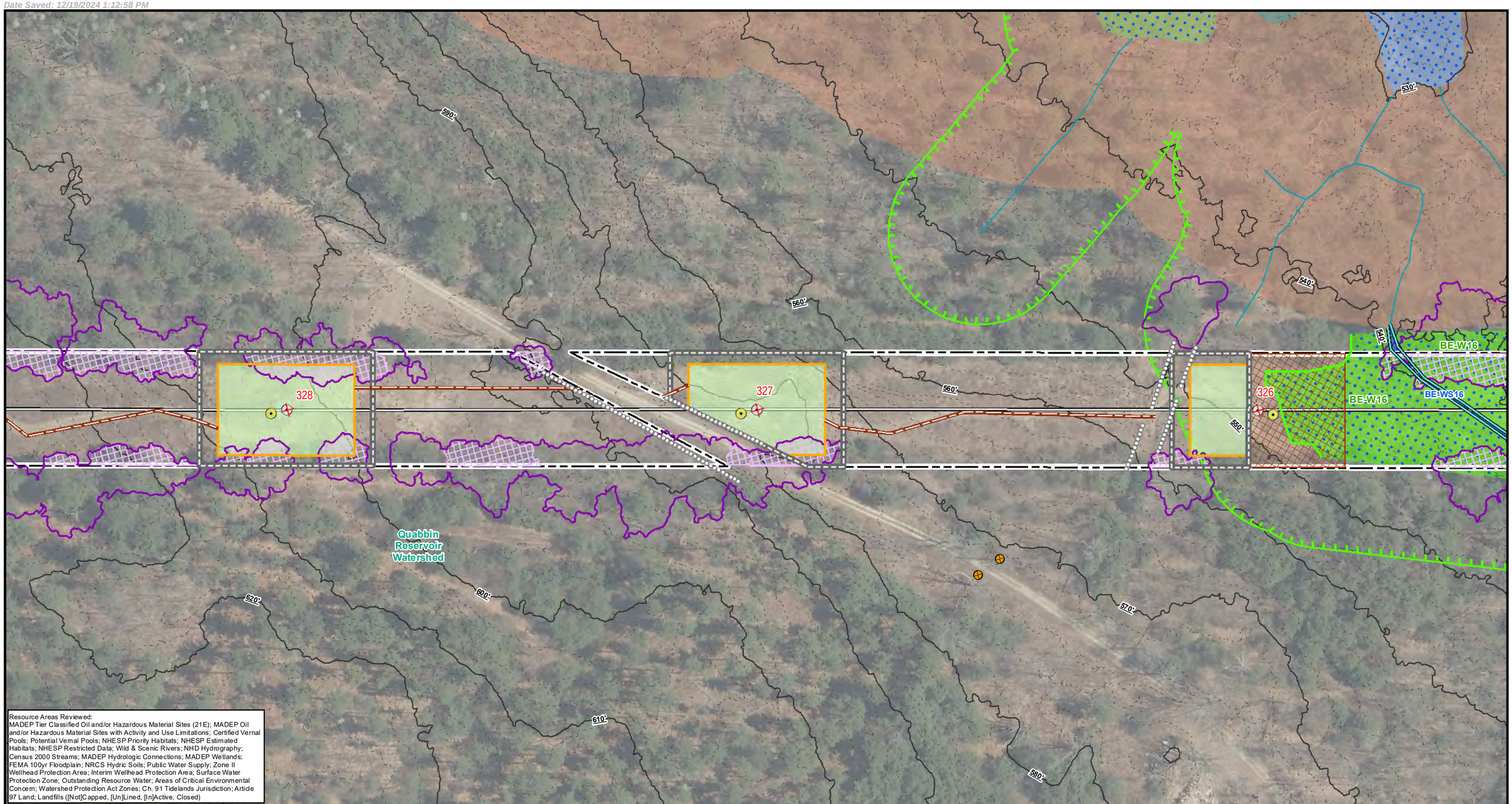

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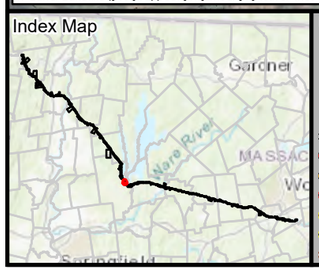

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- Tree Removal
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*Indicates Layers Set to Transparency

- Town Boundary
- Parcel Boundaries

Article 97 Lands

- DCR-Water Supply Protection

N

1 inch = 100 feet
0 50 100
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Belchertown, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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Quabbin Reservoir Watershed

BE-W16

BE-W17

BE-W18

BE-WS16

BE-WS16A

SPAN STREAM

326

325

324

530'

540'

570'

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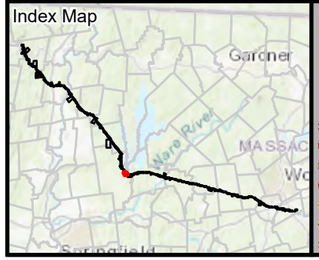

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BE-W16
BE-W17
BE-W18
BE-W19
BE-W20
324
323
322
1E
1F
2E
2F
3E
3F
6T1
6T2
530'
540'
550'
Quabbin Reservoir Watershed
QUABBIN RESERVOIR WORKER HOUSING
BLUE MEADOW RD

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Index Map
Gardner
Springfield

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

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MassGIS
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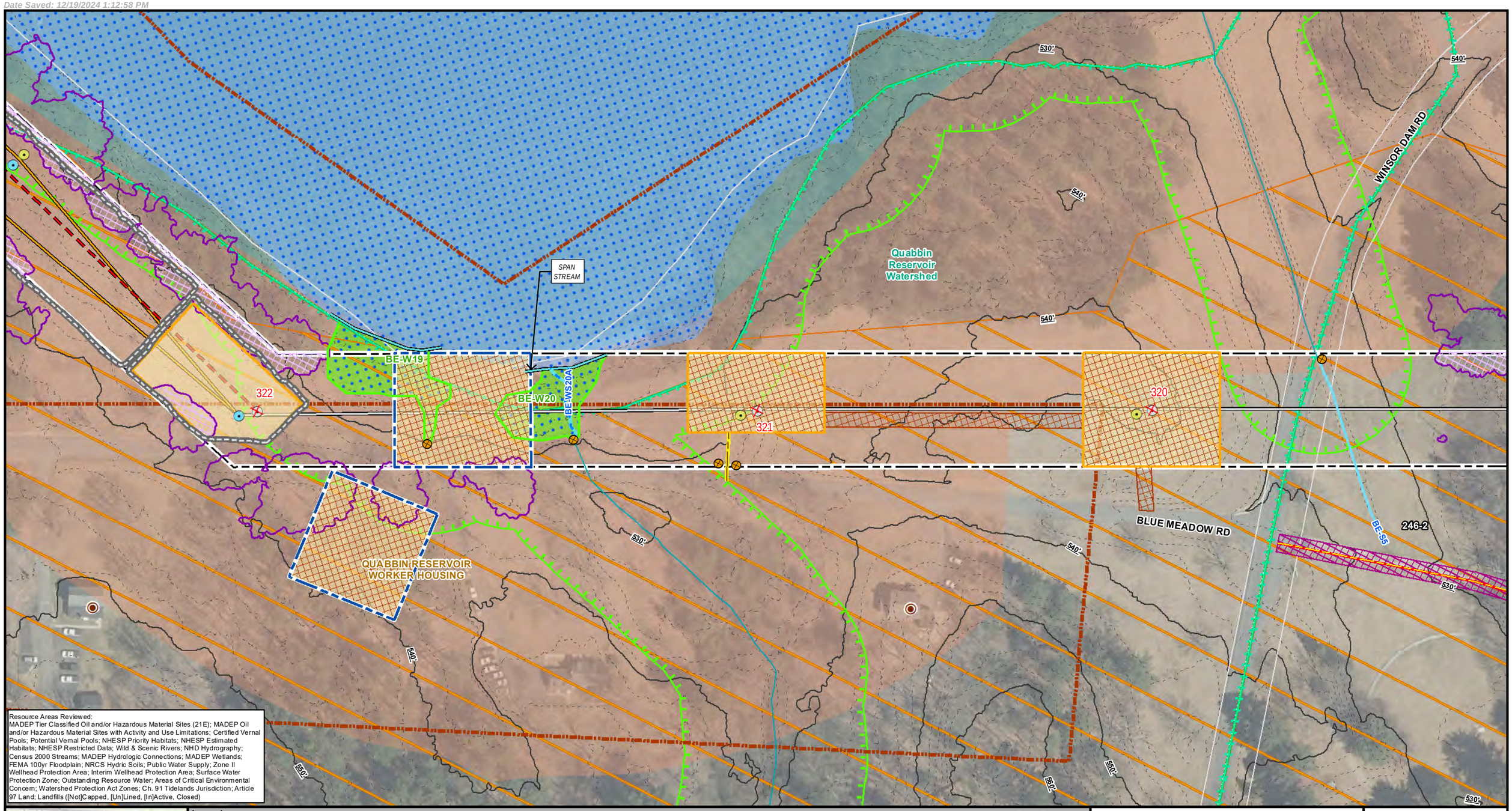

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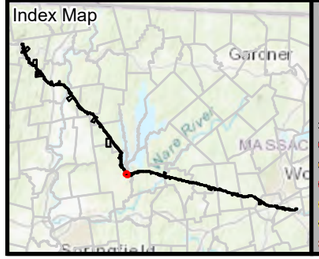

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WINSOR DAM RD

Quabbin Reservoir Watershed

246-2

319

318

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Sheet 124
Sheet 124A

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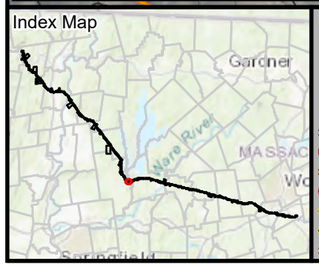

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Environmental Resources Map

Belchertown, MA
Page 124 of 240

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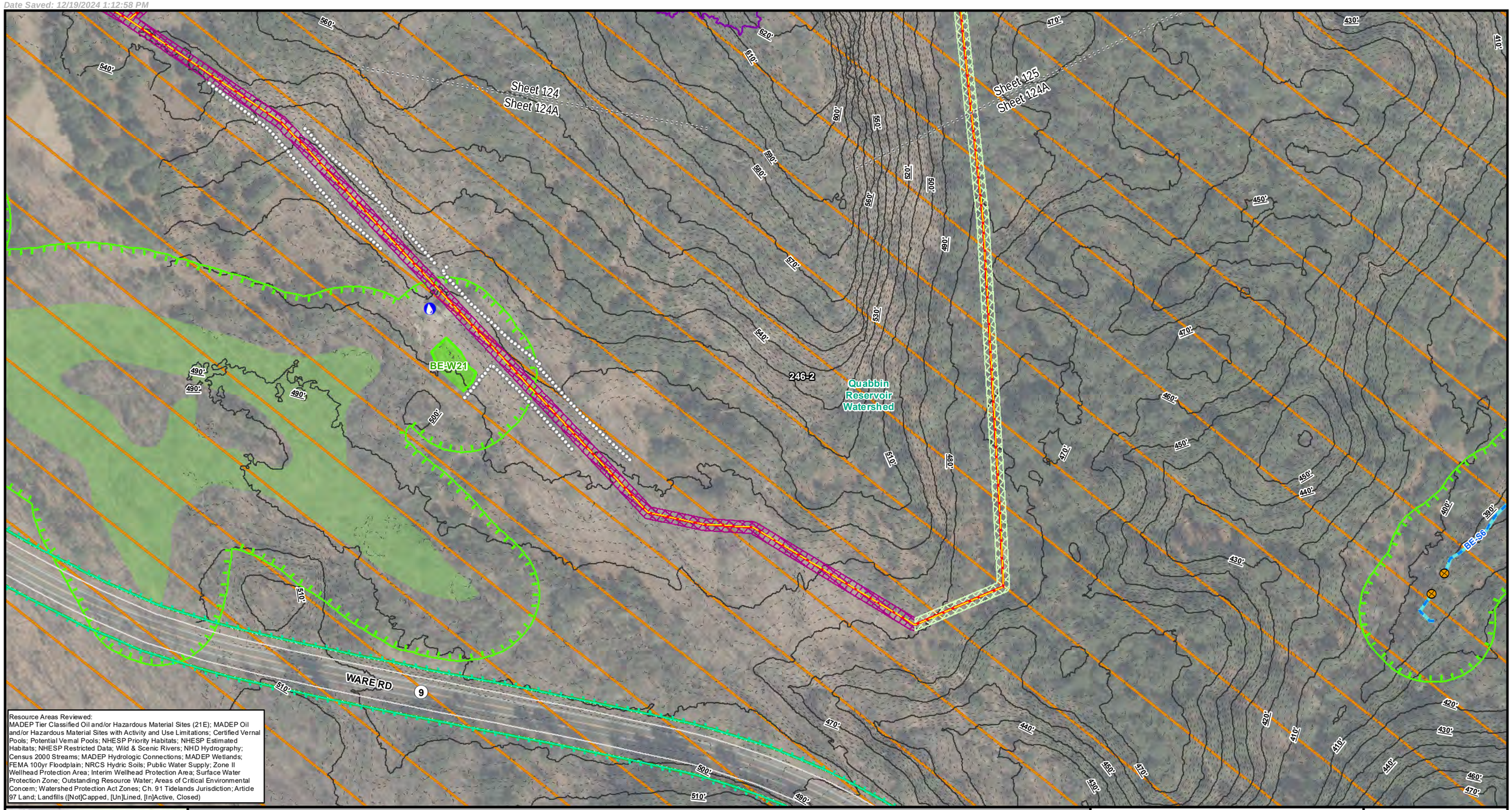

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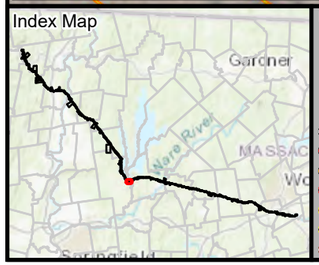

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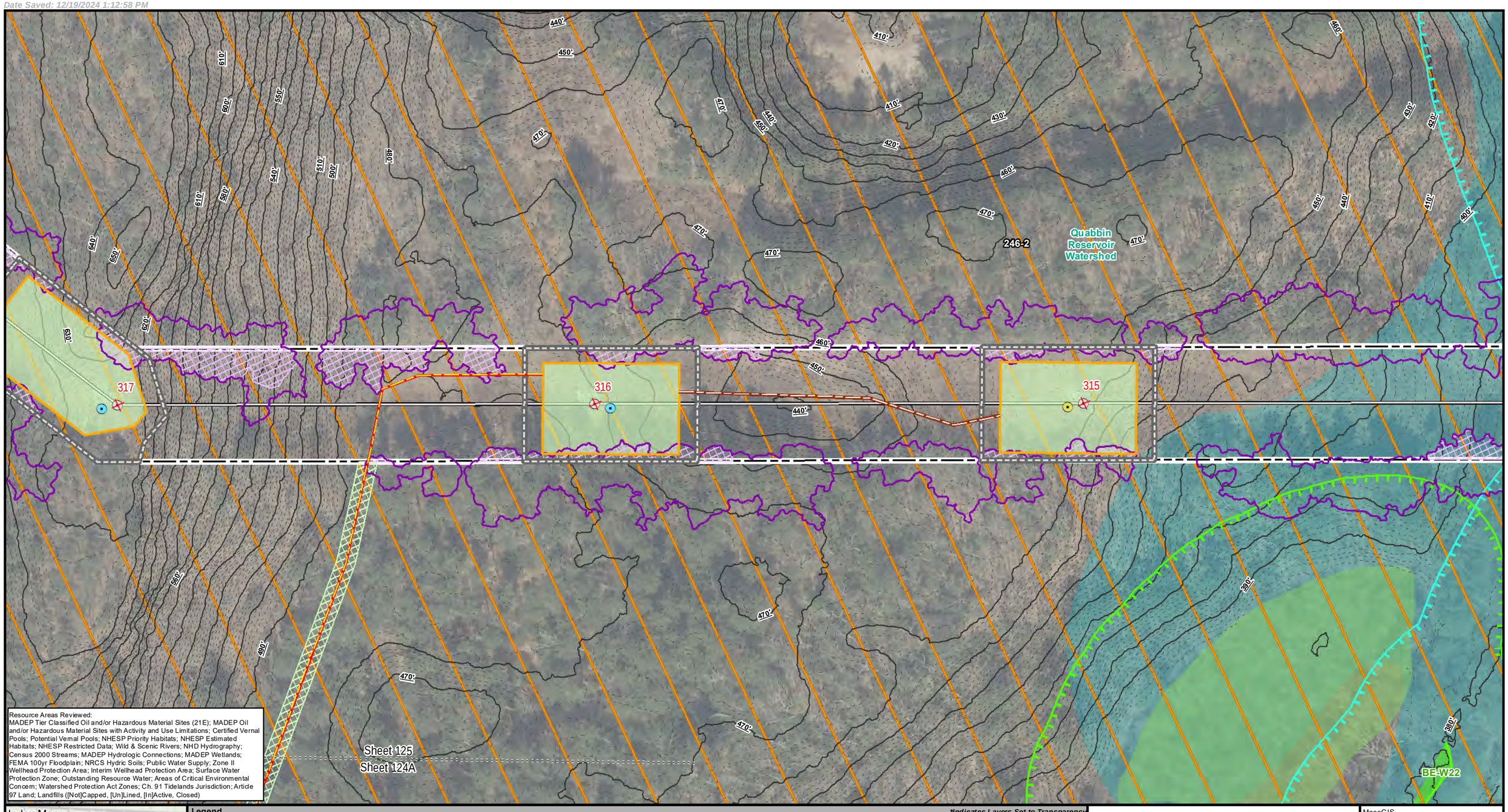

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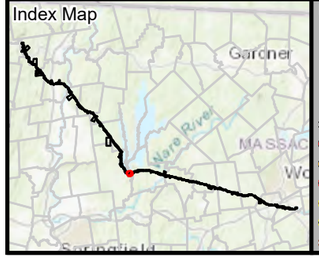

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Belchertown, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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Belchertown & Ware, MA

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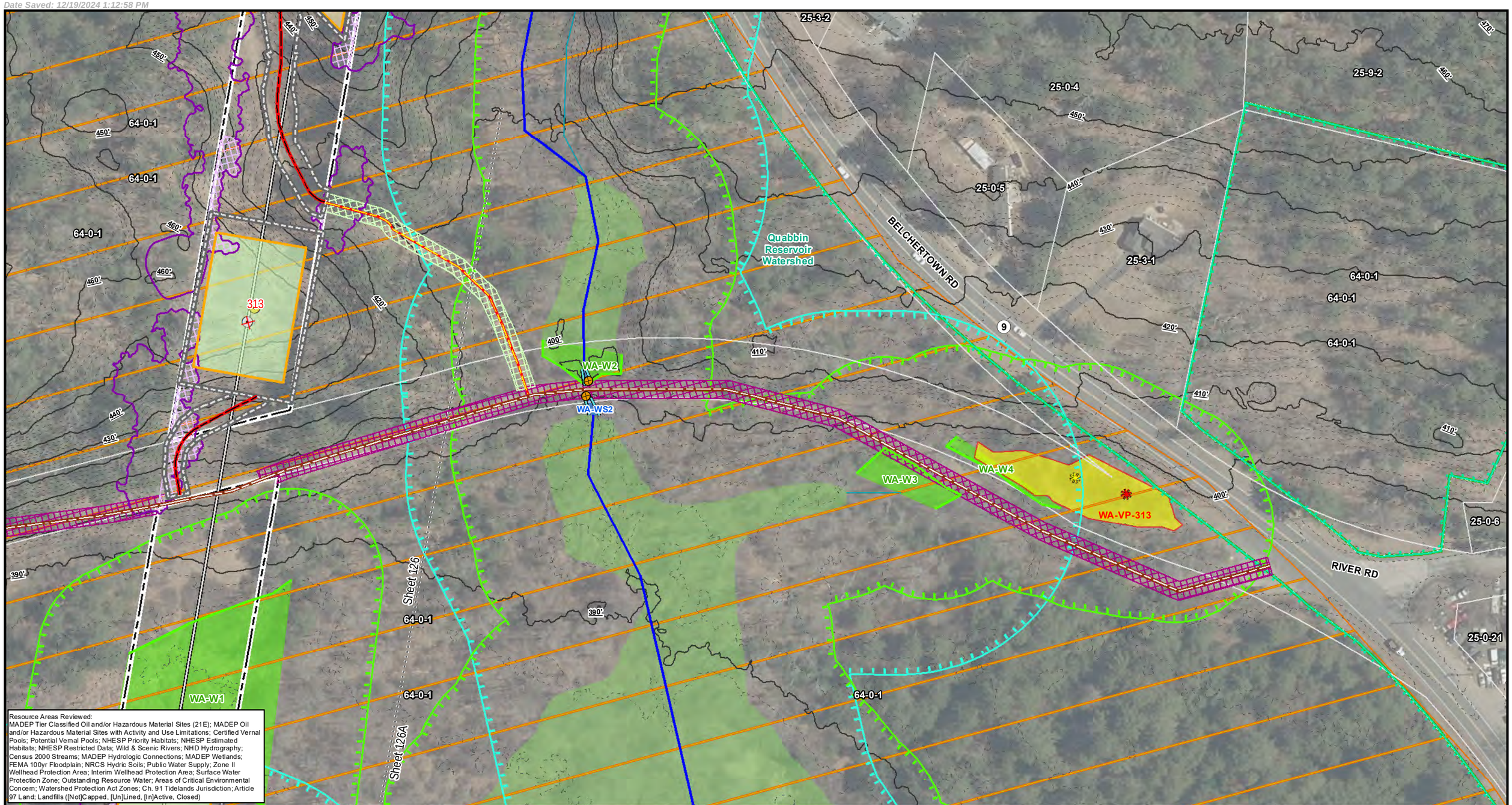

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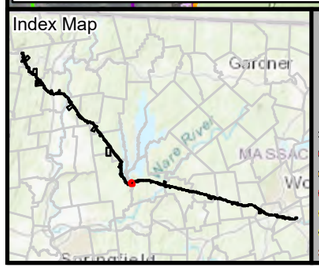

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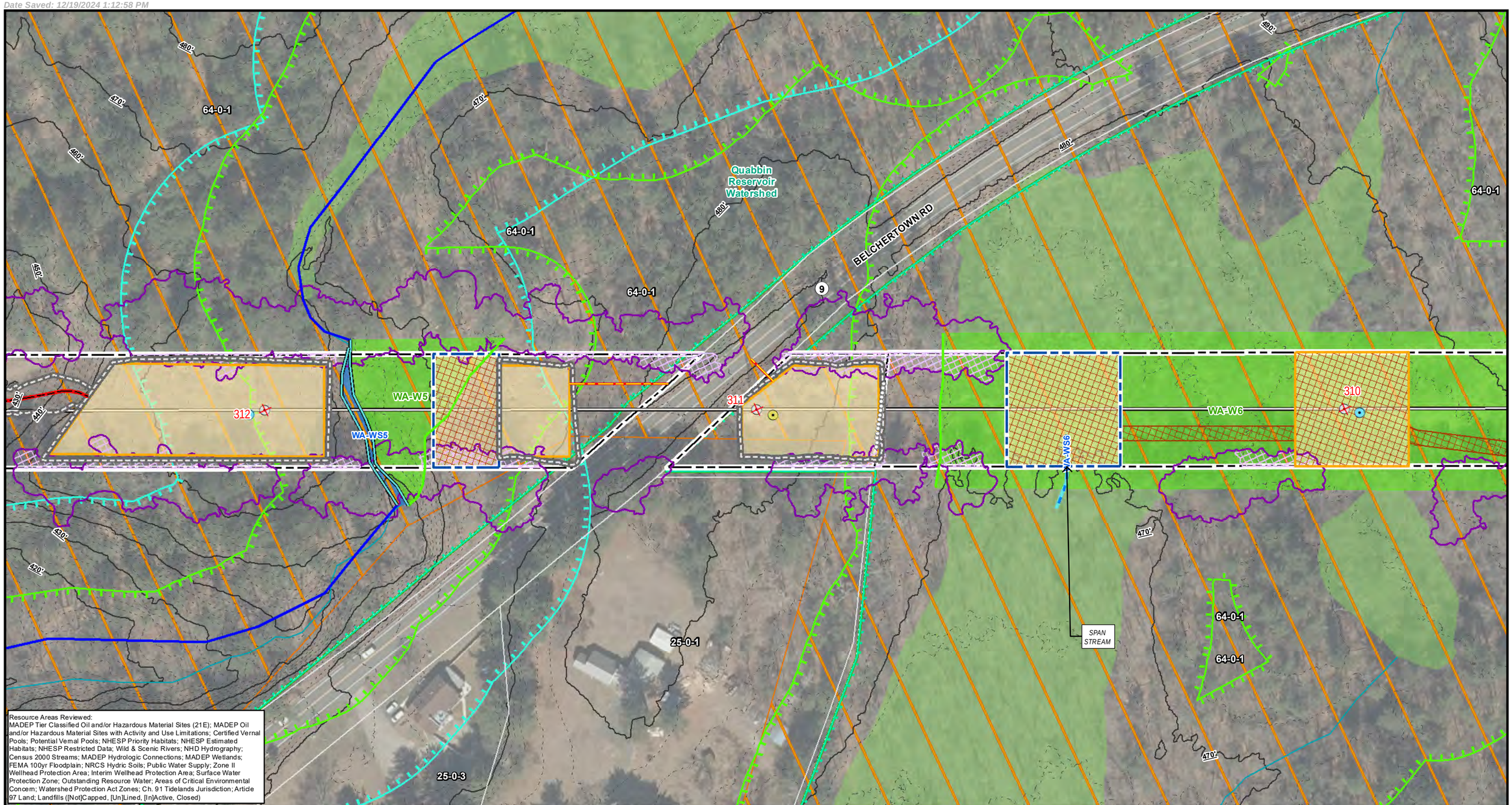

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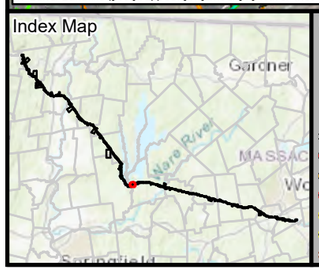

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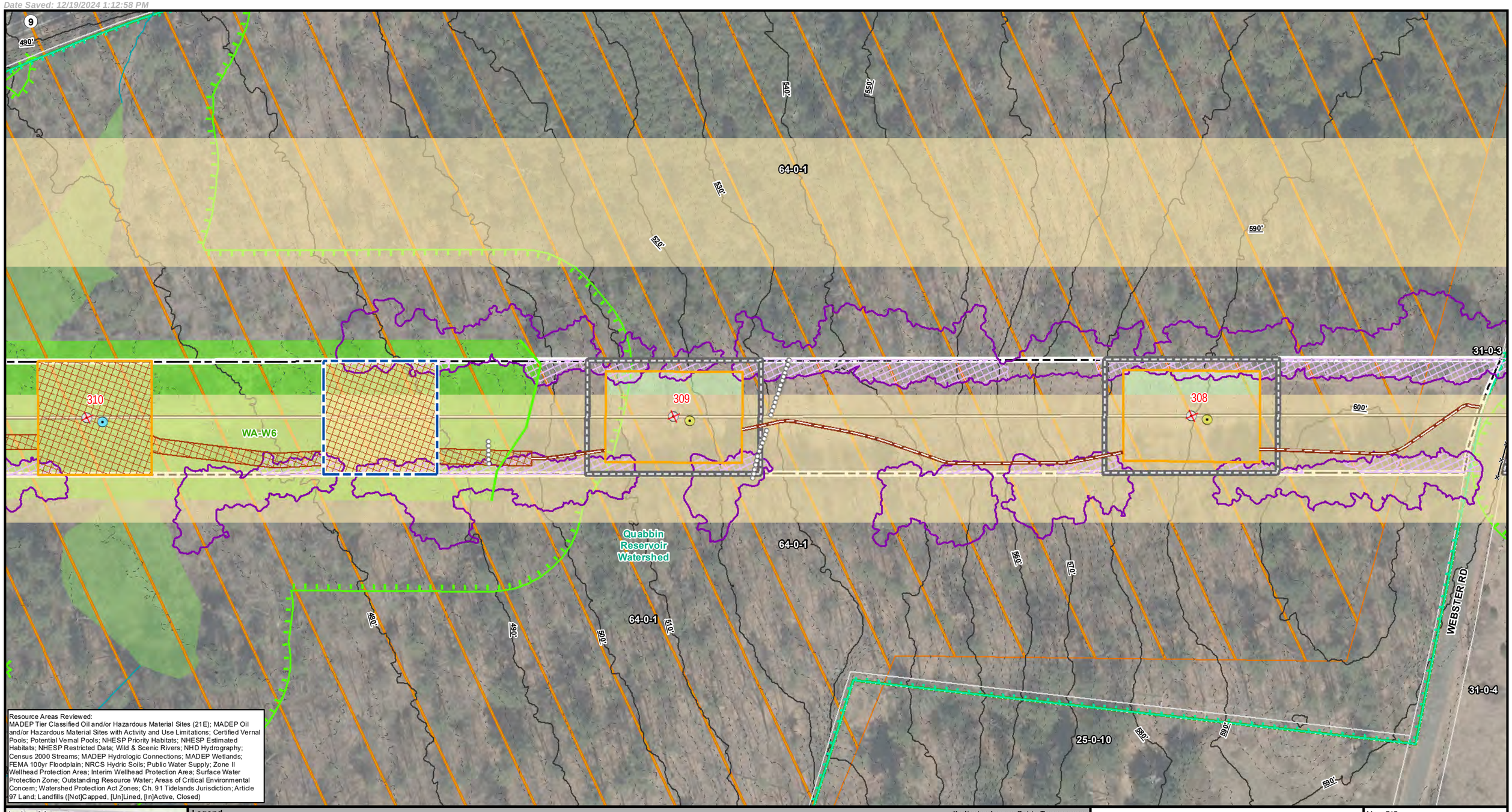

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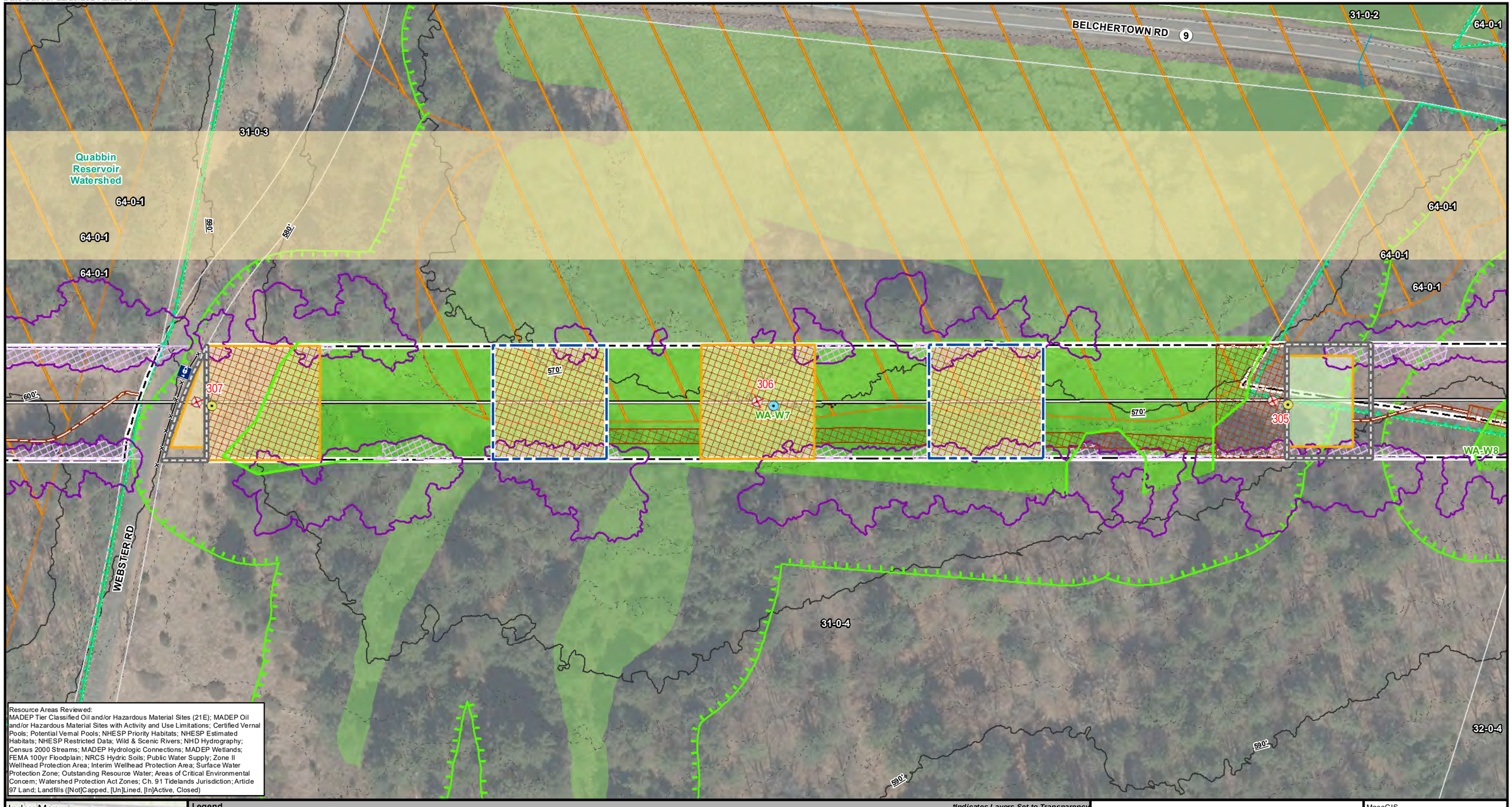

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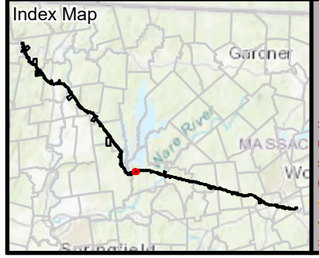

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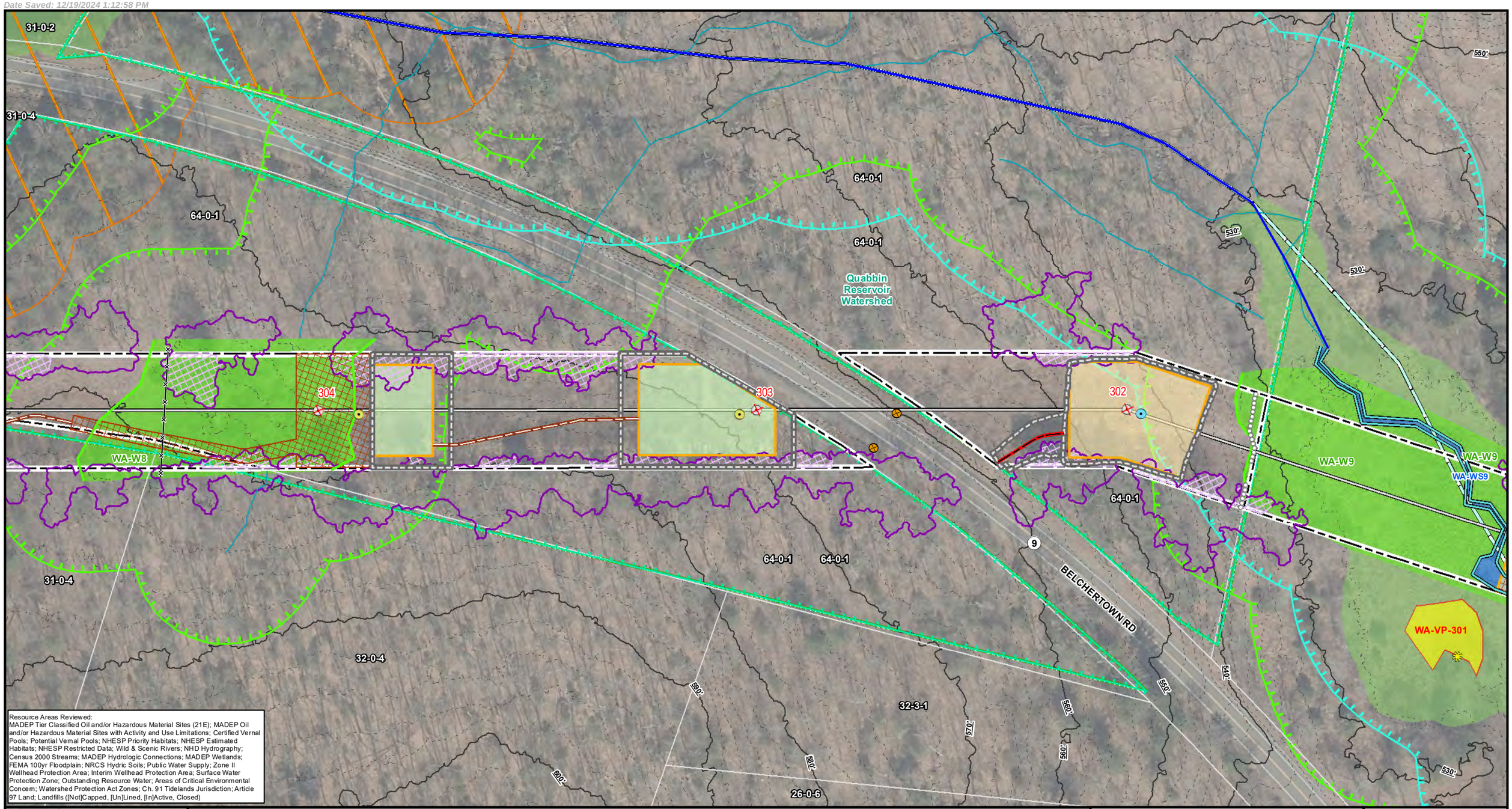

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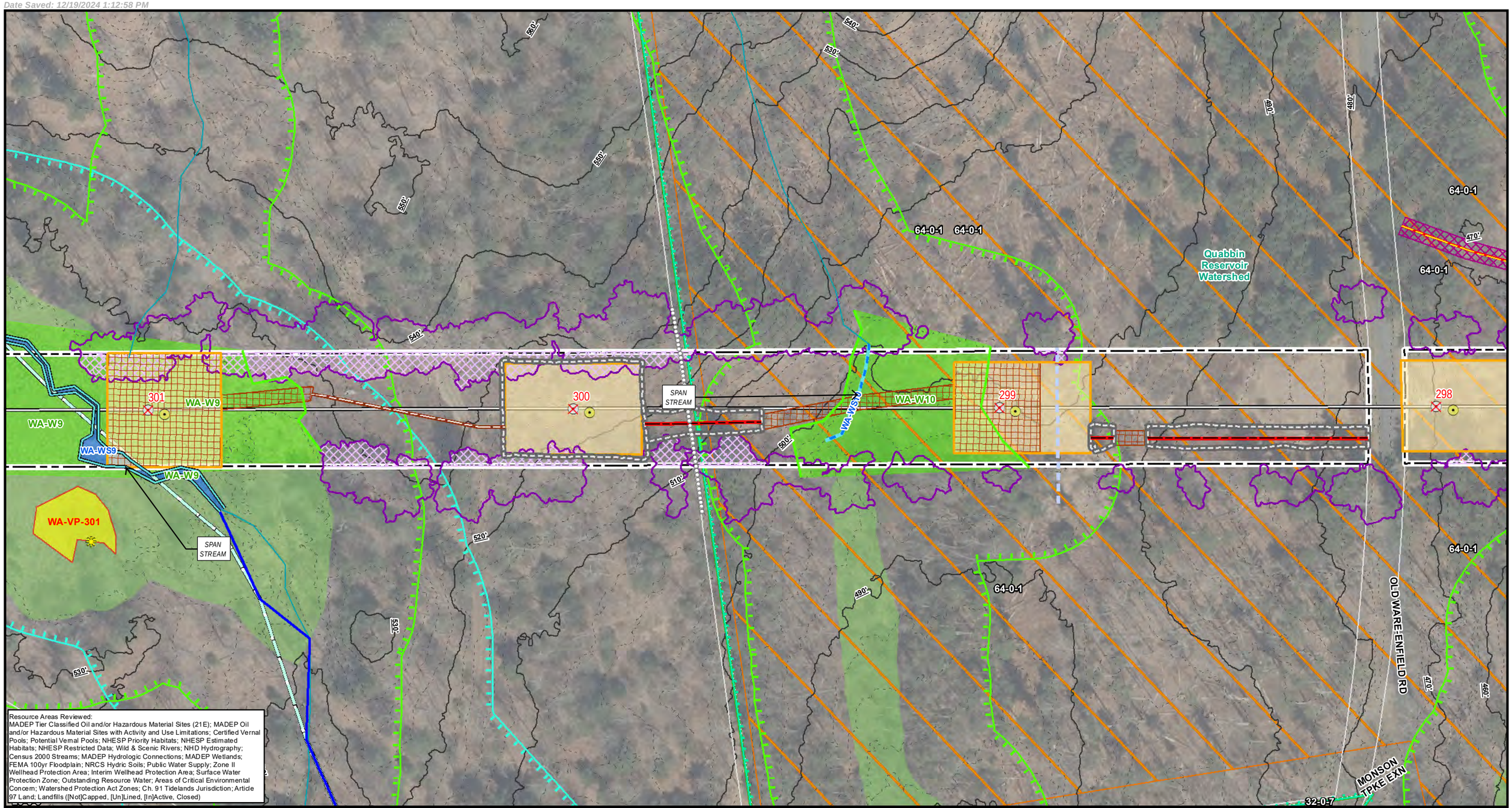

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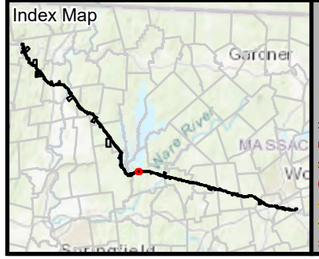

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Article 97 Lands

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N

1 inch = 100 feet

0 50 100

Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Ware, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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Quabbin Reservoir Watershed

64-0-1

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OLD WARE-ENFIELD RD

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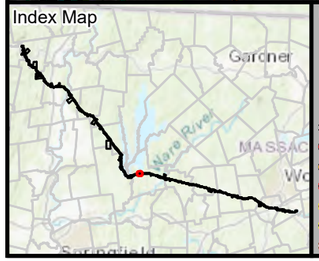

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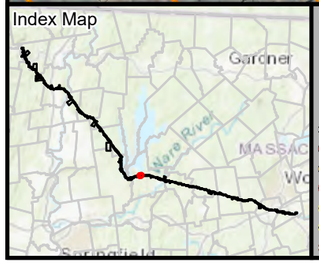

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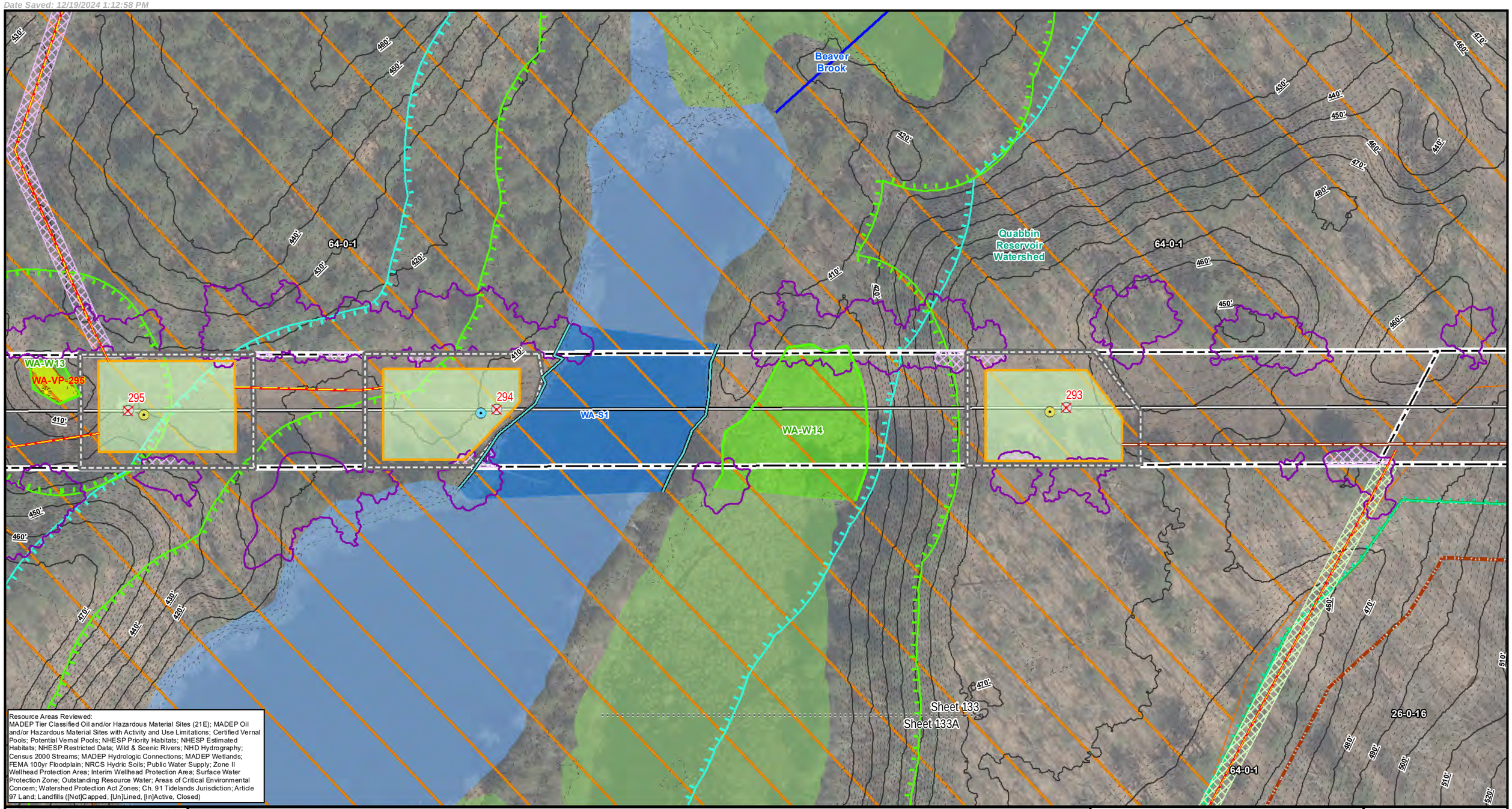

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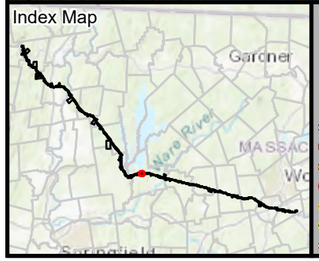

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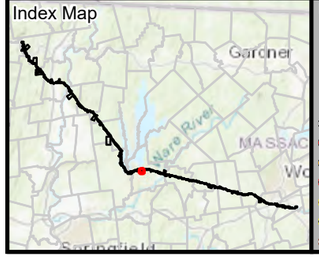

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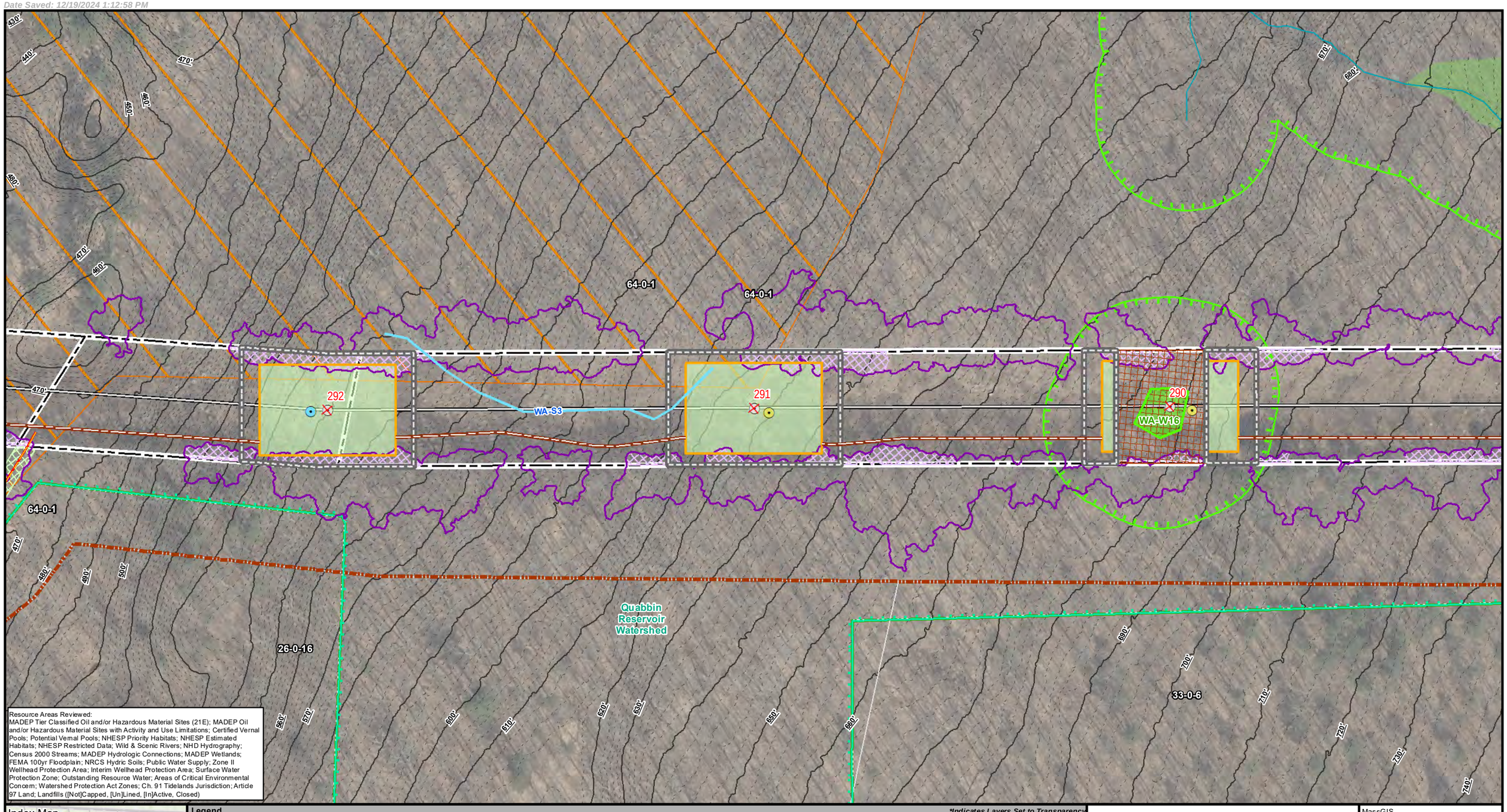

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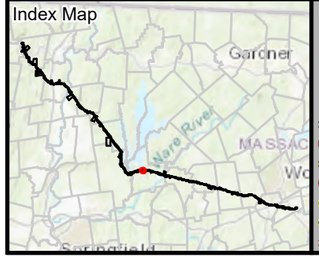

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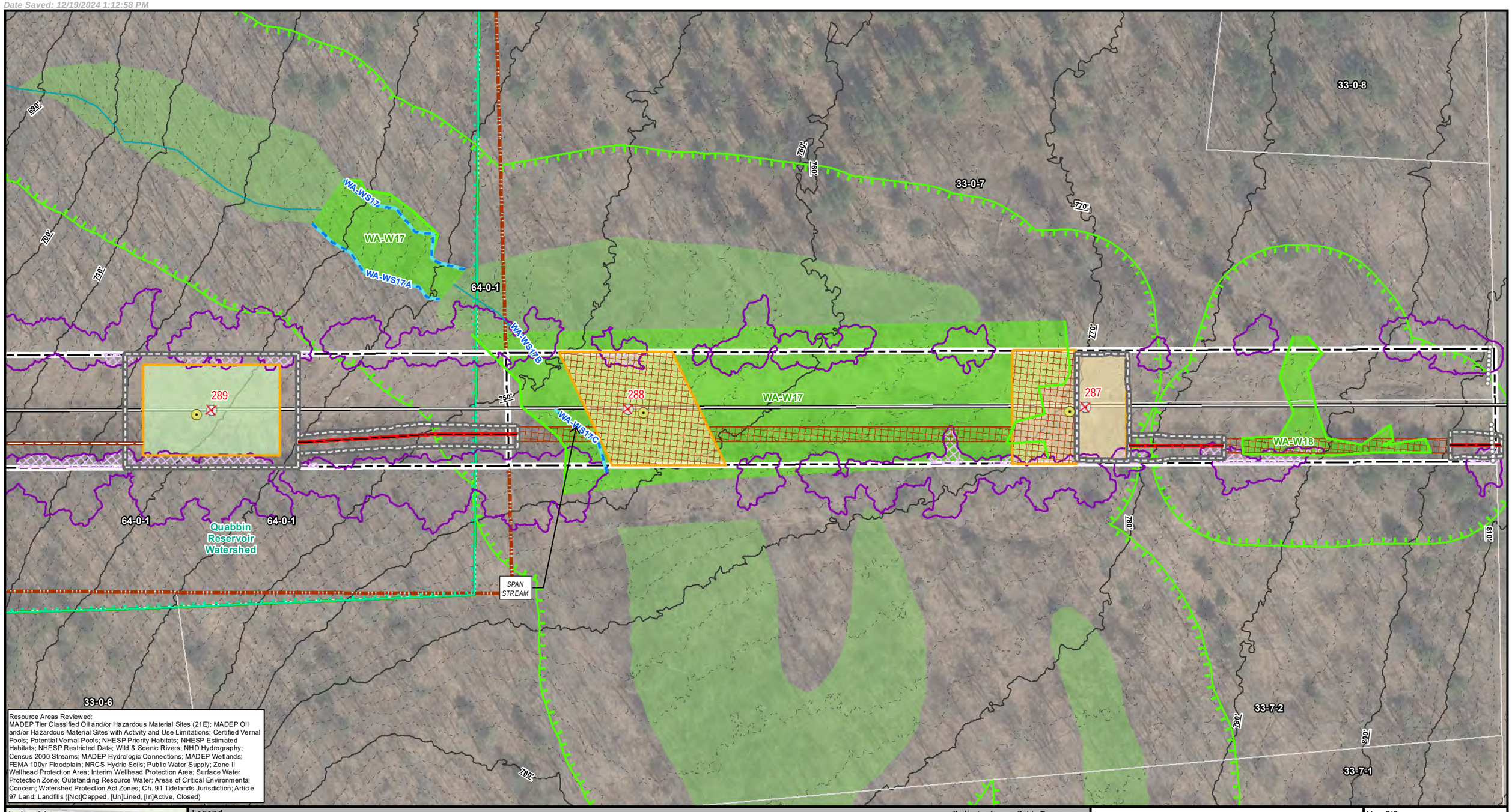

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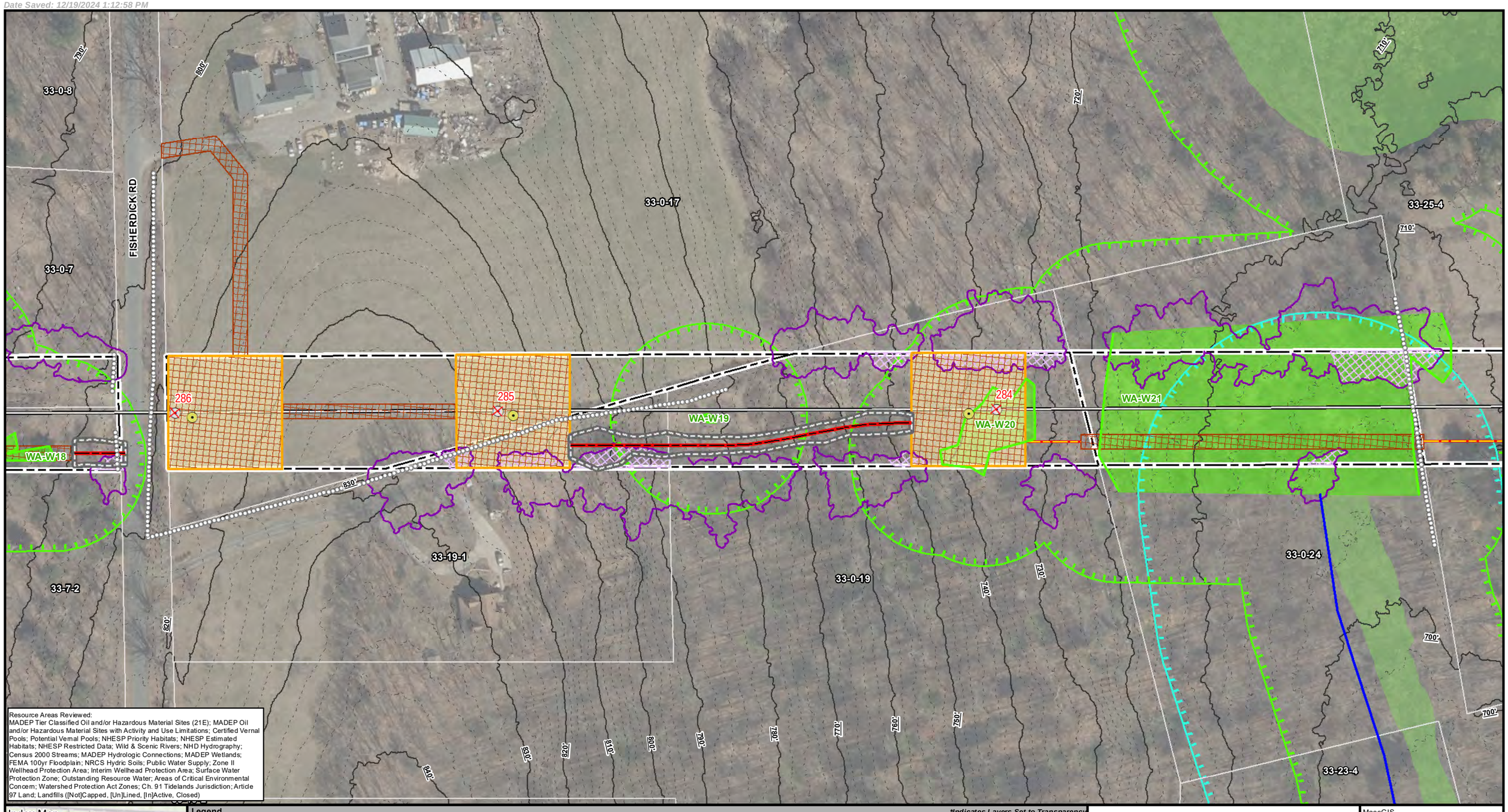

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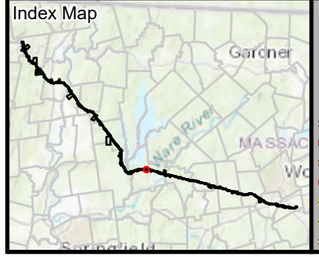

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- Hiking Trails
- Approximate Pipeline
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- 10ft Contour
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- Stonewall
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- Selective Tree Removal
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- Parcel Boundaries

*Indicates Layers Set to Transparency

N

1 inch = 100 feet
0 50 100
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Ware, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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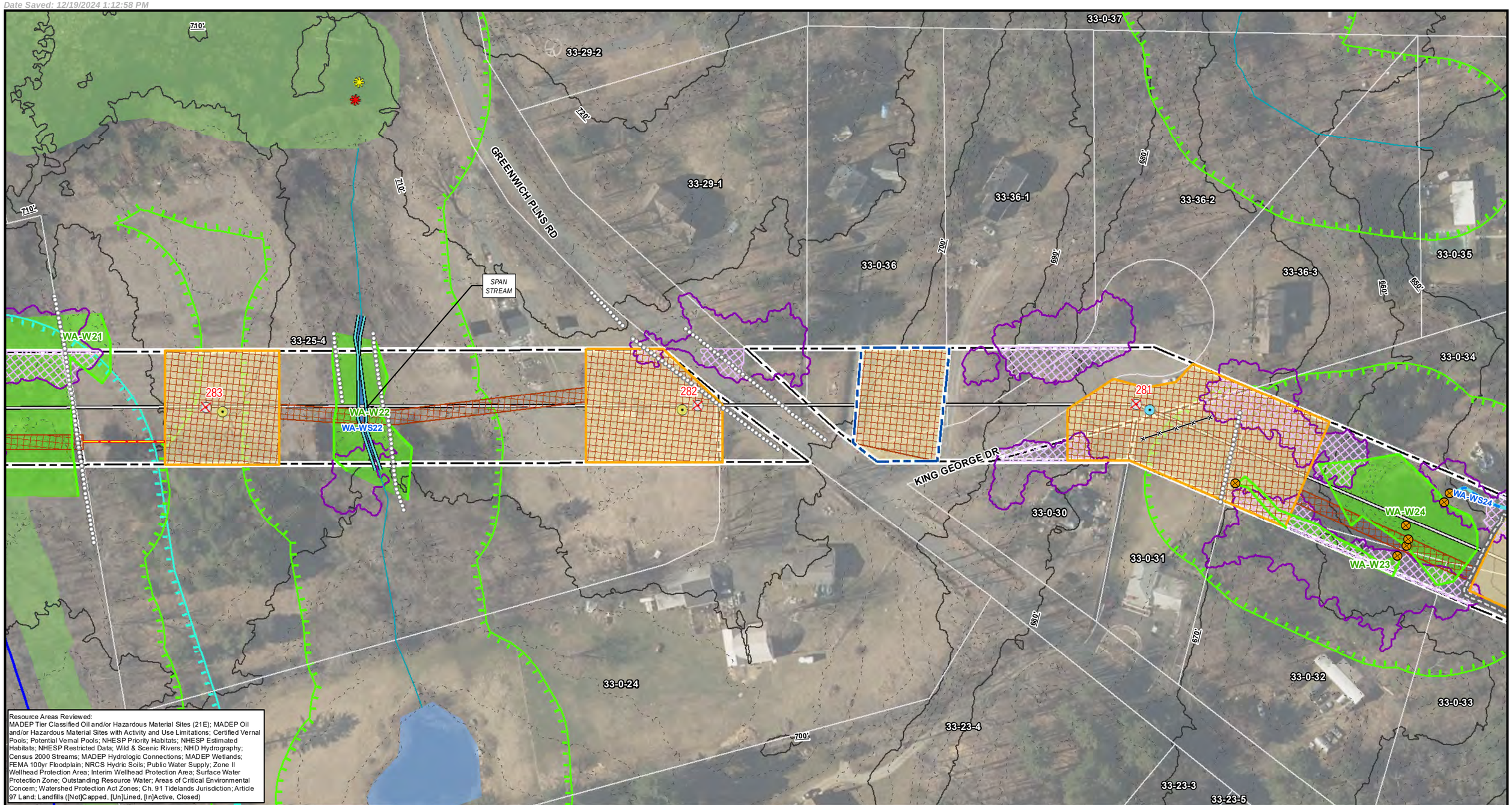

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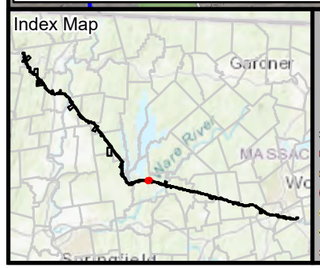

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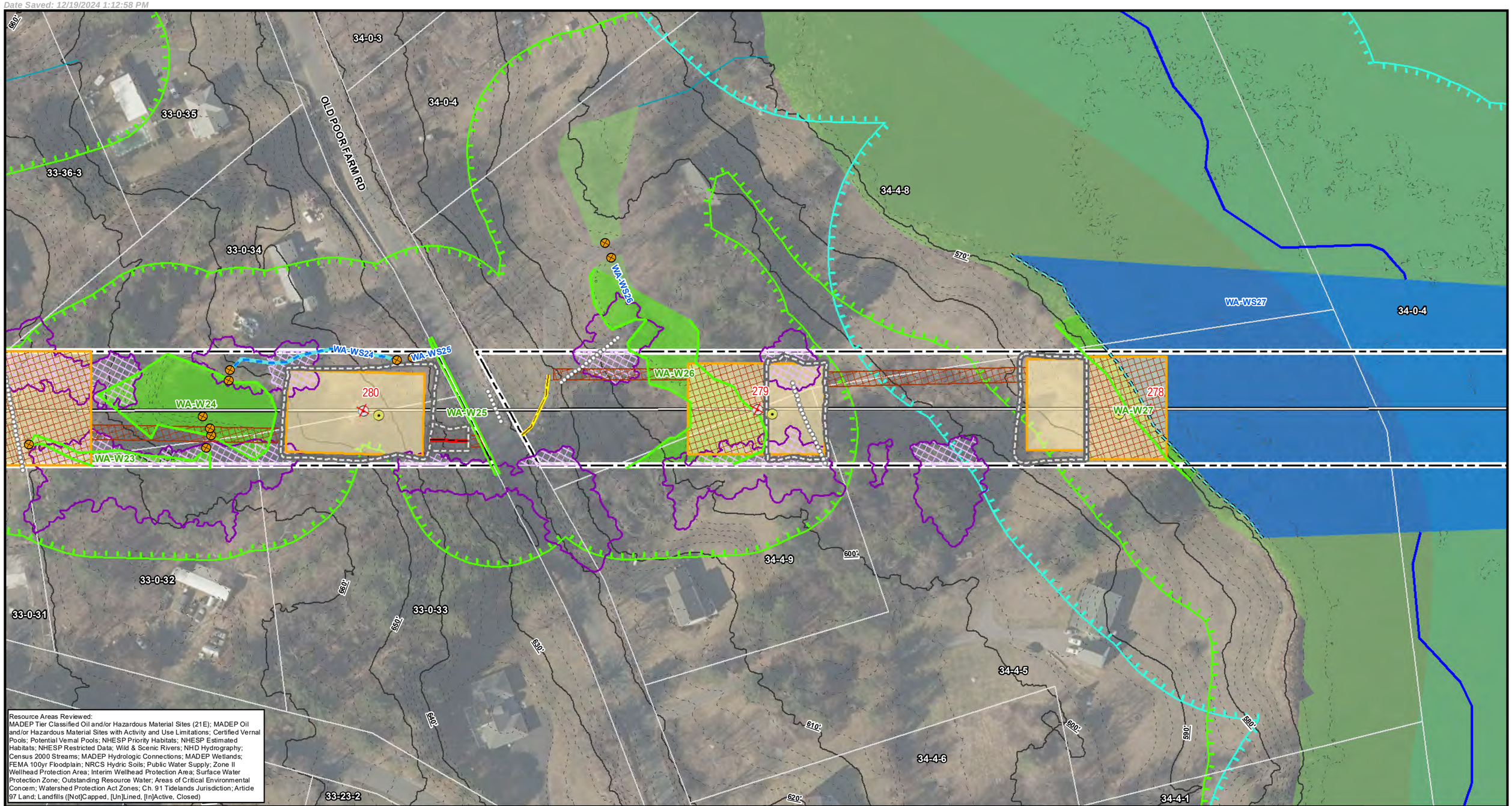

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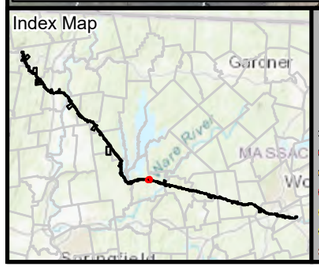

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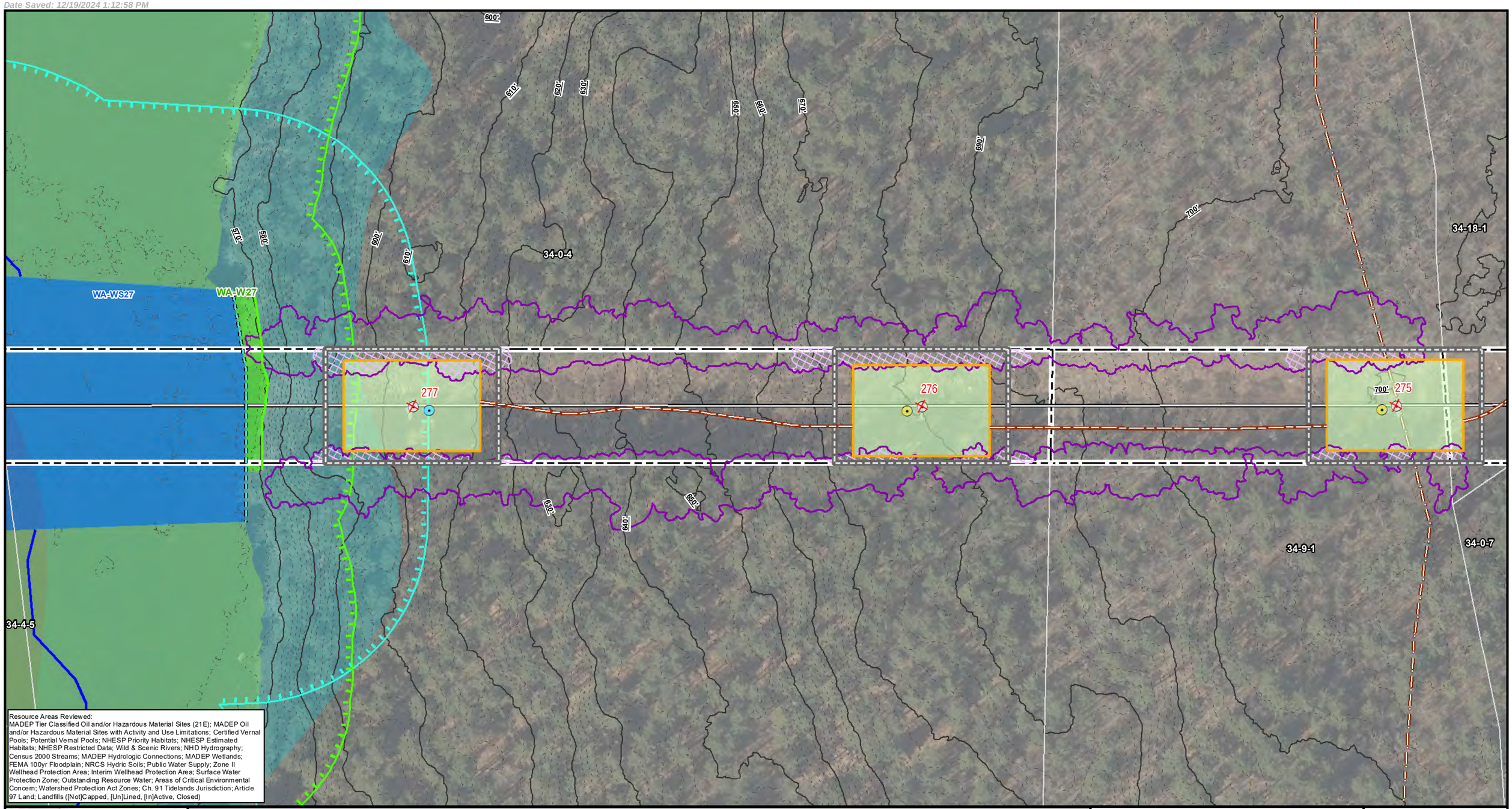

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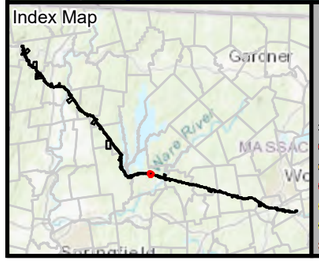

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34-18-1
34-0-7
34-18-3
34-13-1
34-9-1
34-9-2
34-0-12
34-13-2
34-0-11
275
274
273
272

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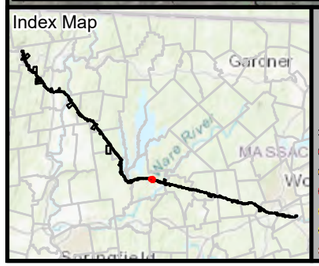

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Environmental Resources Map

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34-0-14
34-0-30
OSBORNE RD
34-0-31
34-33-2
34-13-1
34-13-2
WA-W29
WA-W28
WA-W30
WA-W31
34-0-12
272
271
270
269
34-0-11
34-0-33
28-42-1
34-0-10
700'
690'
680'
670'

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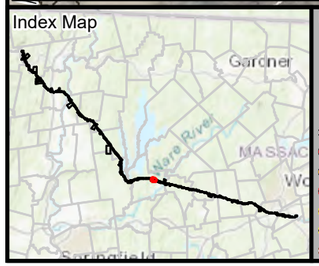

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35-0-2
28-42-1
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29-0-14
WA-W32
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WA-W34
268
267
610'
620'
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650'
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Index Map
Gardner
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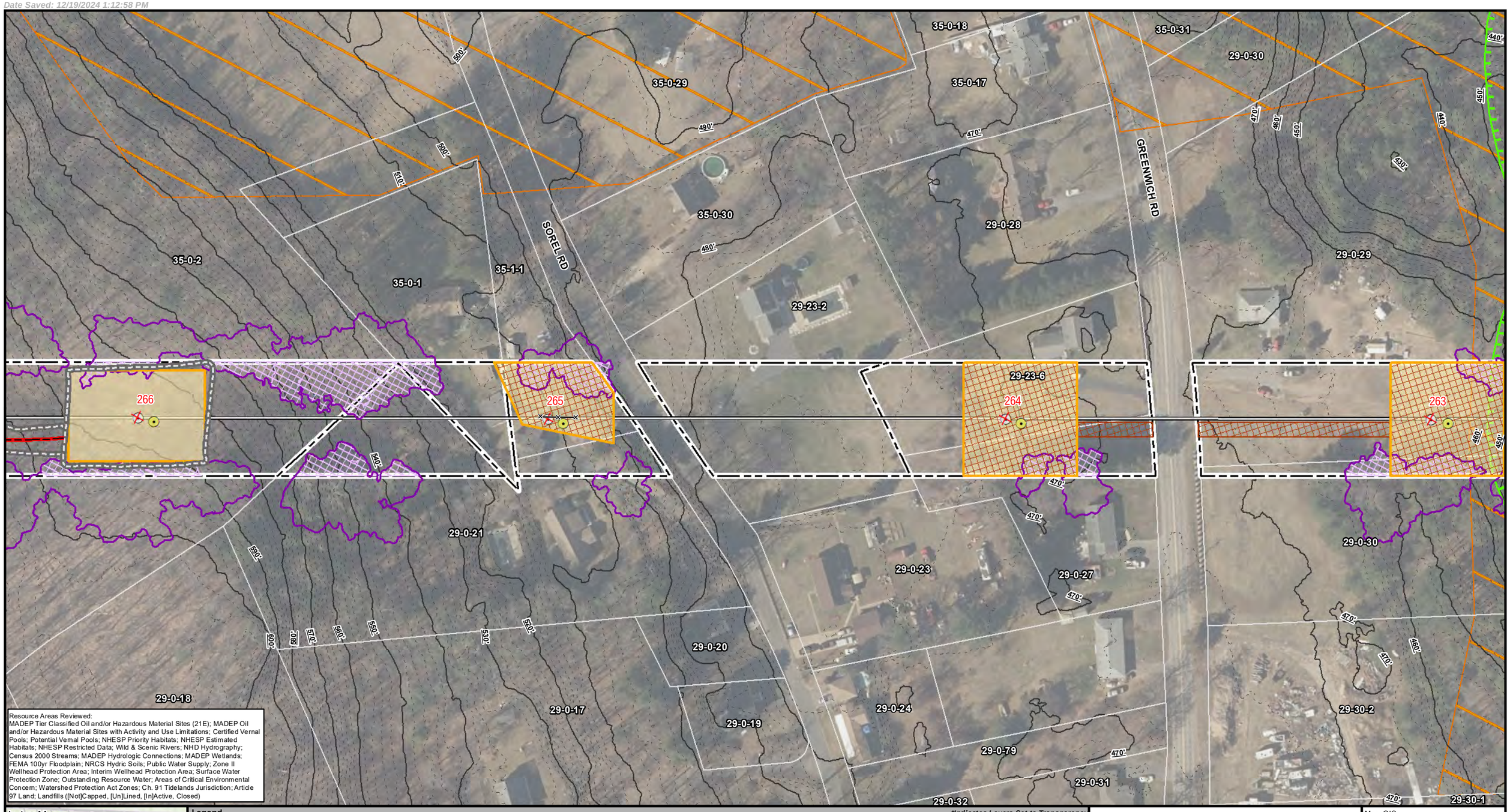

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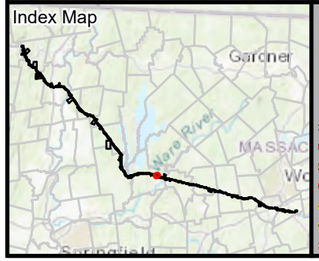

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Environmental Resources Map

Ware, MA

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29-0-29
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SPAN STREAM
WA-WS35
WA-W35
WA-W36
WA-S4
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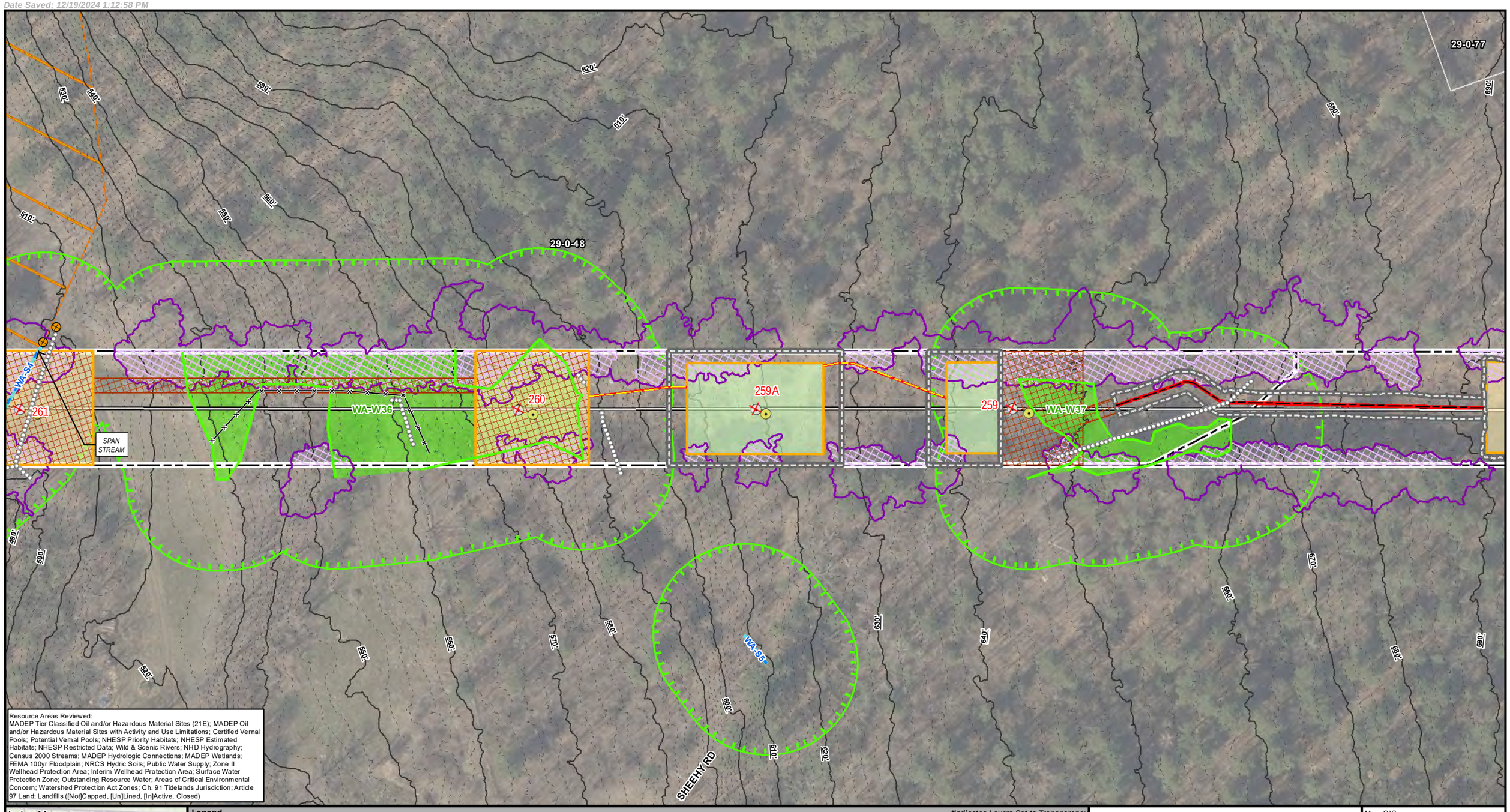

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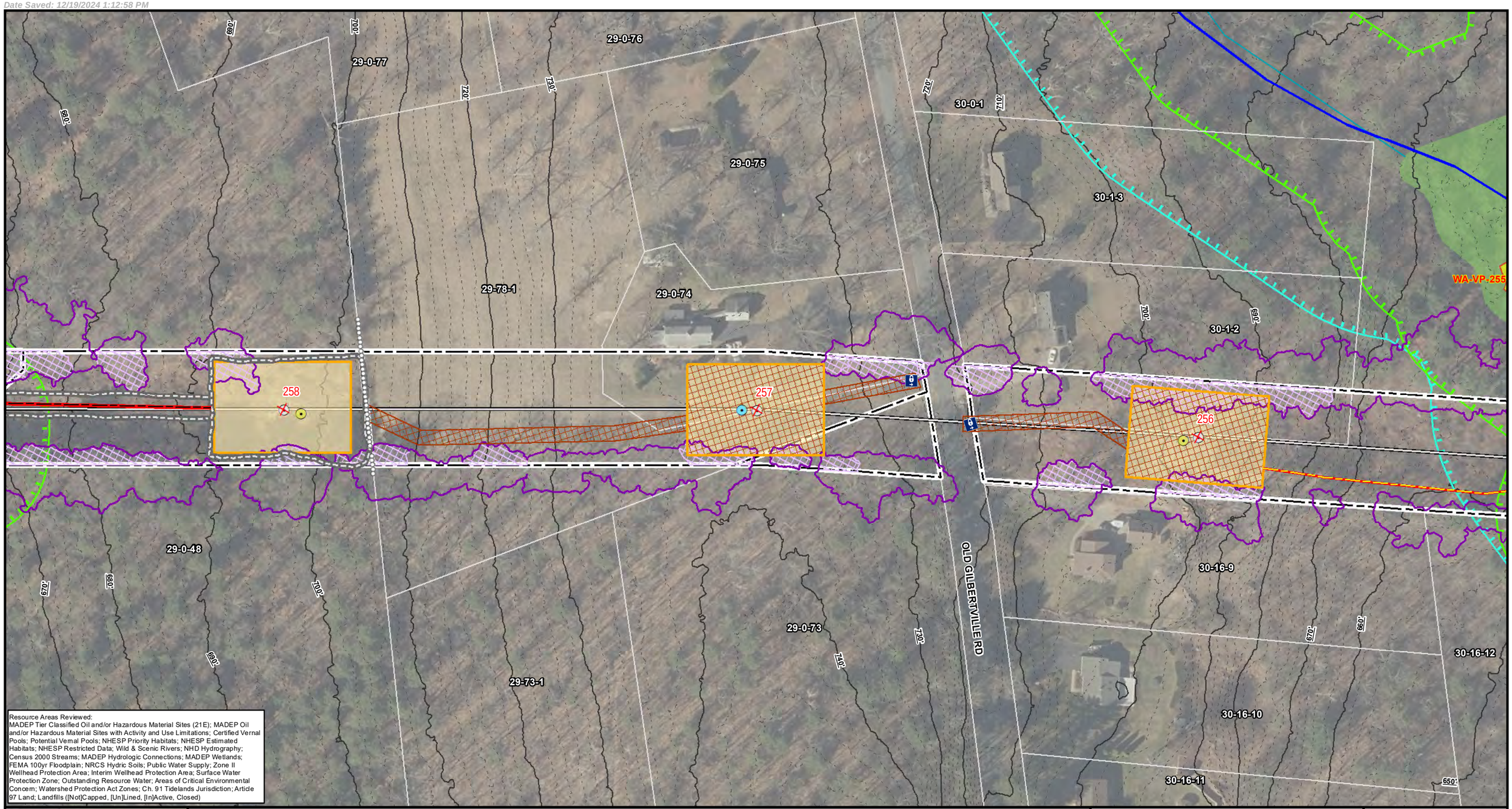

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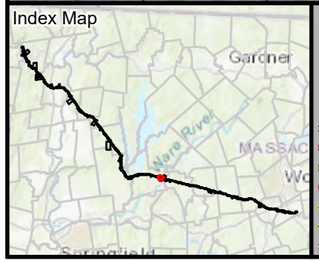

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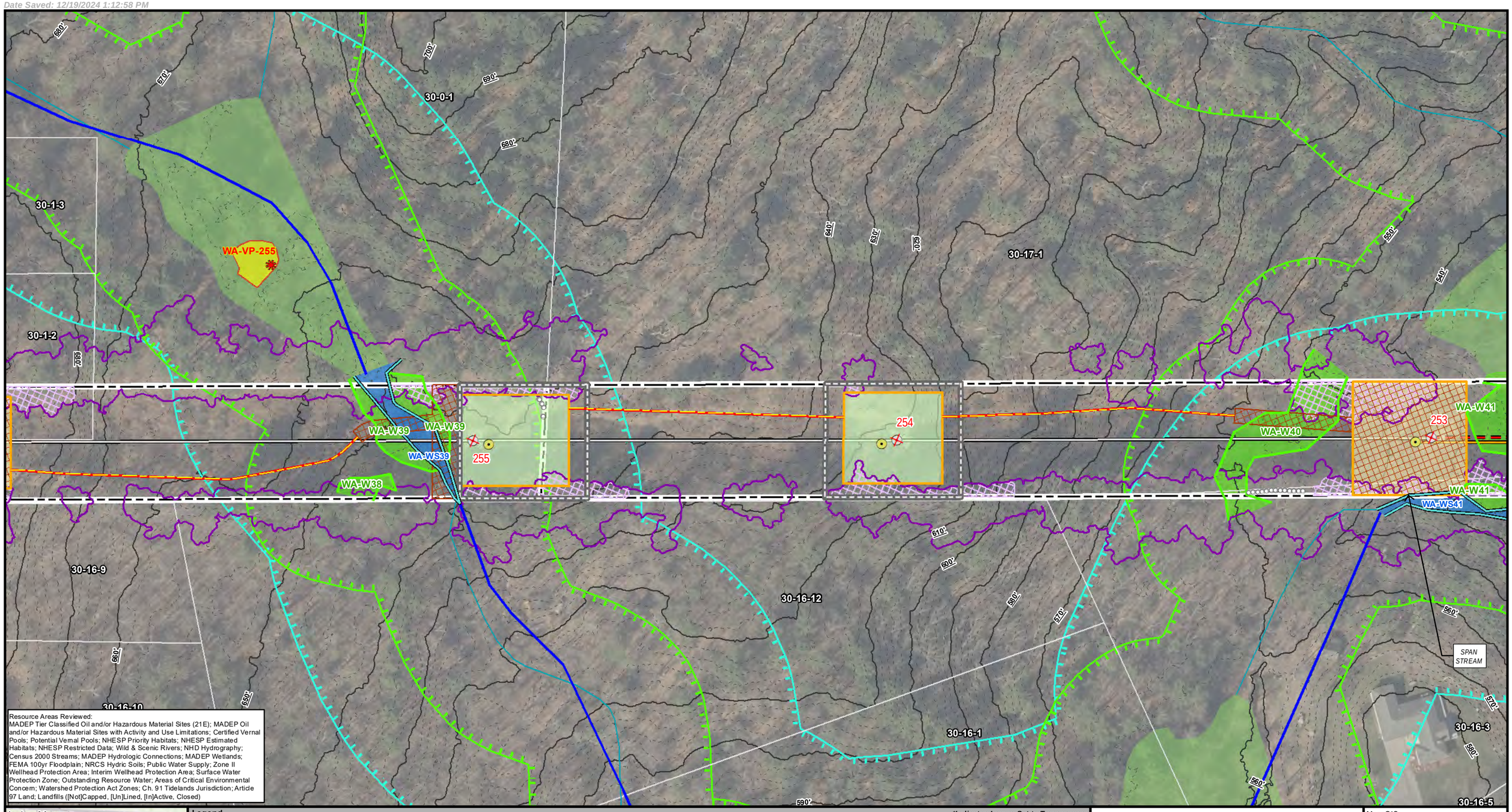

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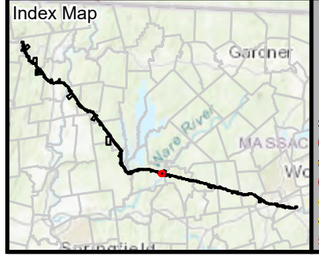

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30-0-17
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30-0-23
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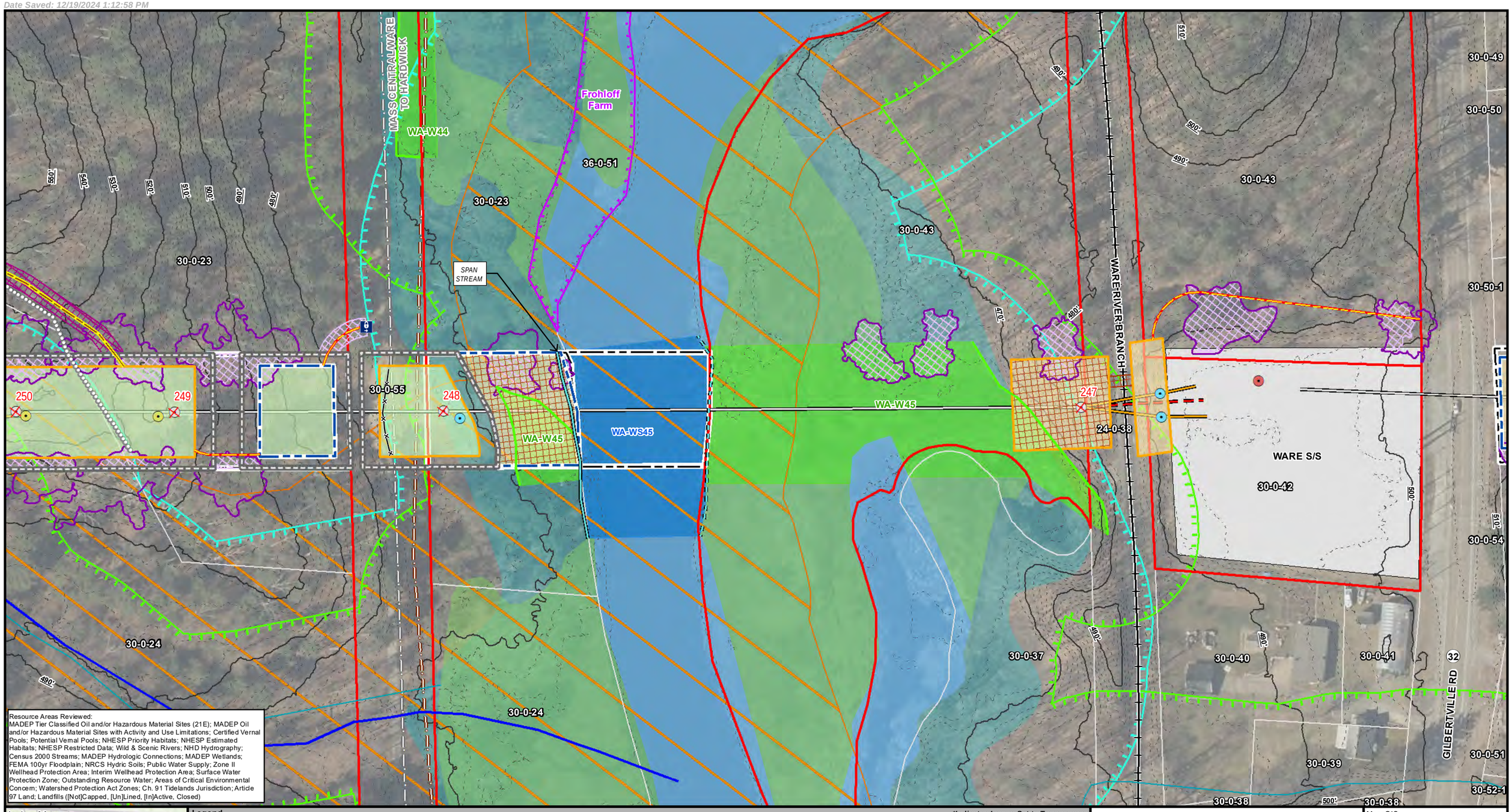

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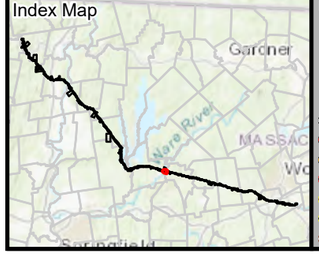

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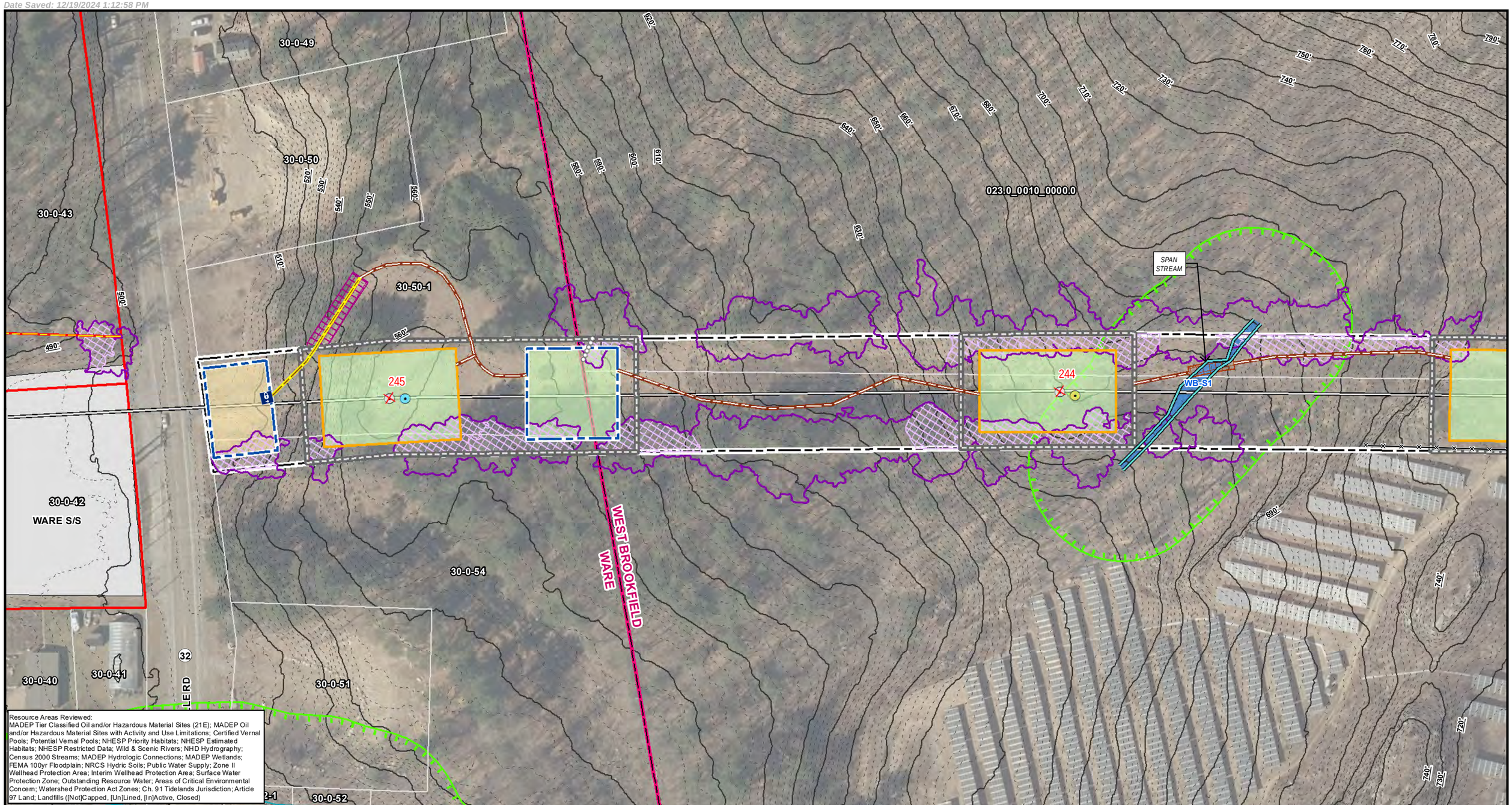

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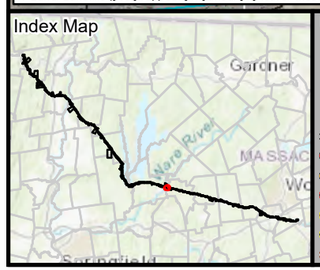

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- Tree Removal
- Selective Tree Removal
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*Indicates Layers Set to Transparency

N

1 inch = 100 feet
0 50 100
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Ware & West Brookfield, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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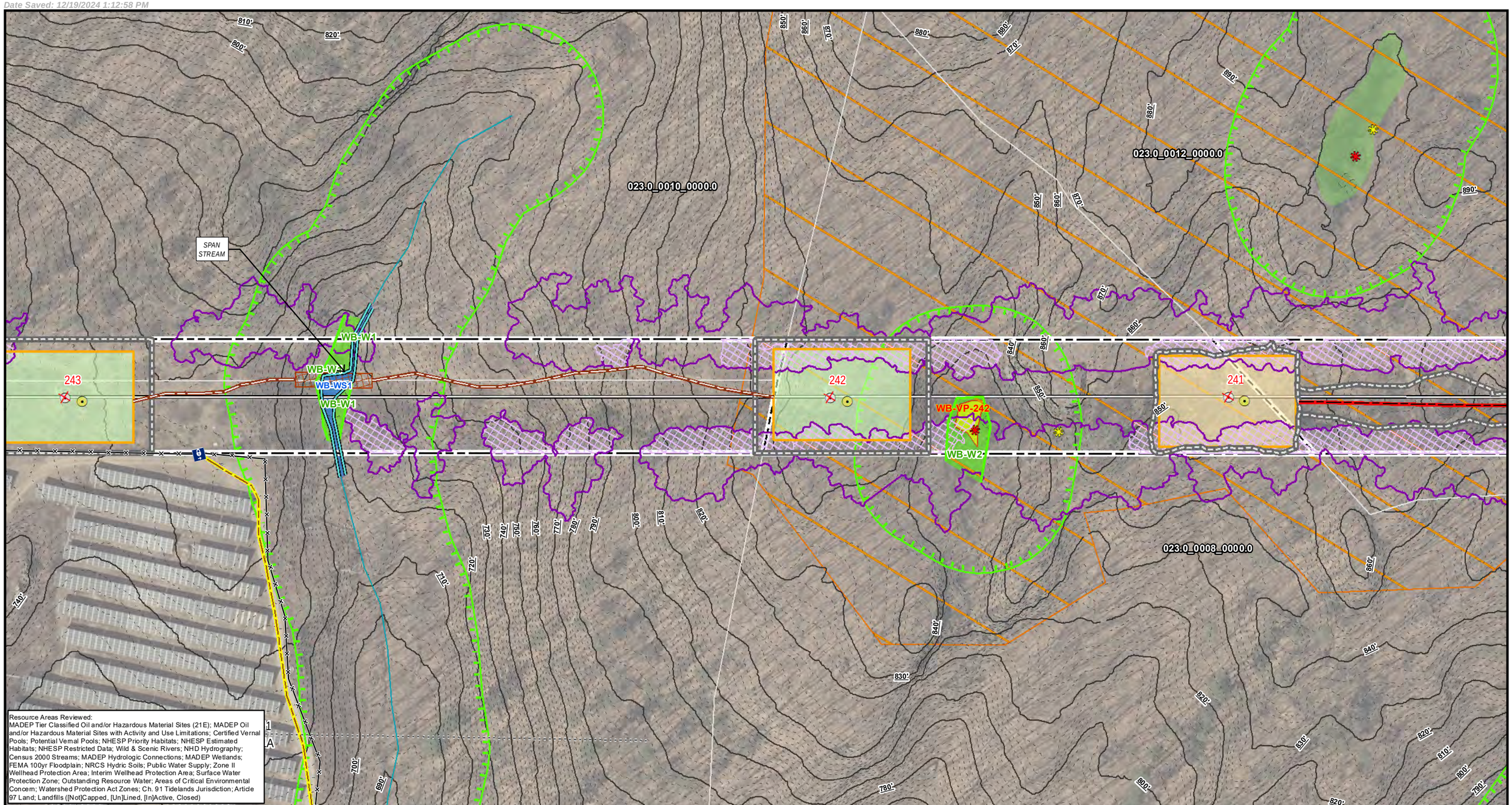

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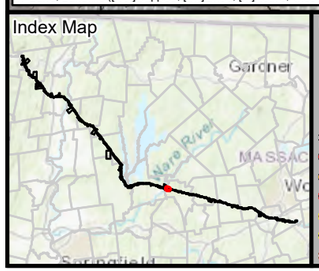

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

West Brookfield, MA

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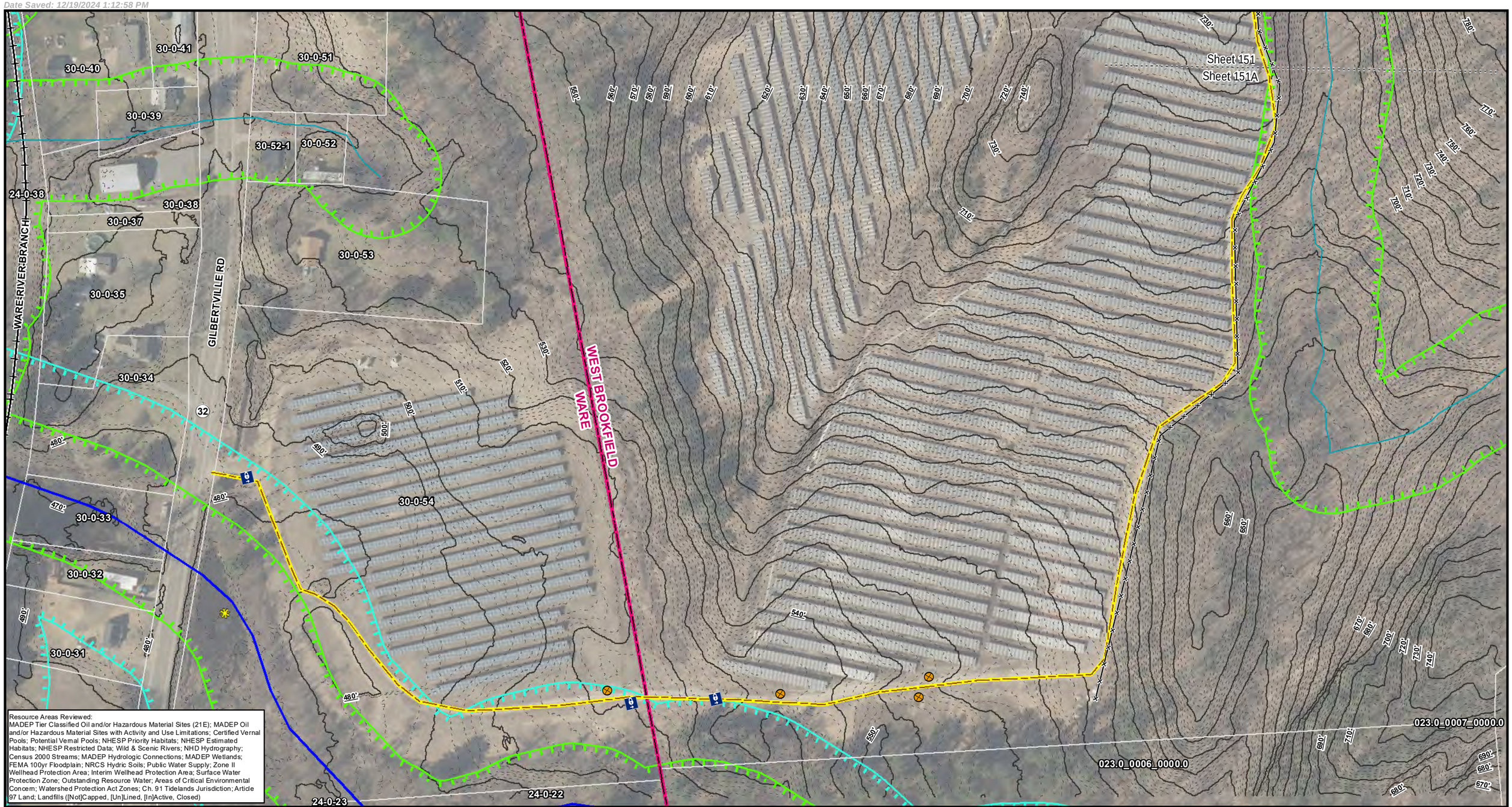

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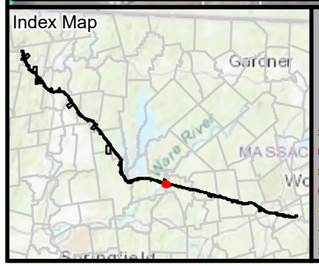

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0 75 150
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Ware & West Brookfield, MA
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MassGIS
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WB-W4
WB-W5
WB-W5
WB-W6
WB-W6
WB-WS3
WB-WS5
WB-WS6

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Index Map
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Springfield

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Article 97 Lands

- Private

Indicates Layers Set to Transparency

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0 50 100
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

West Brookfield, MA

MassGIS
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Sheet 153A
Sheet 153

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WB-W8

WB-W9

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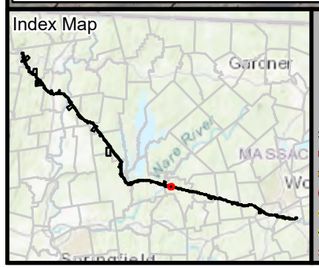
Index Map



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Indicates Layers Set to Transparency

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Article 97 Lands

- Private

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1 inch = 100 feet
0 50 100
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

West Brookfield, MA
Page 153 of 240

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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Sheet 153A
Sheet 153

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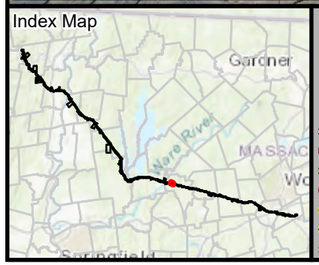

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

West Brookfield, MA
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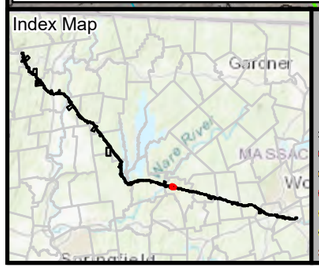

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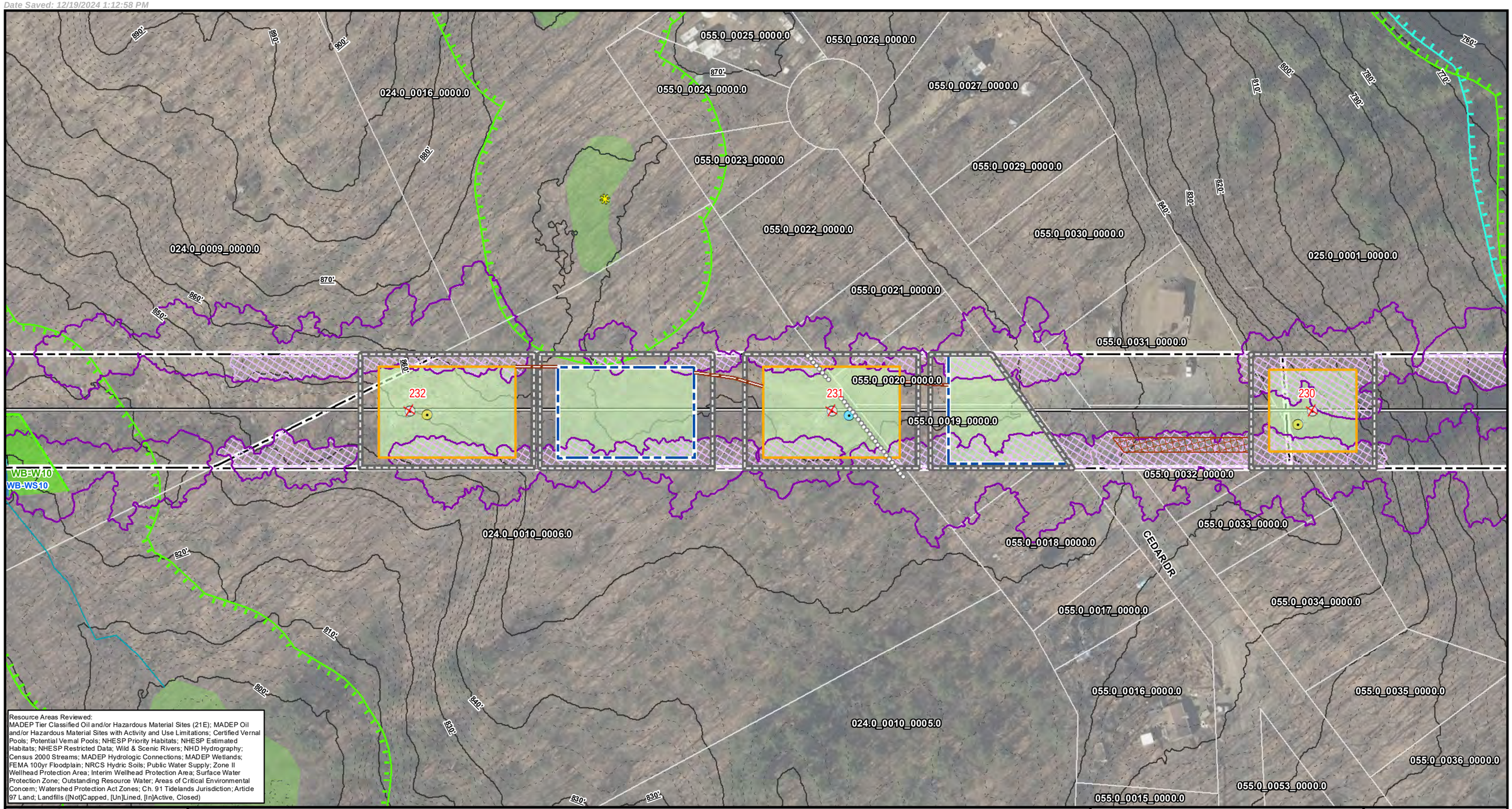

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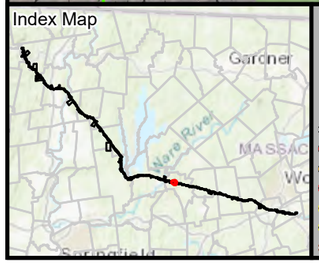

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Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

West Brookfield, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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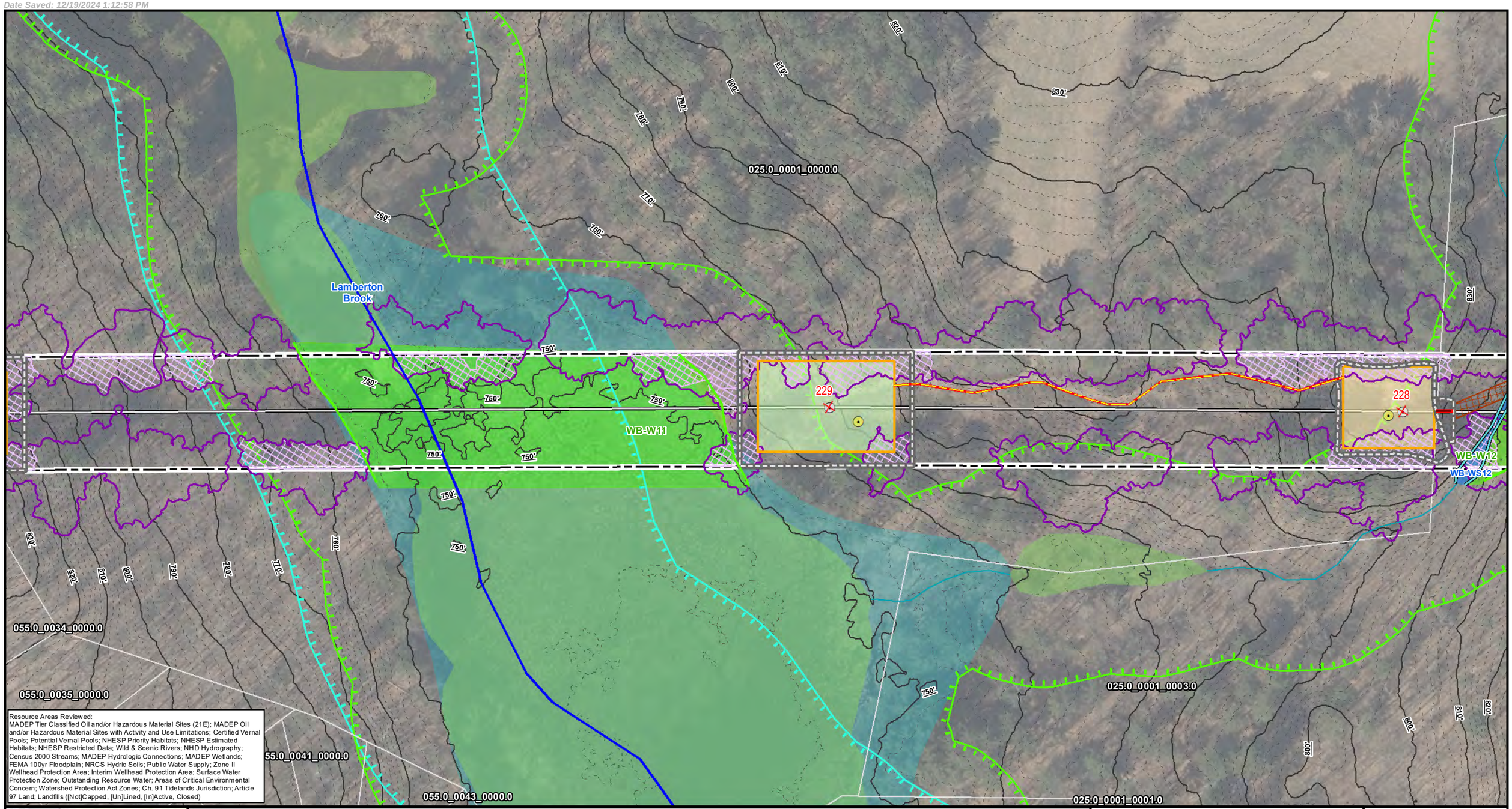

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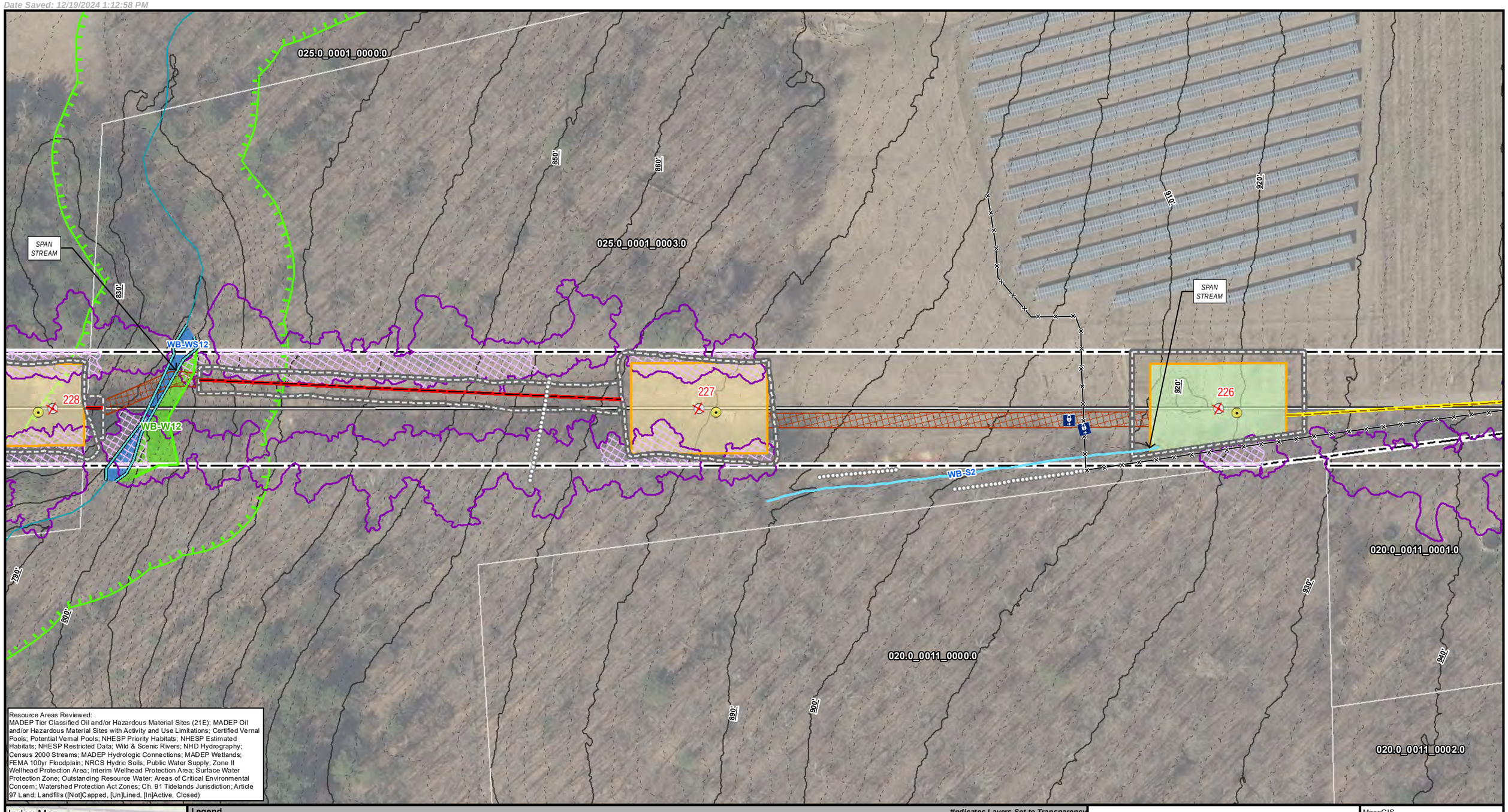

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Environmental Resources Map

West Brookfield, MA

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JOHN GILBERT RD
225
224
940'
950'
960'
970'
930'
920'
910'
900'
890'
880'
870'
860'
850'
840'
830'
810'
800'
790'
780'

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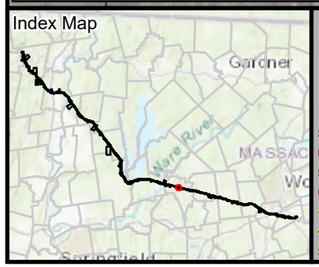

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WB-W16
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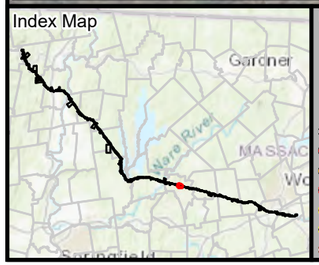

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Sheet 160A
Sheet 160

WB-W15
WB-W16
WB-WS16
WB-VP-219
219
220
218
217
MADDEN RD
SHEA ROAD
Mill Brook

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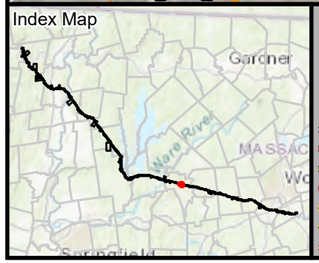

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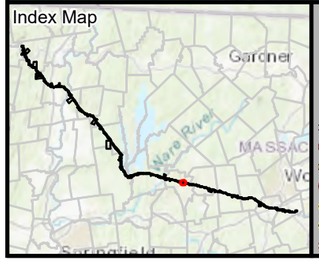

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

West Brookfield, MA

MassGIS
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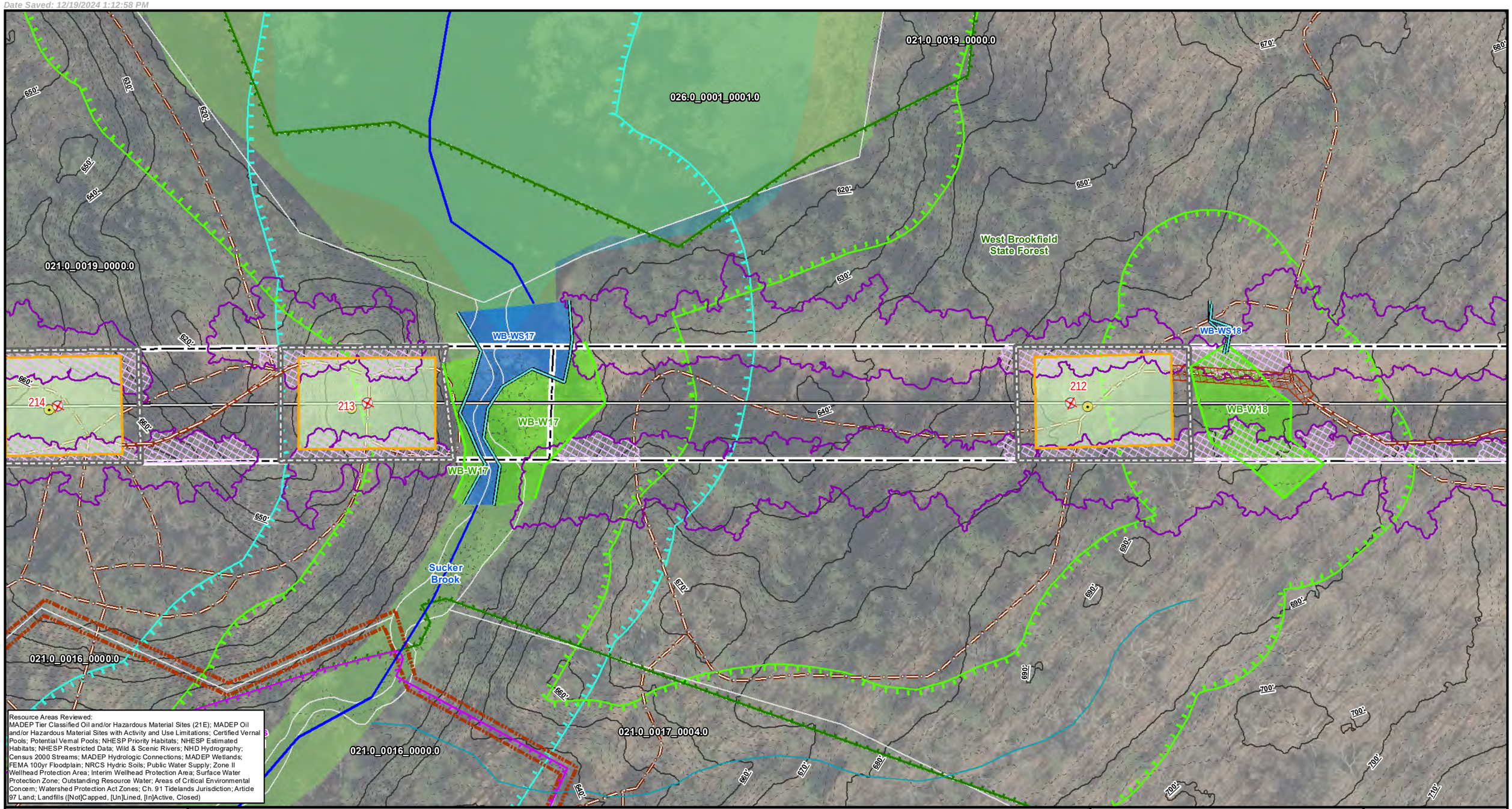

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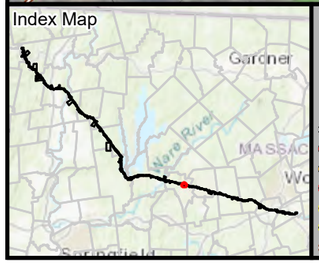

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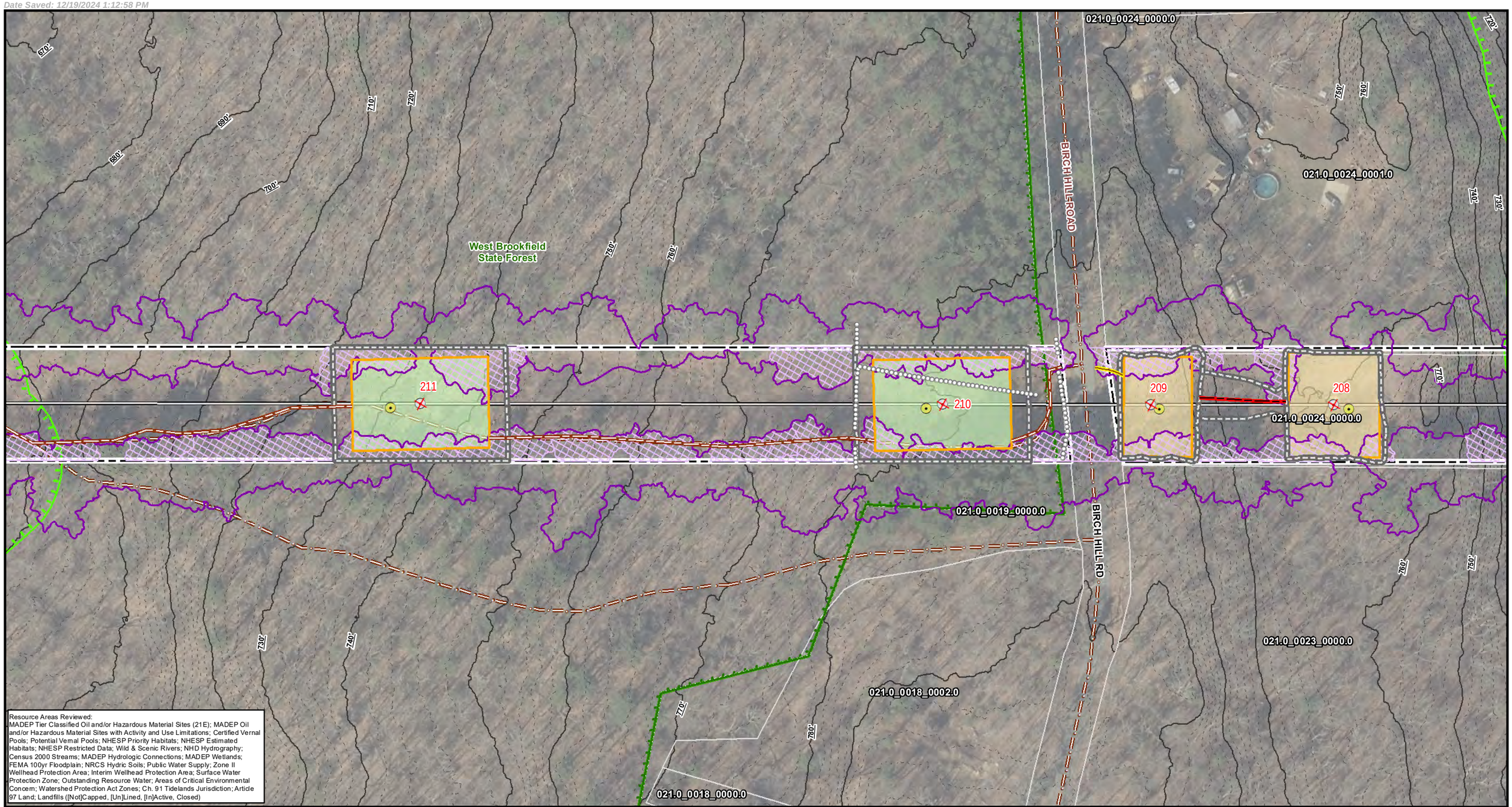

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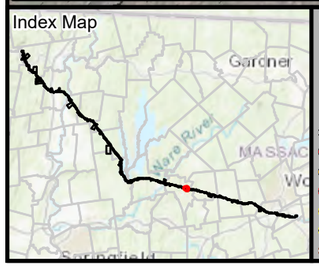

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Environmental Resources Map

West Brookfield, MA

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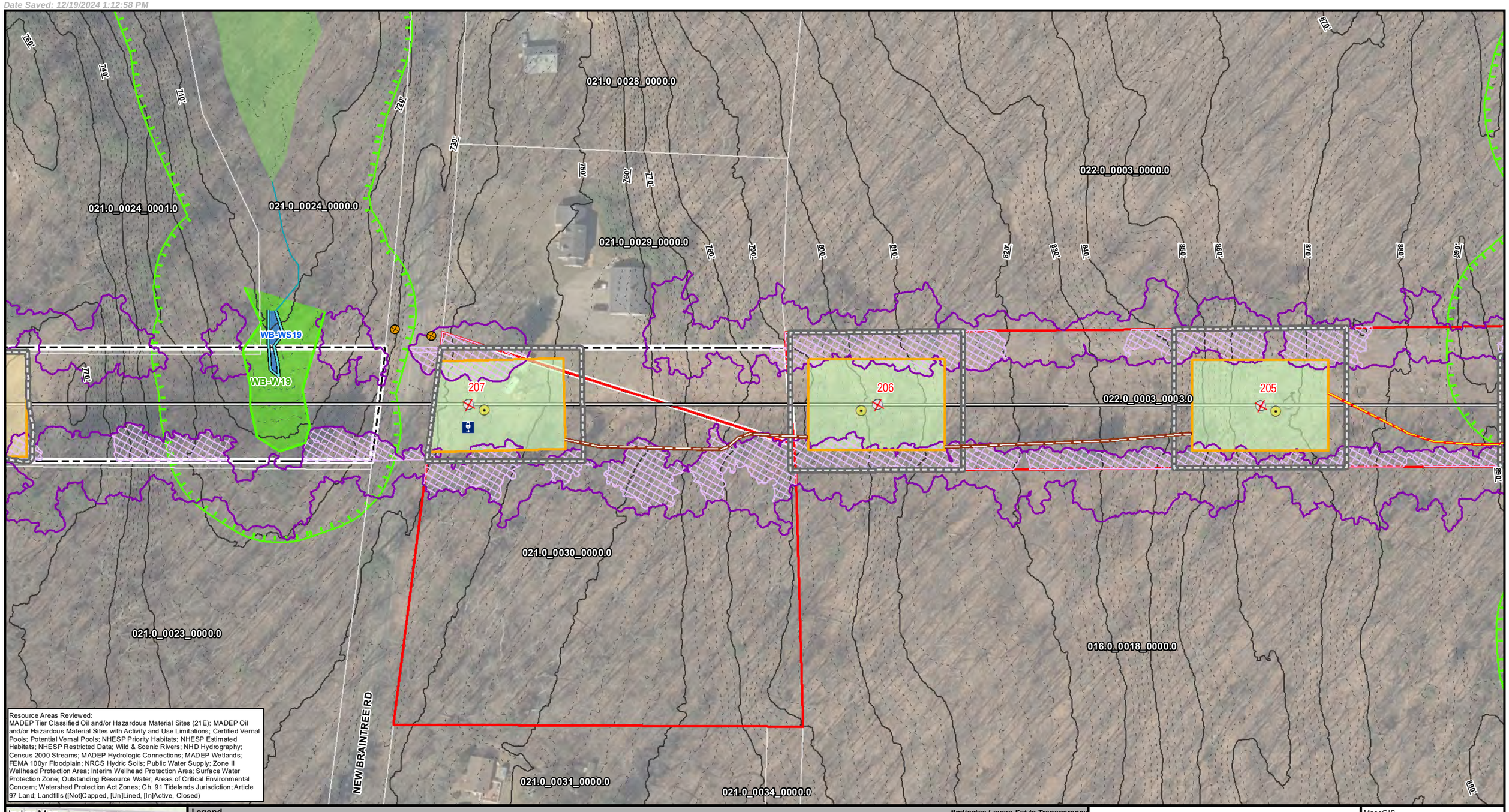

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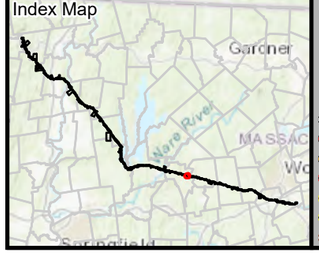

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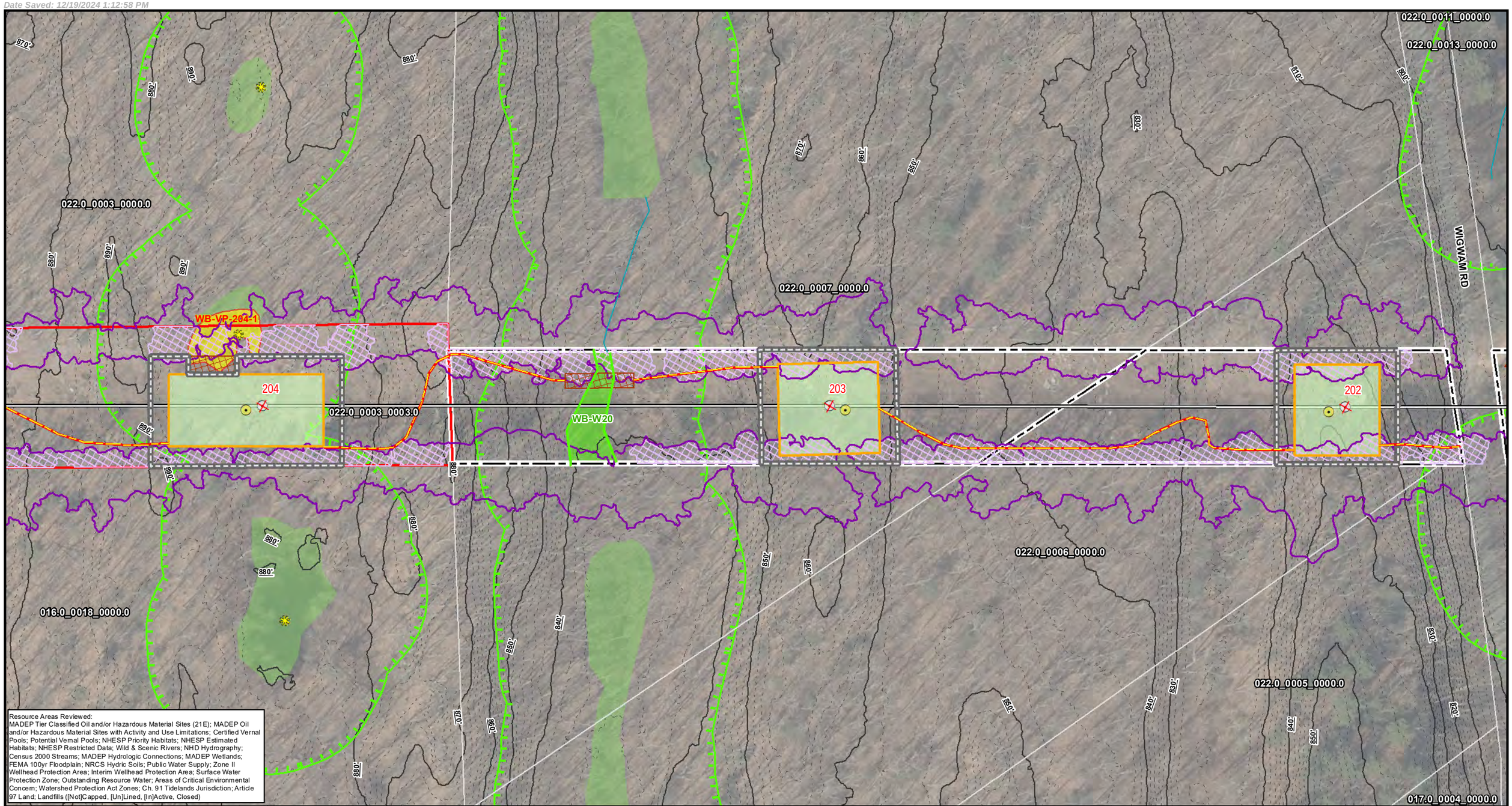

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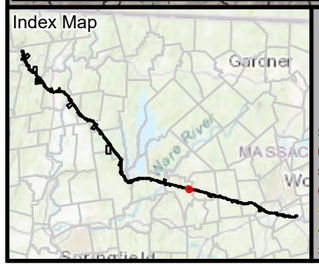

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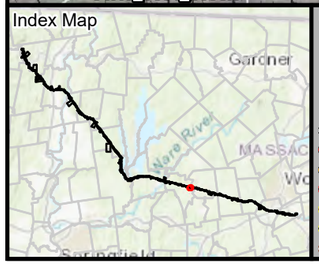

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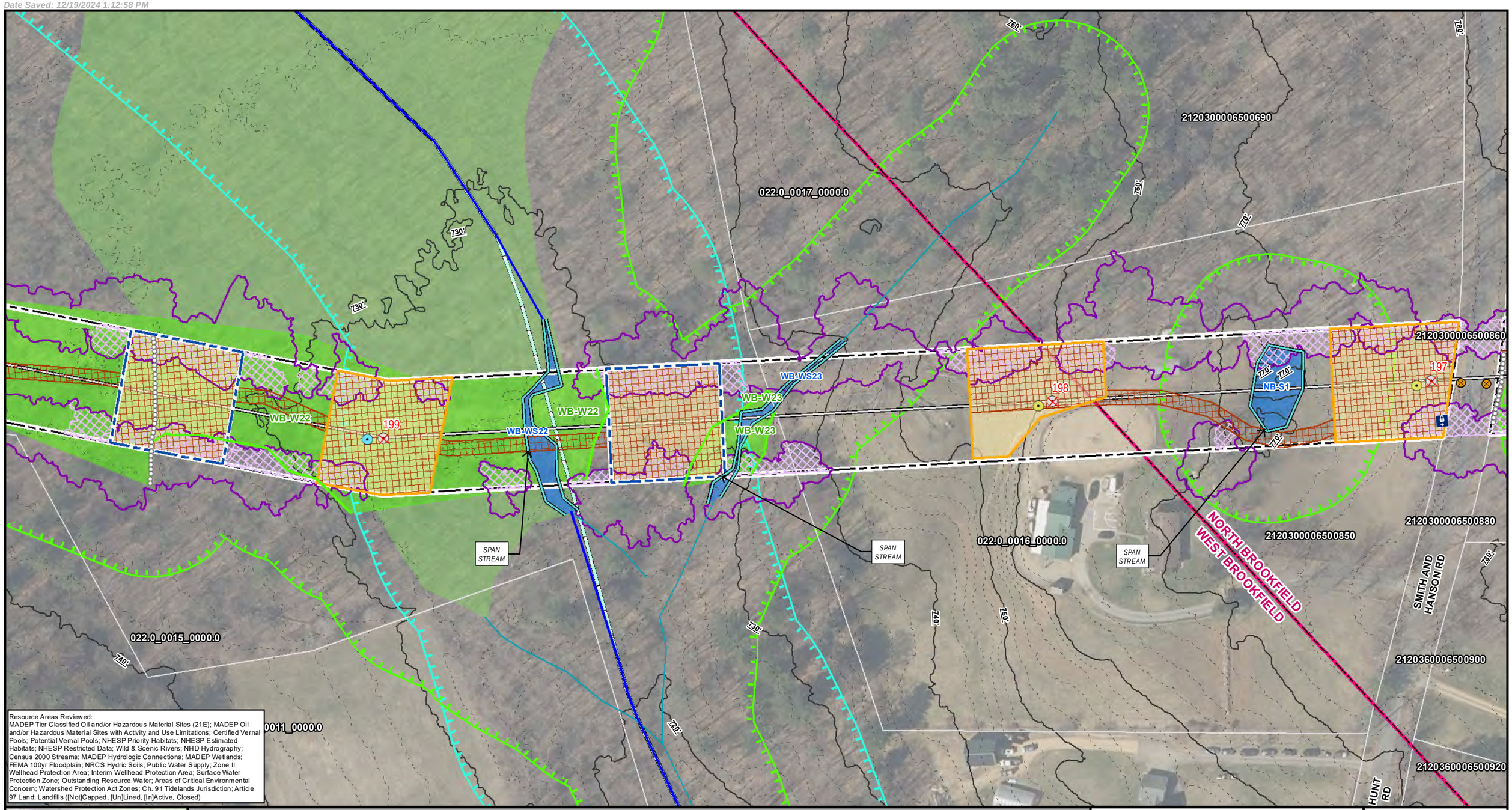

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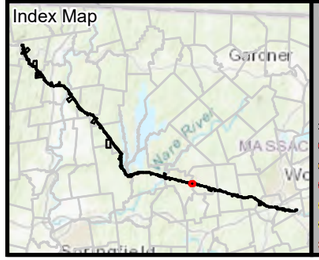

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West Brookfield & North Brookfield, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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2120300006500820
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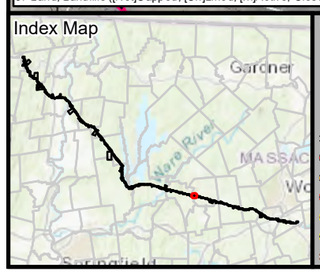
2120300006500850
2120300006500880
2120360006500900
2120360005100240
2120360005100260
2120360005100340A
SMITH AND HANSON RD
NB-W1
NB-WS1
197
196
195
850'
840'
830'
820'
810'
800'
790'
780'
770'
760'
750'
740'

Resource Areas Reviewed:
MADEP Tier Classified Oil and/or Hazardous Material Sites (21E); MADEP Oil and/or Hazardous Material Sites with Activity and Use Limitations; Certified Vernal Pools; Potential Vernal Pools; NHESP Priority Habitats; NHESP Estimated Habitats; NHESP Restricted Data; Wild & Scenic Rivers; NHD Hydrography; Census 2000 Streams; MADEP Hydrologic Connections; MADEP Wetlands; FEMA 100yr Floodplain; NRCS Hydric Soils; Public Water Supply; Zone II Wellhead Protection Area; Interim Wellhead Protection Area; Surface Water Protection Zone; Outstanding Resource Water; Areas of Critical Environmental Concern; Watershed Protection Act Zones; Ch. 91 Tidelands Jurisdiction; Article 97 Land; Landfills ([Not]Capped, [Un]Lined, [In]Active, Closed)

Index Map



Legend

*Indicates Layers Set to Transparency

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- 10ft Contour
- Fenceline
- Guardrail
- Stonewall
- Existing Treeline
- Tree Removal
- Selective Tree Removal
- Pruning
- Town Boundary
- Parcel Boundaries

N

1 inch = 100 feet
0 50 100
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

North Brookfield, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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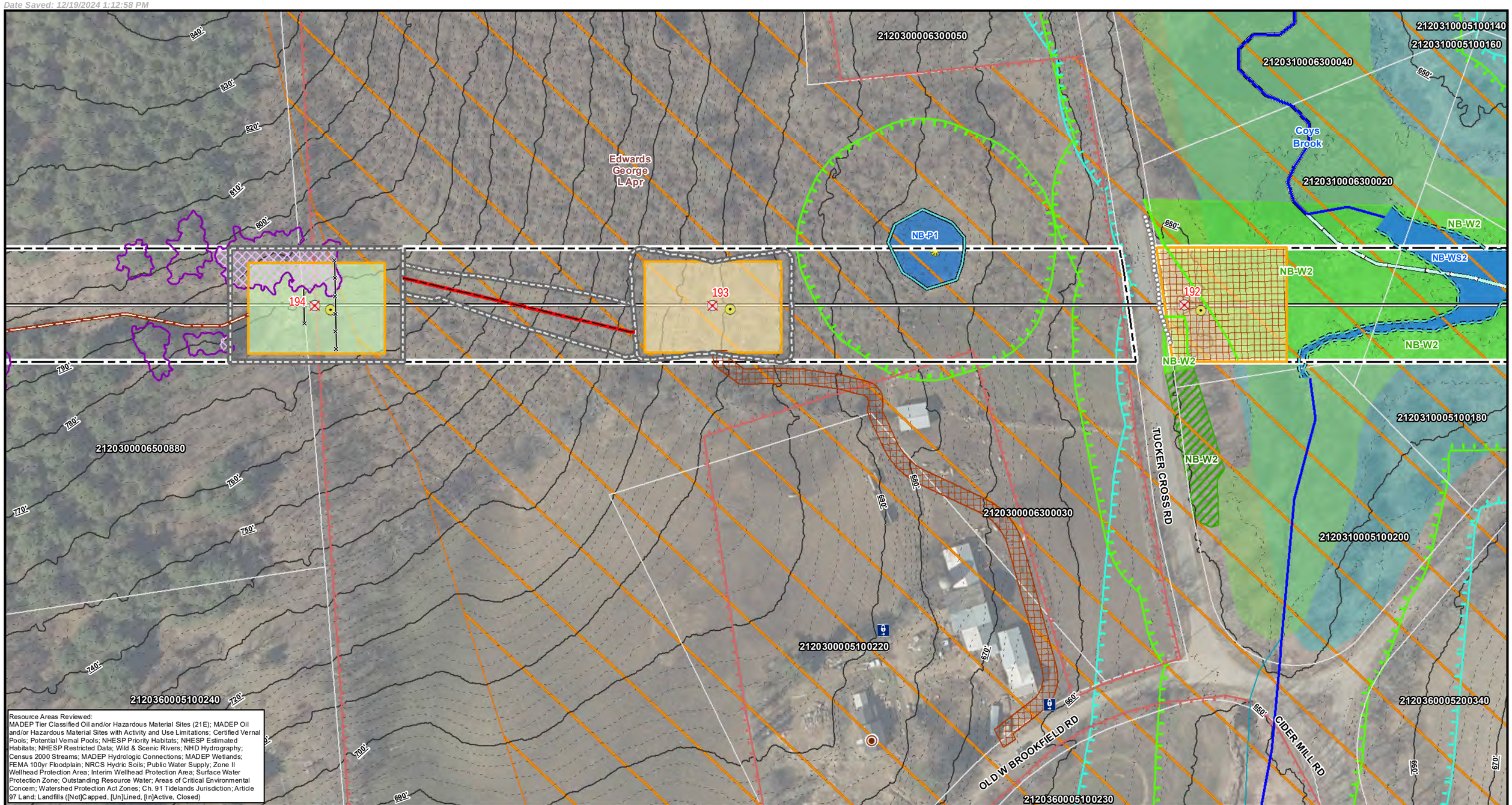

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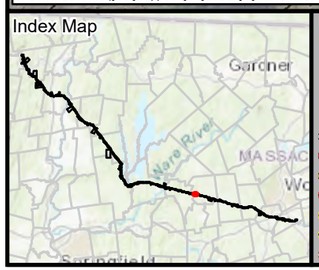

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Article 97 Lands

- Private

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2120310005100120
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2120310005100140
2120310005100130
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2120310006300020
2120310005100160
2120310005100150
2120310005100180
2120310005100200
2120360005200340
2120310005000610
NB-W2
NB-WS2
NB-WS3
NB-W3
191
190
189
SPAN STREAM
SPAN STREAM
OLD W BROOKFIELD RD
Coys Brook
650'
640'

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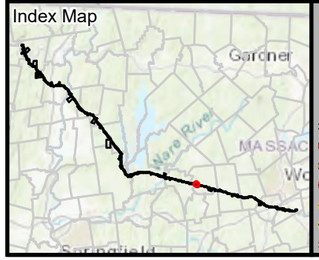

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

North Brookfield, MA

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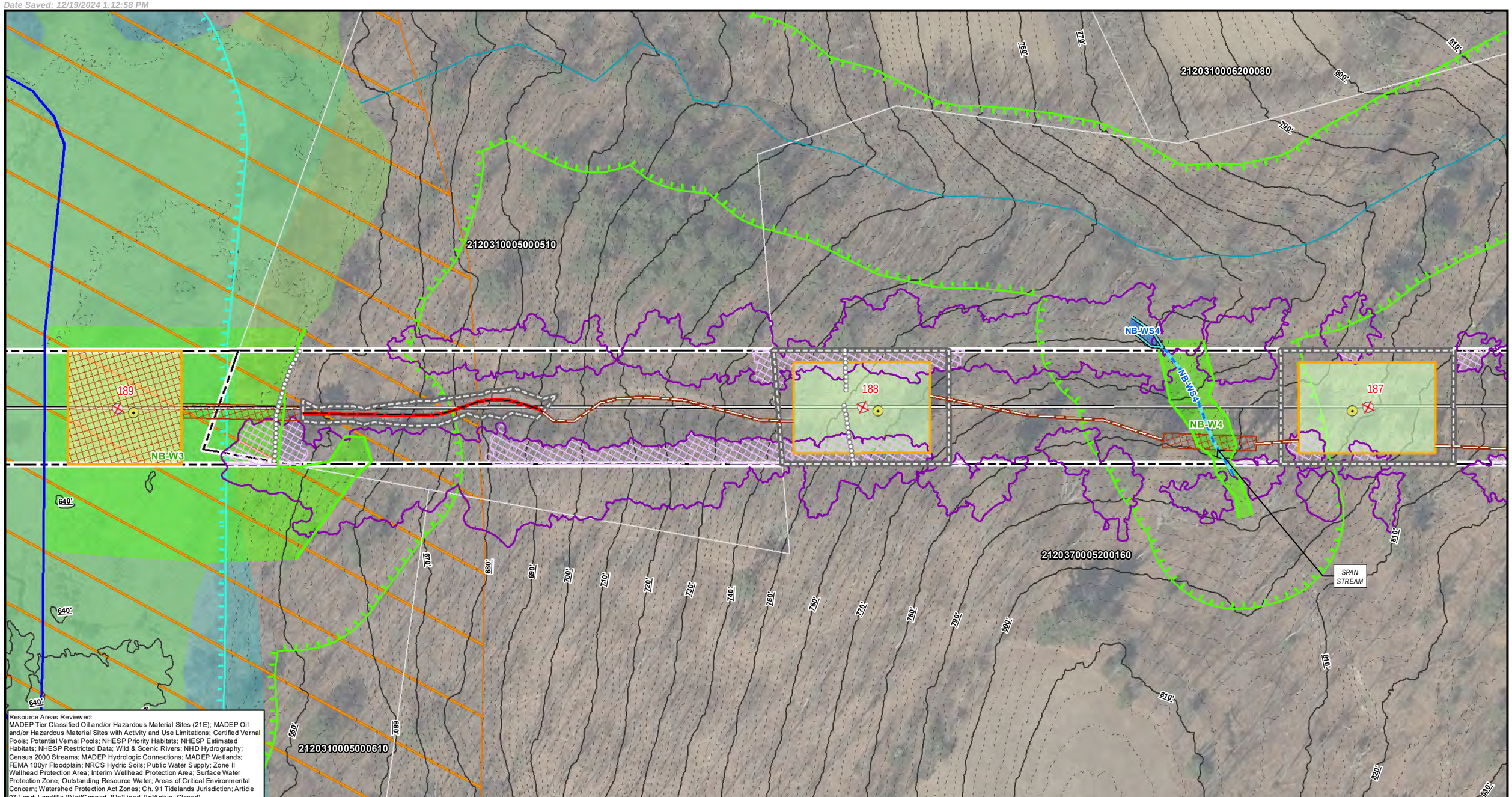

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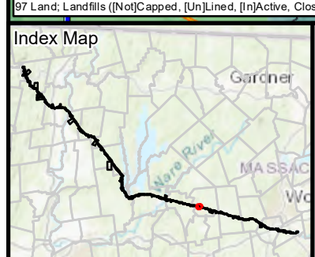

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0 50 100

Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

North Brookfield, MA

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2120310006200080
2120310005000250
2120310006200060
2120310006200040
Wendemuth Meadow
MC CARTHY RD
2120370000100050
2120370006200030
2120370000100040
2120370000100060
2120370000100070
2120370000100080
W BROOKFIELD RD
2120370006200050
2120370000100090
2120370000100100
2120370006200100
2120370000100110
2120370000100120
North Brookfield Town Forest
67
2120370005500020
148
2120370000100190
2120370005500040
2120370005200160
2120370000100130
2120370000100020
NB-W5
186
185
184
2120370000100200
Resource Areas Reviewed:
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Index Map
Gardner
Ware River
MASSAC
Springfield

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Article 97 Lands

- Municipal
- Land Trust

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Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

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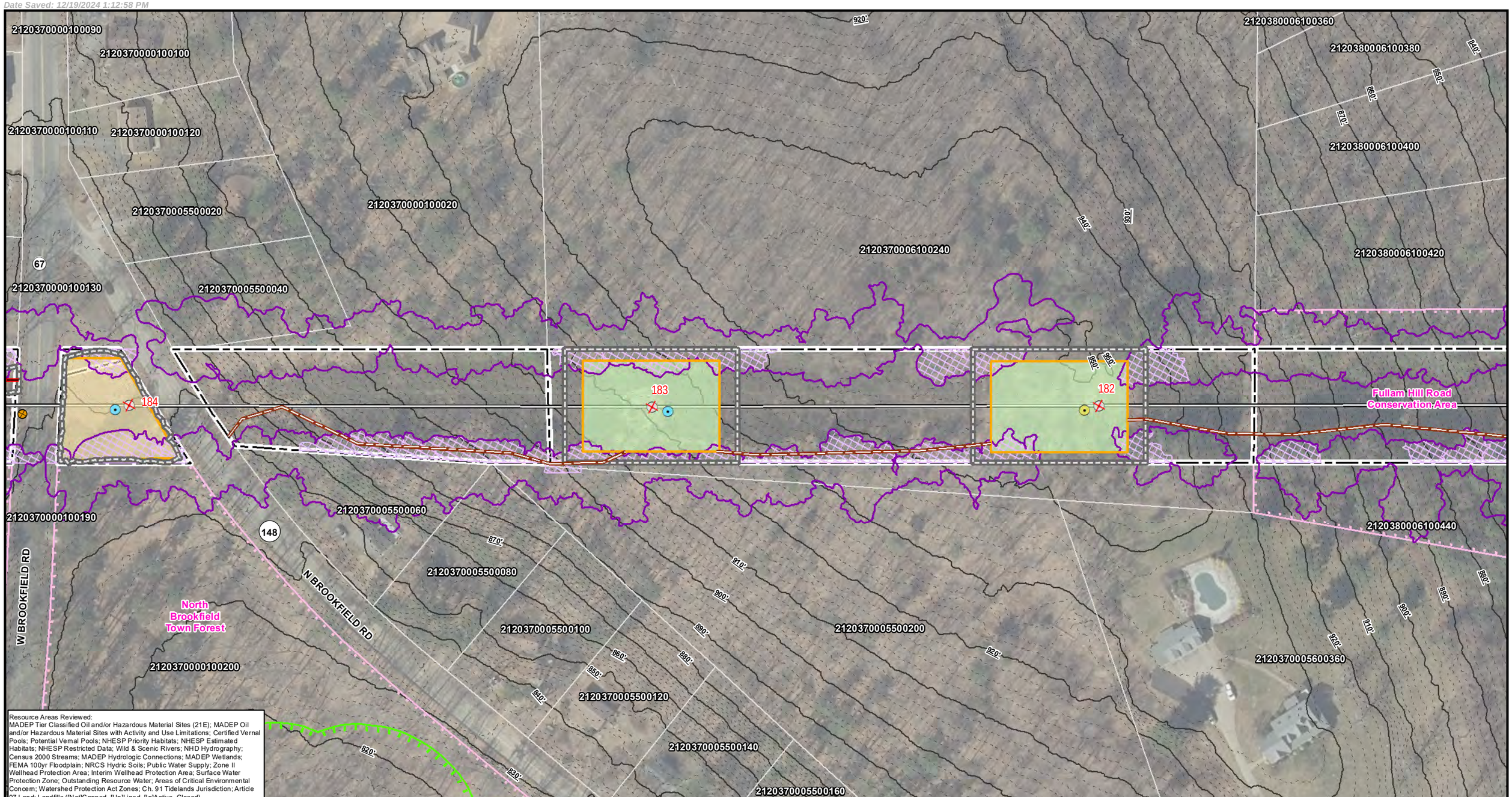

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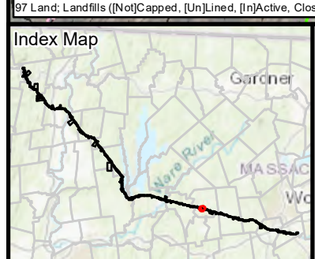

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2120380006100380
2120380006100400
2120380006100410
2120380005600560
Donovan Road Conservation Area
2120380006100420
2120380006100450
720'
730'
181
NB-W6
180
179
Fullam Hill Road Conservation Area
2120380006100440
2120380006100460
2120380006100470
FULLAM HILL RD
750'
740'
730'
2120380006100490
2120370005600360
770'
780'
790'
800'
810'
820'
830'
840'
850'
860'
920'
2120380005600420
2120380006100520
2120380005600440
2120380005600400
2120380005600480
760'

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- Town Boundary
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Article 97 Lands

- Municipal

N

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

North Brookfield, MA

MassGIS
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Forget-me-not Brook
E BROOKFIELD RD
SPAN STREAM
DONOVAN RD
Donovan Road Conservation Area
LASHAWAY S/S
NB-W7
NB-W8
NB-W9
NB-WS9
176
176A
176B
177A
177B
178
700'
710'
720'
730'
740'
750'
690'

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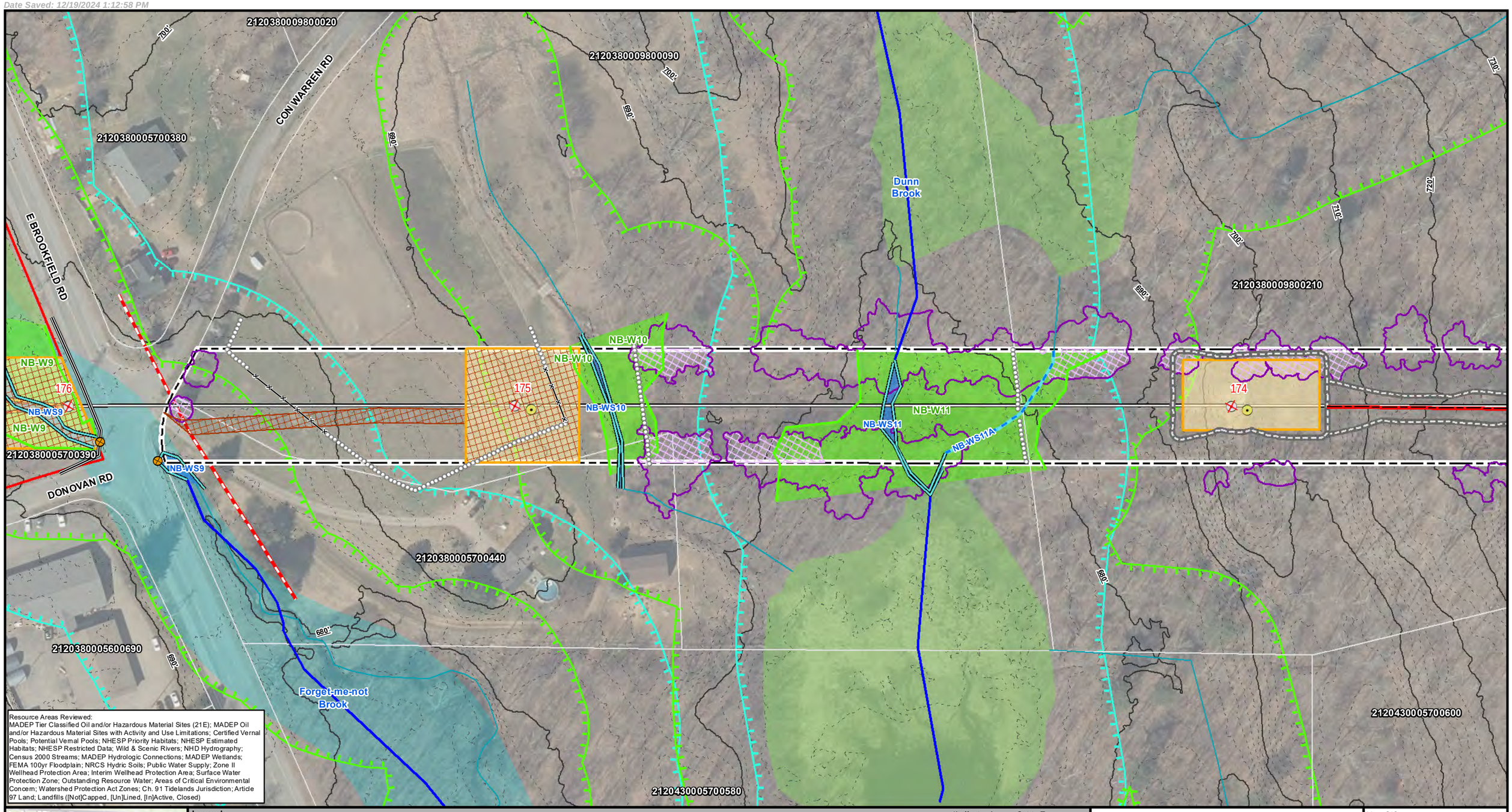

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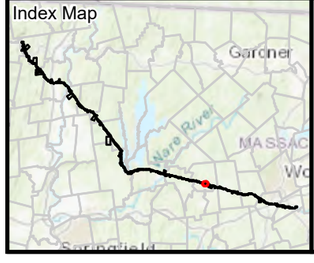

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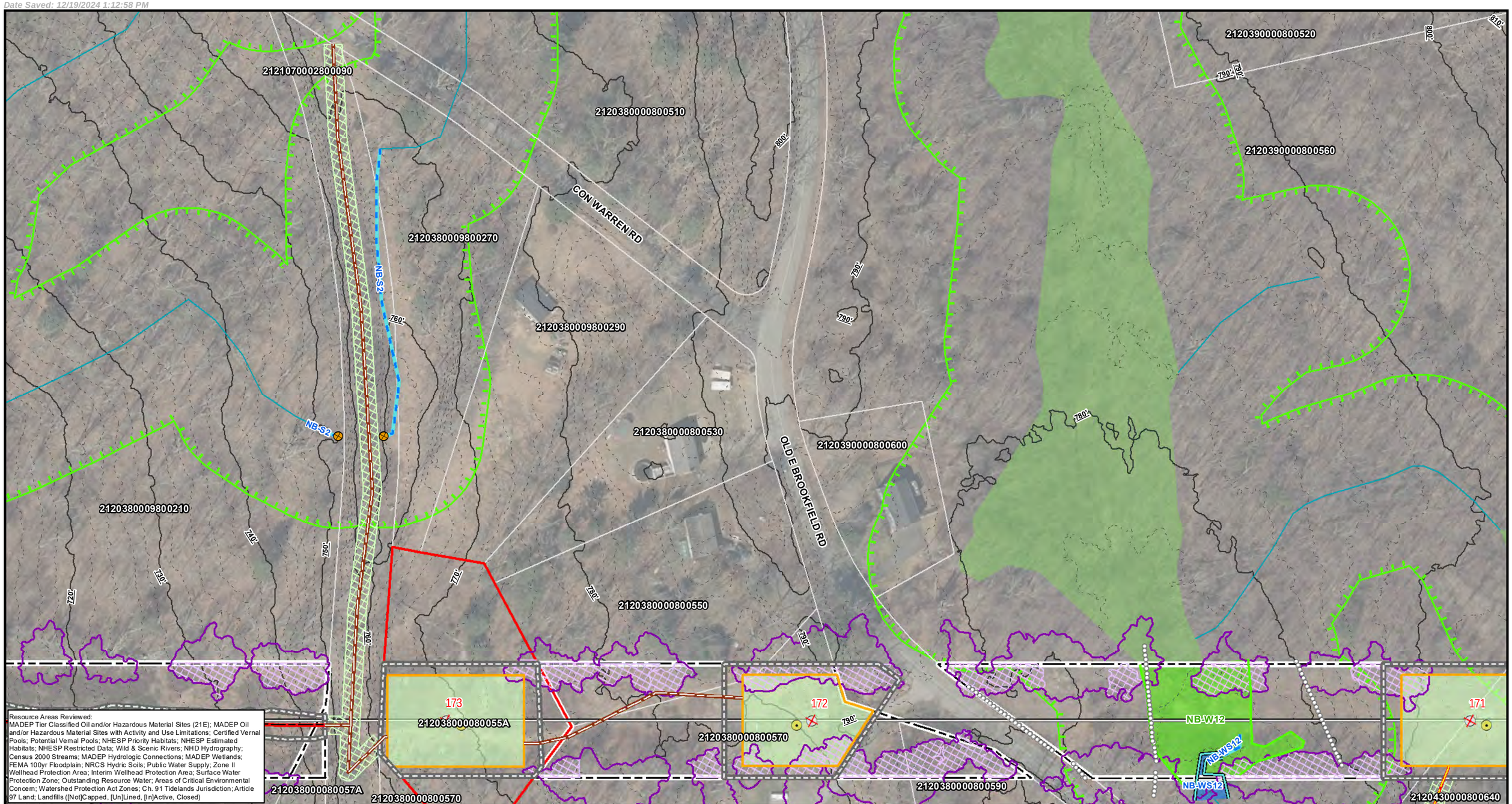

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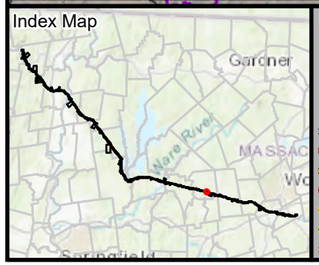

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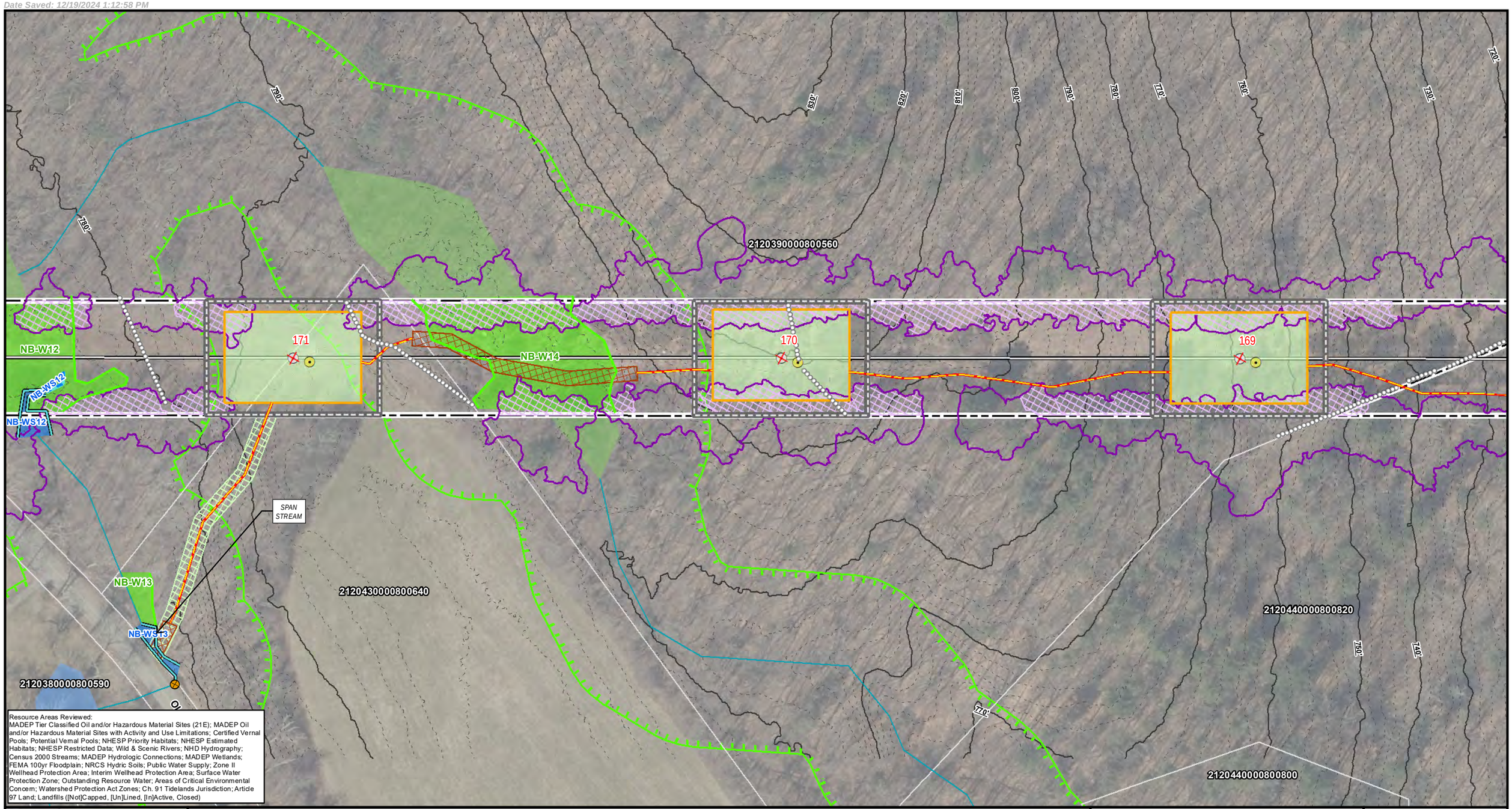

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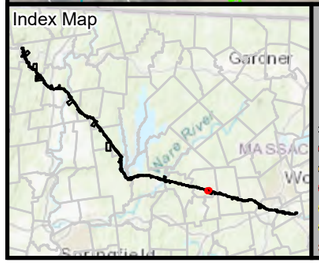

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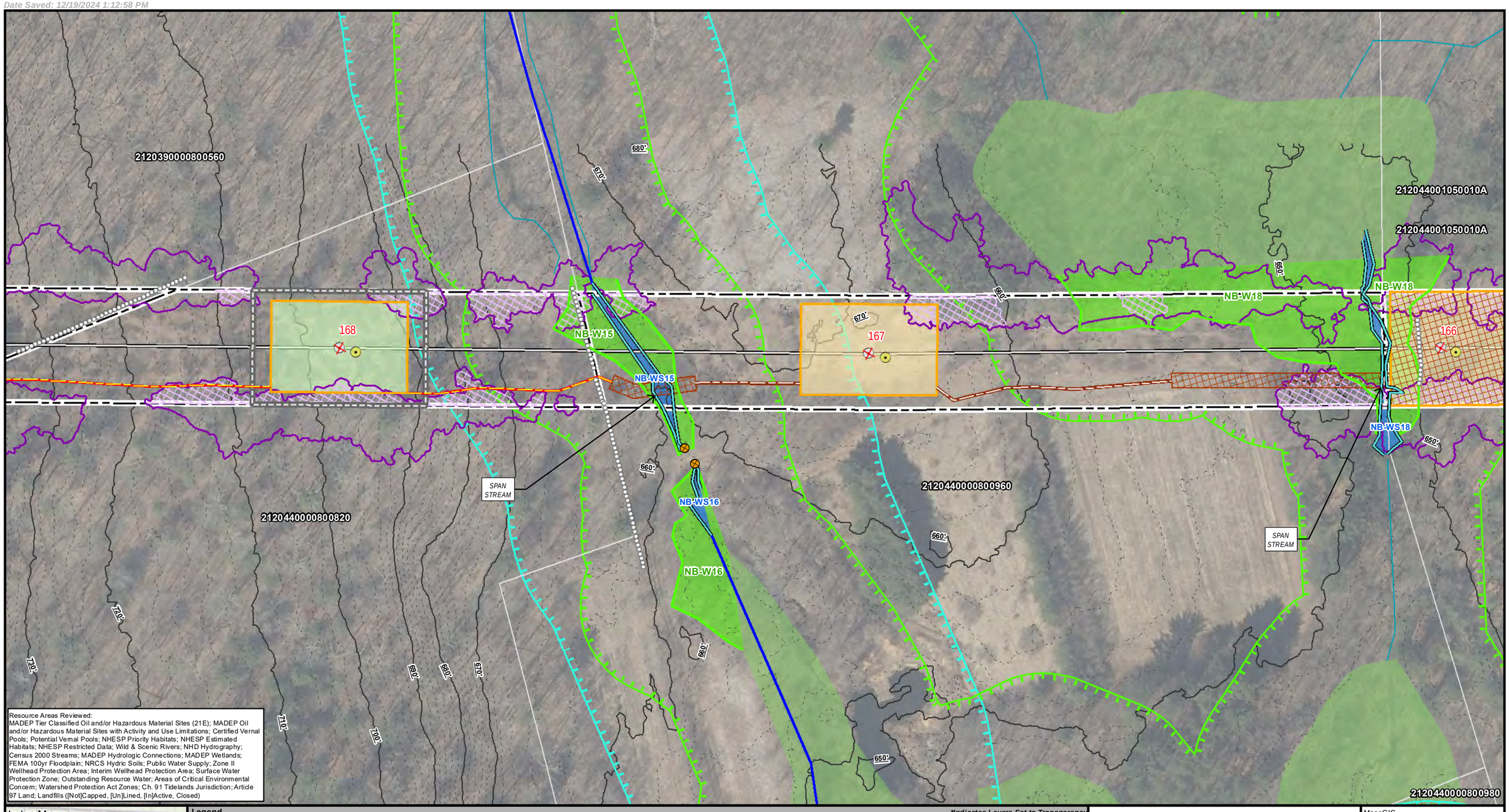

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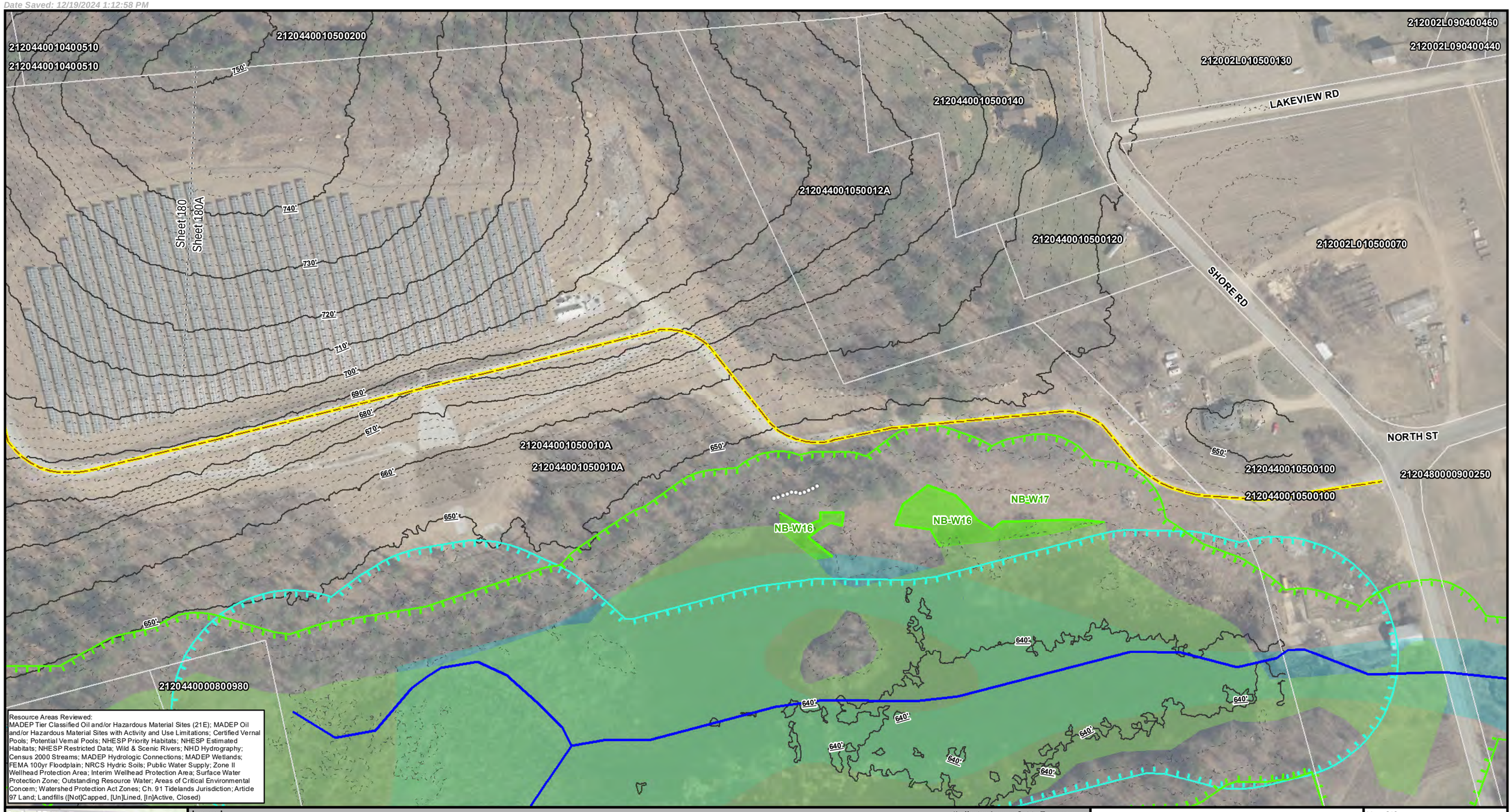

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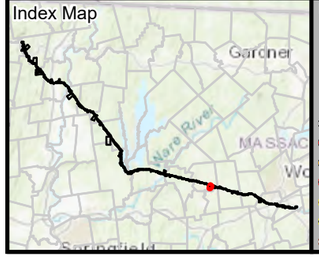

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- 200ft Riverfront Area
- FEMA 100yr Floodplain*
- Outstanding Resource Water
- NHESP Priority & Estimated Habitats
- Watershed Protection Act Primary Zone
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- Guardrail
- Stonewall
- Existing Treeline
- Tree Removal
- Selective Tree Removal
- Pruning
- Town Boundary
- Parcel Boundaries

1 inch = 150 feet
0 75 150
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

North Brookfield, MA
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MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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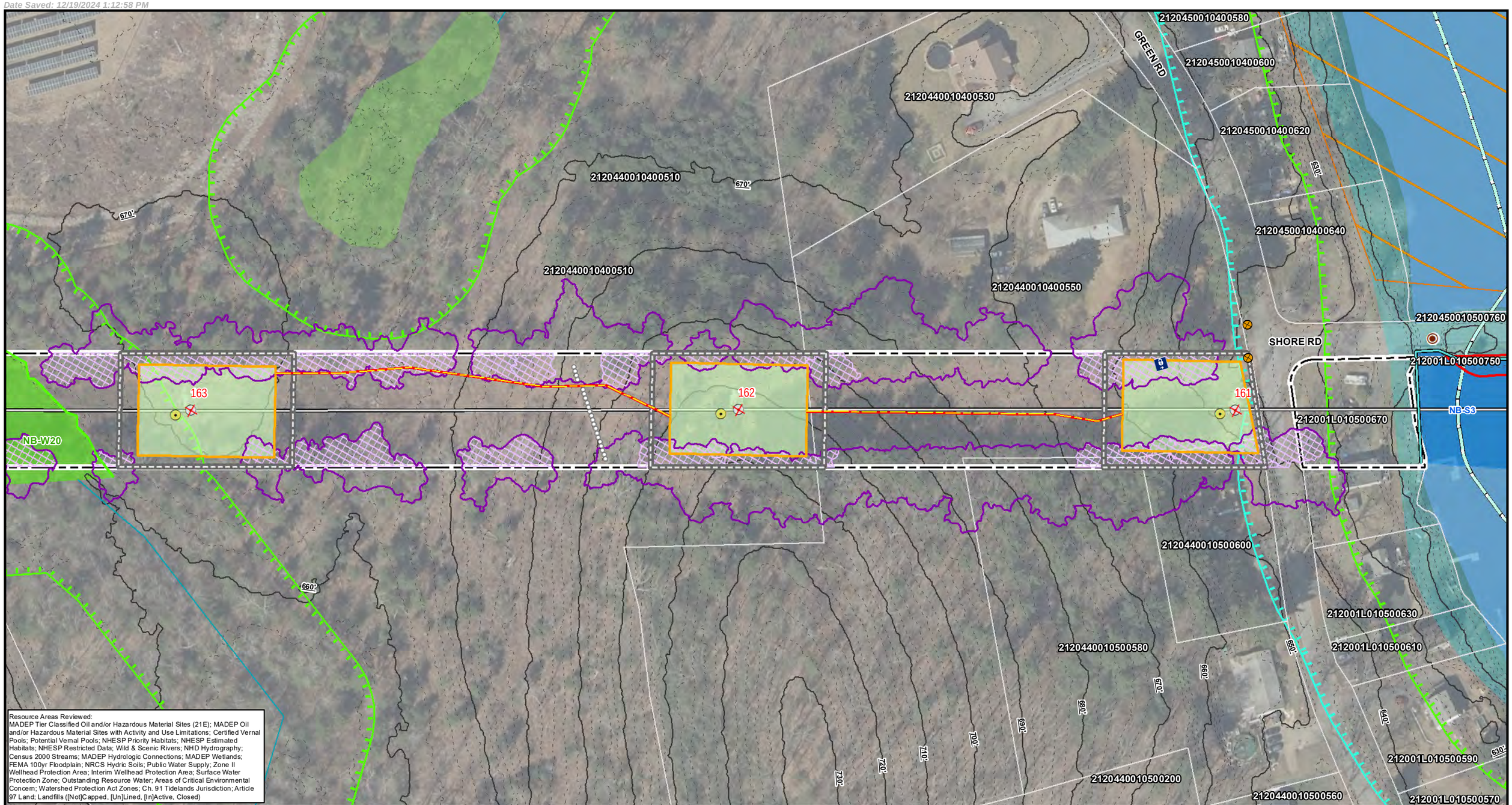

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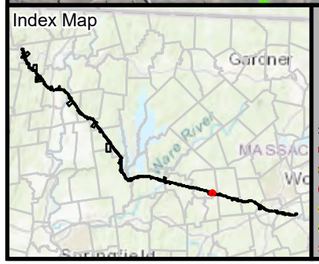
Index Map



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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

North Brookfield, MA

MassGIS
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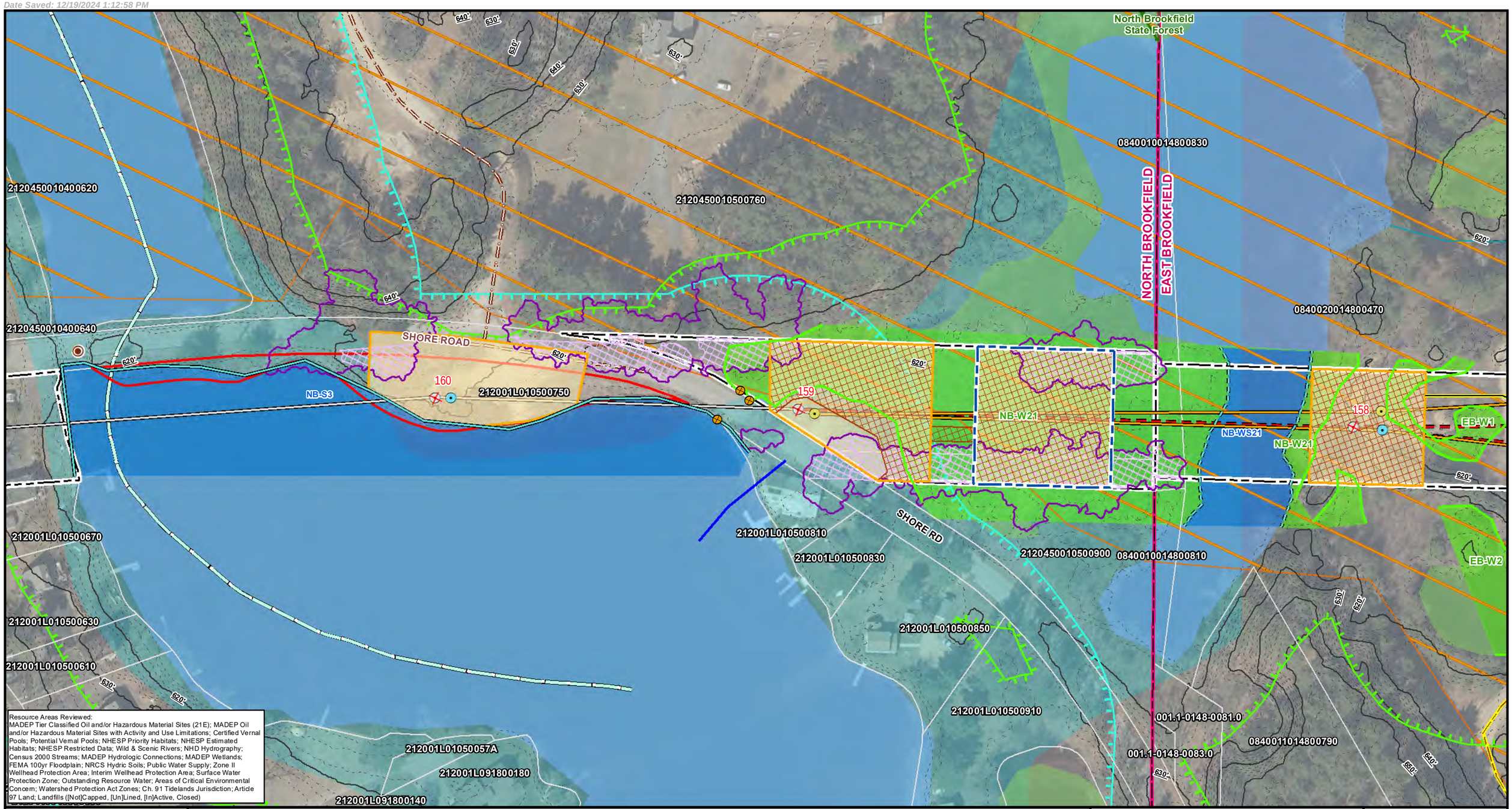

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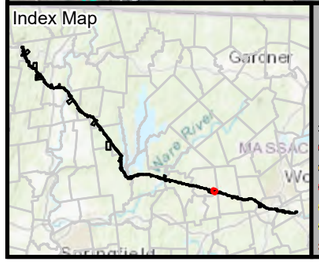

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Article 97 Lands

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

North Brookfield & East Brookfield, MA

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HARRINGTON SWITCHYARD

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EB-W2
EB-W3
EB-W4
EB-W5
EB-WS3
EB-WS4
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1 inch = 100 feet
0 50 100
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

East Brookfield, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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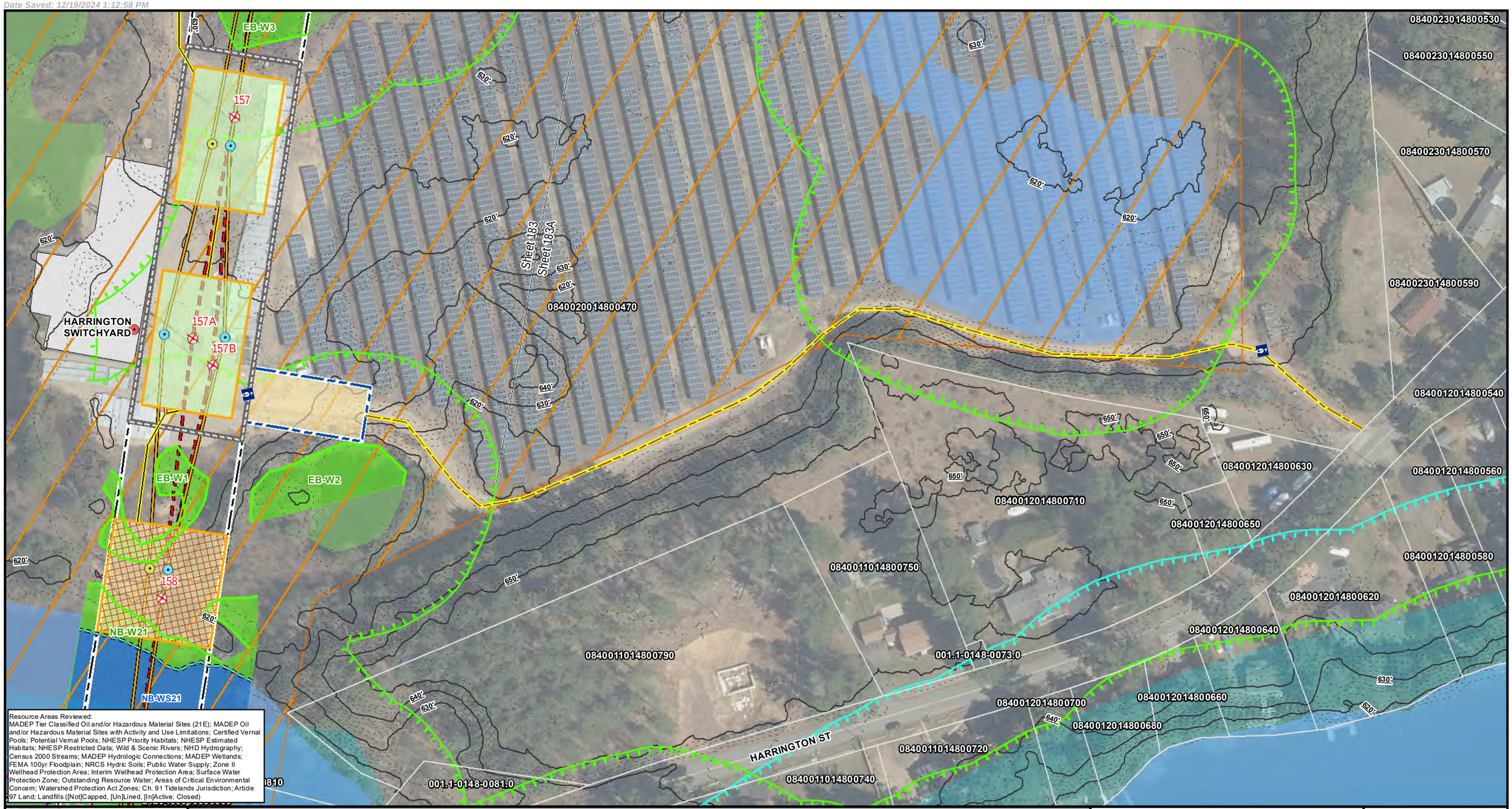

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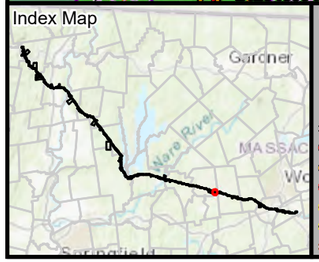

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

East Brookfield, MA
Page 183A of 240

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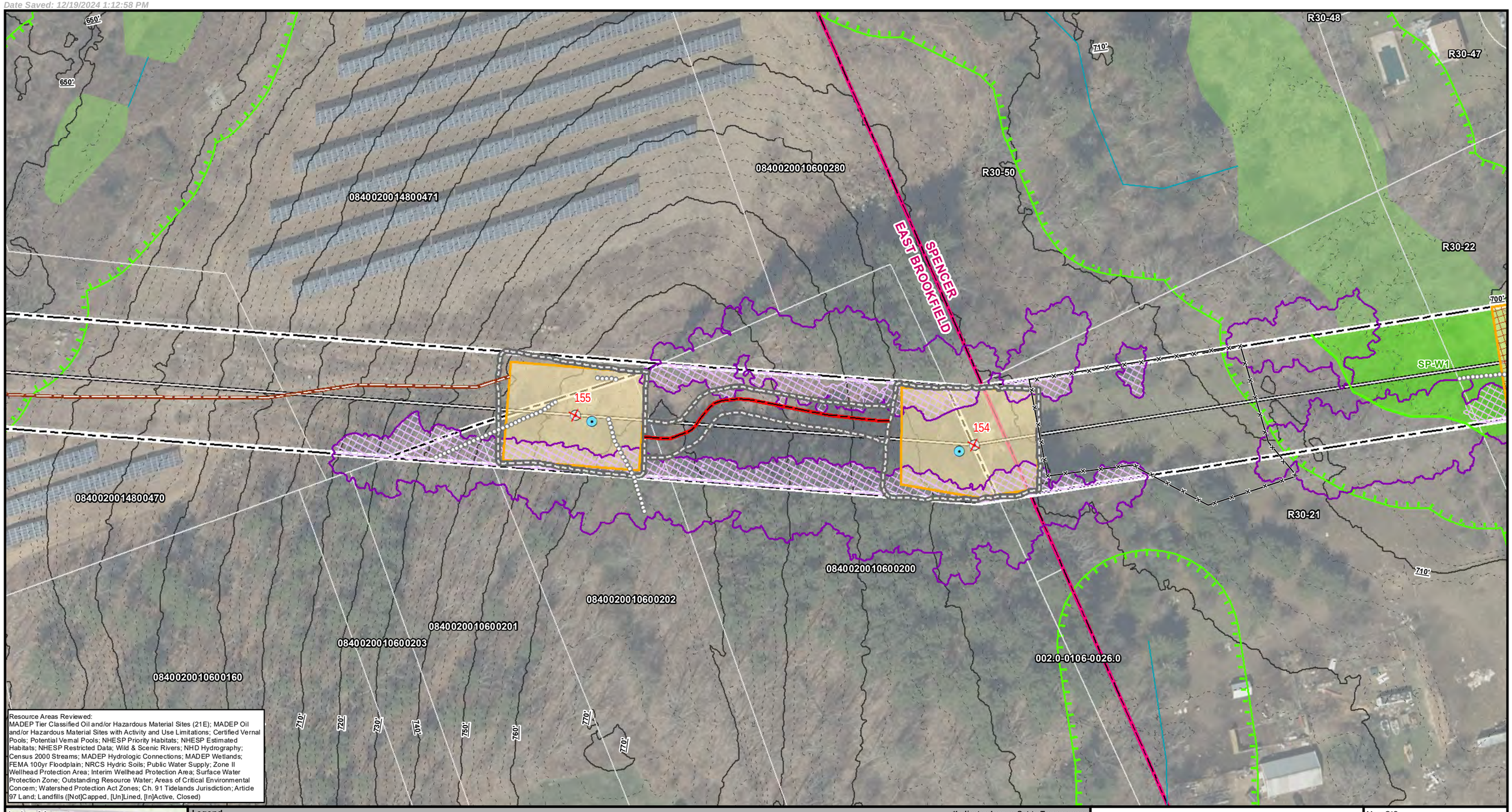

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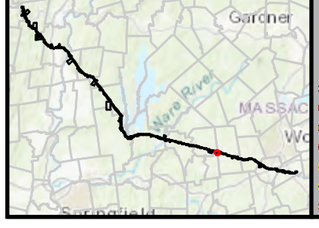

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

East Brookfield & Spencer, MA

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R30-47 R30-50 R30-39-1 R30-29 R30-28 R30-39 R30-14 R30-27 R30-26 R30-23 R30-25 R30-15 R30-21 R30-16 R30-24 R30-22 R30-16-2 R30-16-3 R30-17 SMITHVILLE RD

153 SP-W1 SP-WS1 152 151

700' 710' 690' 670' 660'

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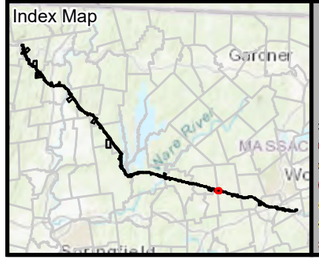

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Spencer, MA

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SP-WS2
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700'
690'
680'
670'
770'
760'
750'
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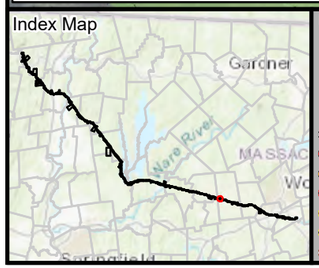

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Spencer, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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Sheet 187A
Sheet 187

SPAN STREAM

SP-W4
R30-2
SP-W3
SP-WS4
SP-W4
U11-9
U11-3
R30-1

148
147
146

760'
770'
710'
750'
740'
730'
720'
710'
700'
690'
680'
650'
640'
630'

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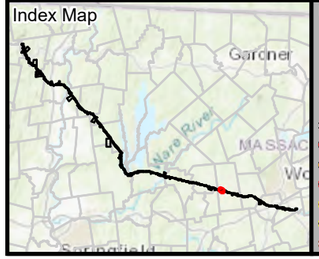

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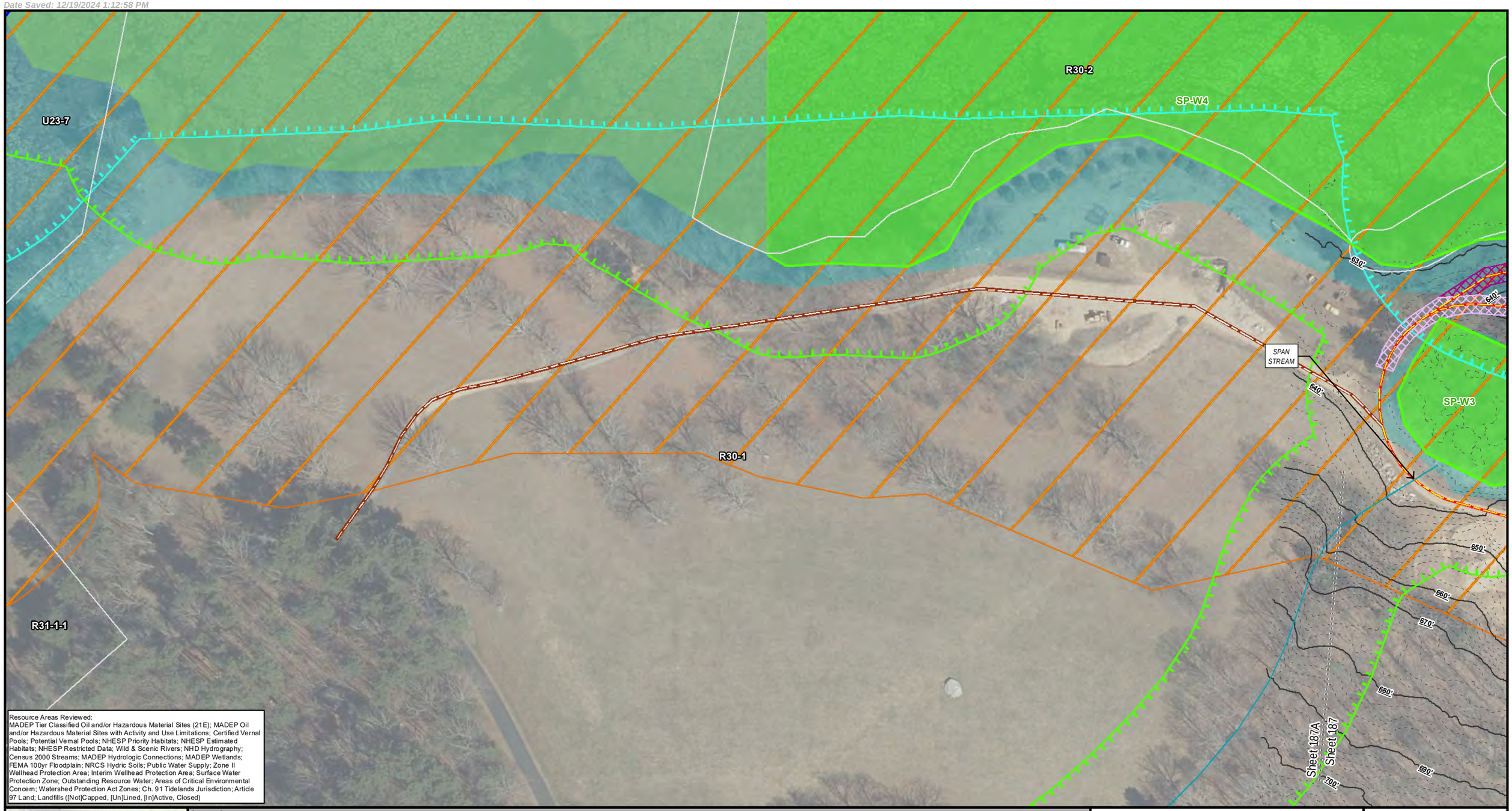

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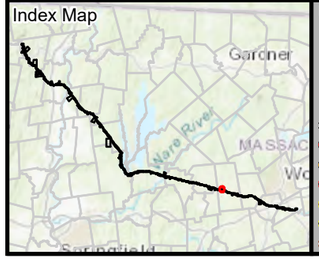

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Spencer, MA
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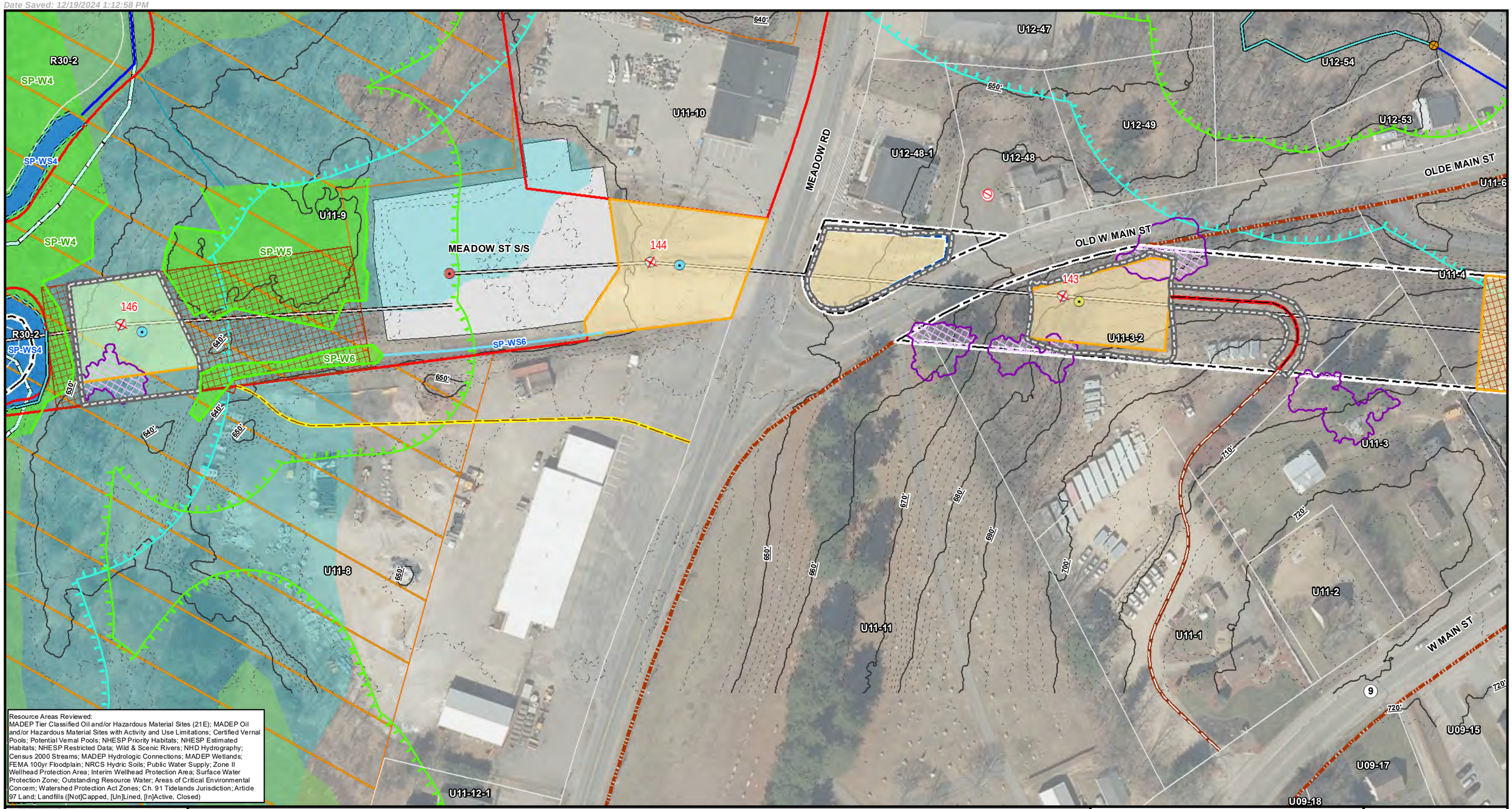

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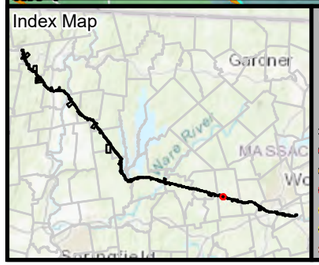

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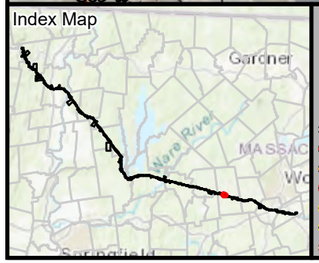

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U08-113-1
U09-2
U09-2
VALLEY ST
U08-103
SP-W9
U02-73
U02-66
U08-104
O'gara Park
U08-94
INCOME EJ
POPULATION
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U09-6-2
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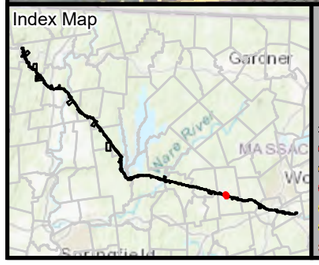

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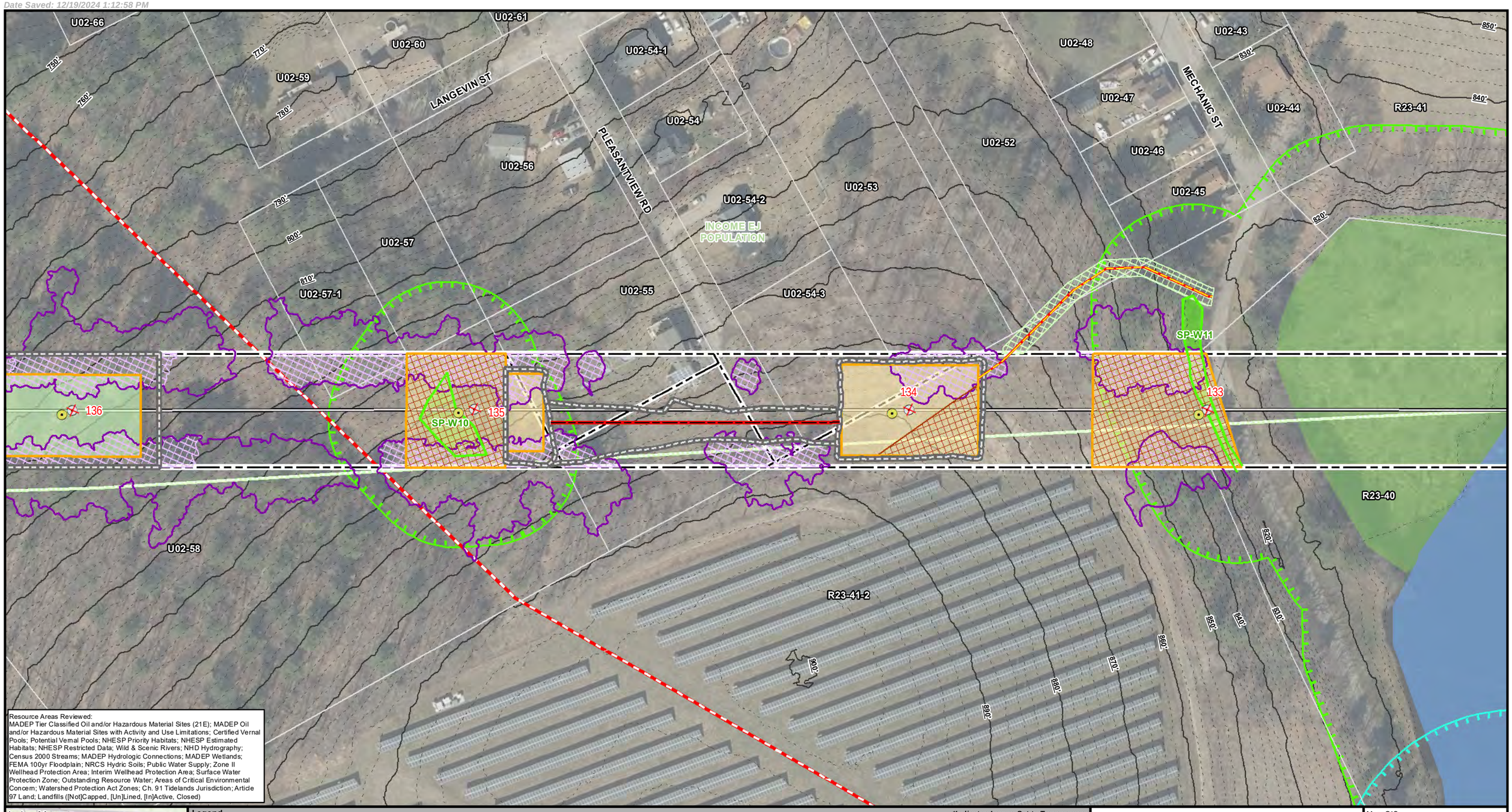

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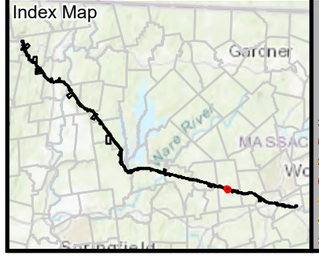
Index Map



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Indicates Layers Set to Transparency

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Environmental Justice Populations 2020

- Income

N

1 inch = 100 feet
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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Spencer, MA

MassGIS
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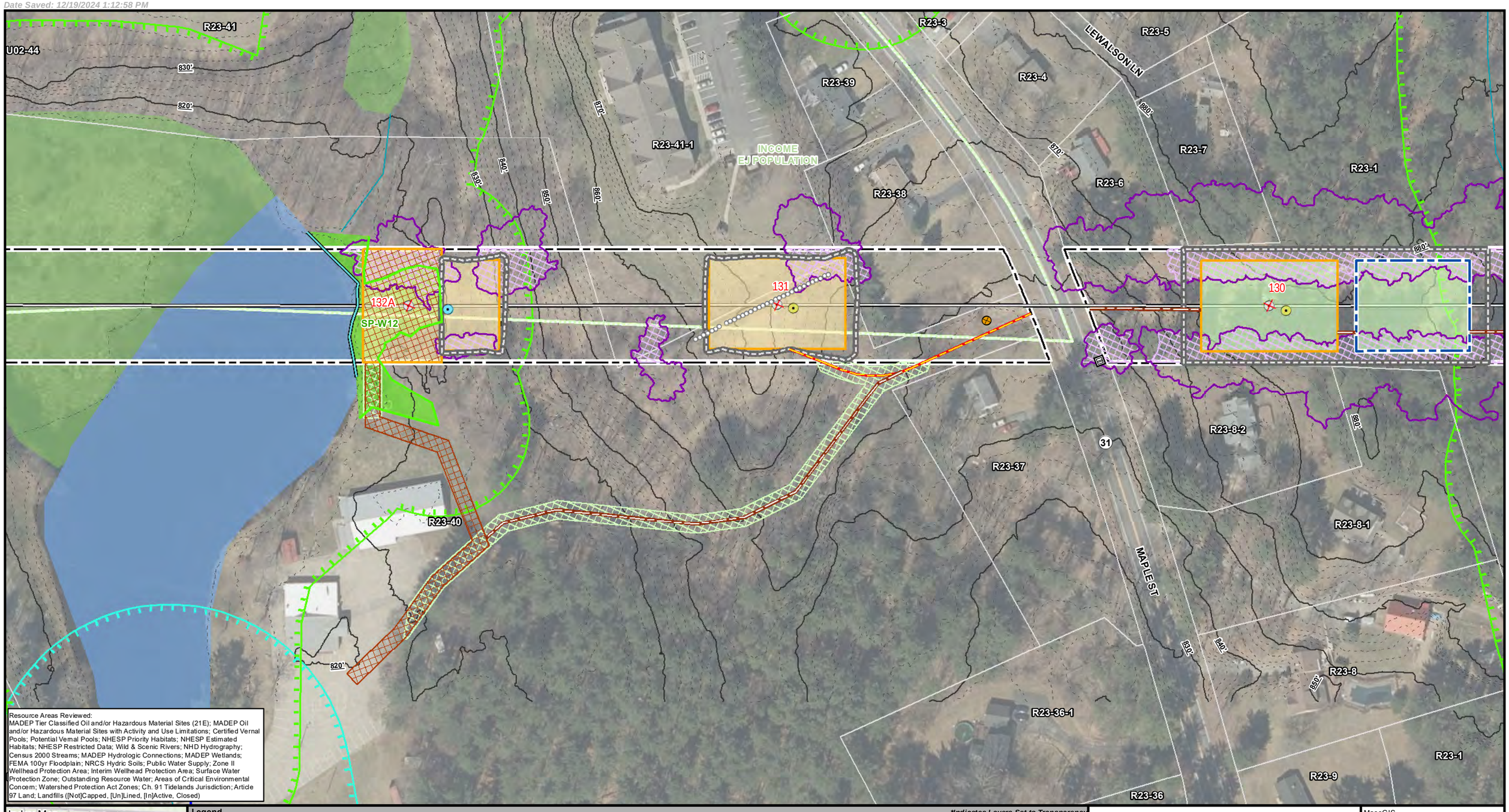

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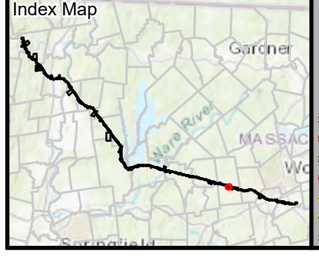

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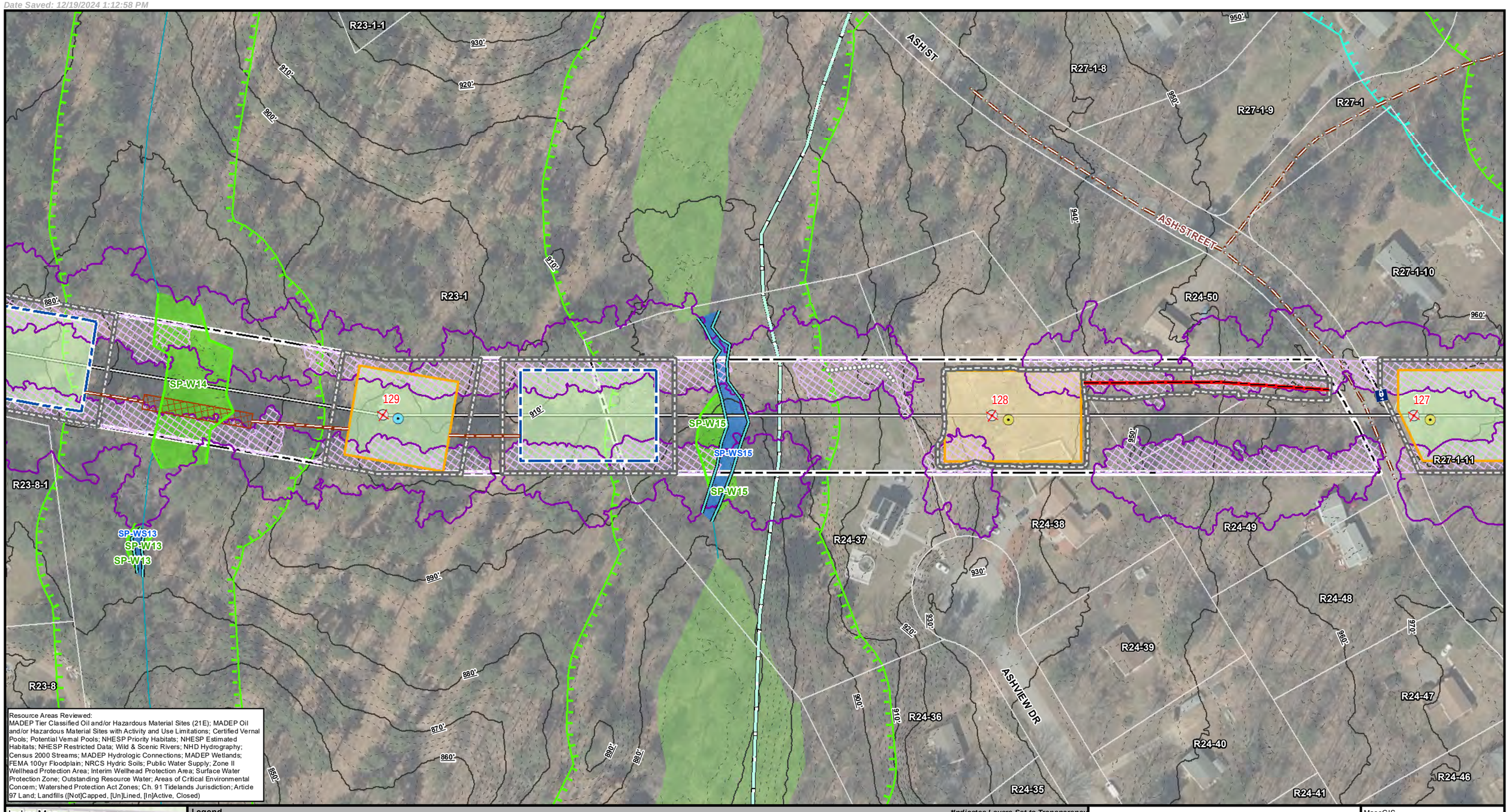

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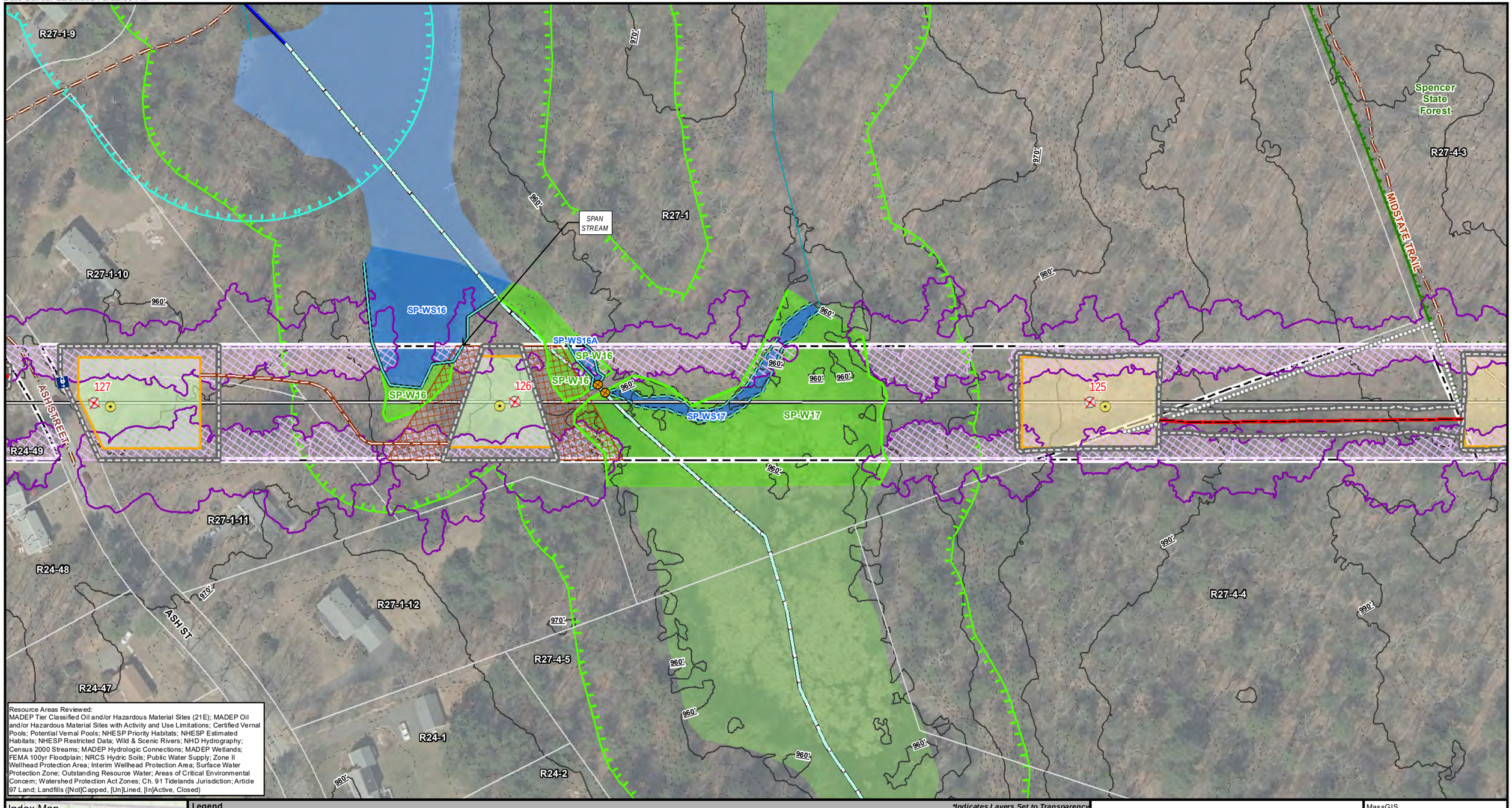

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SP-W21
SP-W19
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Sheet 195
Sheet 195A
960'
990'

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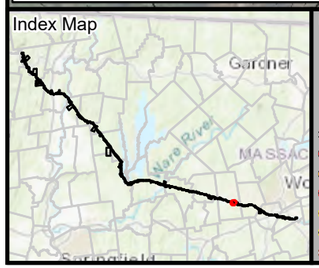

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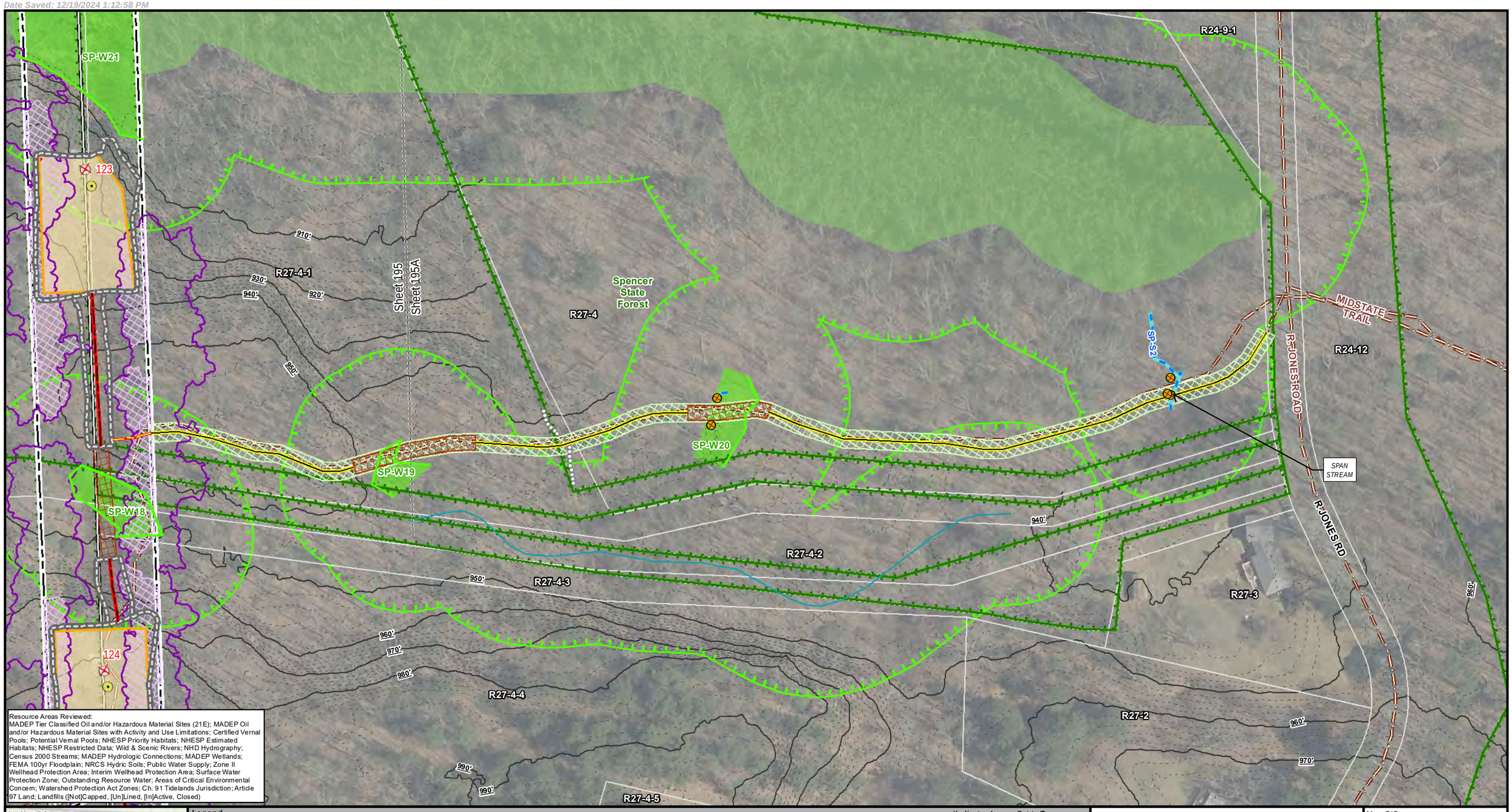

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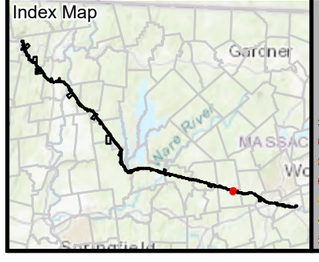

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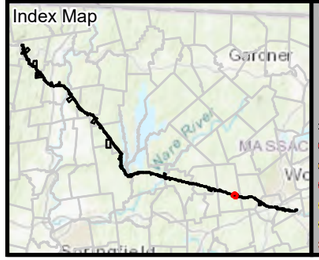

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Article 97 Lands

- DCR-State Parks & Recreation

N

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0 50 100
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Spencer, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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R25-18
R25-16
R25-17
Sheet 197A
Sheet 197
SP-W22
SP-WS22
SP-W24
SP-W25
SP-W23
SP-WS23
118
117
960'
930'
910'
890'
900'
970'

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Gardner
Springfield

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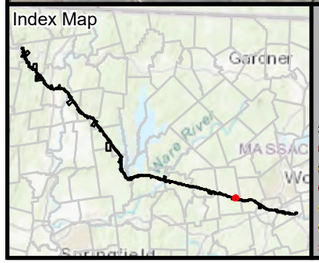

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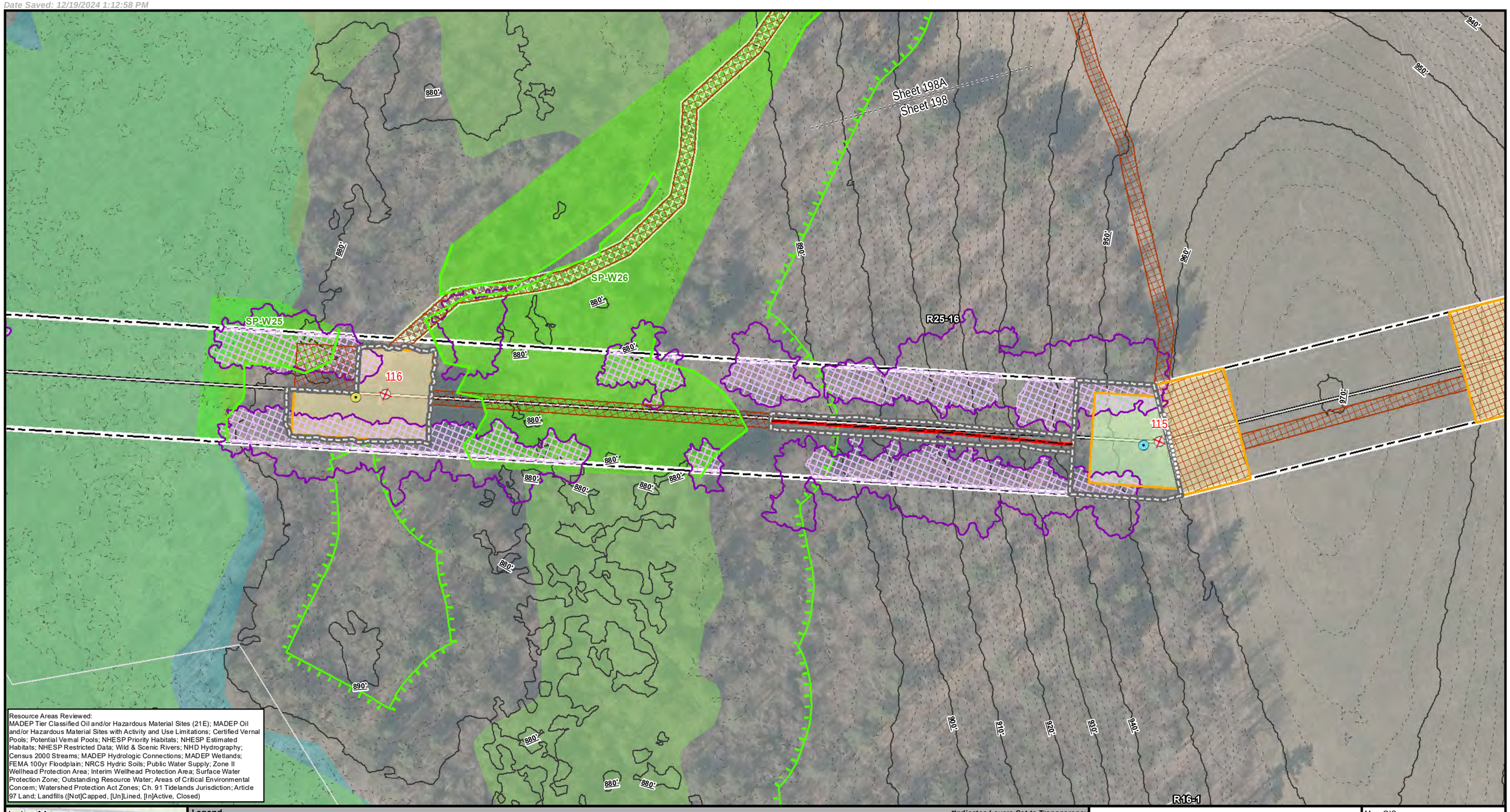

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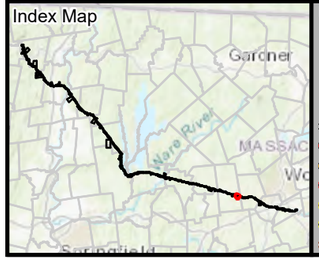

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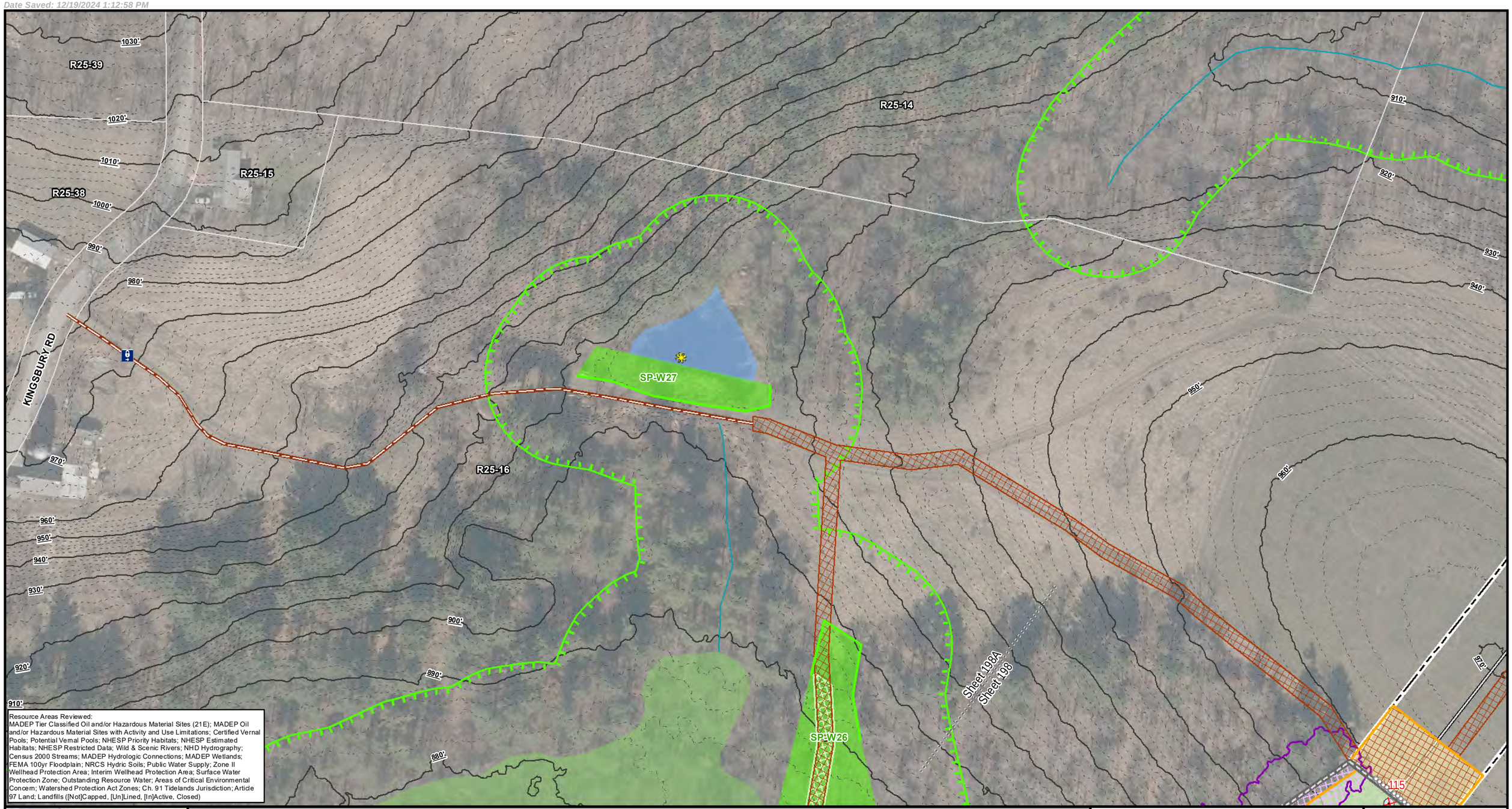

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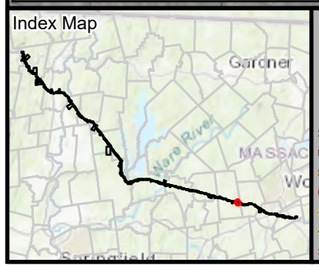

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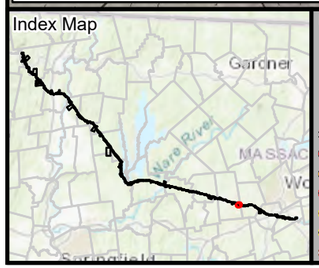

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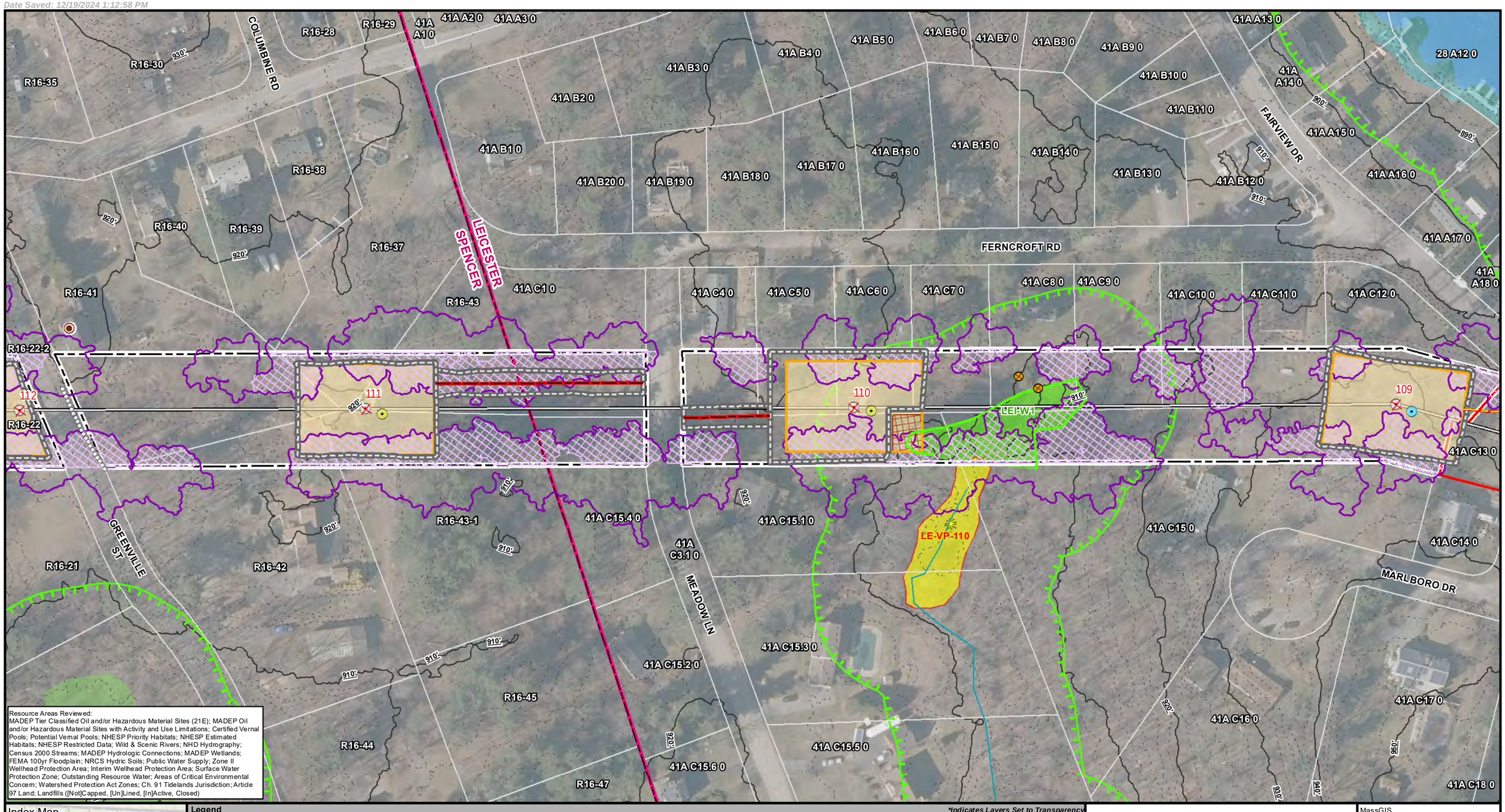

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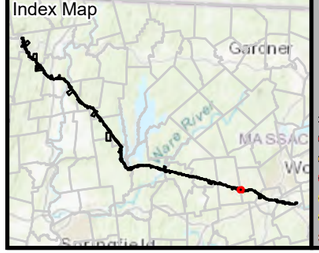

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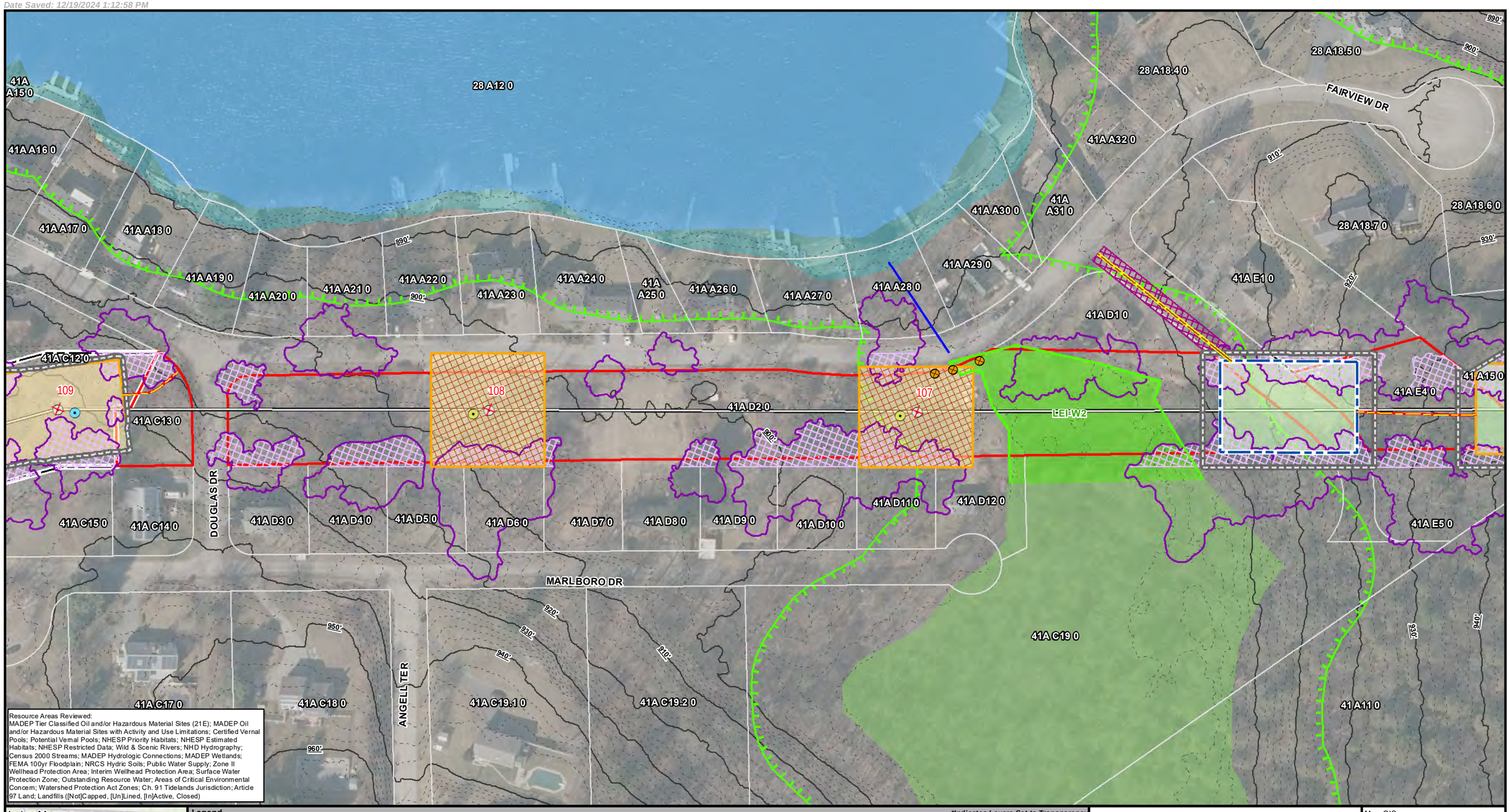

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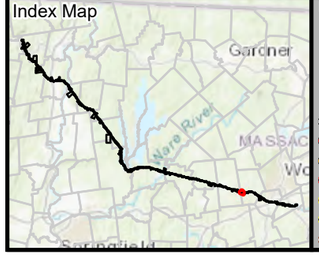

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Leicester, MA

MassGIS
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28 A18.4 0
28 A18.5 0
FAIRVIEW DR
900'
890'
28 A12 0
28 A18.1 0
40 A11 0
870'
880'
880'
910'
28 A18.7 0
41A
E1 0
28 A18.6 0
880'
28 A18 0
890'
40 A10 0
920'
930'
41A E4 0
106
105
41A 15 0
LEI-W3
LEI-W4
104
LEI-W3
870'
41A E5 0
LEI-WS3
41A C19 0
41A11 0
Burncoat
Brook
40 A10.1 0
870'
960'
940'
940'
CHARLES ST
41 A14.1 0
PINE ST
870'
41 A14 0
40 B1 0
860'

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MASSAC
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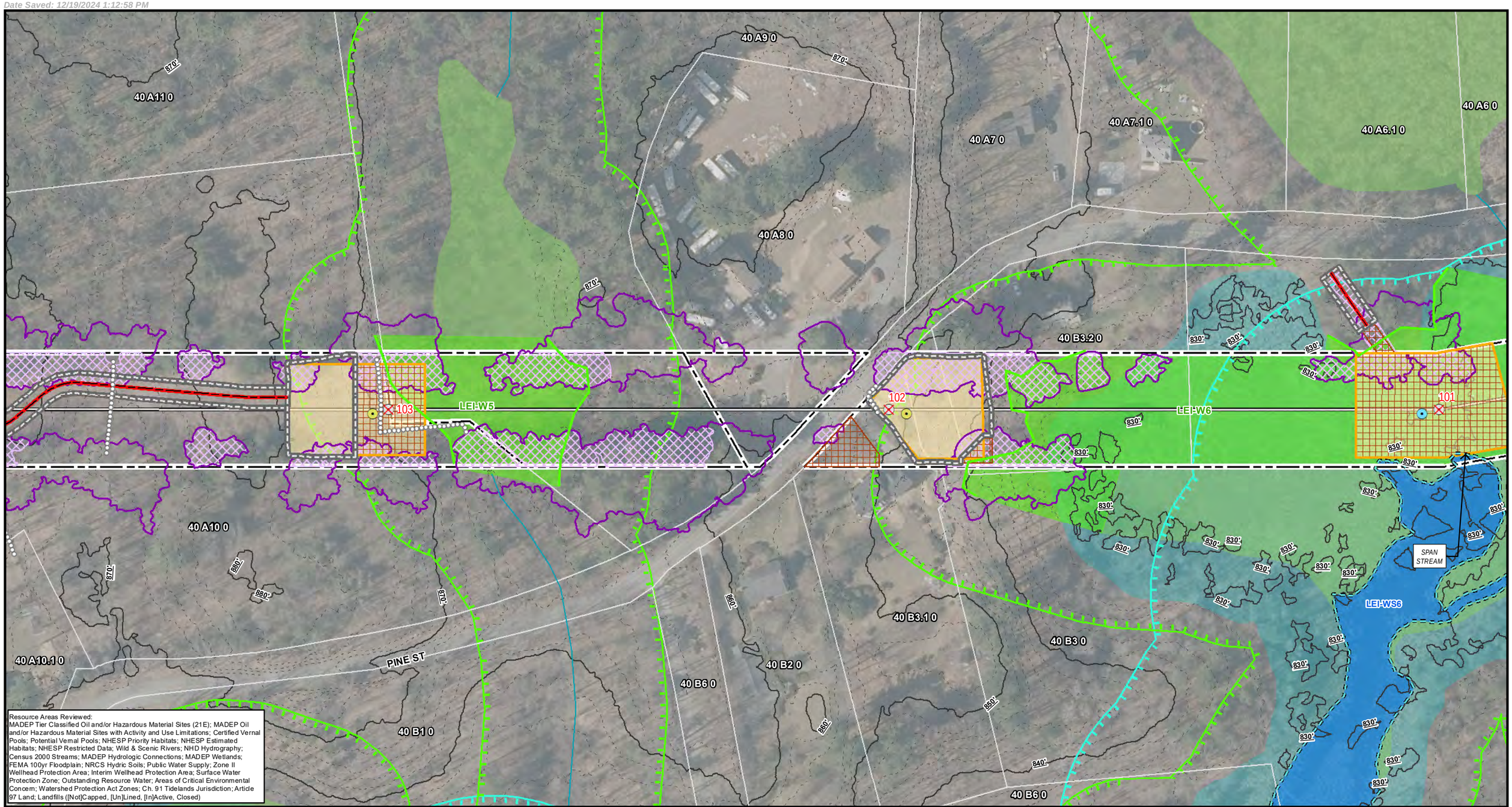

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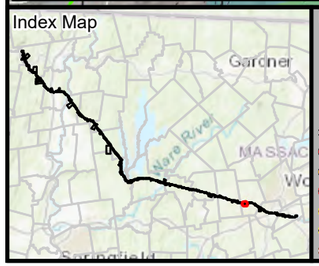

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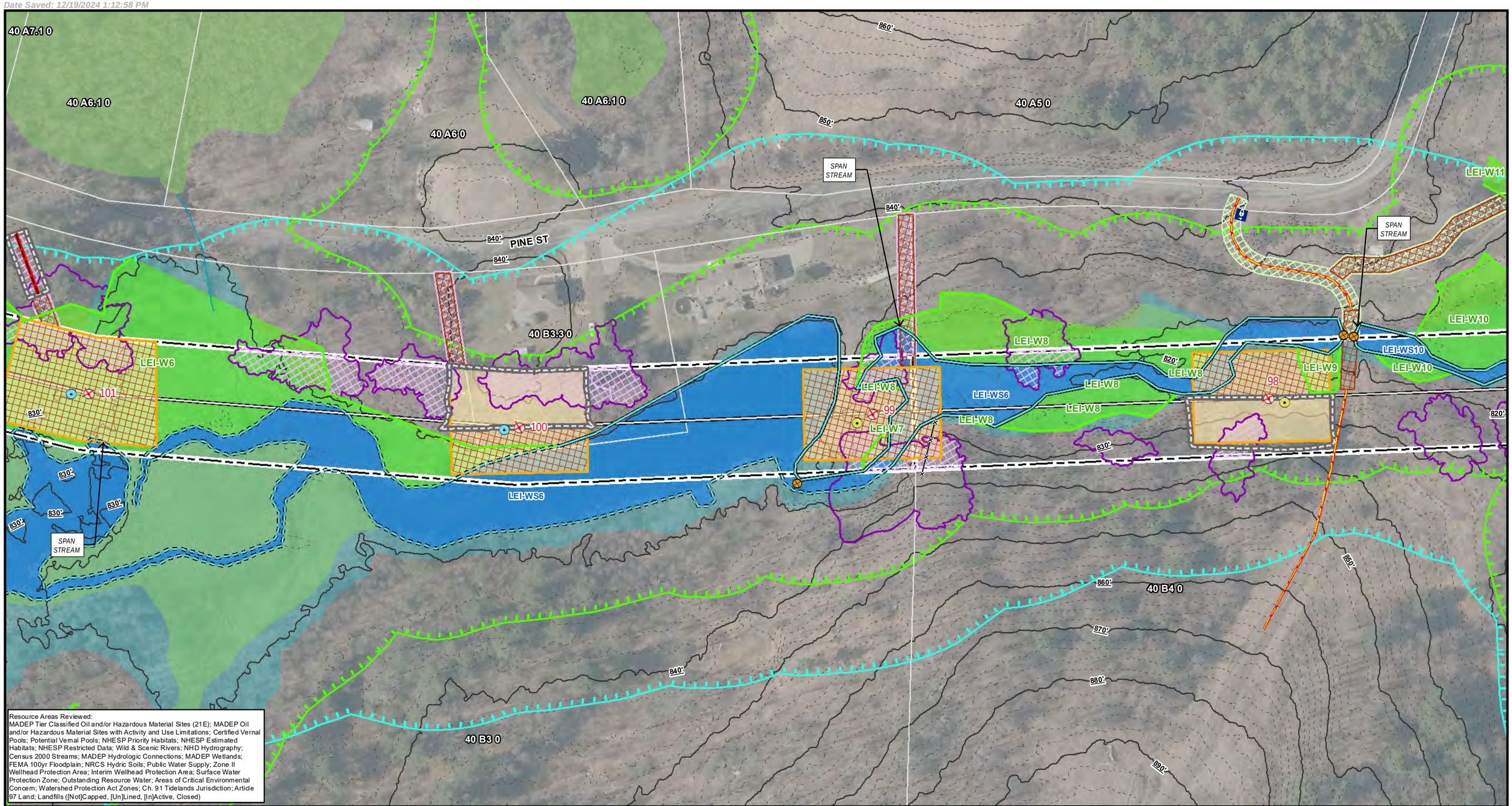

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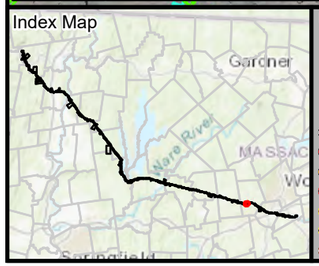

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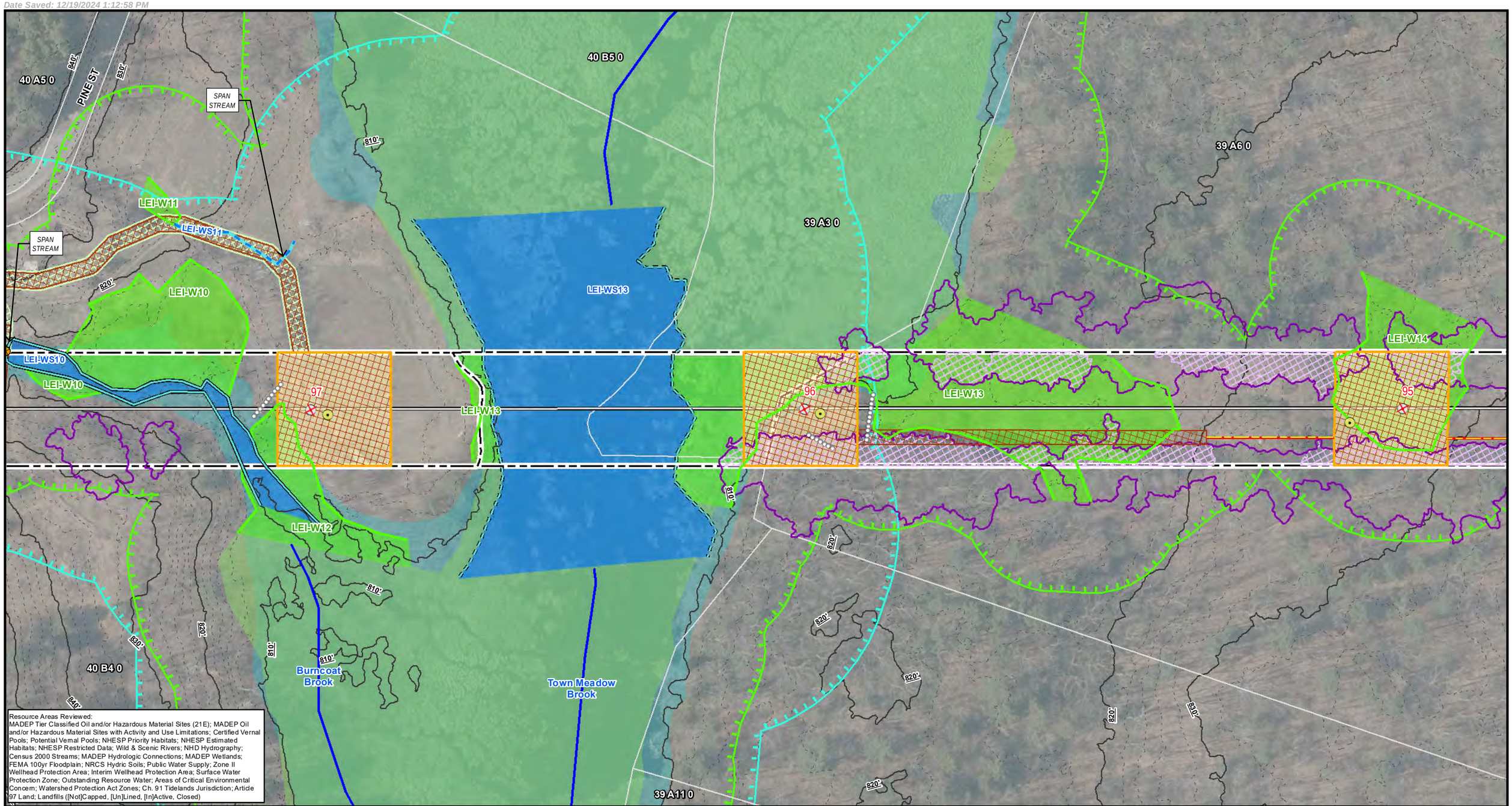

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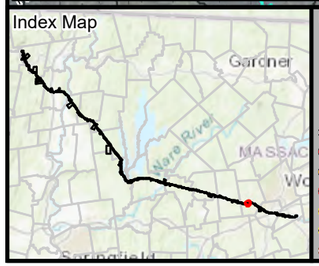

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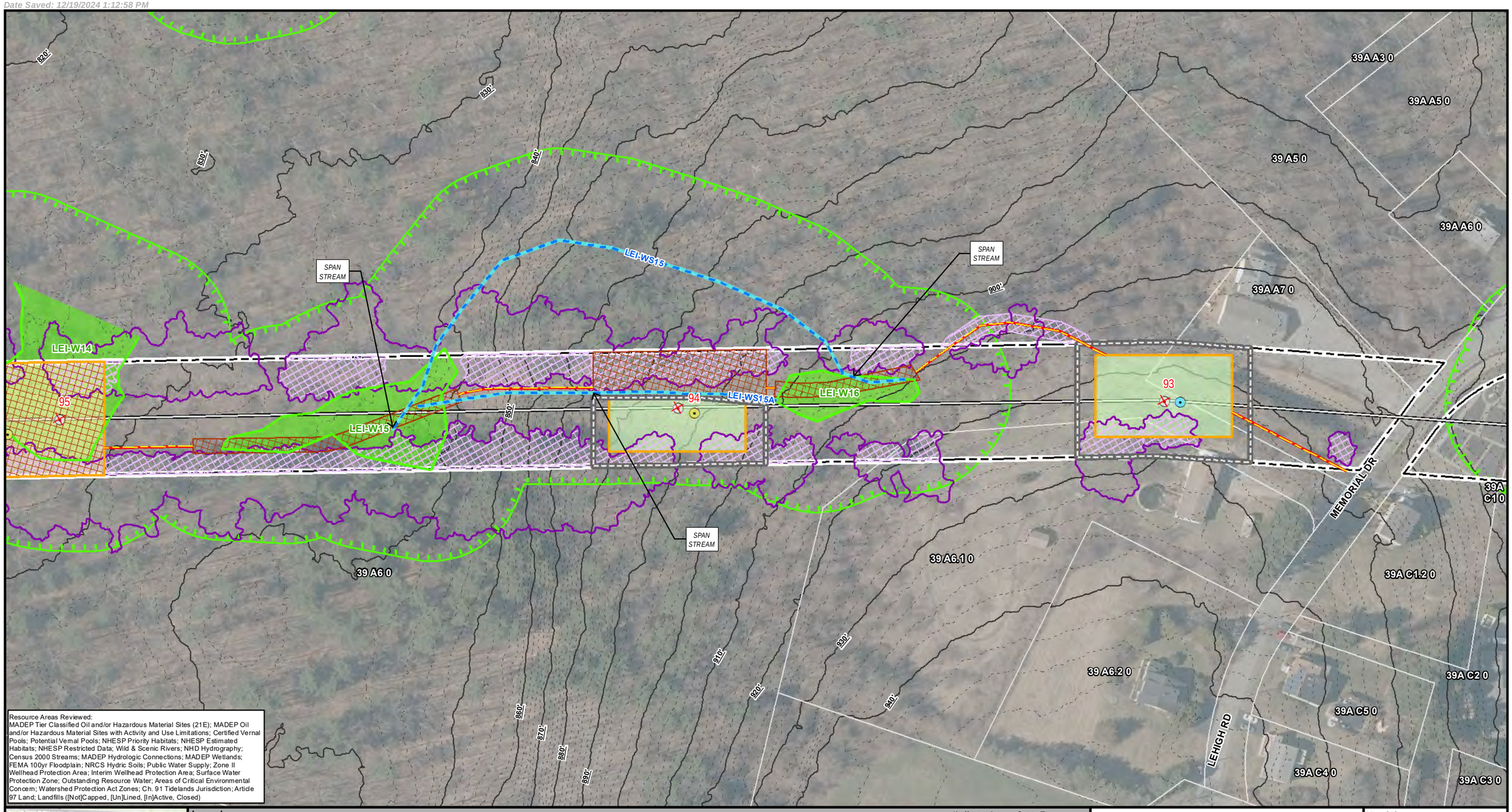

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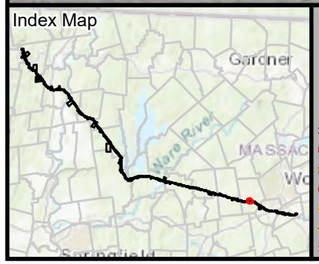

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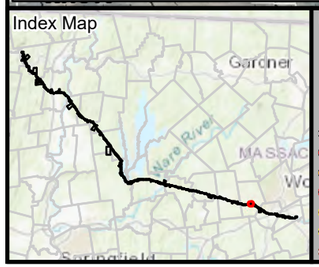

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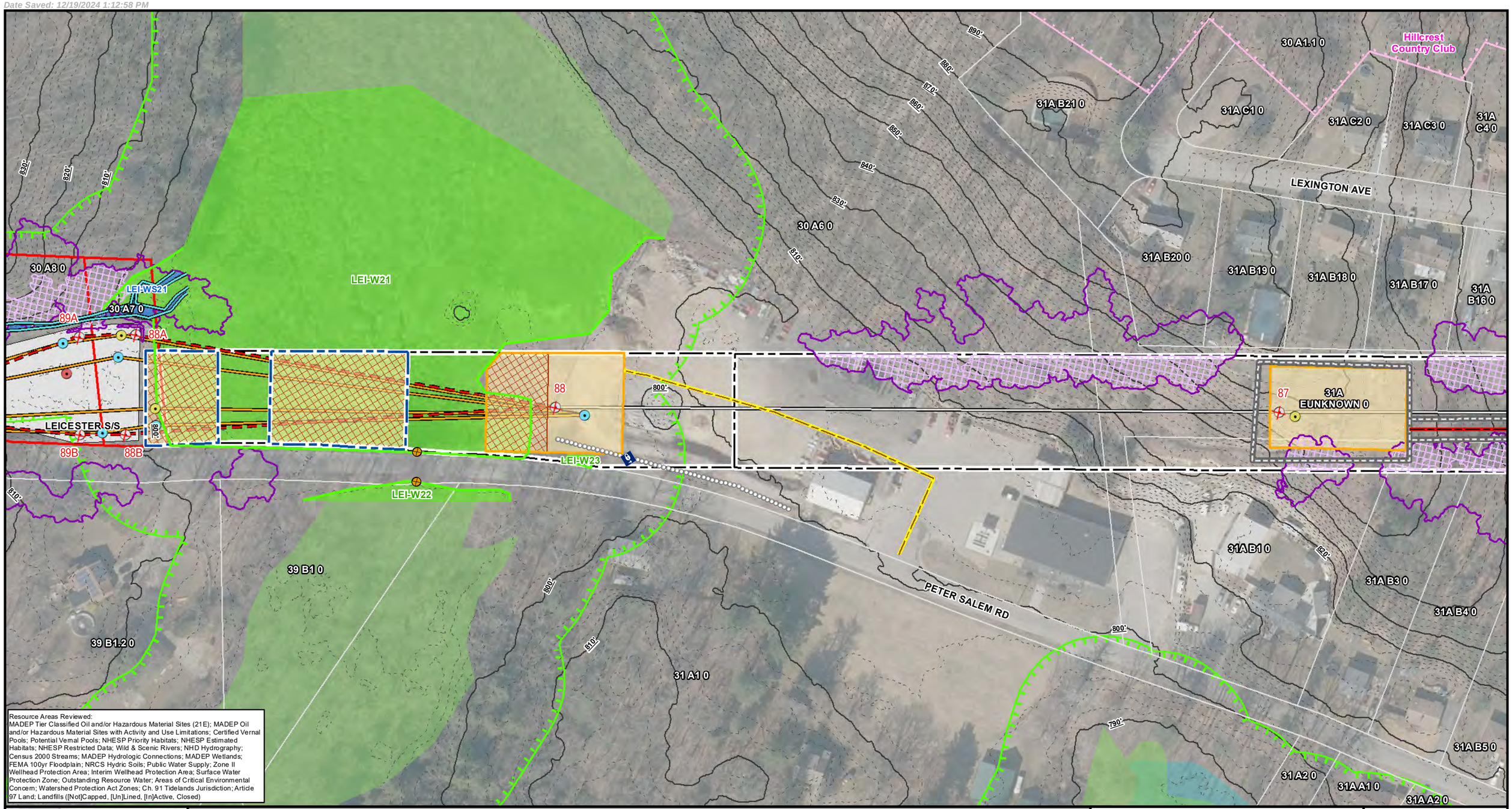

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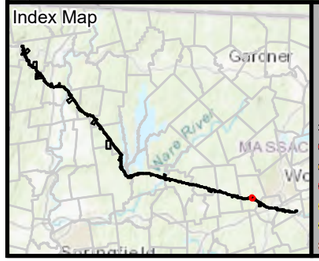

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Article 97 Lands

- Municipal

1 inch = 100 feet
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Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Leicester, MA

MassGIS
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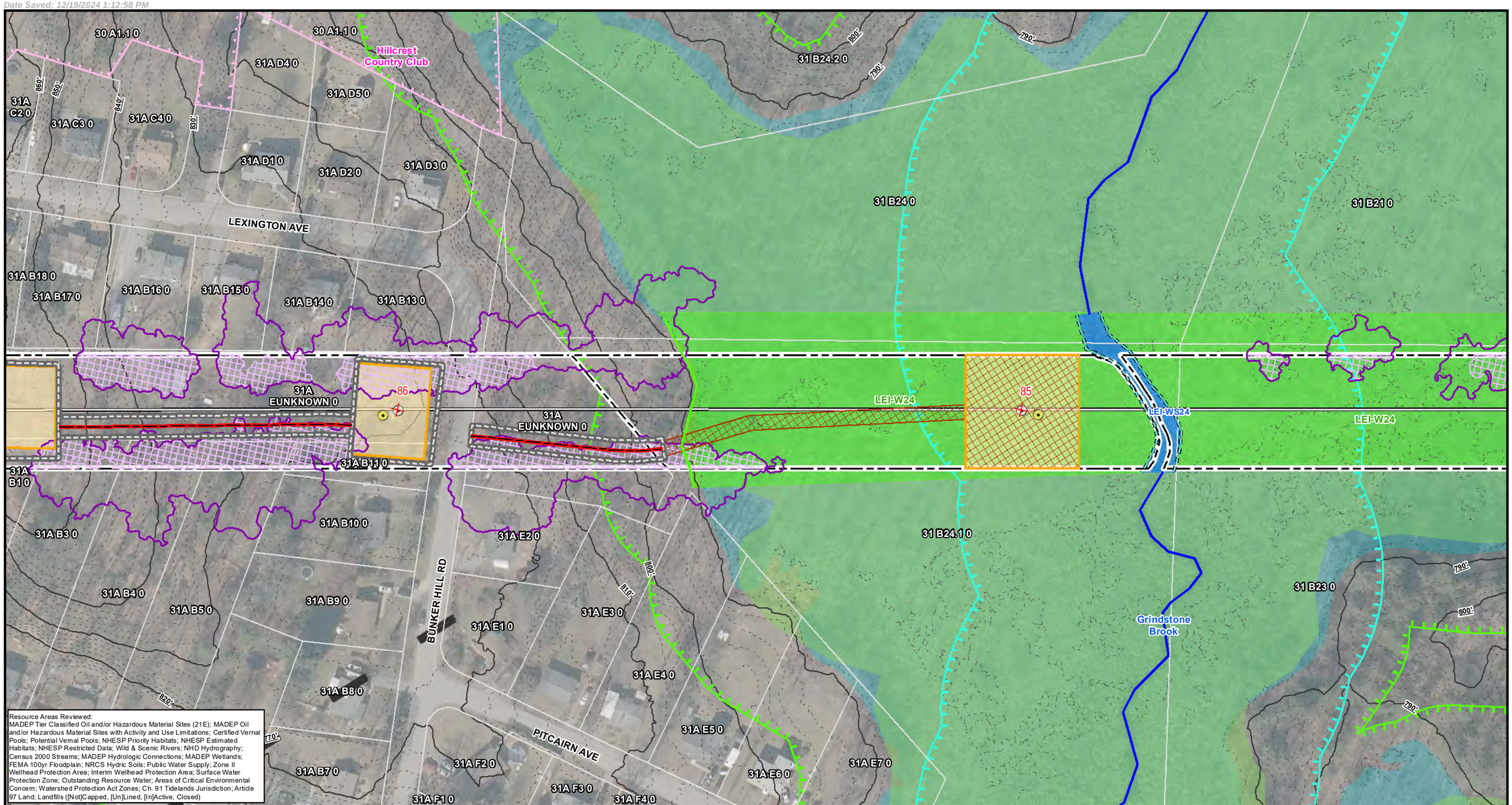

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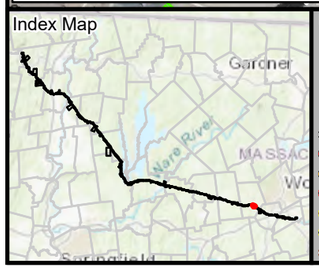

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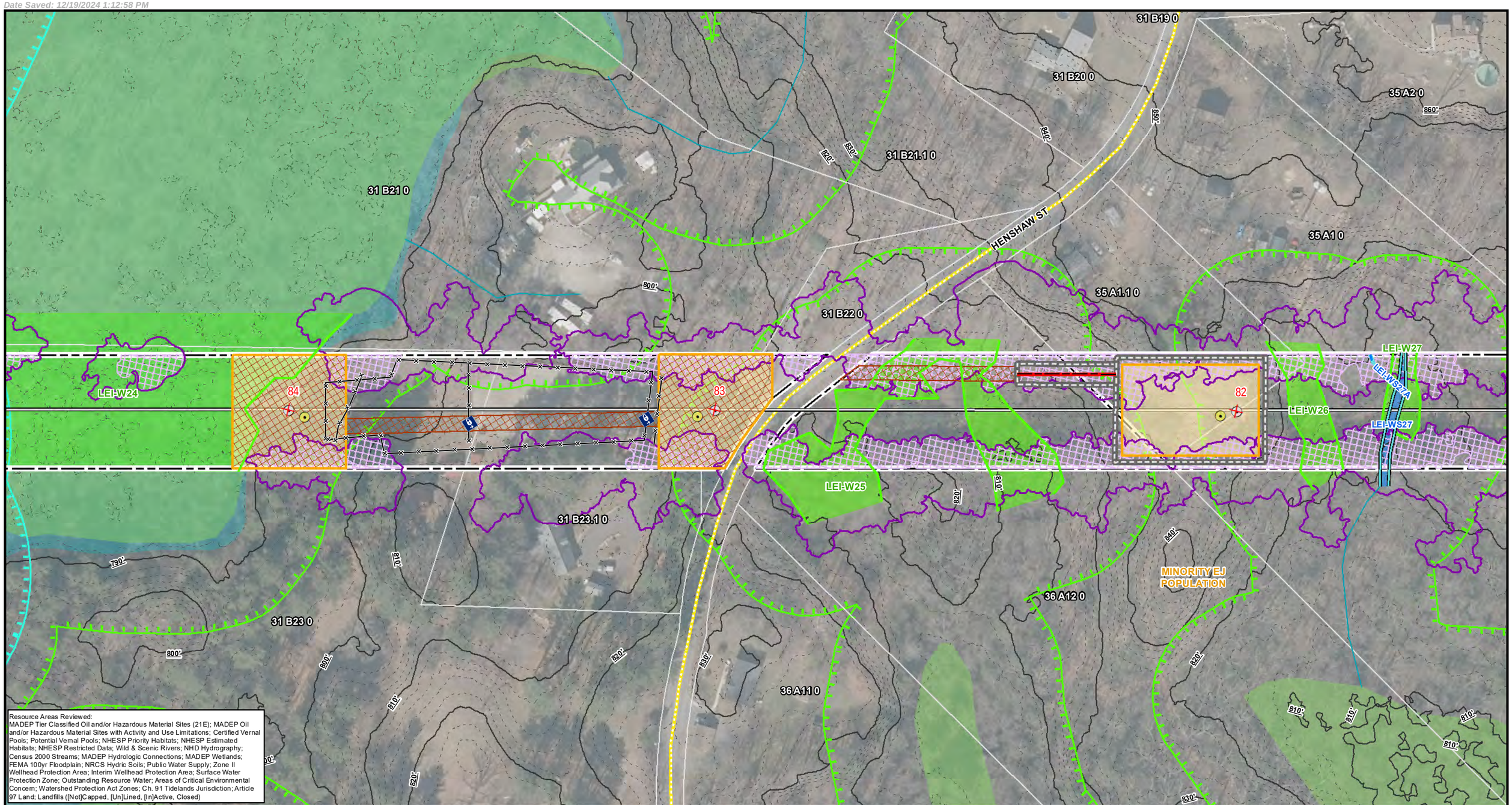

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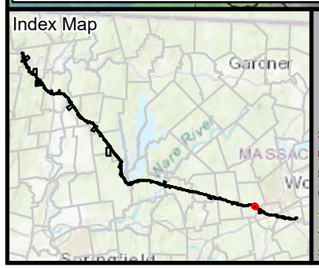

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BOUTILIER RD

35 B1 0
35 B1.1 0
35 B2.1 0
35 B3 0
35 A2 0
35 A2.2 0
35 A2.1 0
35 A1 0
36 A1.4 0
36 A1.3 0

MINORITY EJ POPULATION

81
80
79

LEI-W27
LEI-WS27A
LEI-WS27
LEI-WS28
LEI-W28
LEI-W29

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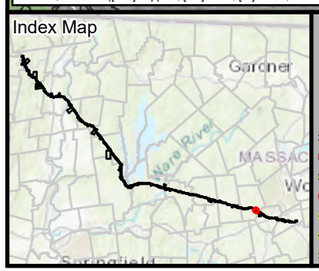

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35 B3 0

35 B3.1 0

36 A1.3 0

36 A3 0

36 A1.2 0

MINORITY EJ POPULATION

BOUTILIER RD

79

78

77

LEI-W29

LEI-W30

LEI-W31

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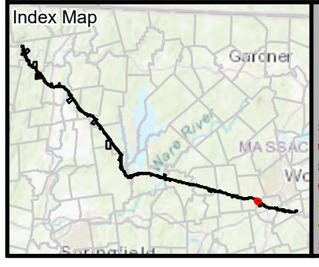

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35 F4 0
35 E2.3 0
35 F2 0
OLD STAFFORD TPKE
35 B3 0
35 B4 0
35 E2.1 0
36 B2 0
MINORITY EJ POPULATION
35 B3.1 0
STAFFORD ST
35 F1 0
35 E2.2 0
35 E2 0
LEI-W30
76
75
LEI-W32
LEI-WS32
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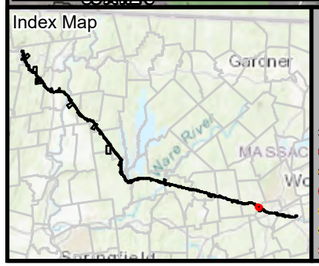

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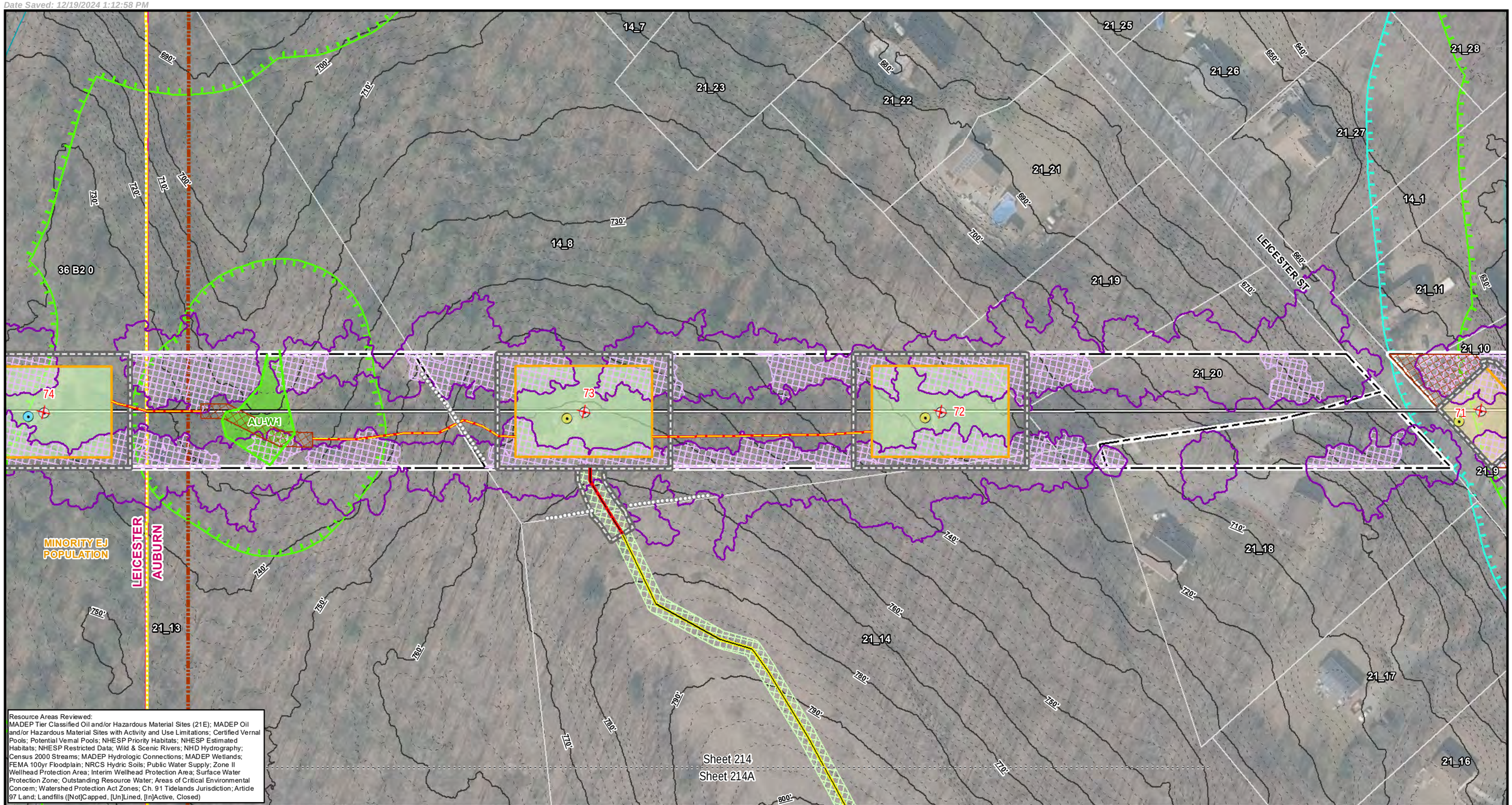

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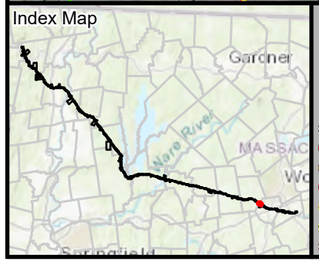

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GROWL HILL RD
Henshaw Street Land
Kinnear Brook
AU-W1
AU-W2
AU-W3
AU-WS2
AU-VP-73
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72
73
Sheet 214
Sheet 214A
MINORITY EJ POPULATION
AUBURN
LEICESTER

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- Parcel Boundaries

Article 97 Lands

- Municipal

Environmental Justice Populations 2020

- Minority

1 inch = 225 feet
0 110 220
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Auburn & Leicester, MA

MassGIS
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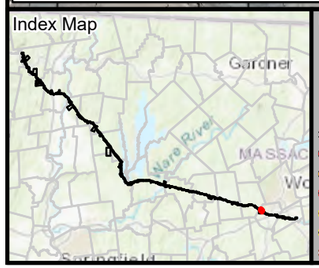

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Auburn, MA

MassGIS
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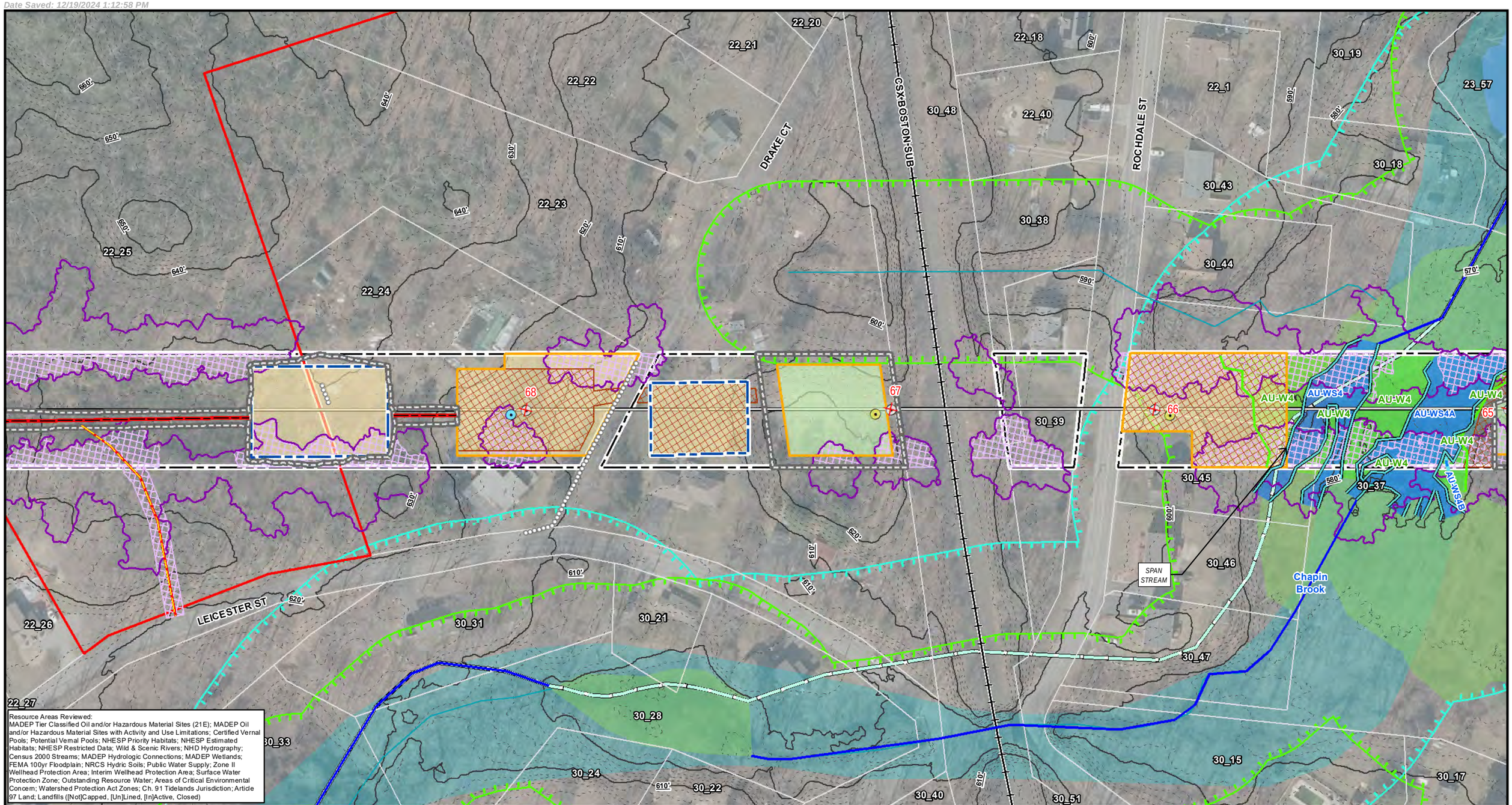

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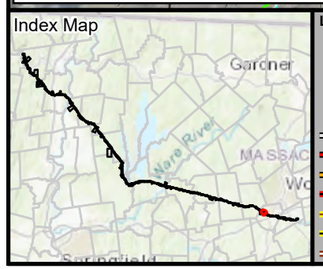

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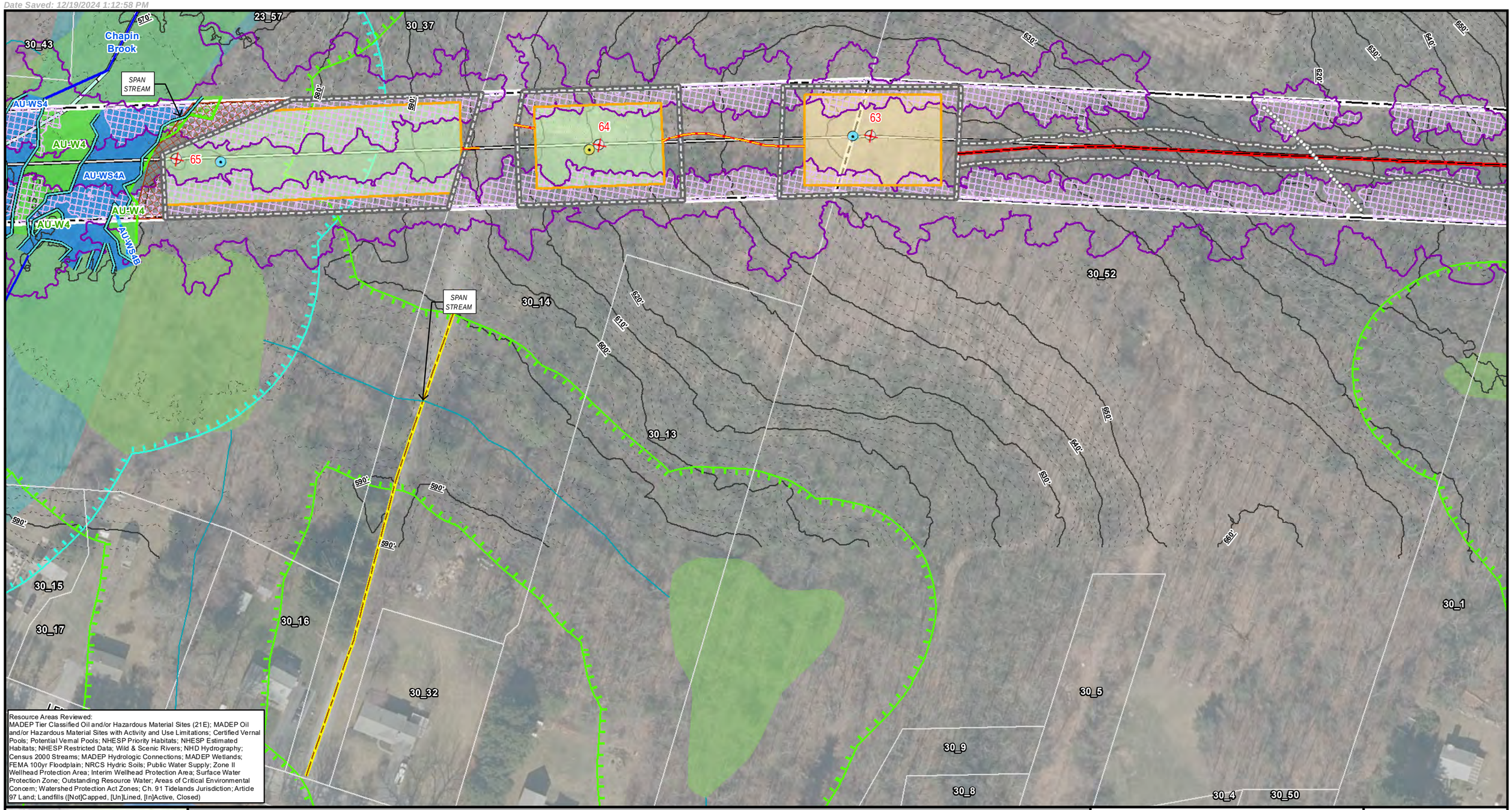

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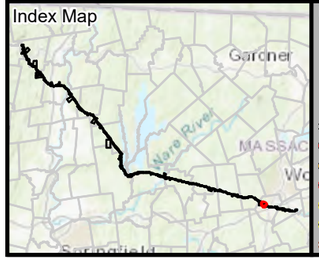

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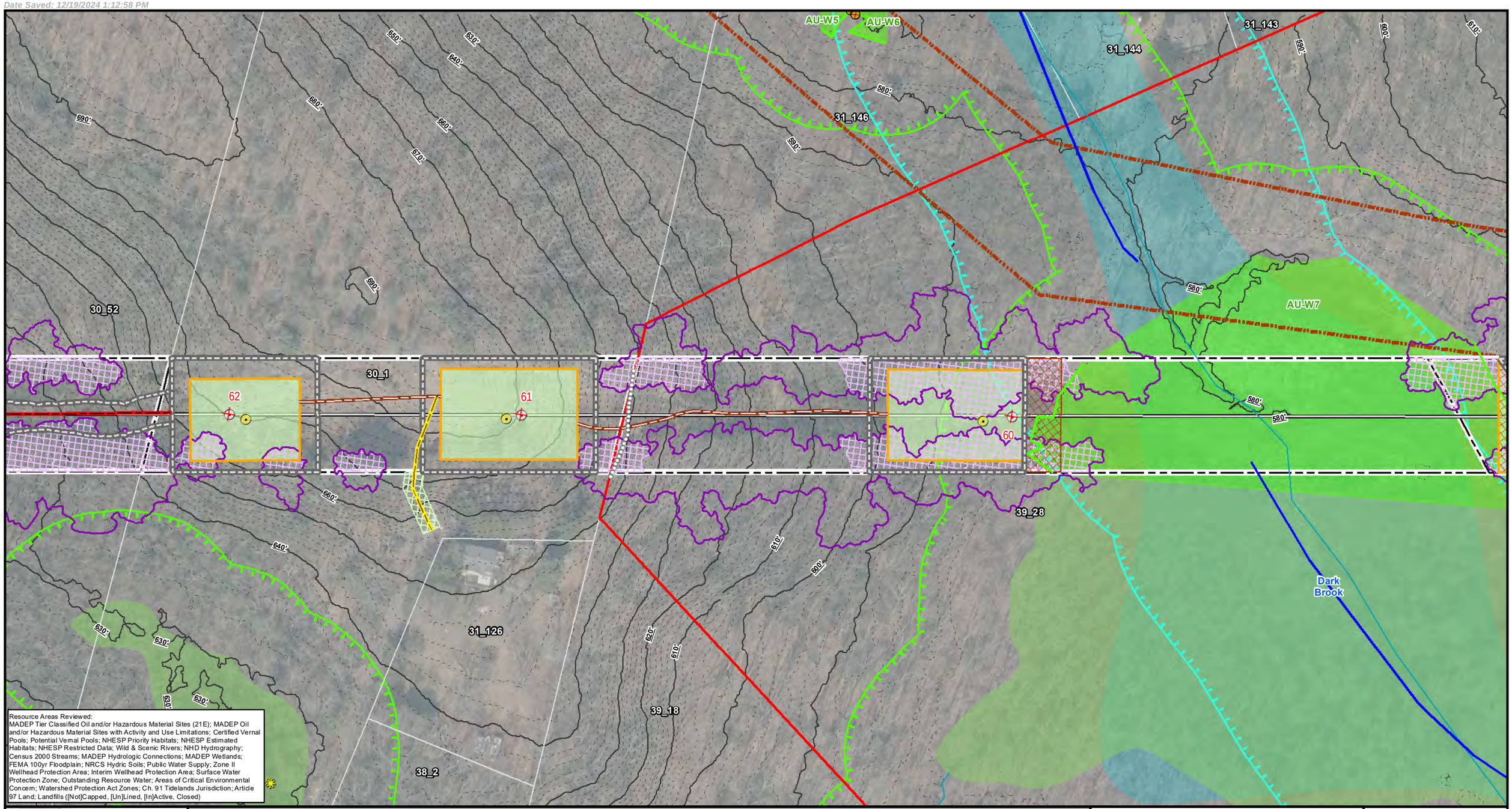

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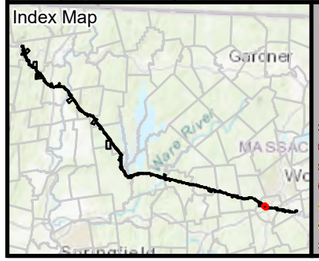

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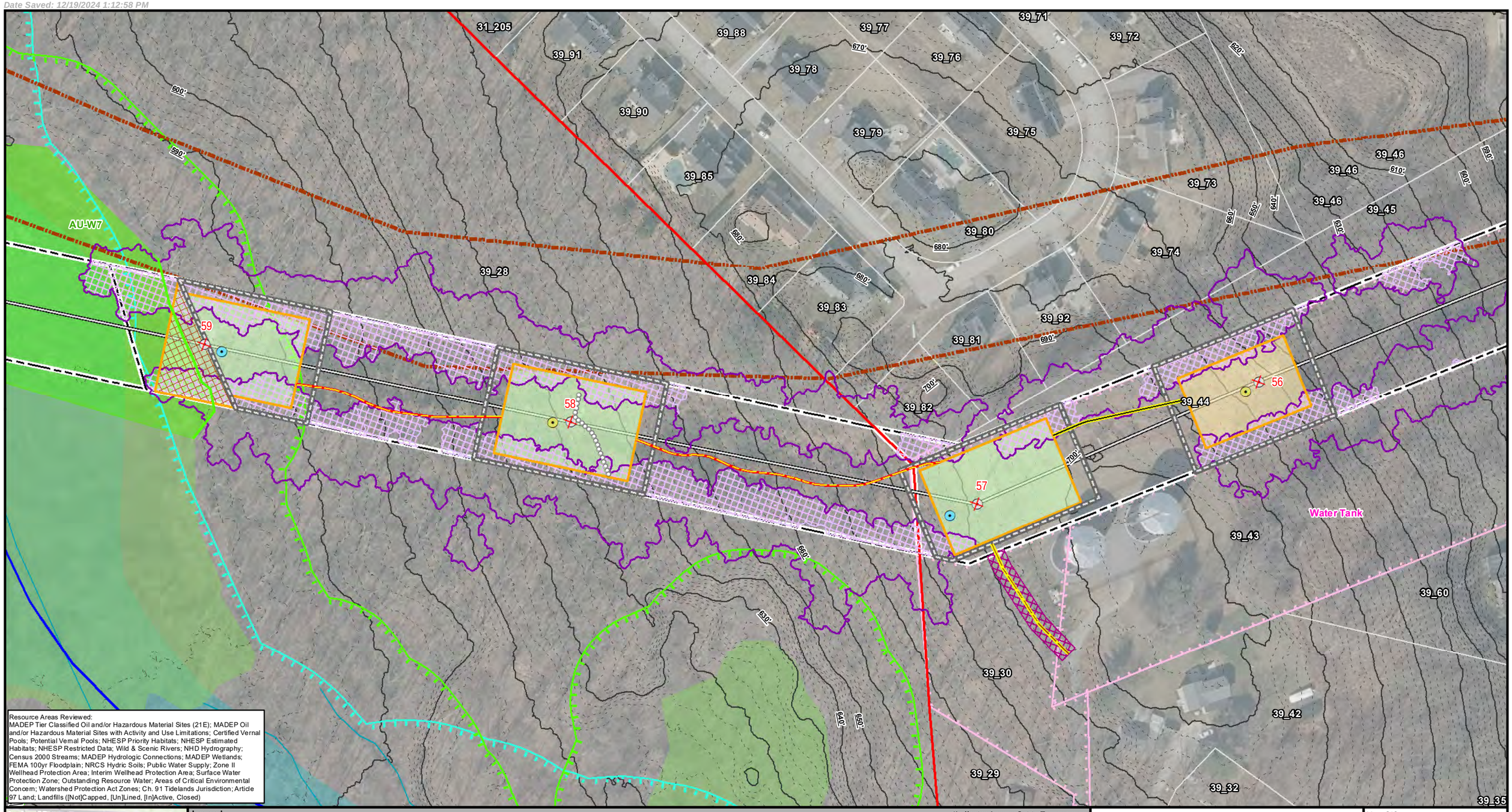

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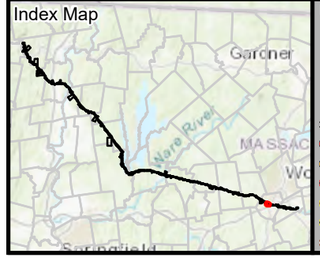

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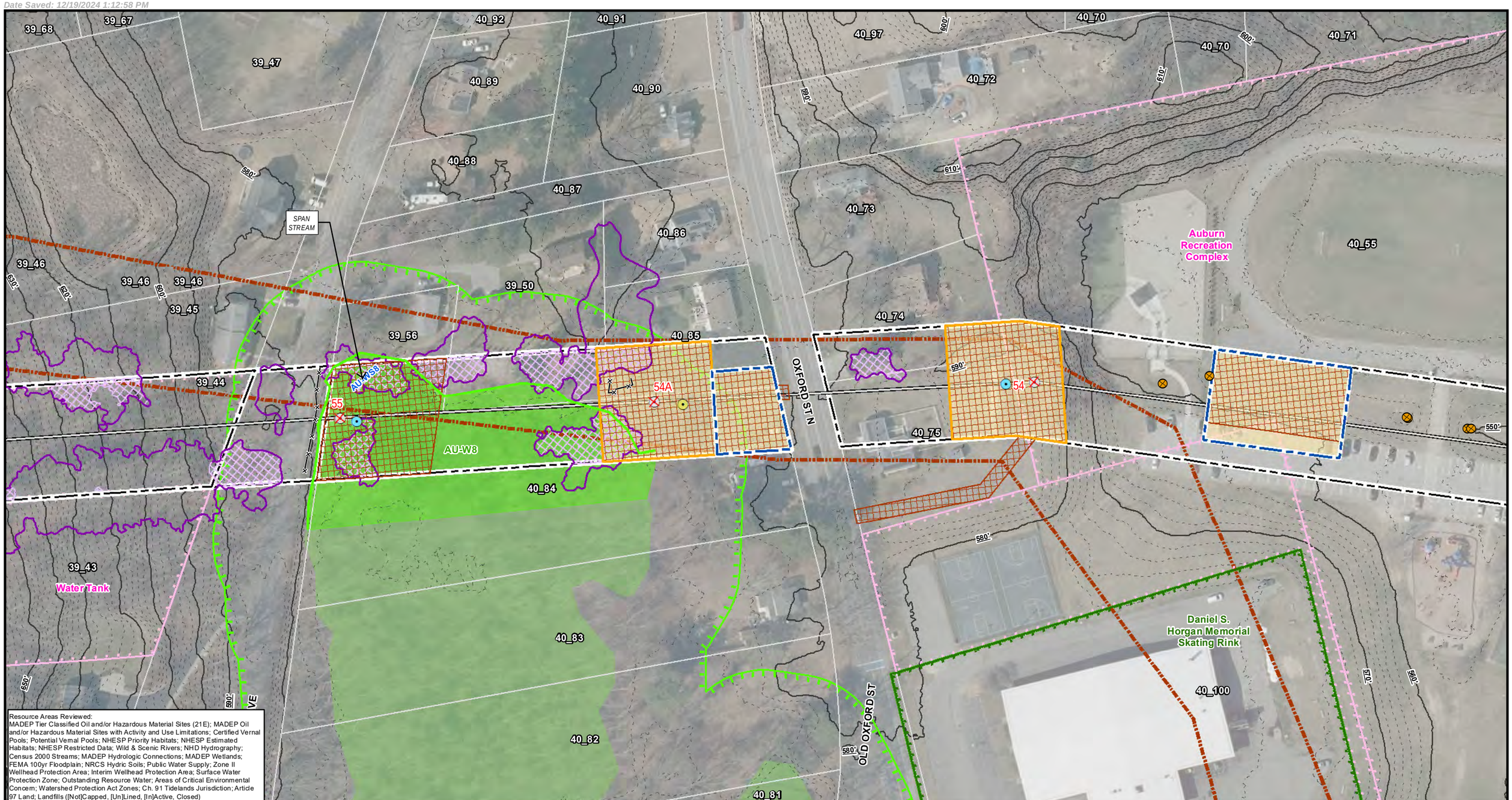

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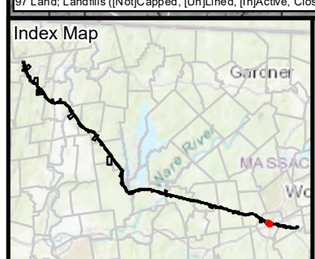

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Auburn Recreation Complex

BRAYMAN ST

SOUTHBRIDGE ST

I-290

I-90

Dark Brook

AU-S1

53

52

40_71 40_55 40_107 40_48 40_49 40_50 40_51 40_52 40_45 40_44 40_43 40_42 40_41 40_38 40_39 40_40 40_32 40_31

290 12 90

Resource Areas Reviewed:
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Gardner

Springfield

Legend

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Article 97 Lands

- DCR-State Parks & Recreation
- Municipal

N

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Auburn, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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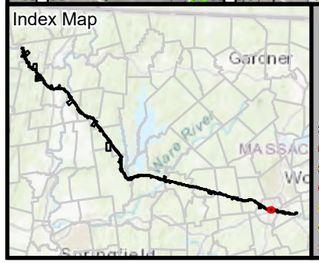

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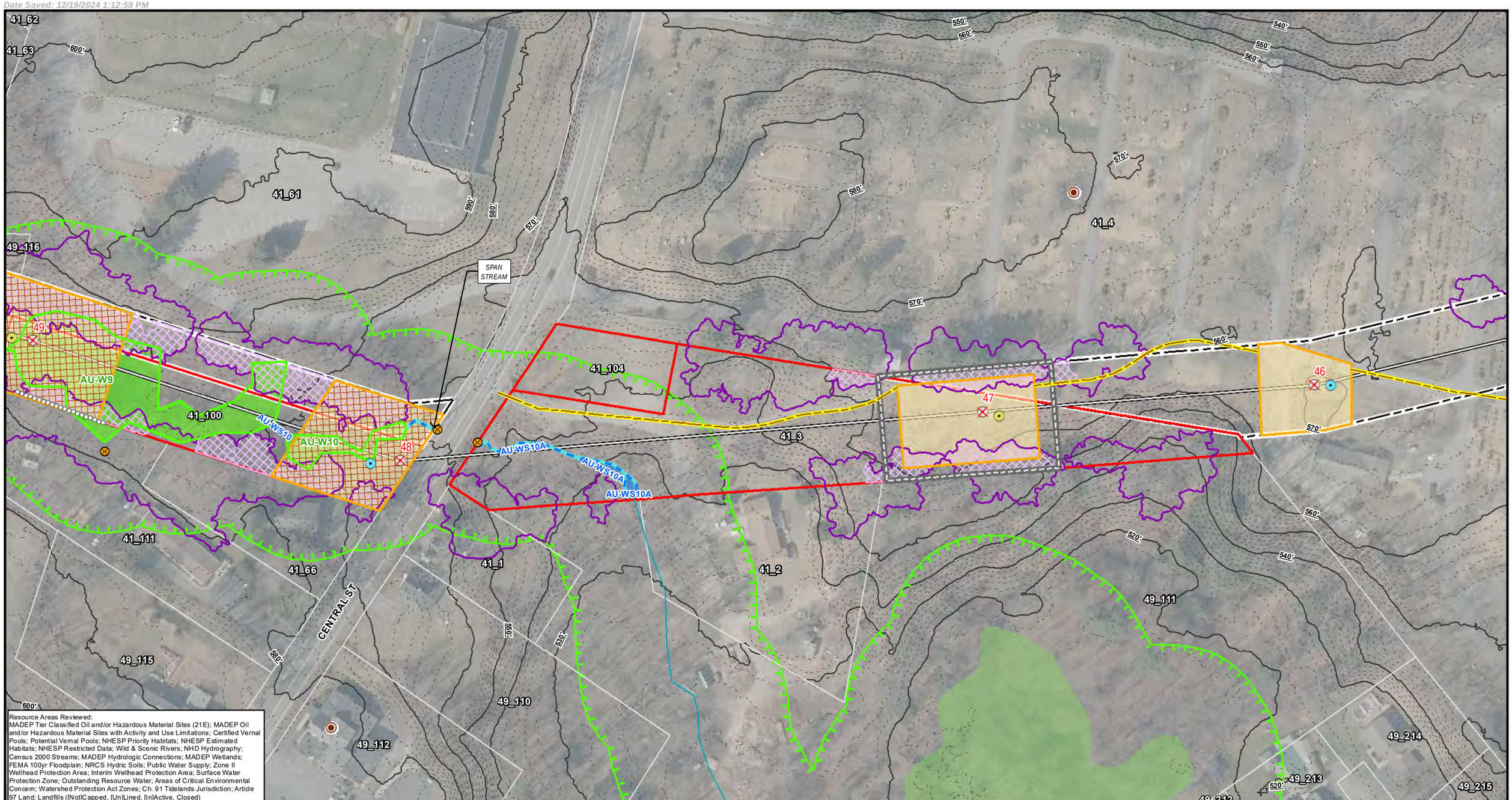

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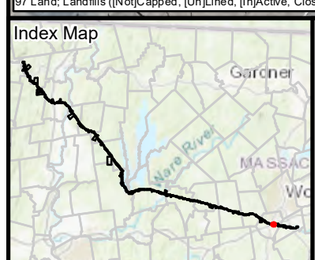

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Environmental Resources Map

Auburn, MA
Page 223 of 240

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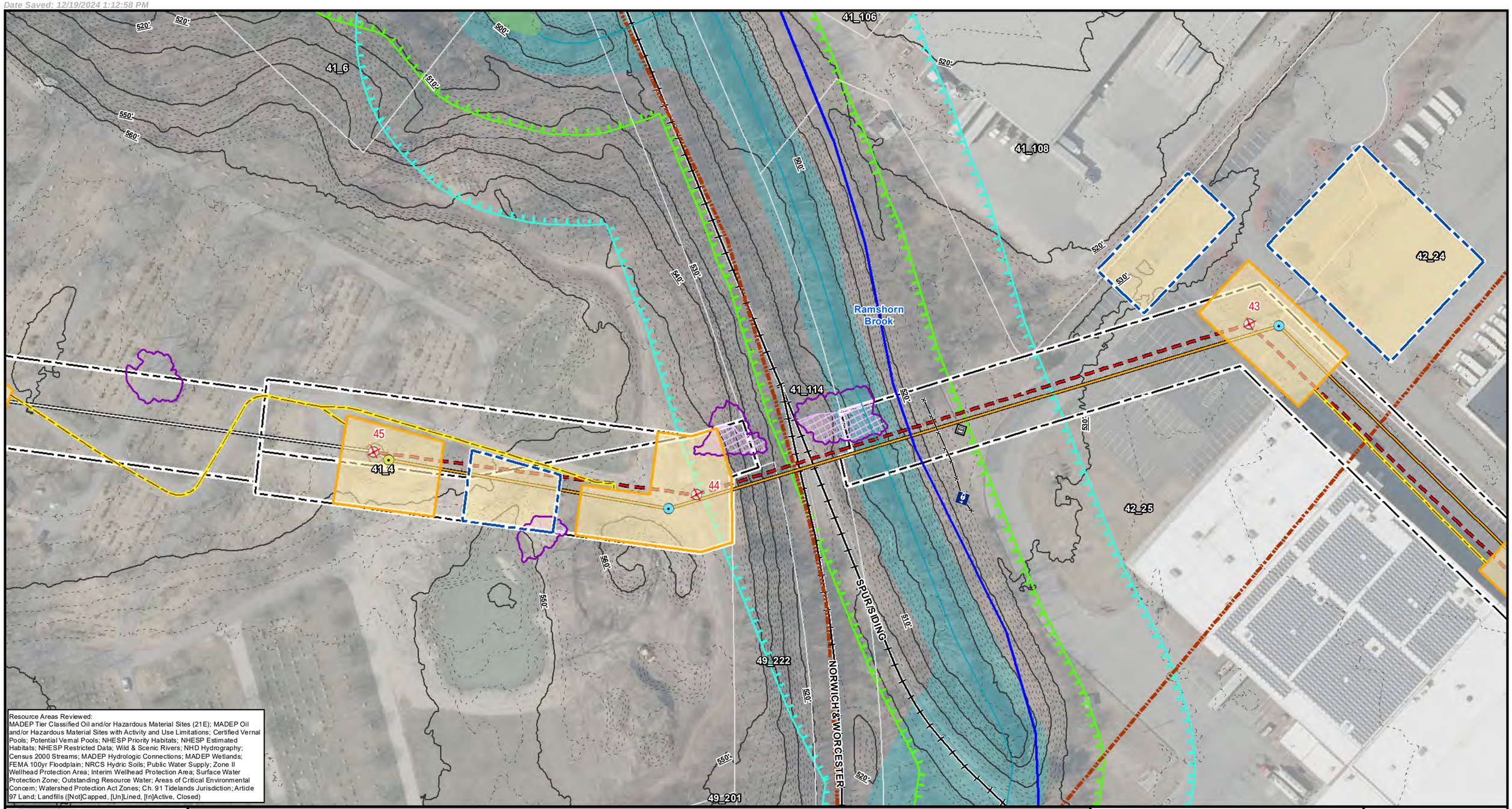

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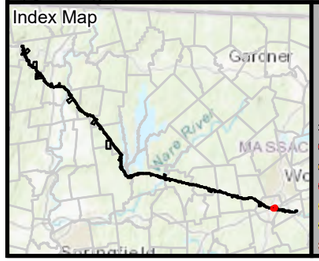

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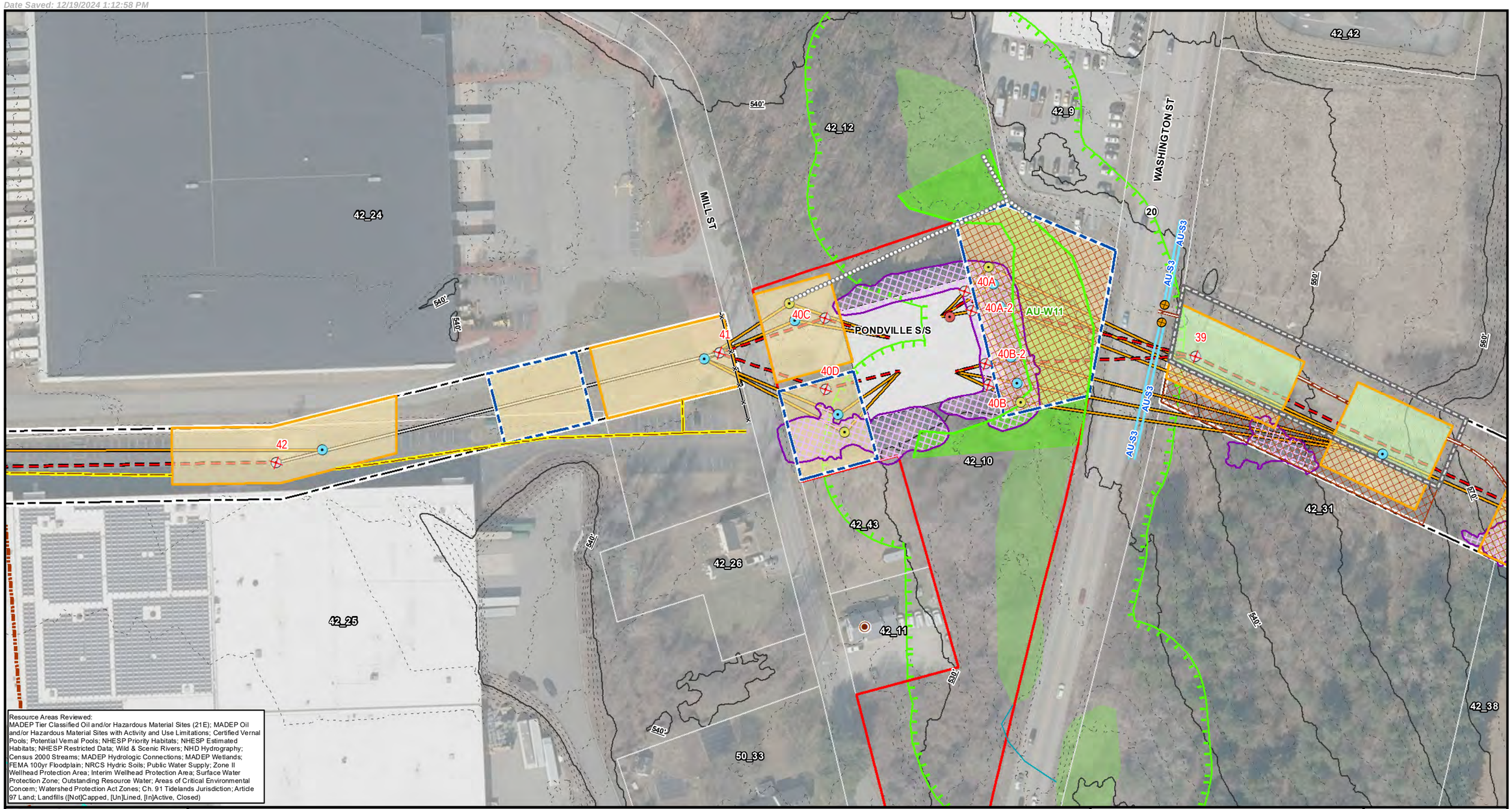

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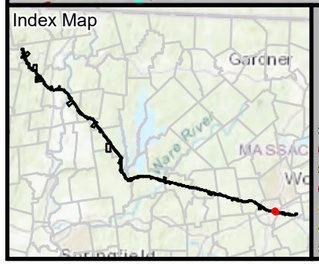

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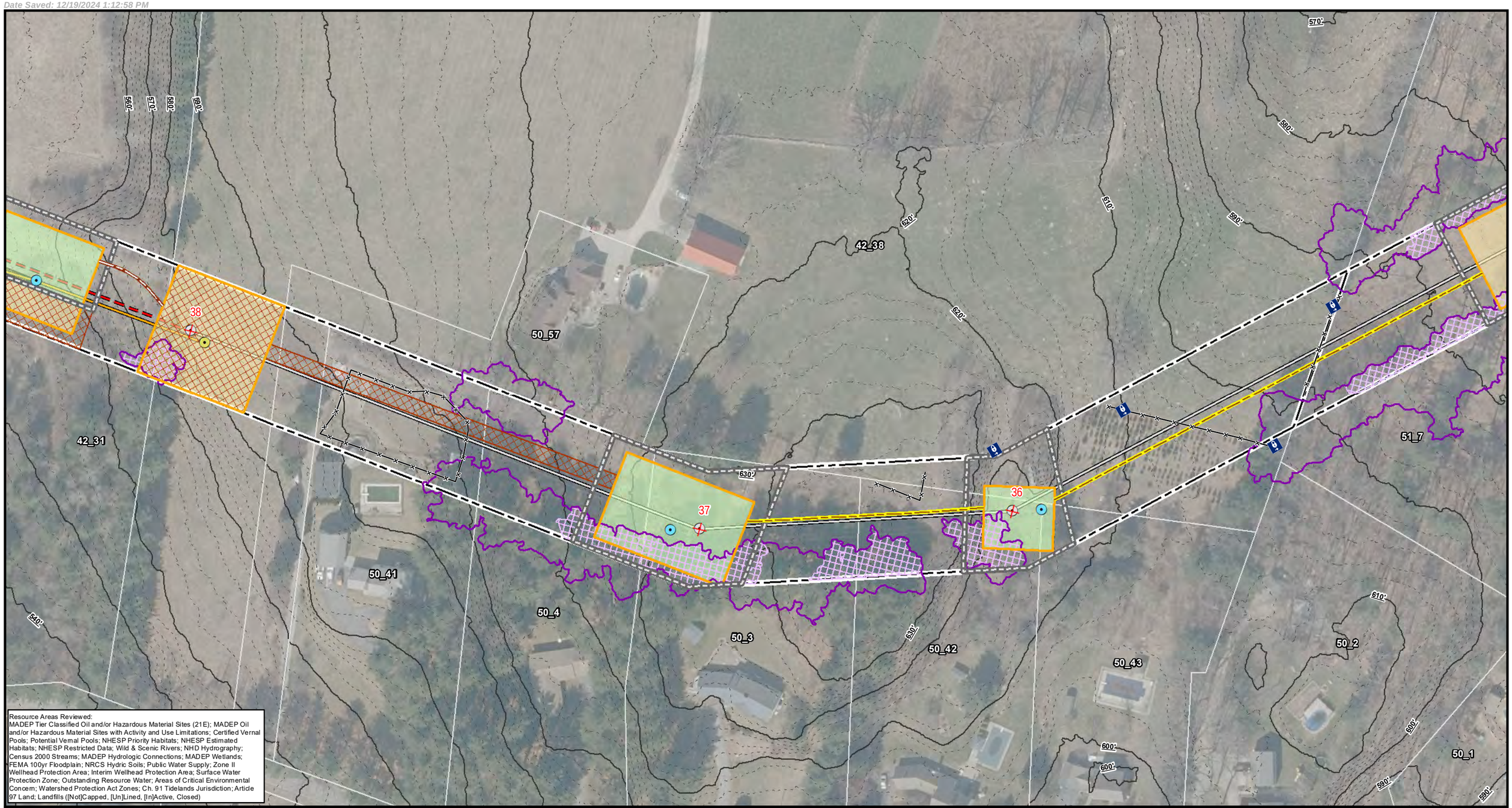

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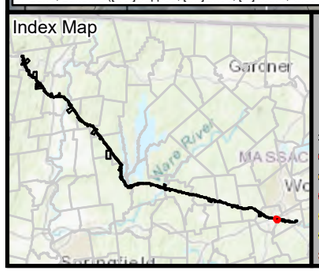

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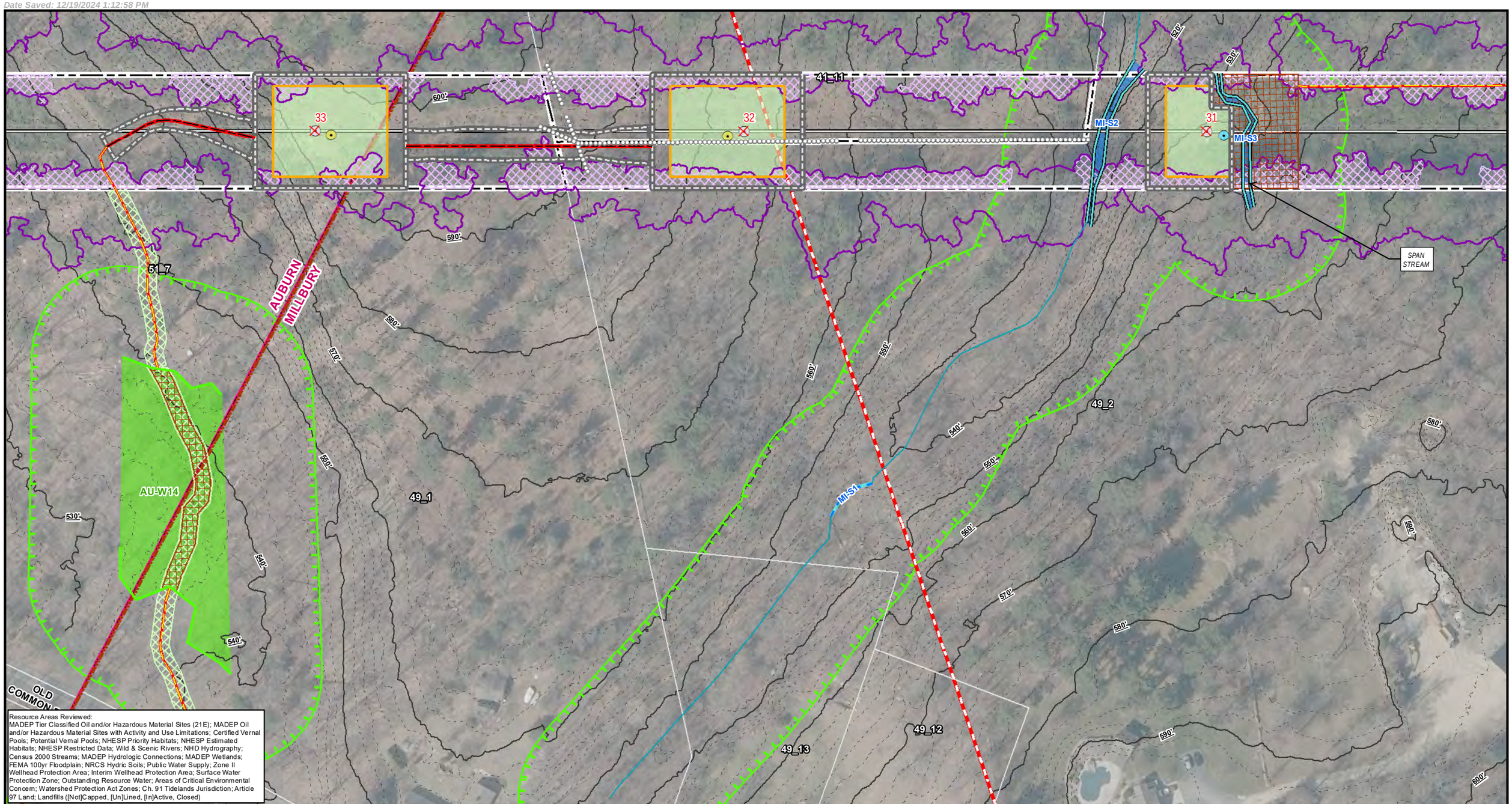

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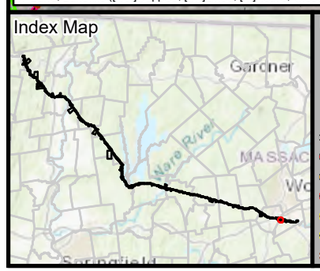
Index Map



Legend

*Indicates Layers Set to Transparency

- Existing Structure
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- Install Structure (Direct Embed)
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- Remove Structure
- Replace Overhead Line
- Remove Overhead Line
- Proposed Overhead Line
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- Type S Access
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- Work Envelope
- Temporary Work Area
- Pull Pad
- Specialized Equipment Required
- Edge of ROW
- National Grid Owned Property
- Field Delineated Wetland Lines
- Field Delineated Wetlands*
- Field Delineated Vernal Pool*
- Estimated Wetland
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- Catch Basin
- Access Gate
- Railroad
- Hiking Trails
- Approximate Pipeline
- 2ft Contour
- 10ft Contour
- Fenceline
- Guardrail
- Stonewall
- Existing Treeline
- Tree Removal
- Selective Tree Removal
- Pruning
- Town Boundary
- Parcel Boundaries

N

1 inch = 100 feet
0 50 100
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Auburn & Millbury, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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SPAN STREAM

SPAN STREAM

MI-WS1B

MI-W2

MI-WS2

MI-WS1

MI-W1

49_2

50_5

30

29

28

530'
540'
550'
560'
570'
580'
590'
600'
610'
620'
630'
640'
650'

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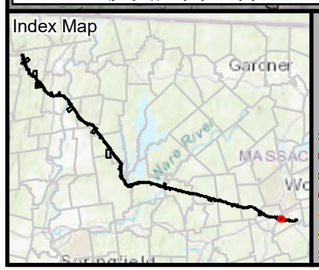

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Millbury, MA

MassGIS
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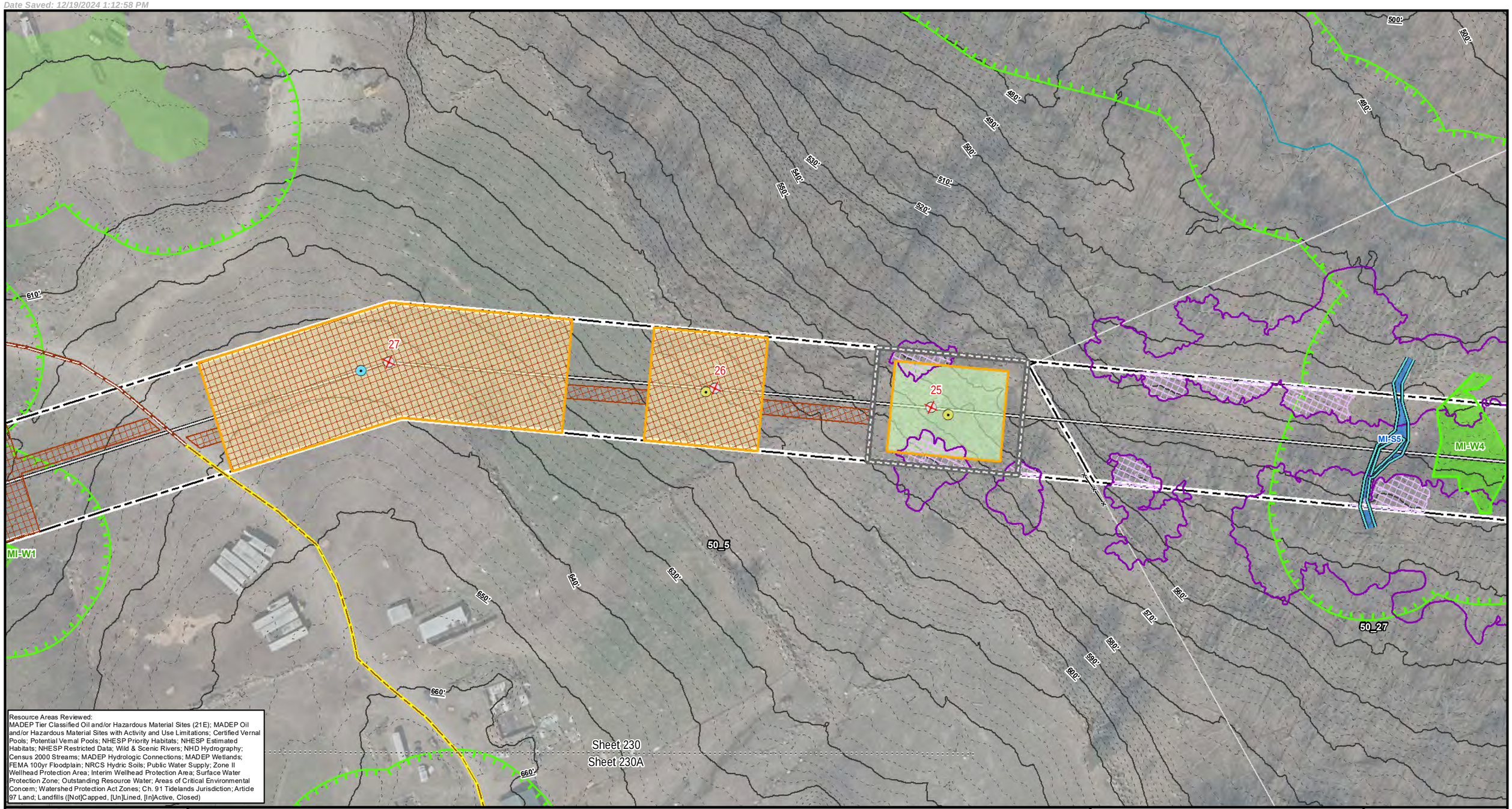

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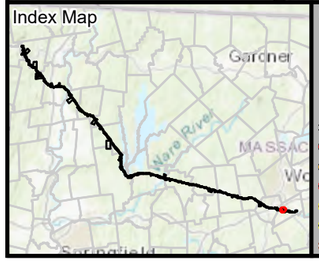

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Millbury, MA

MassGIS
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Article 97 Lands

- Municipal

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Millbury, MA

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DWINELL RD

SPAN STREAM

50_5

51_3

51_57

50_7

50_8

Sheet 231
Sheet 231A

51_60

51_59

MI-S5

MI-W4

MI-W5

MI-W6

MI-WS5

MI-WS5A

MI-WS6

22

23

24

610'
600'
590'
580'
570'
560'
550'
540'
530'
520'
510'
500'
490'

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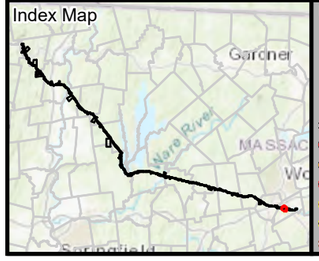

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Millbury, MA

MassGIS
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Sheet 231
Sheet 231A

DWINELL RD
AUBURN RD

MI-W7
MI-W8

Stowe Meadows Conservation Area

50_7
50_8
50_20
50_21
50_22
50_23
50_26
51_51
51_52
51_57
51_58
51_59
51_60
51_61
59_13
60_54
60_55
60_56
60_58
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60_61
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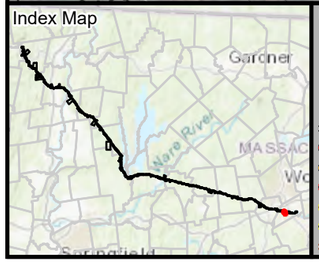

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Millbury, MA
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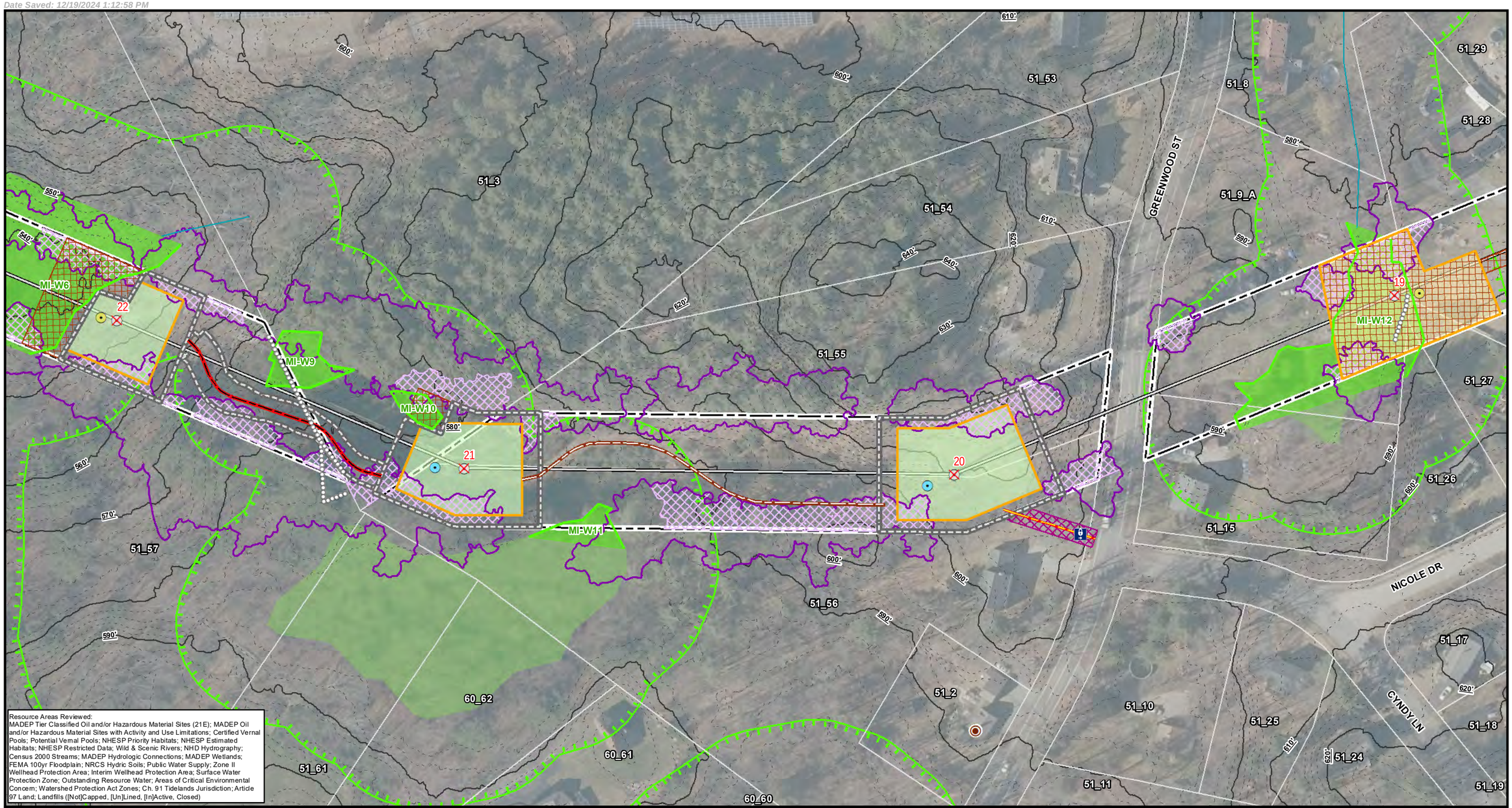

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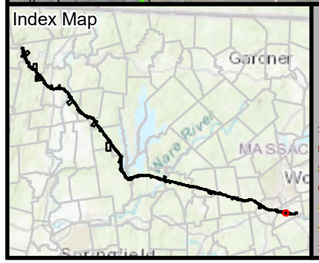

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Millbury, MA

MassGIS
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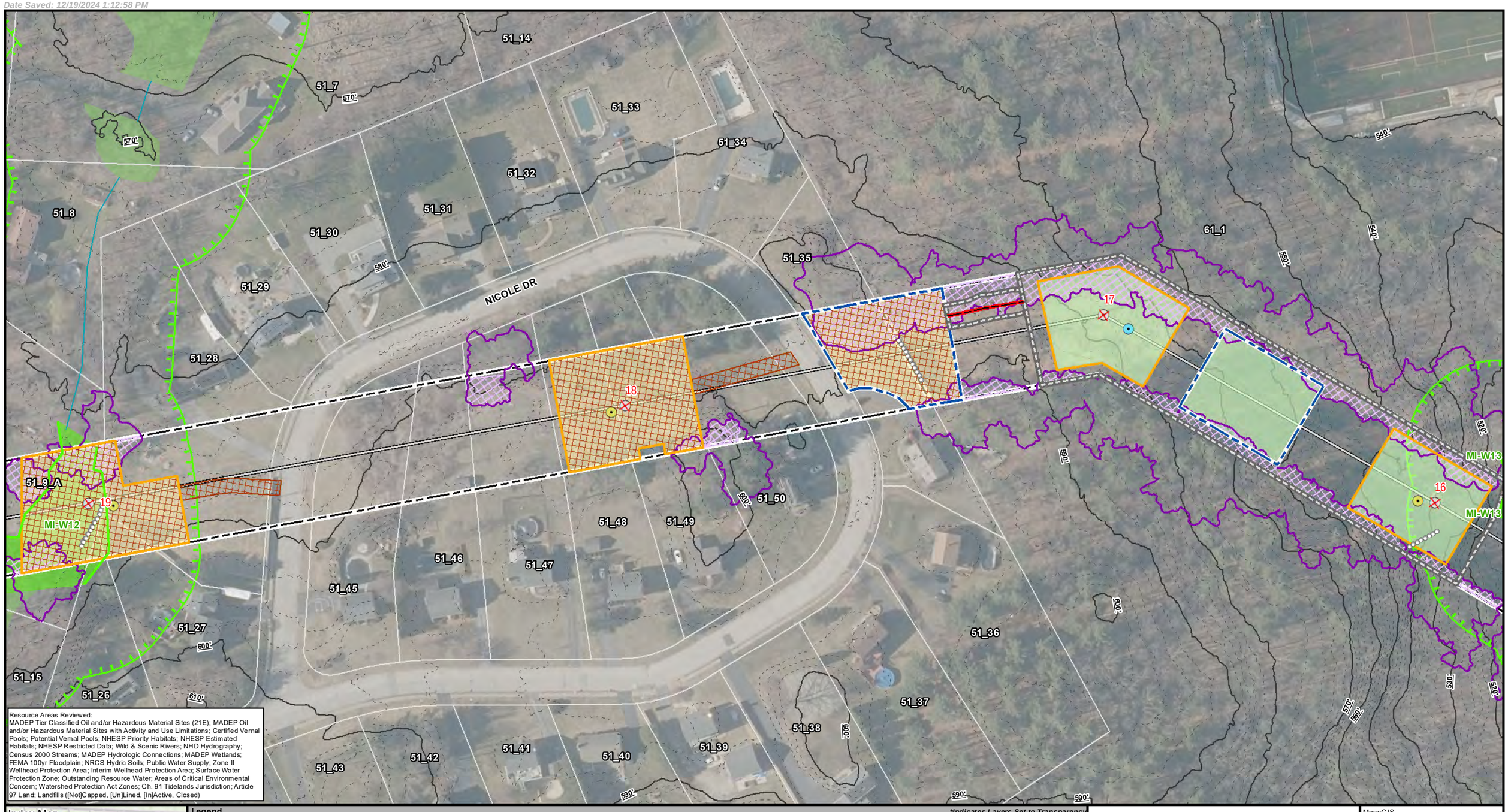

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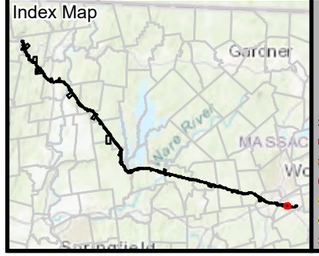

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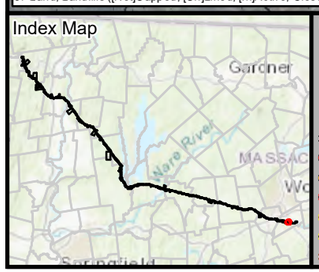

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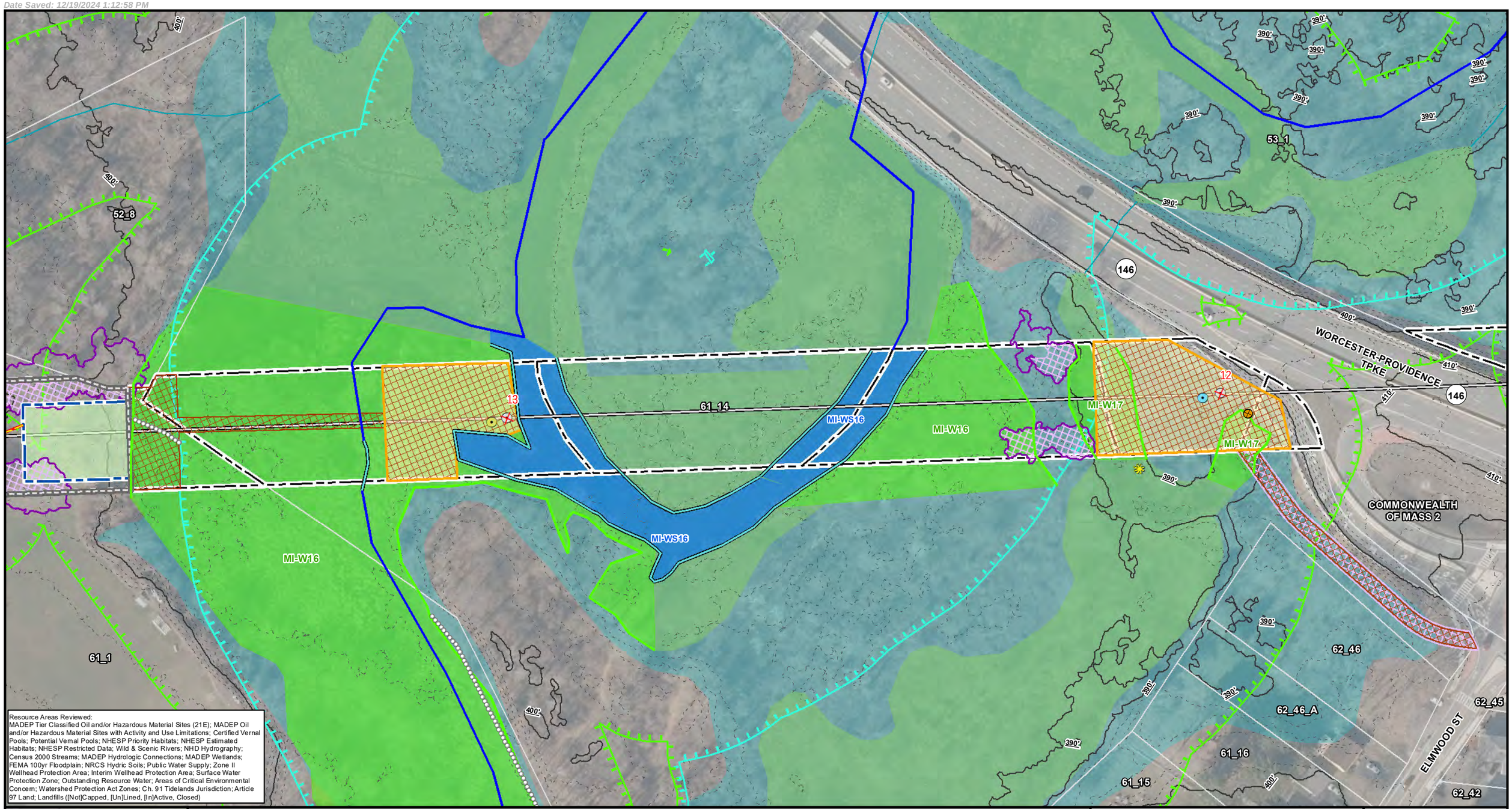

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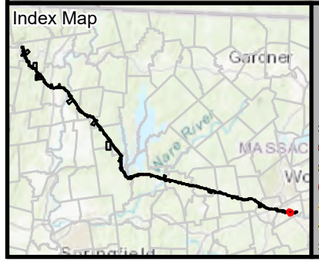

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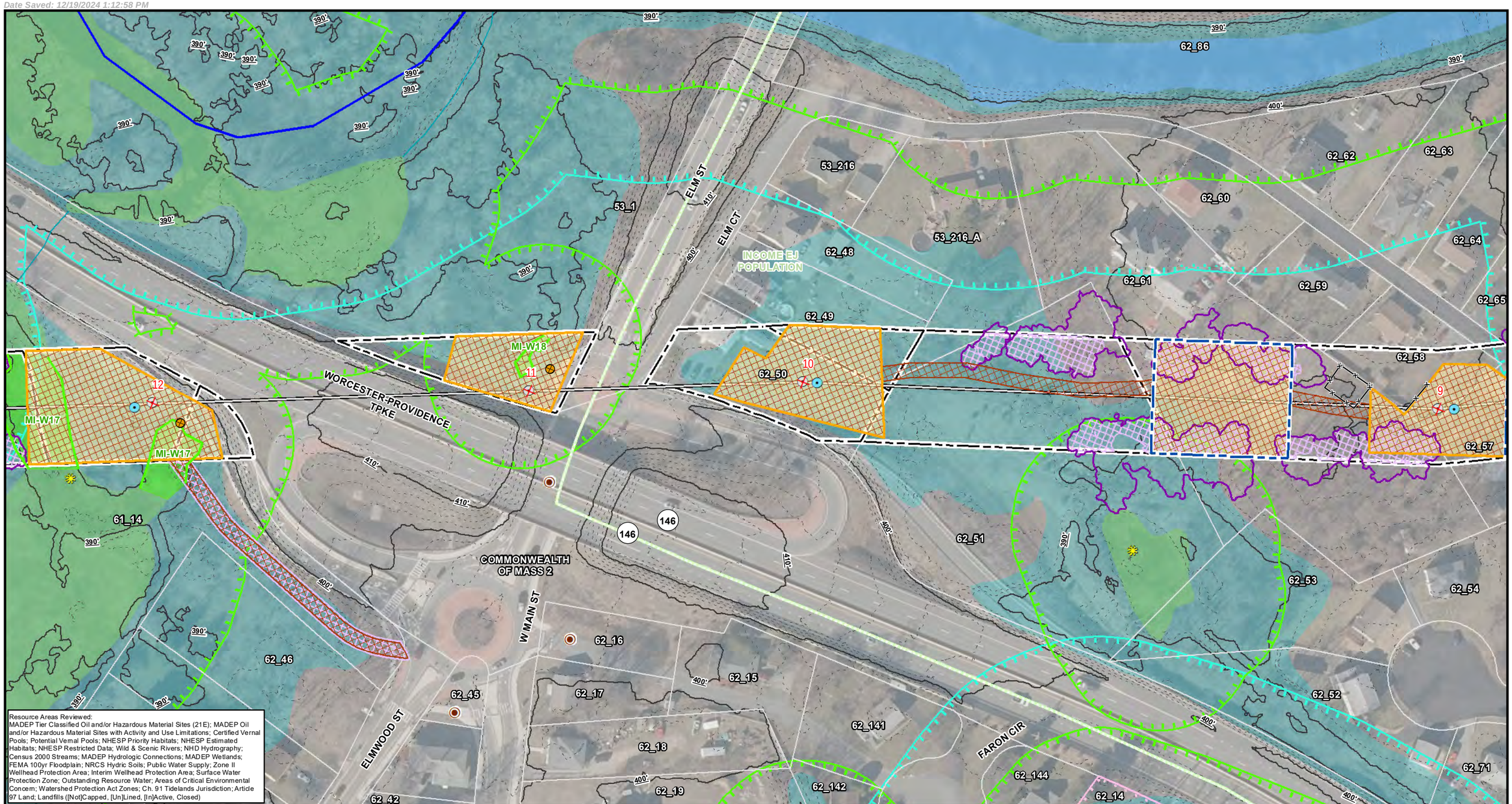

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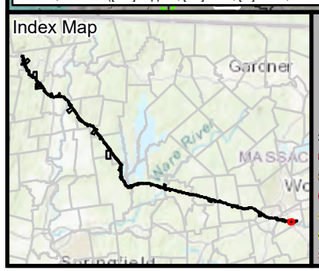

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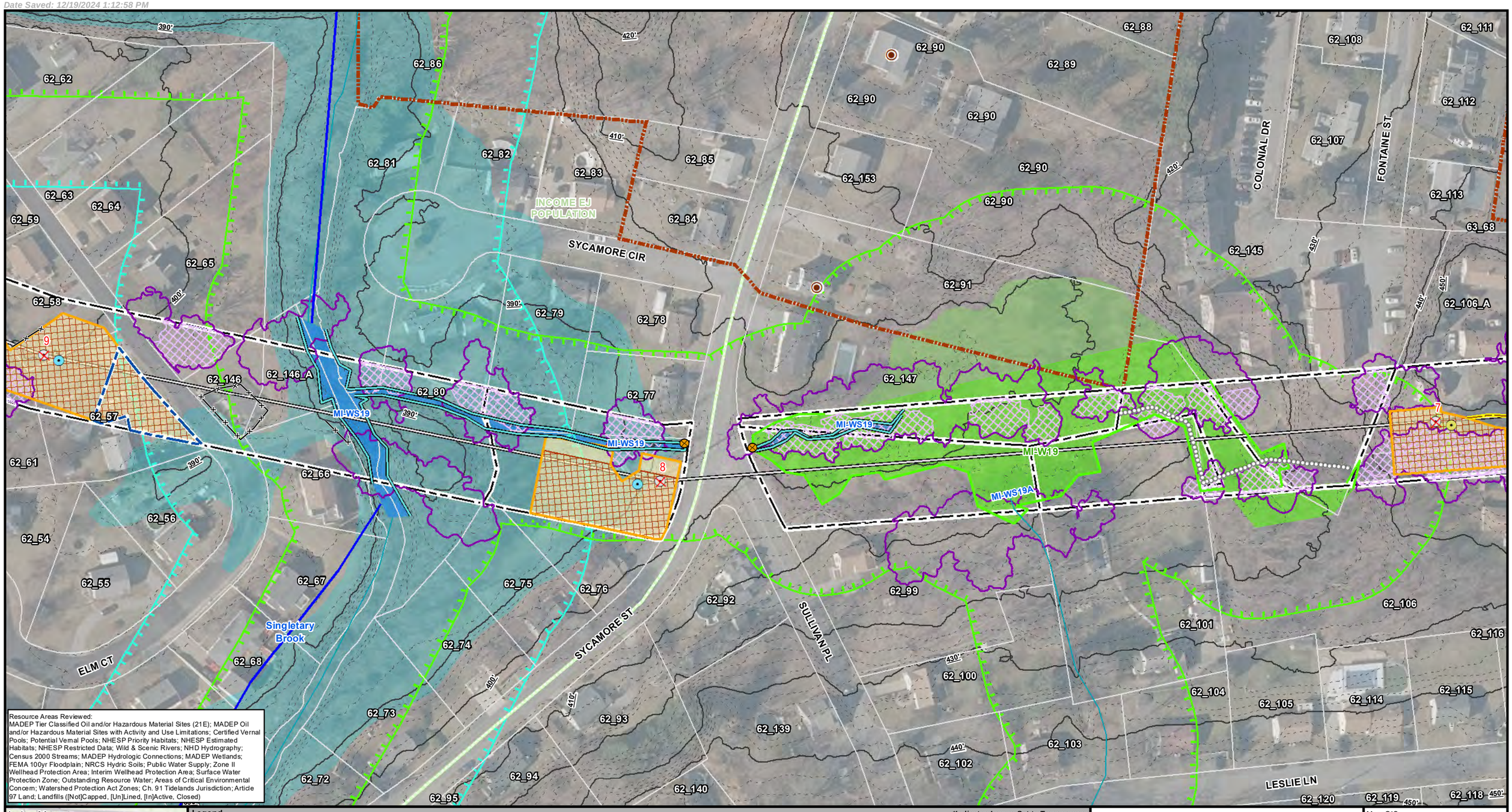

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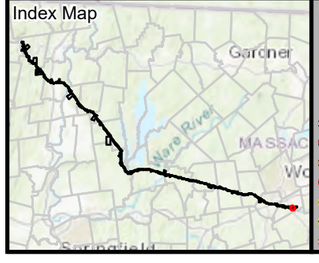

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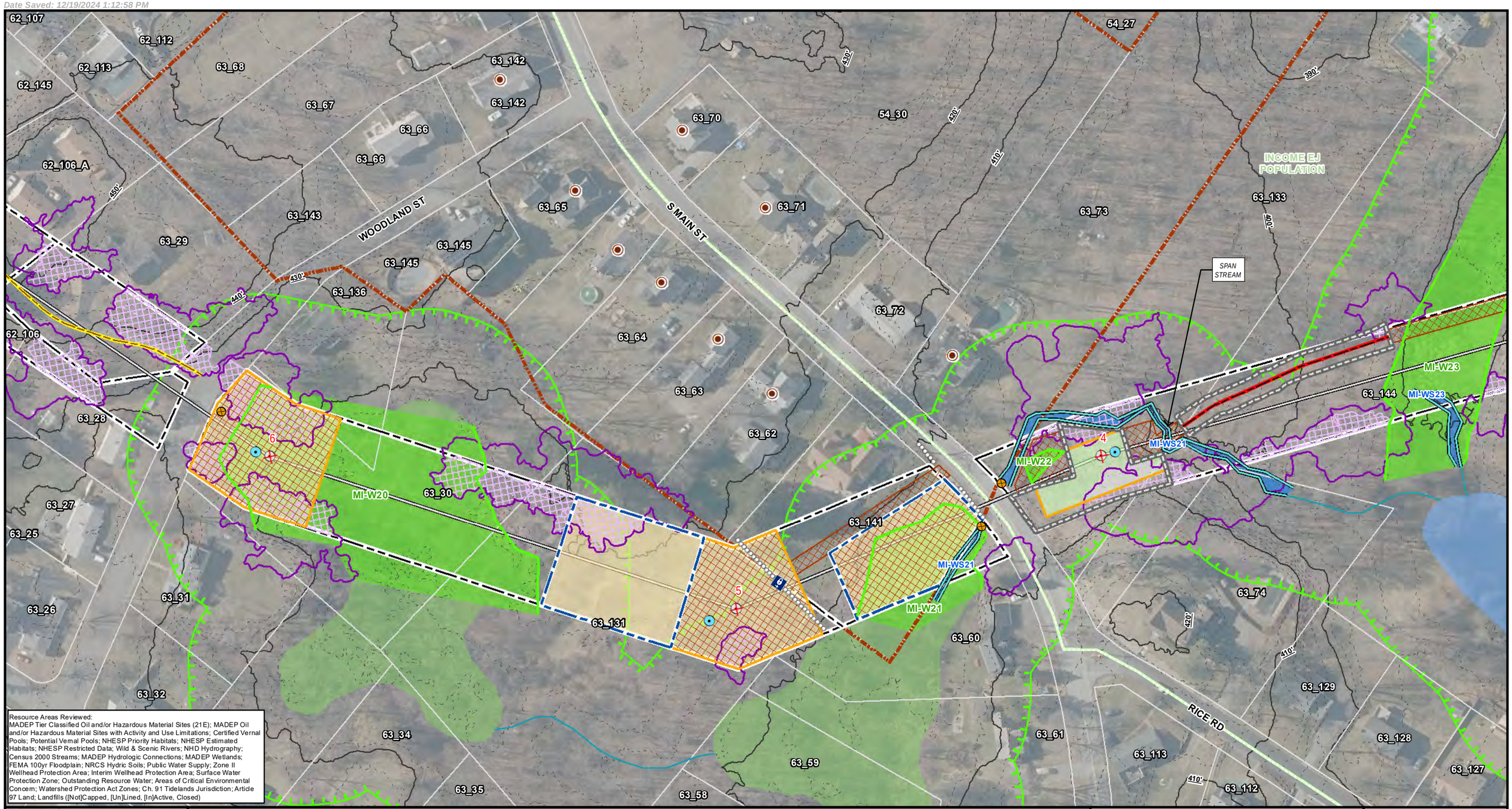

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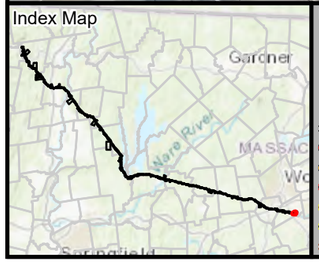

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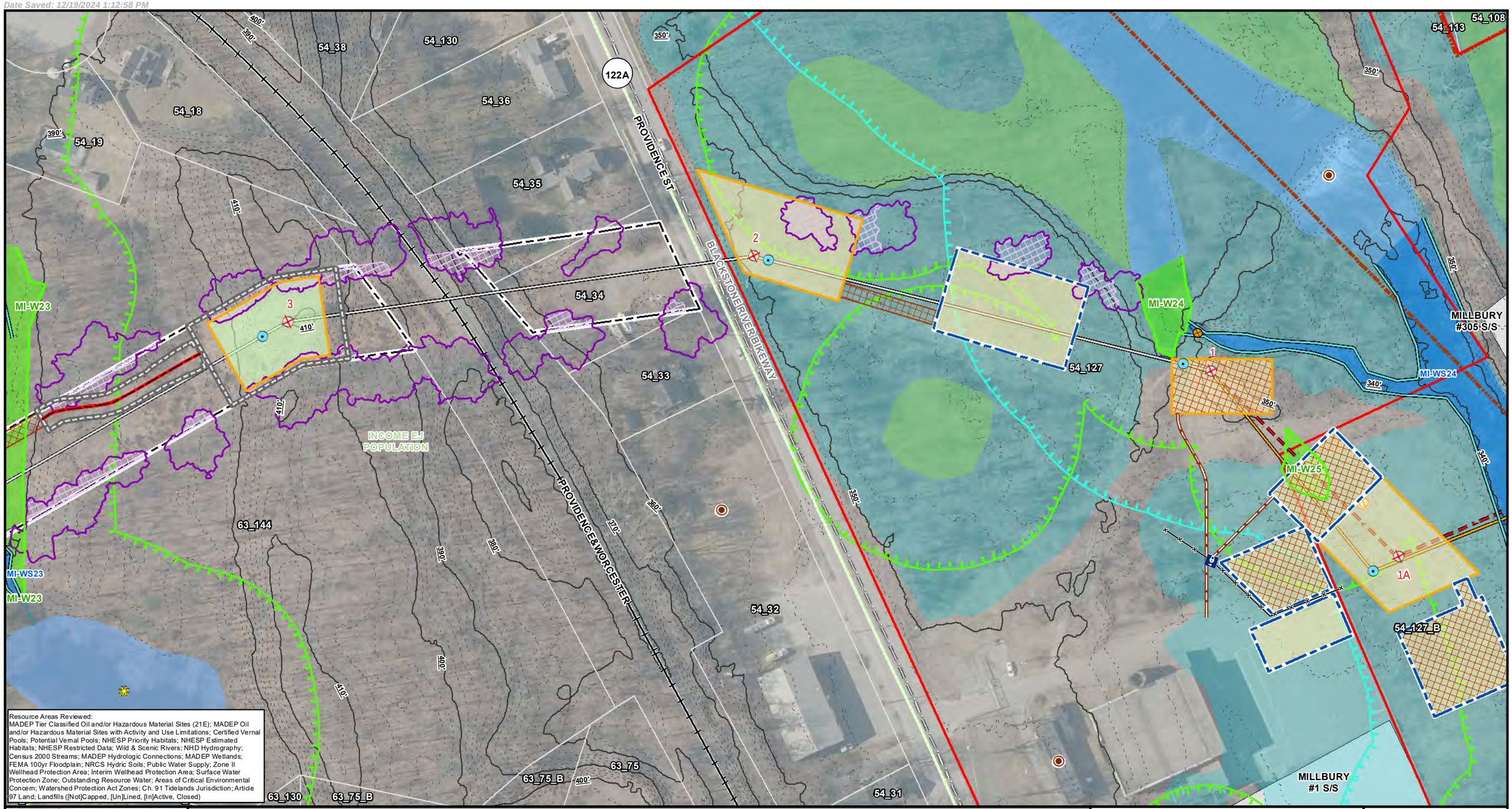

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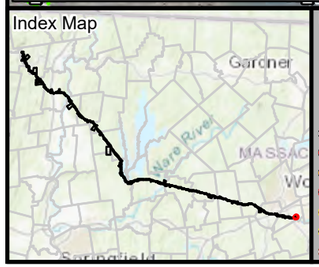

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- Estimated Wetland
- Field Delineated Stream Centerline
- Field Delineated Inland Bank
- Field Delineated Ditch / Swale
- Estimated Inland Bank
- Estimated Stream Centerline
- Field Delineated Stream Area*
- Approximate Water Line
- Perennial Stream
- Coldwater Fisheries Resources
- MADEP Hydrologic Connections
- MADEP Wetlands*
- MADEP Open Water*
- 100ft Buffer to Wetlands and Streams
- 200ft Riverfront Area
- FEMA 100yr Floodplain*
- Outstanding Resource Water
- NHESP Priority & Estimated Habitats
- Watershed Protection Act Primary Zone
- Watershed Protection Act Secondary Zone
- Certified Vernal Pools
- Potential Vernal Pools
- Public Water Supply
- MADEP 21E Site
- MADEP AUL Site
- MHC Historic Point
- MHC Historic Area
- DCR Owned Property
- Culvert
- Catch Basin
- Access Gate
- Railroad
- Hiking Trails
- Approximate Pipeline
- 2ft Contour
- 10ft Contour
- Fenceline
- Guardrail
- Stonewall
- Existing Treeline
- Tree Removal
- Selective Tree Removal
- Pruning

*Indicates Layers Set to Transparency

- Town Boundary
- Parcel Boundaries

Environmental Justice Populations 2020

- Income

N

1 inch = 100 feet

0 50 100

Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Environmental Resources Map

Millbury, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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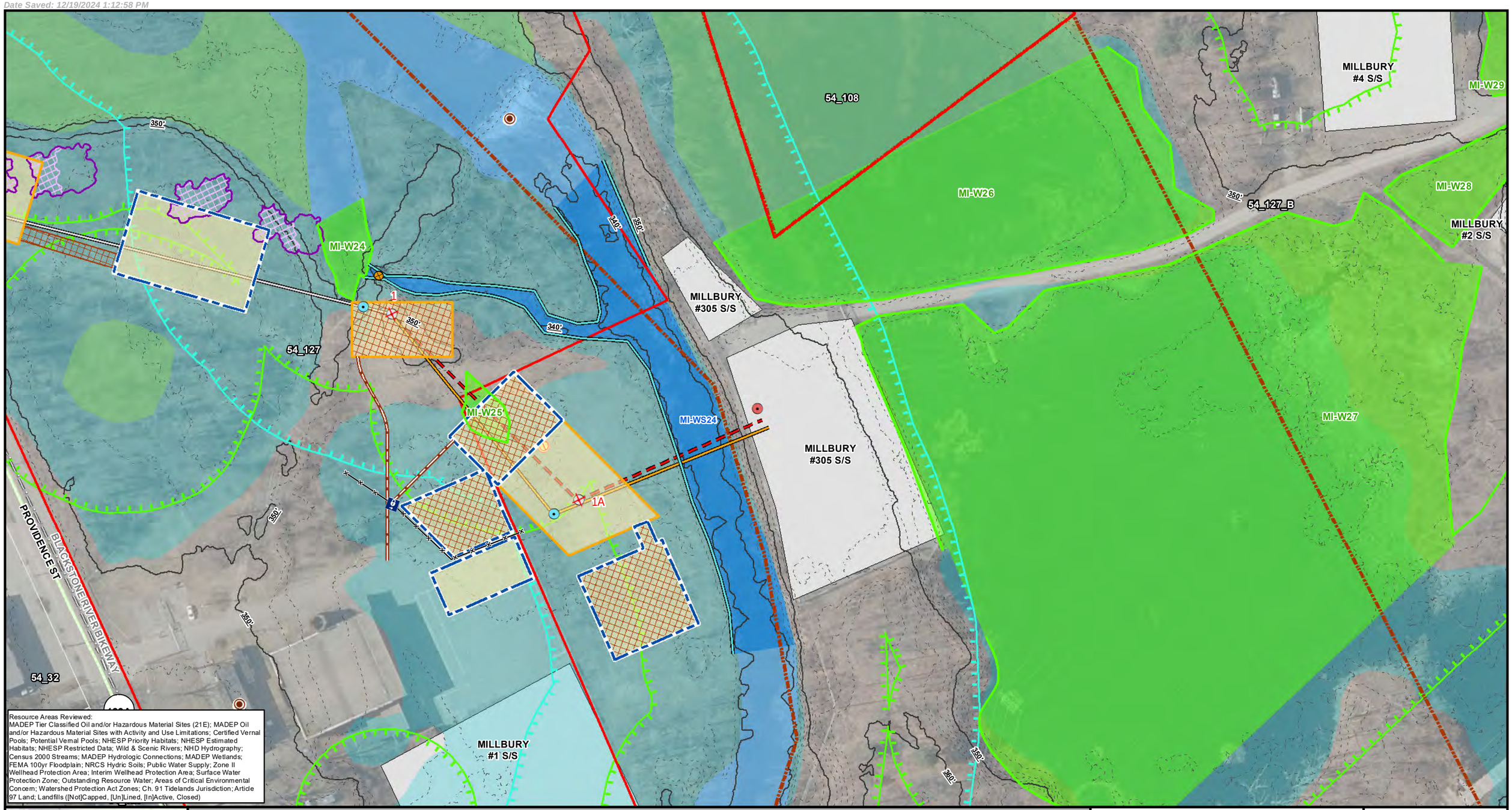

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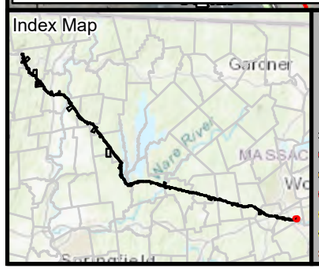

Legend

- Existing Structure
- Install Structure (Concrete Caisson)
- Install Structure (Direct Embed)
- Install Structure (Foundation TBD)
- Remove Structure
- Replace Overhead Line
- Remove Overhead Line
- Proposed Overhead Line
- Engineered Type 1-5 Access
- No Modifications Access
- Temporary Access
- Type R Access
- Type S Access
- Limit of Disturbance
- Construction Matting
- Work Envelope
- Temporary Work Area
- Pull Pad
- Specialized Equipment Required
- Edge of ROW
- National Grid Owned Property
- Field Delineated Wetland Lines
- Field Delineated Wetlands*
- Field Delineated Vernal Pool*
- Estimated Wetland
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Environmental Resources Map

Millbury, MA

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Appendix A – Figures and Plans
Figure 3 – Water Supply Protection Areas

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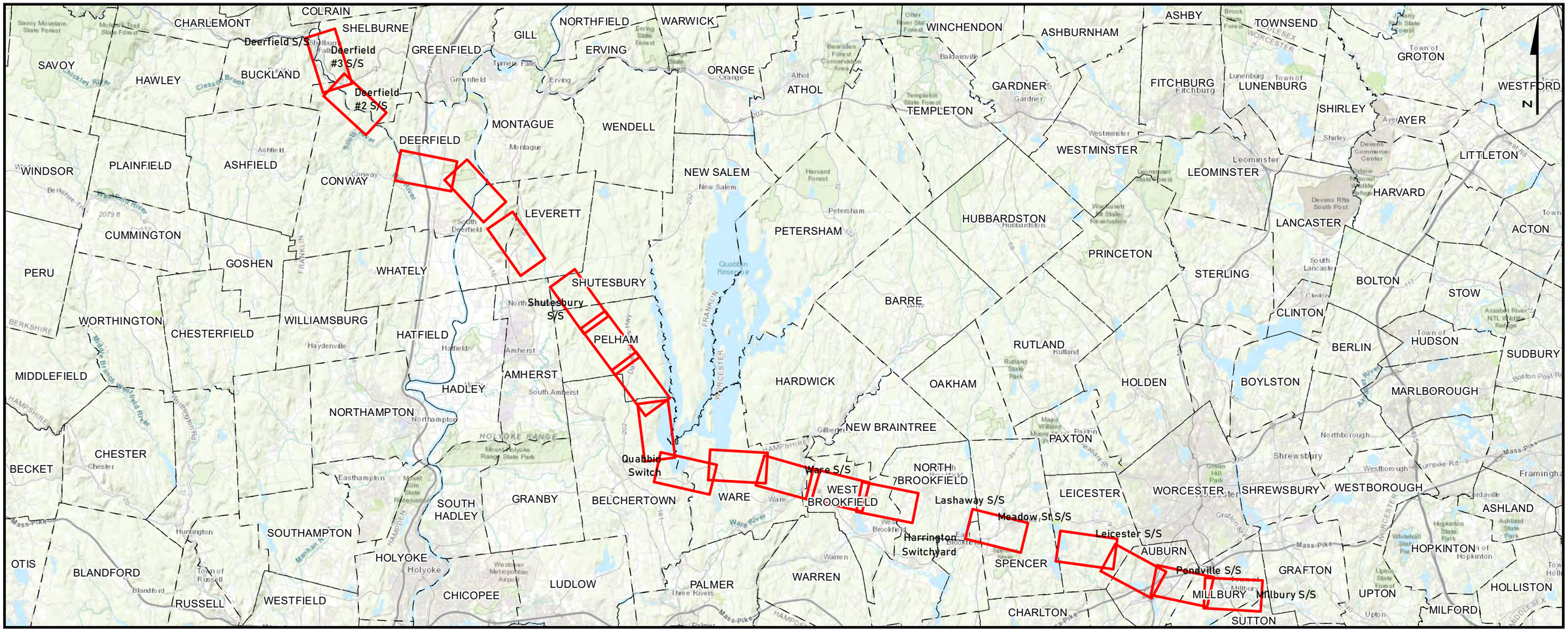
BSC Project Number: 100181.00

Central to Western Massachusetts Energy Improvement Project

Shelburne, Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn & Millbury, MA
Water Supply Protection Areas
December 13, 2024



INDEX OF FIGURES

T1 - TITLE SHEET
1 - 19 - MAP SHEETS

PREPARED FOR:

nationalgrid

170 Data Drive
Waltham, MA 02451

PREPARED BY:

BSC GROUP

1 Mercantile Street Suite 601
Worcester, MA 01608

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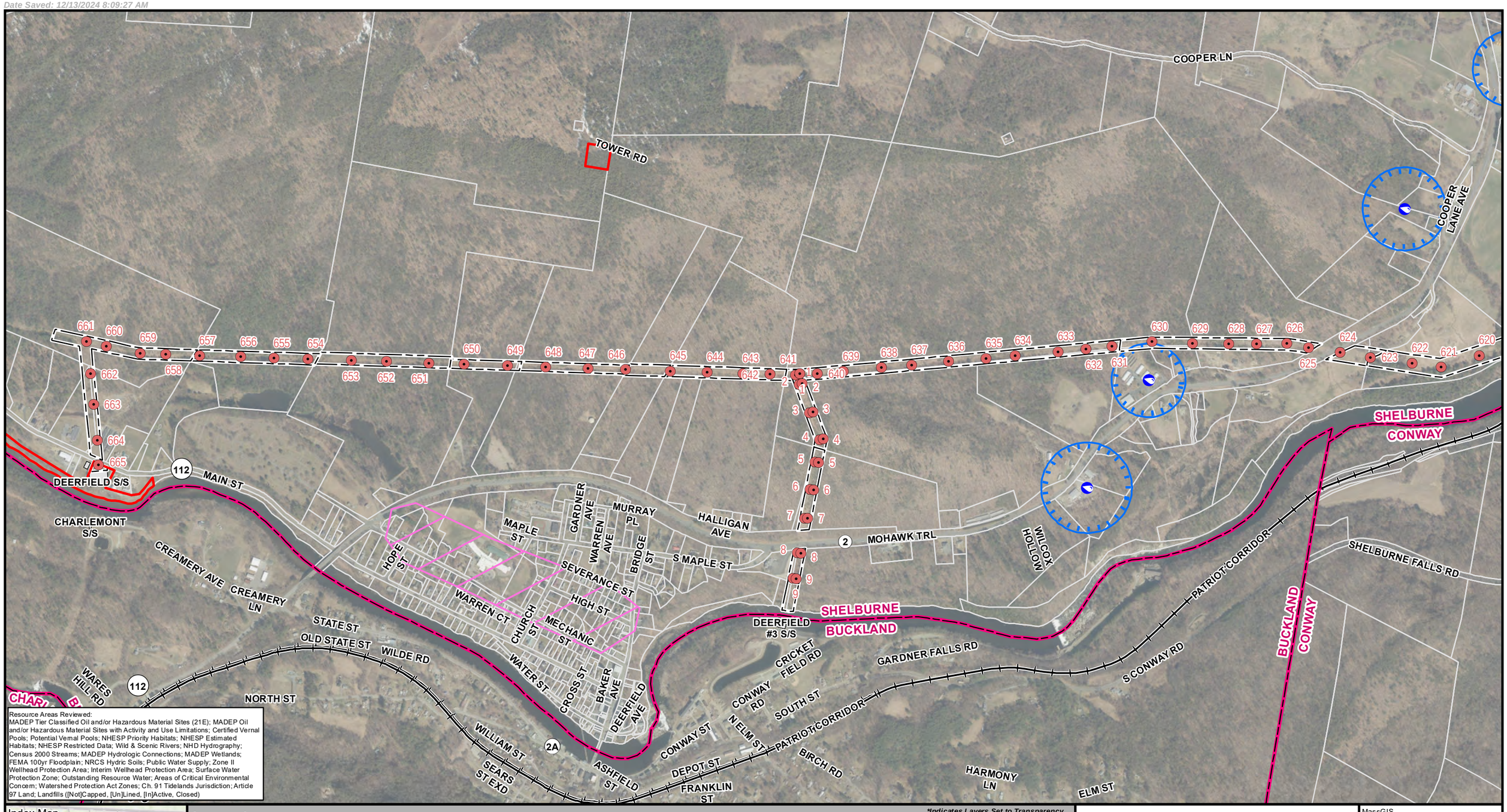
NOT CONSTRUCTION



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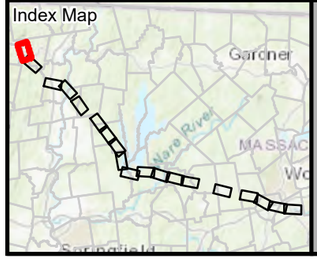

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Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Water Supply Protection Areas

Shelburne, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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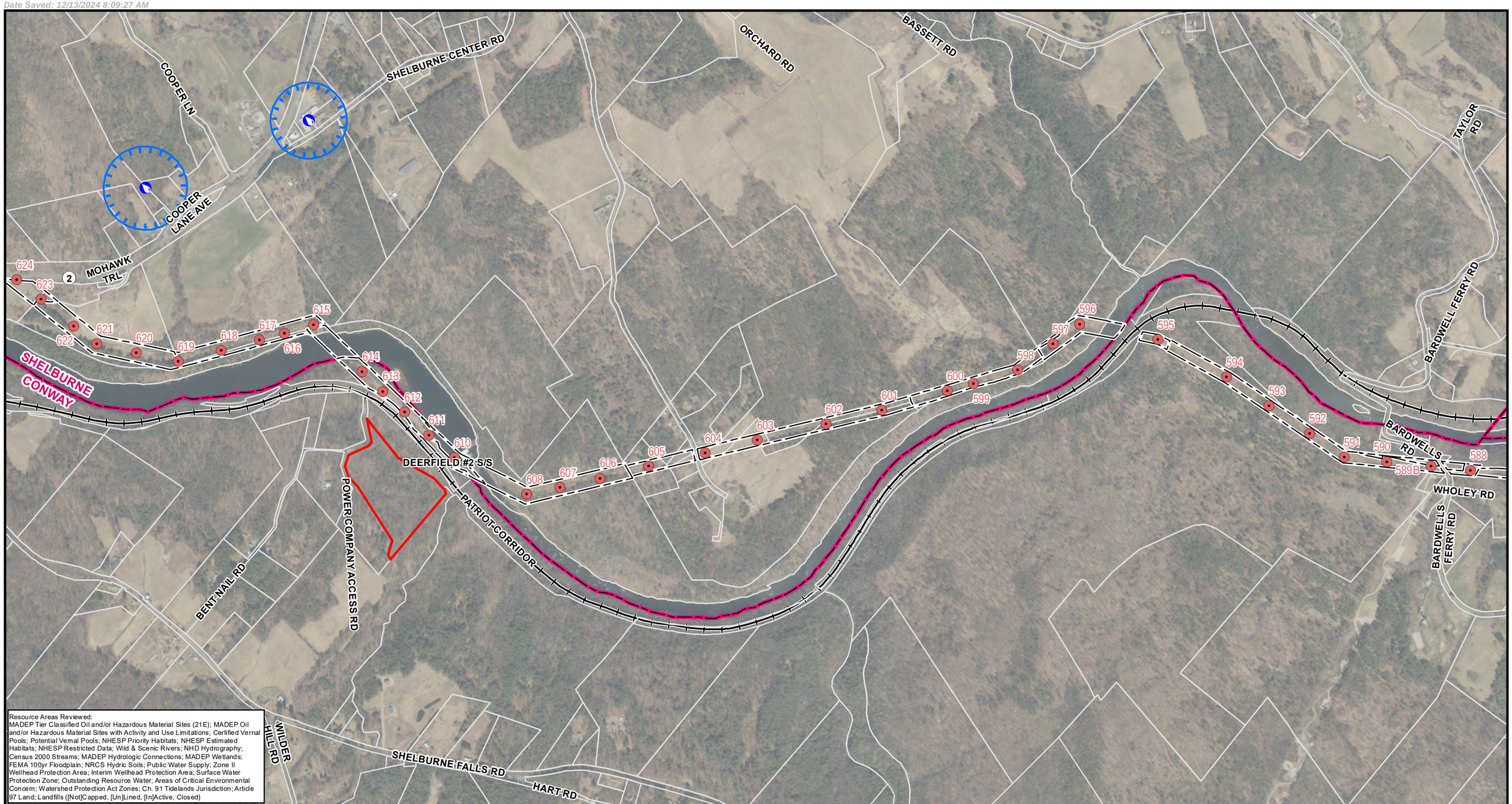

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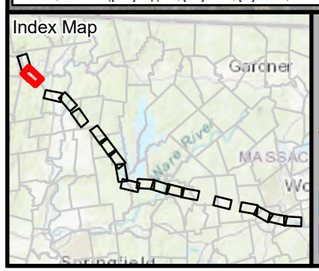

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Shelburne & Conway, MA

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PATRIOT CORRIDOR
UPPER RD
LOWER RD
STILLWATER RD
HOOSAC RD
I-91
WELLS CROSS RD
CHILDS CROSS RD
STEAM MILL RD
HIKING TRL
GREENFIELD RD
CONN RIVER MAIN LINE
MEADOW OAK LN
TYLER WAY
DUNCAN DR
SANDGULLY RD
ALLEN DR
LEE RD
ADAMS CT
HERITAGE WAY
MILL VILLAGE RD
CLARK CROSS RD
BOYNTON RD
N HILLSIDE RD

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Water Supply Protection Areas

Deerfield, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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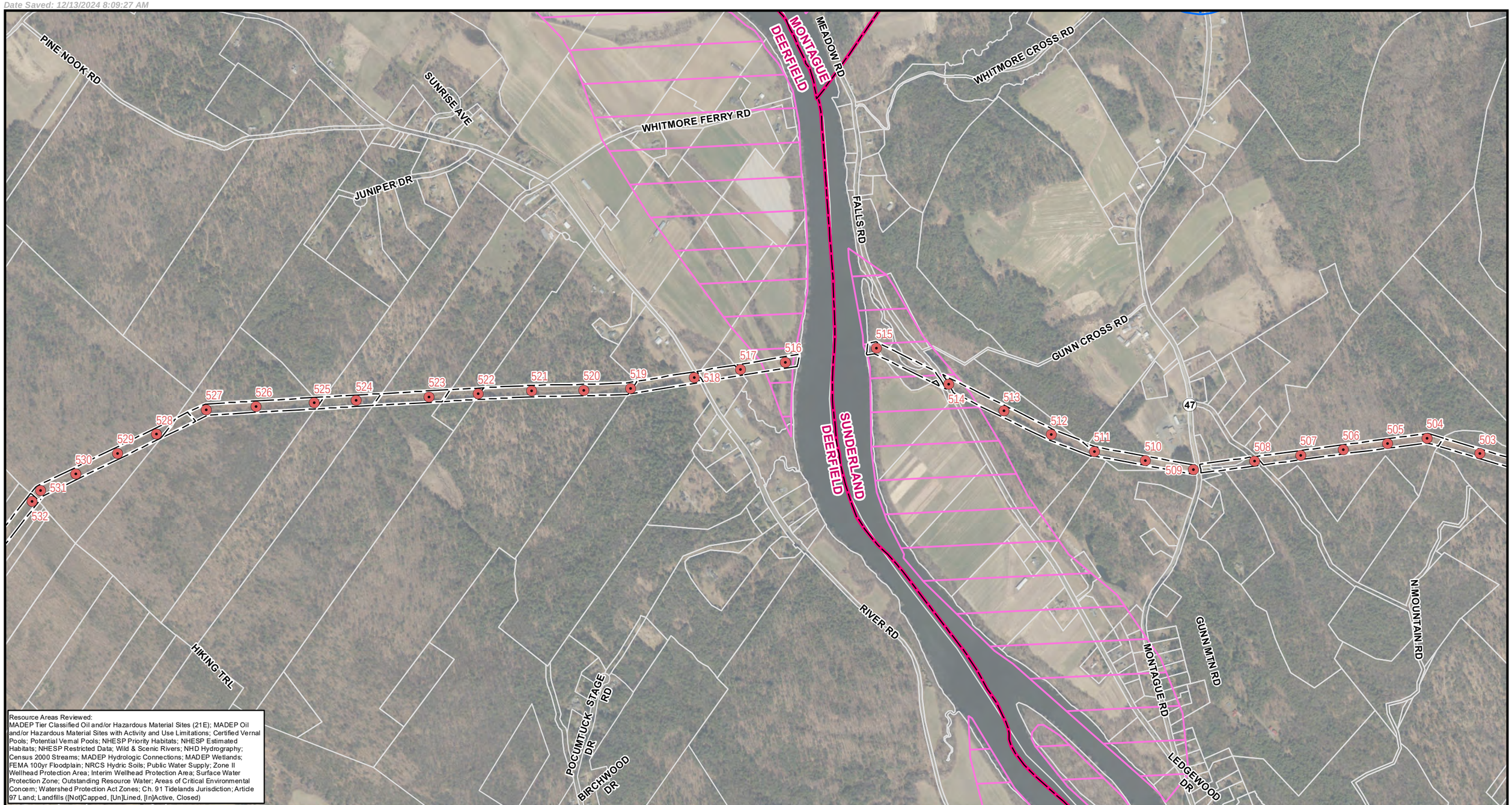

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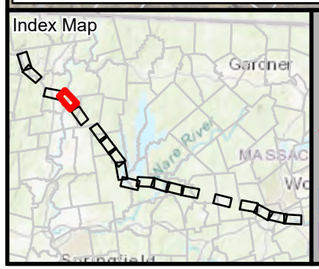

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Water Supply Protection Areas

Deerfield & Sunderland, MA

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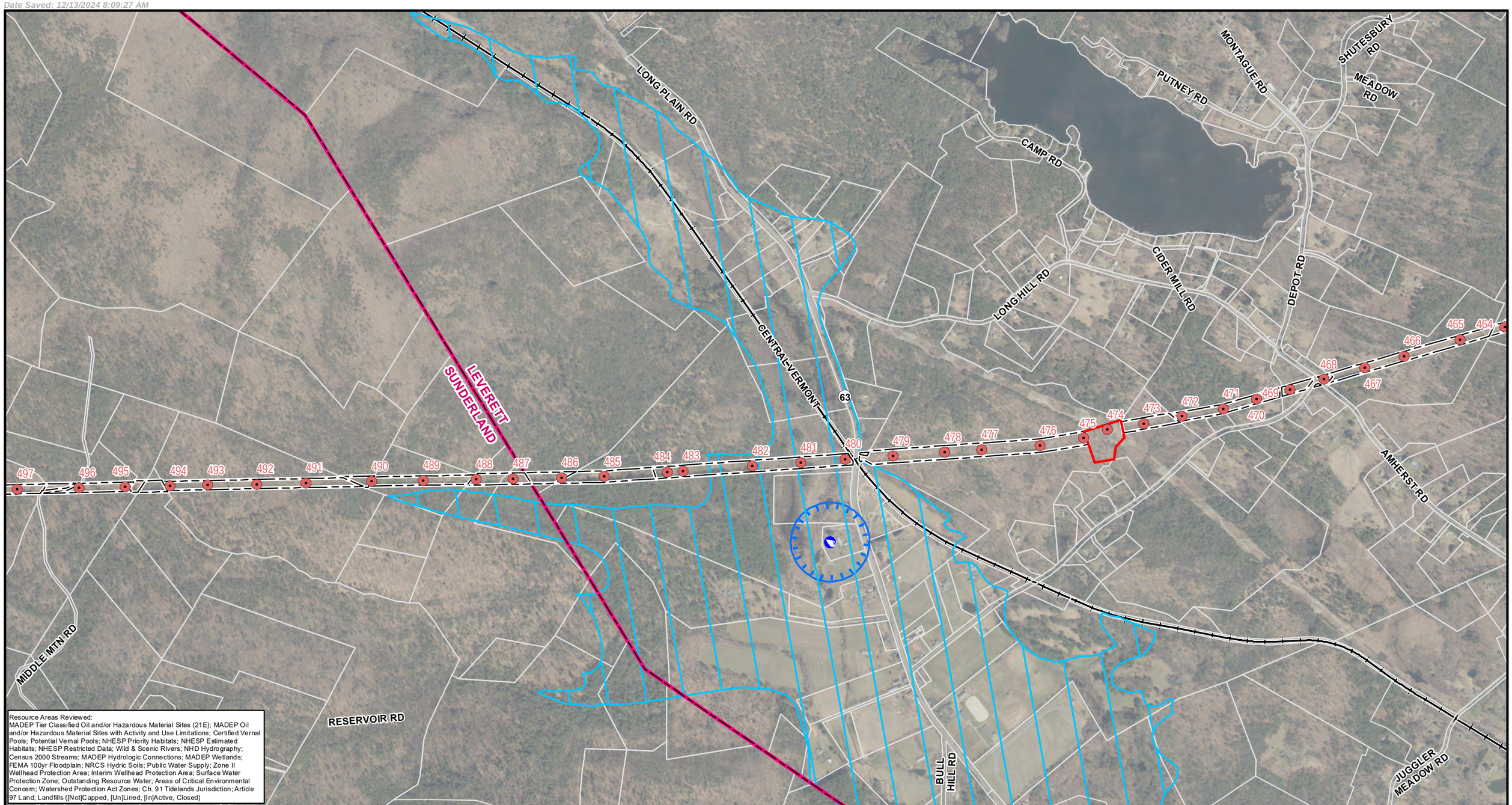

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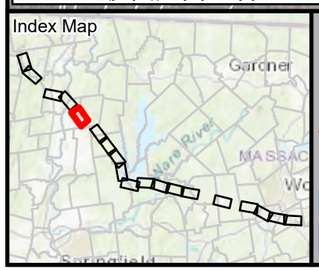

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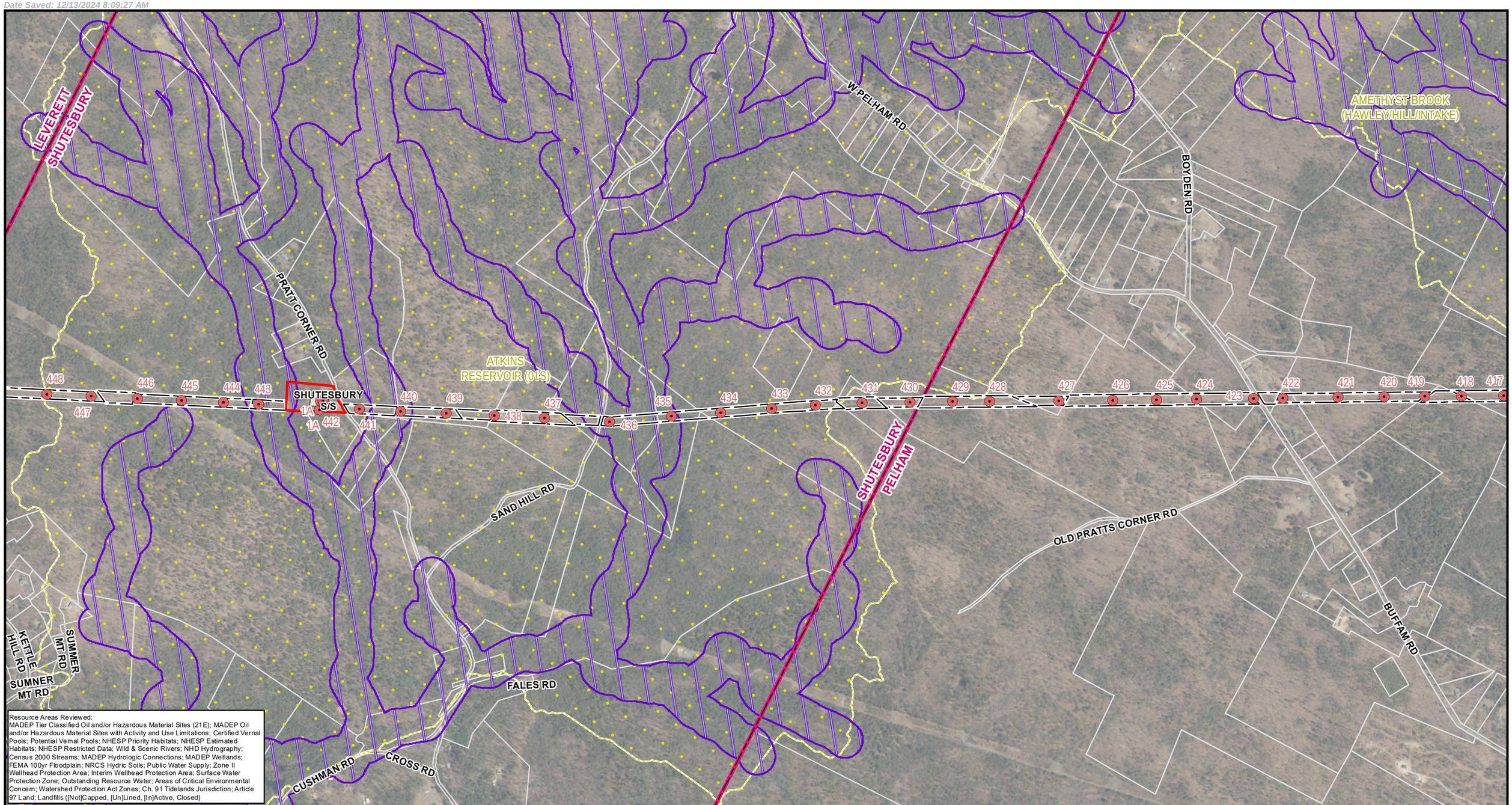

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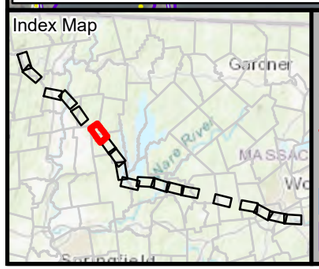

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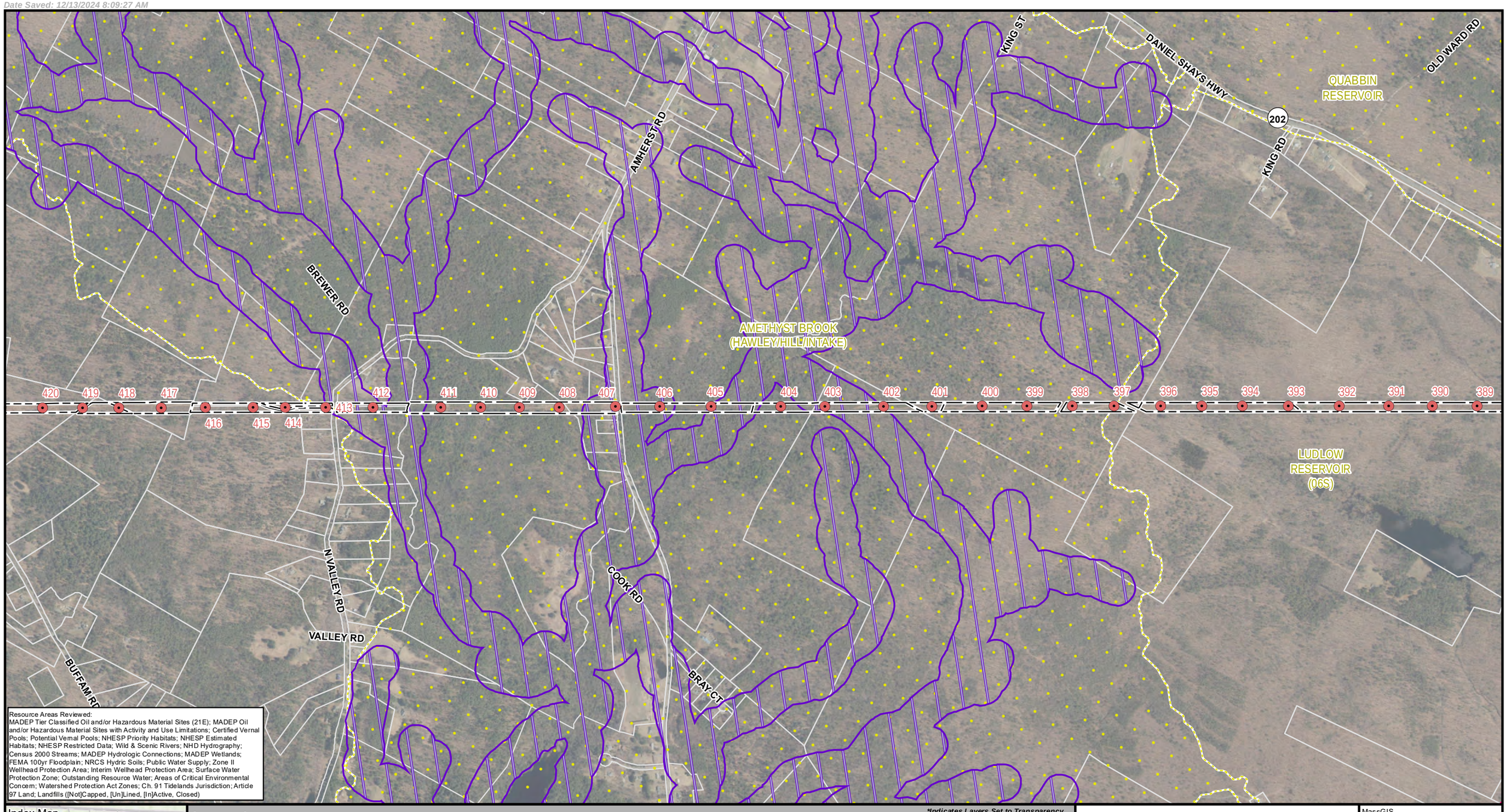

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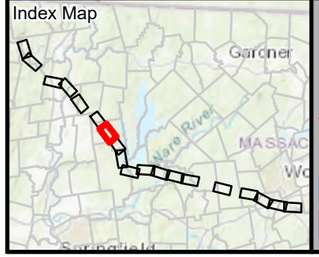

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Pelham, MA

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OLD WARD RD
DANIEL SHAYS HWY
QUABBIN RESERVOIR
PACKARDVILLE RD
JUCKETT HILL RD
PELHAM
BELCHERTOWN
JUCKETT RD
LUDLOW RESERVOIR (06S)
KNIGHT ST
GOLD ST
202

391 390 389 388 387 386 385 384 383 382 381 380 379 378 377 376 375 374 373 372 371 370 369 368 367 366 365 364 363 362 361 360

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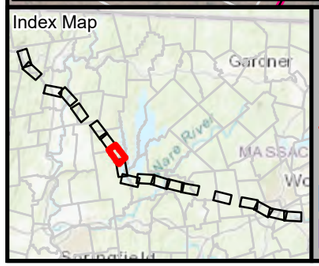

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Pelham & Belchertown, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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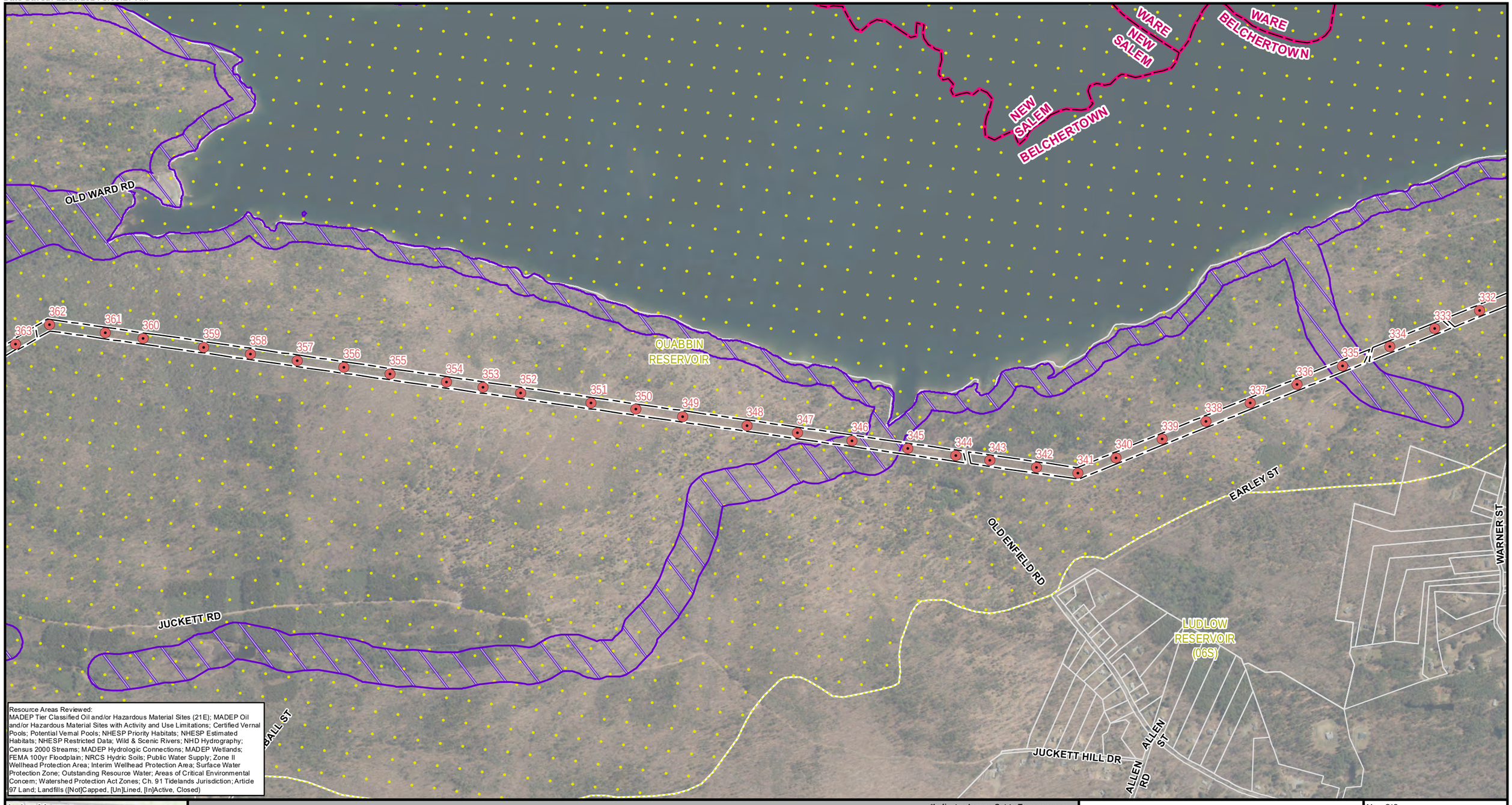

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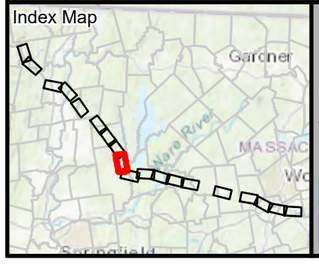
Index Map



Legend

- Existing Structure
- Edge of ROW
- National Grid Owned Property
- Public Water Supply
- Interim Wellhead Protection Area
- Surface Water Protection Zone
- Zone II Wellhead Protection Area
- Surface Water (Active or Inactive)
- Aquifer
- Town Boundary
- Parcel Boundaries
- Railroad

*Indicates Layers Set to Transparency

N

1 inch = 1,000 feet
0 500 1,000
Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Water Supply Protection Areas

Belchertown, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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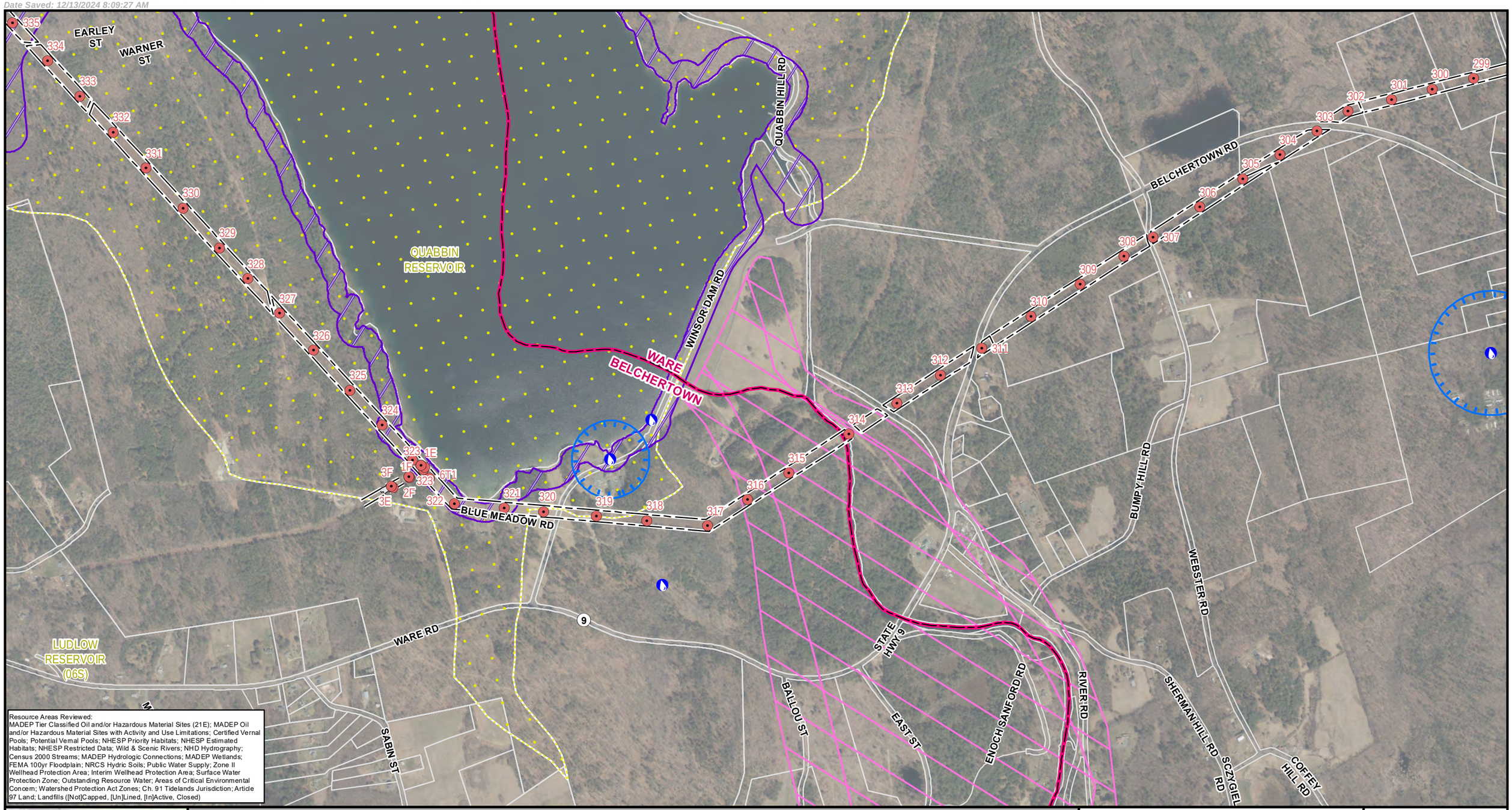

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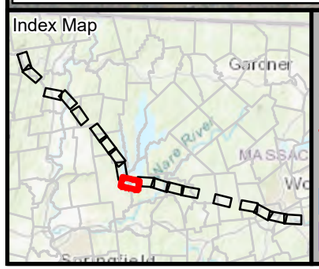

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Water Supply Protection Areas

Belchertown & Ware, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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QUABBIN RESERVOIR
OLD WARE-ENFIELD RD
MONSON TPKE EXN
TURNPIKE RD
MONSON
HUTCHINSON RD
GREENWICH PLNS RD
OLD POOR FARM RD
OSBORNE RD
FISHERDICK RD
GREENWICH PLAINS RD
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CUMMINGS RD
WINSLOW RD
WALKER RD
CRESCENT ST
BELCHERTOWN RD
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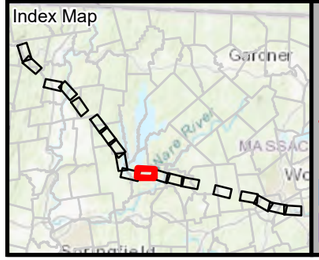

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Water Supply Protection Areas

Ware, MA

MassGIS
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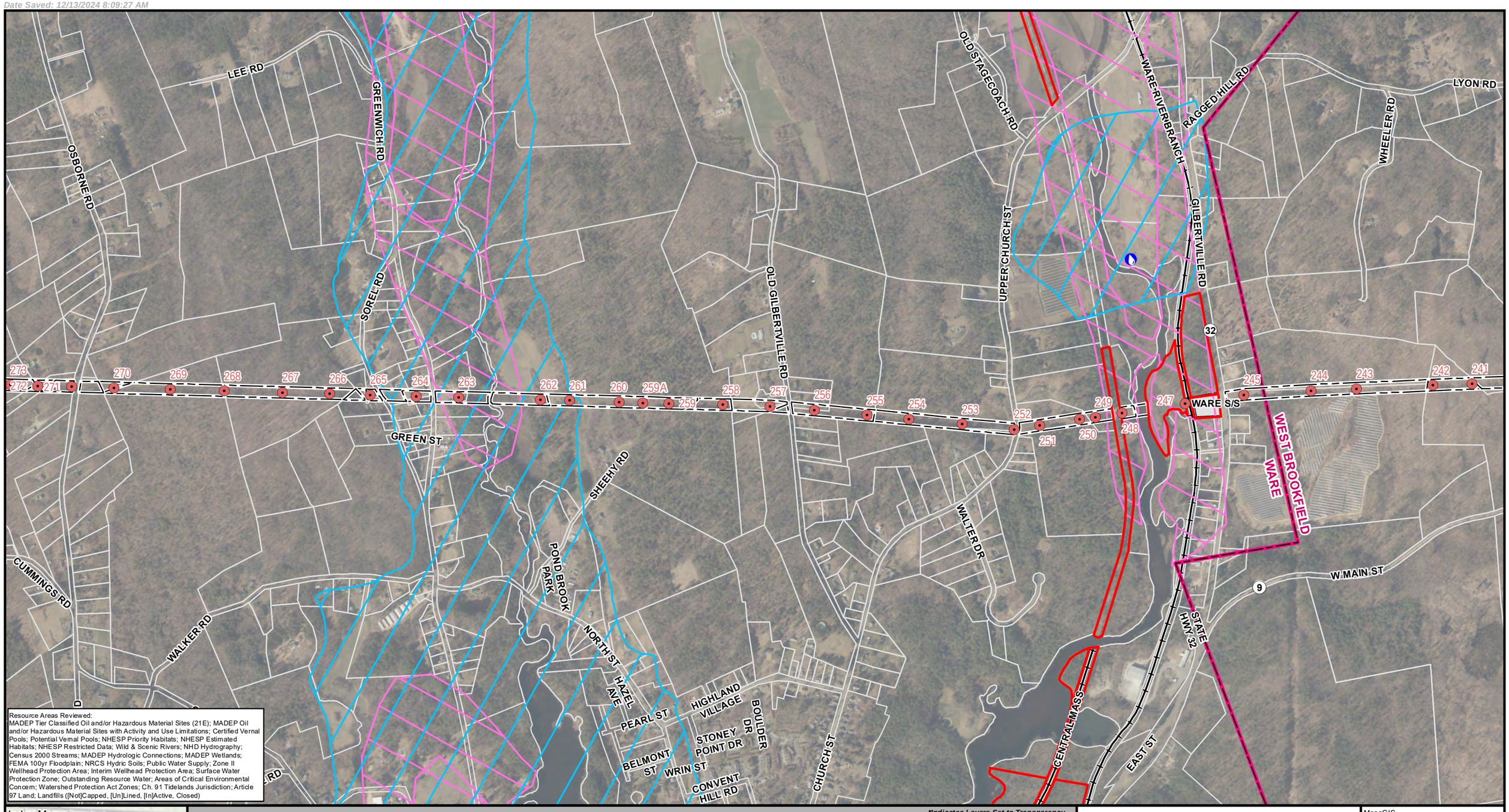

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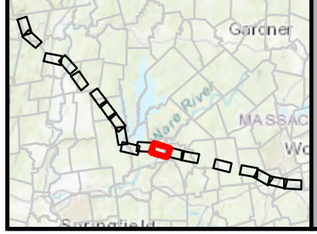

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Water Supply Protection Areas

Ware & West Brookfield, MA

MassGIS
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KENNEDY RD
LYON RD
WHEELER RD
PIERCE RD
PROUTY RD
TUCKER RD
RAGGED HILL RD
WICKABOAG VALLEY RD
MILBROOK CIR
MADDEN RD
SHEA RD
243 242 241 240 239 238 237 236 235 234 233 232 231 230 229 228 227 226 225 224 223 222 221 220 219 218 217 216 215
WHISPERING PINE DR
WHITEBIRCH DR
JUNIPER ST
HILLTOP DR
FOREST DR
CEDAR DR
HEMLOCK ST
WELCOME RD
LAKEVIEW DR
STAGECOACH RD
BROOK DR
MEADOW DR
W MAIN ST
SHORELINE DR
9
HANLEN DR
JOHN GILBERT RD
MILLSTONE RD
SNOW RD
CHECKERED LN

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Water Supply Protection Areas

West Brookfield, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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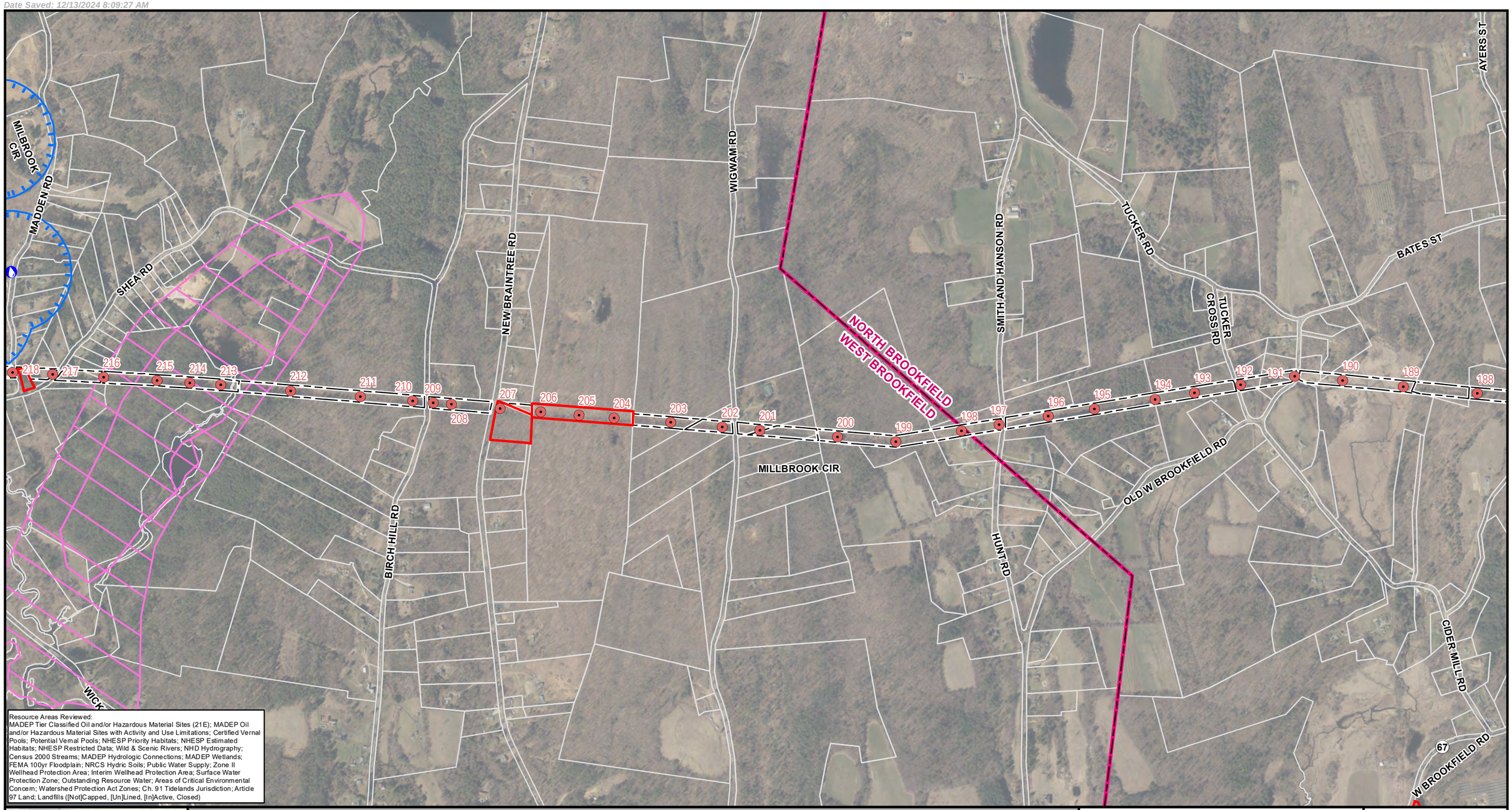

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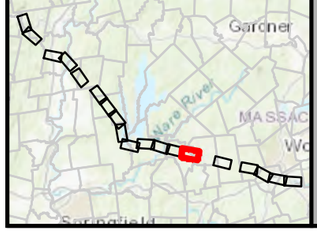

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Water Supply Protection Areas

West Brookfield & North Brookfield, MA

MassGIS
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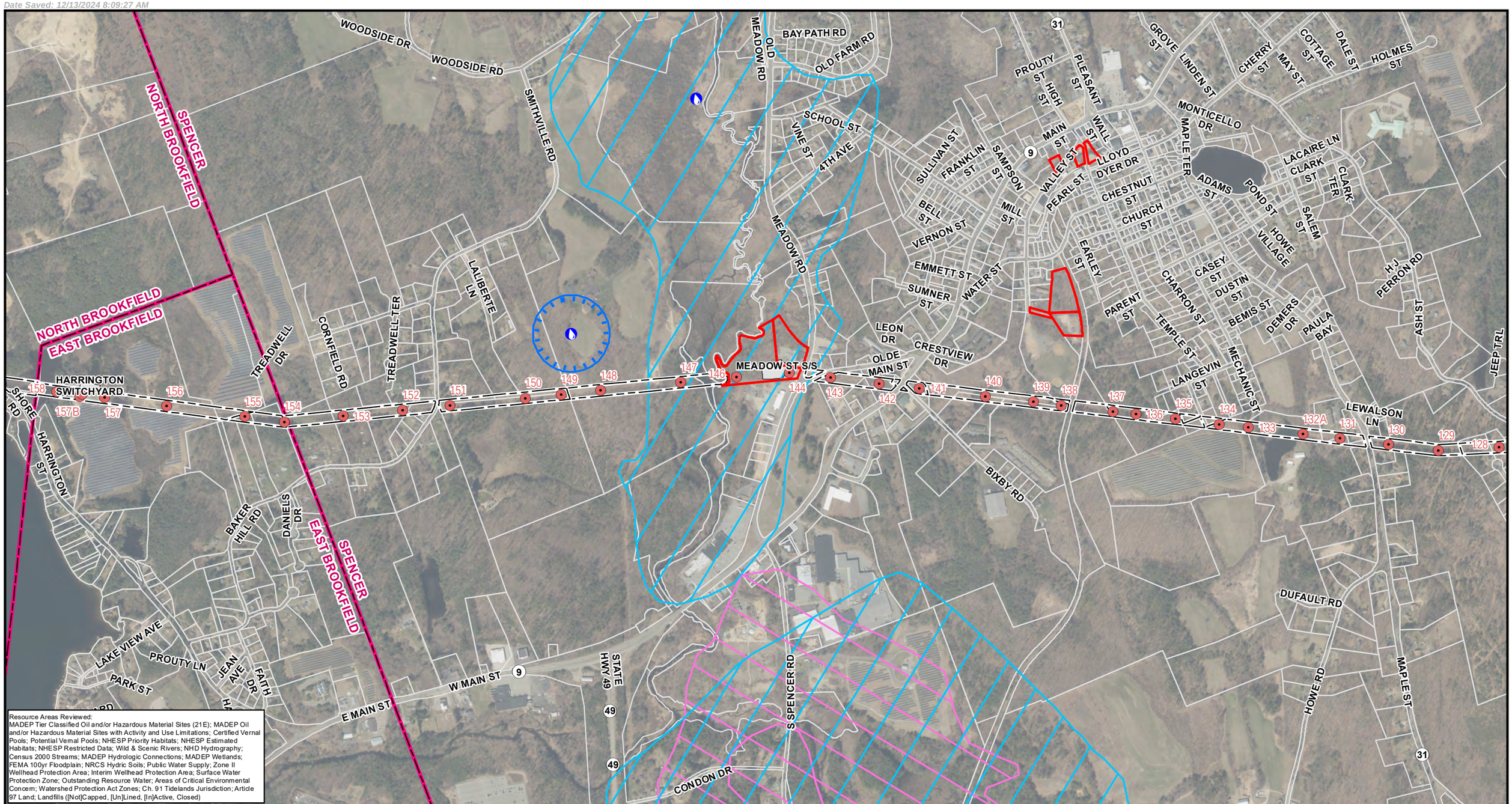

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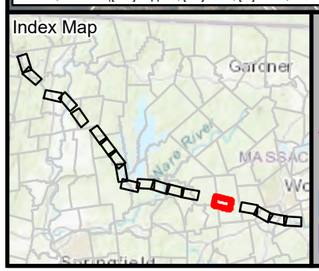

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Water Supply Protection Areas

East Brookfield & Spencer, MA

MassGIS
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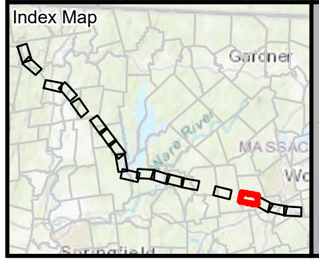

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Water Supply Protection Areas

Leicester MA

MassGIS
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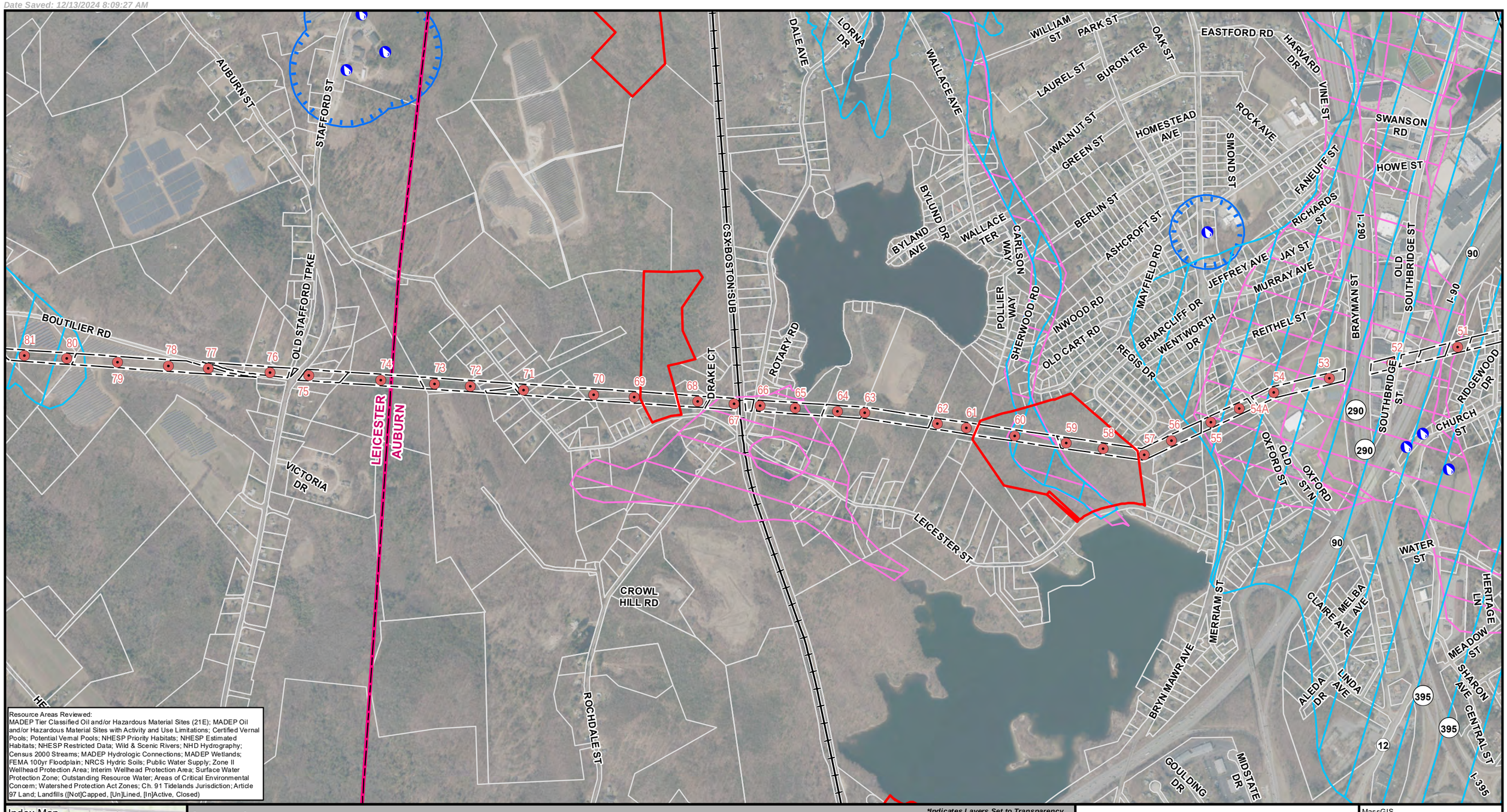

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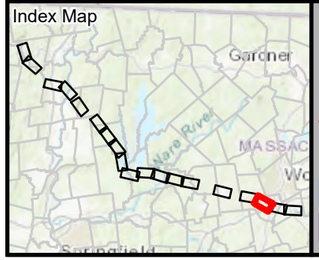

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Water Supply Protection Areas

Leicester & Auburn, MA

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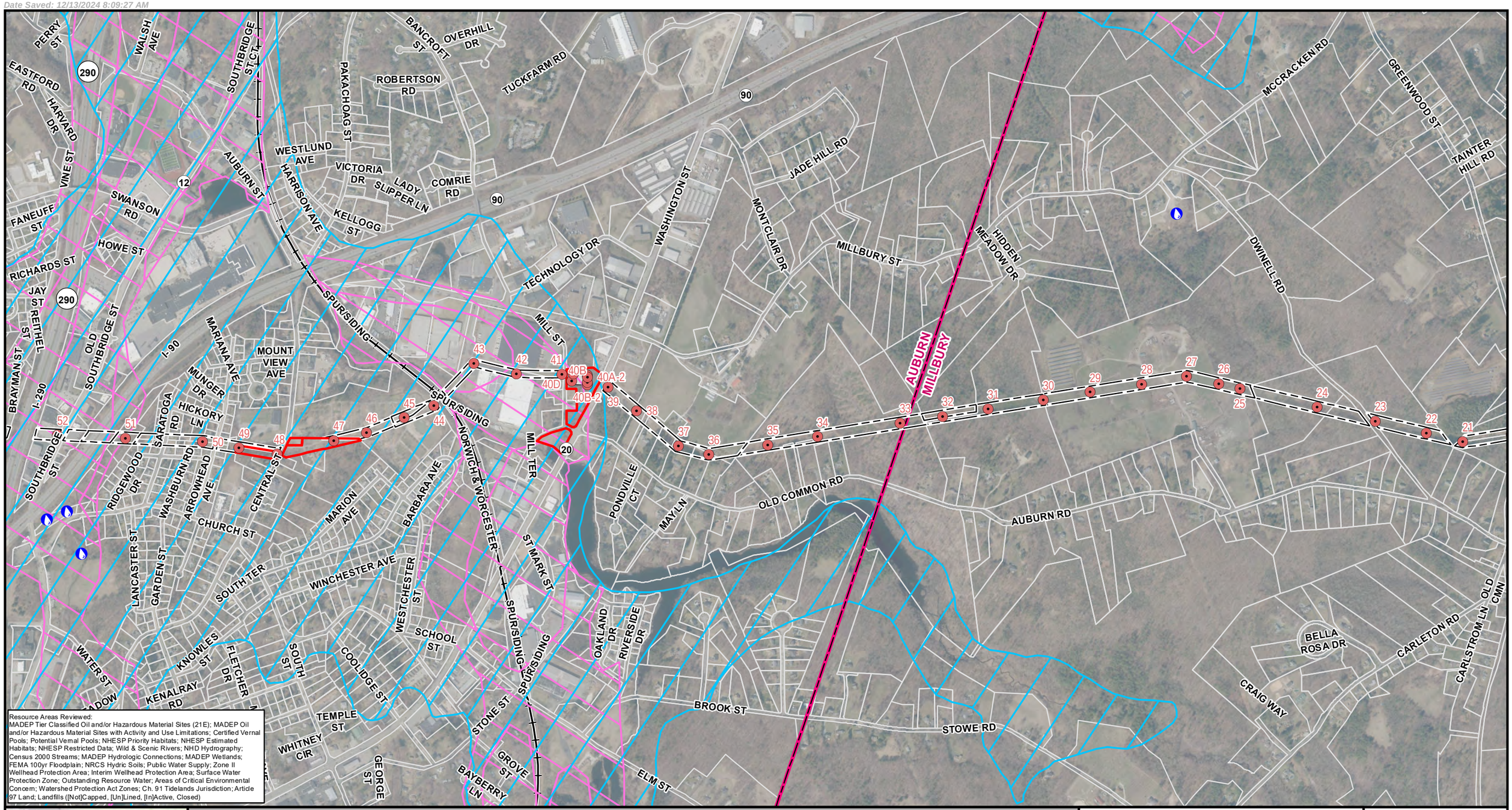

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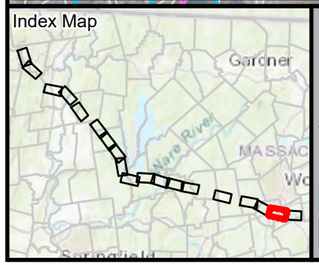

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Water Supply Protection Areas

Auburn & Millbury, MA

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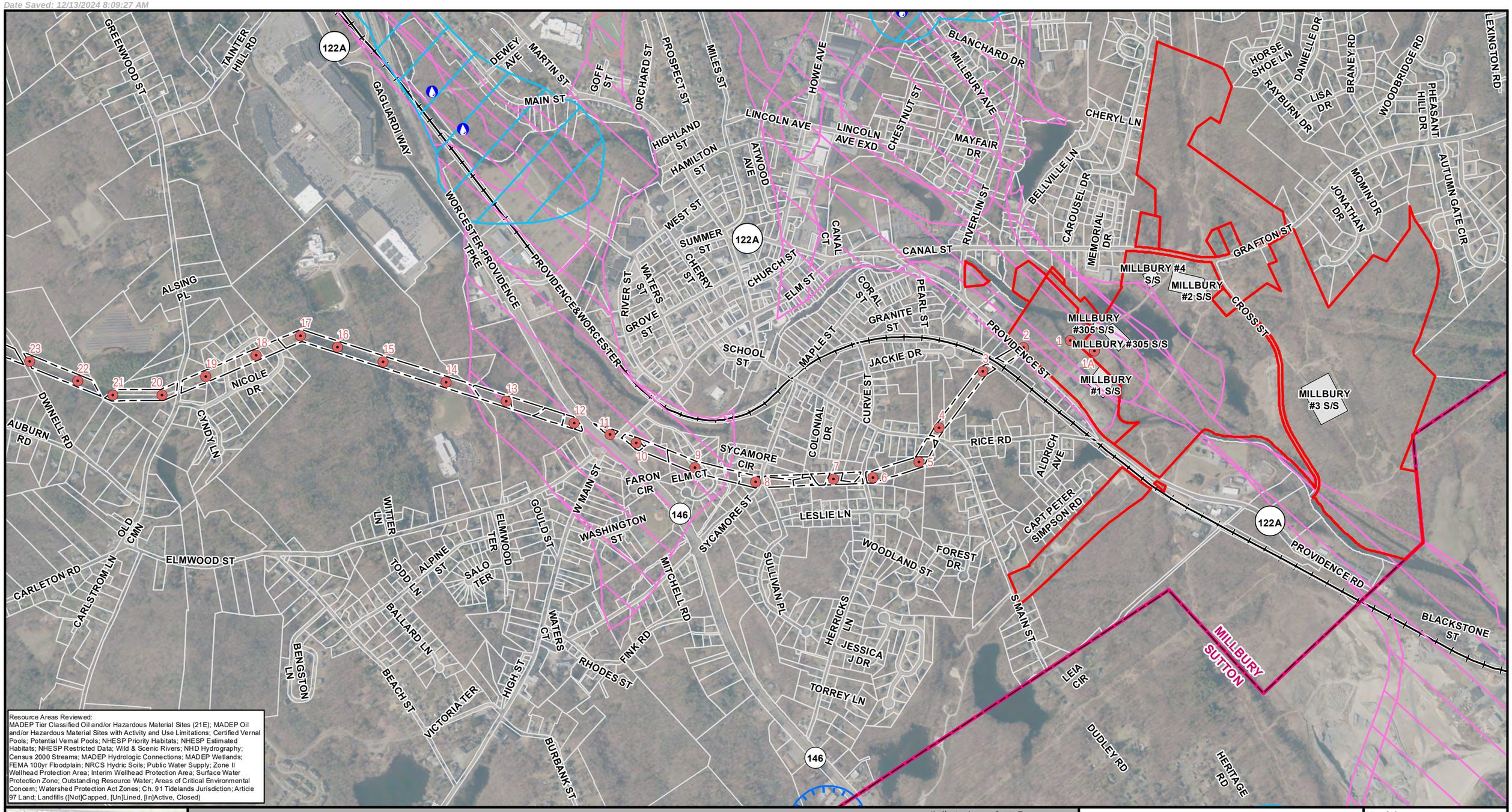
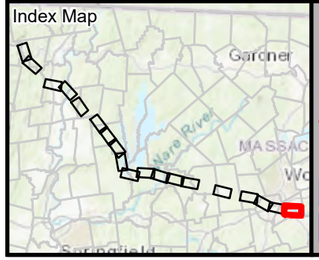


Resource Areas Reviewed:
MADEP Tier Classified Oil and/or Hazardous Material Sites (21E); MADEP Oil and/or Hazardous Material Sites with Activity and Use Limitations; Certified Vernal Pools; Potential Vernal Pools; NHESP Priority Habitats; NHESP Estimated Habitats; NHESP Restricted Data; Wild & Scenic Rivers; NHD Hydrography; Census 2000 Streams; MADEP Hydrologic Connections; MADEP Wetlands; FEMA 100yr Floodplain; NRCS Hydric Soils; Public Water Supply; Zone II Wellhead Protection Area; Interim Wellhead Protection Area; Surface Water Protection Zone; Outstanding Resource Water; Areas of Critical Environmental Concern; Watershed Protection Act Zones; Ch. 91 Tidelands Jurisdiction; Article 97 Land; Landfills ([Not]Capped, [Un]Lined, [In]Active, Closed)

Index Map



Legend

- Existing Structure
- Edge of ROW
- National Grid Owned Property
- Public Water Supply
- Interim Wellhead Protection Area
- Surface Water Protection Zone
- Zone II Wellhead Protection Area
- Surface Water (Active or Inactive)
- Aquifer
- Town Boundary
- Parcel Boundaries
- Railroad

*Indicates Layers Set to Transparency

N

1 inch = 1,000 feet

0 500 1,000

Feet

CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT

Water Supply Protection Areas

Millbury, MA

MassGIS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

nationalgrid
BSC GROUP

THIS DOCUMENT IS INTENDED FOR GENERAL PLANNING & INFORMATION PURPOSES ONLY. ALL MEASUREMENTS & LOCATIONS ARE APPROXIMATE.

Appendix A – Figures and Plans
Figure 4 – Cross Section

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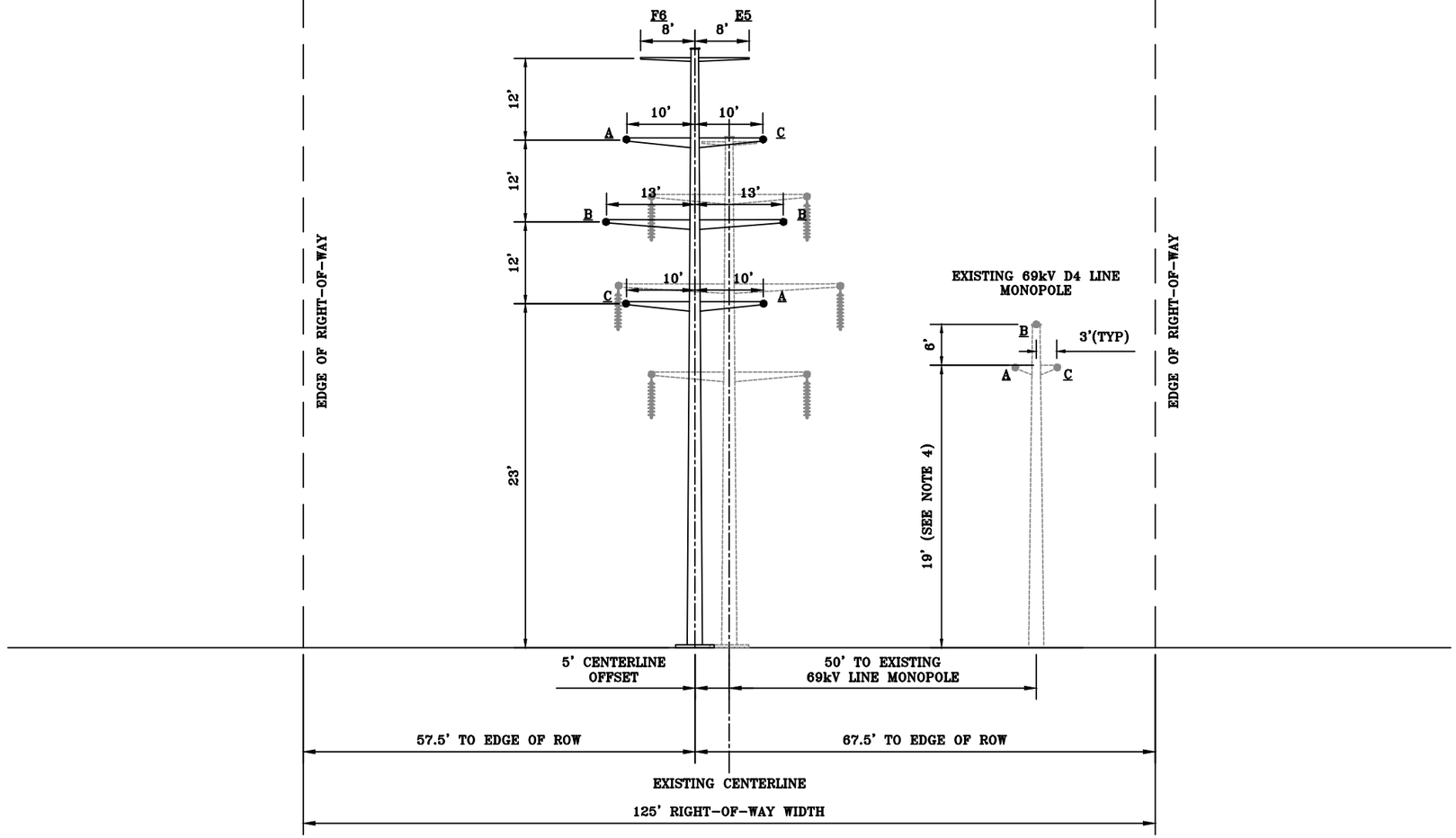
B-13148-NE

PROPOSED 115kV MONOPOLE
EXISTING 69kV TO BE REMOVED
(SEE NOTE 1)



CROSS SECTION 1
LOOKING AHEAD ON LINE TOWARDS DEERFIELD #4 SUB
SEE EMF OVERVIEW MAP FOR STRUCTURE LOCATIONS

NOTES:
1. PROPOSED E5/F6 LINES SHALL BE OPERATED AT 69kV BUT DESIGNED TO ACCOMMODATE 115kV. EMF ANALYSIS REQUIRED AT BOTH 69kV AND 115kV VOLTAGES.
2. SEE TABLES IN APPENDIX FOR EXISTING STRUCTURE GEOMETRY.
3. PHASE SPACING FROM CIRCUIT TO CIRCUIT MAY SLIGHTLY VARY FROM DIMENSIONS SHOWN DEPENDING ON PROPOSED POLE DIAMETERS, WHICH HAVE NOT YET BEEN DETERMINED.
4. THE WIRE SAG UNDER MAXIMUM OPERATING CONDITIONS FOR THE D4 LINE IS UNKNOWN, BUT IS ASSUMED AS CURRENT NESC CODE MINIMUM GROUND CLEARANCE FOR 69kV FOR LAND TRAVERSED BY VEHICLES.

NOT FOR CONSTRUCTION

nationalgrid

E5/F6 LINE REBUILD & UPGRADE
MILLBURY SUB TO DEERFIELD #4 SUB
69kV TRANSMISSION LINE
EMF CROSS SECTION DRAWINGS

SCALE: NTS REV: 1 SHEET 1 OF 8 DATE: 11/03/23

INCHES ON ORIGINAL

B-13148-NE

REVISIONS						
REV.	DATE	DESCRIPTION	MADE	CHECKED	INSPECTED	APPROVED	APPROVED
1	11/03/23	ISSUED WITH EMF BID PACKAGE	AM	AW		LMD	
2							
3							
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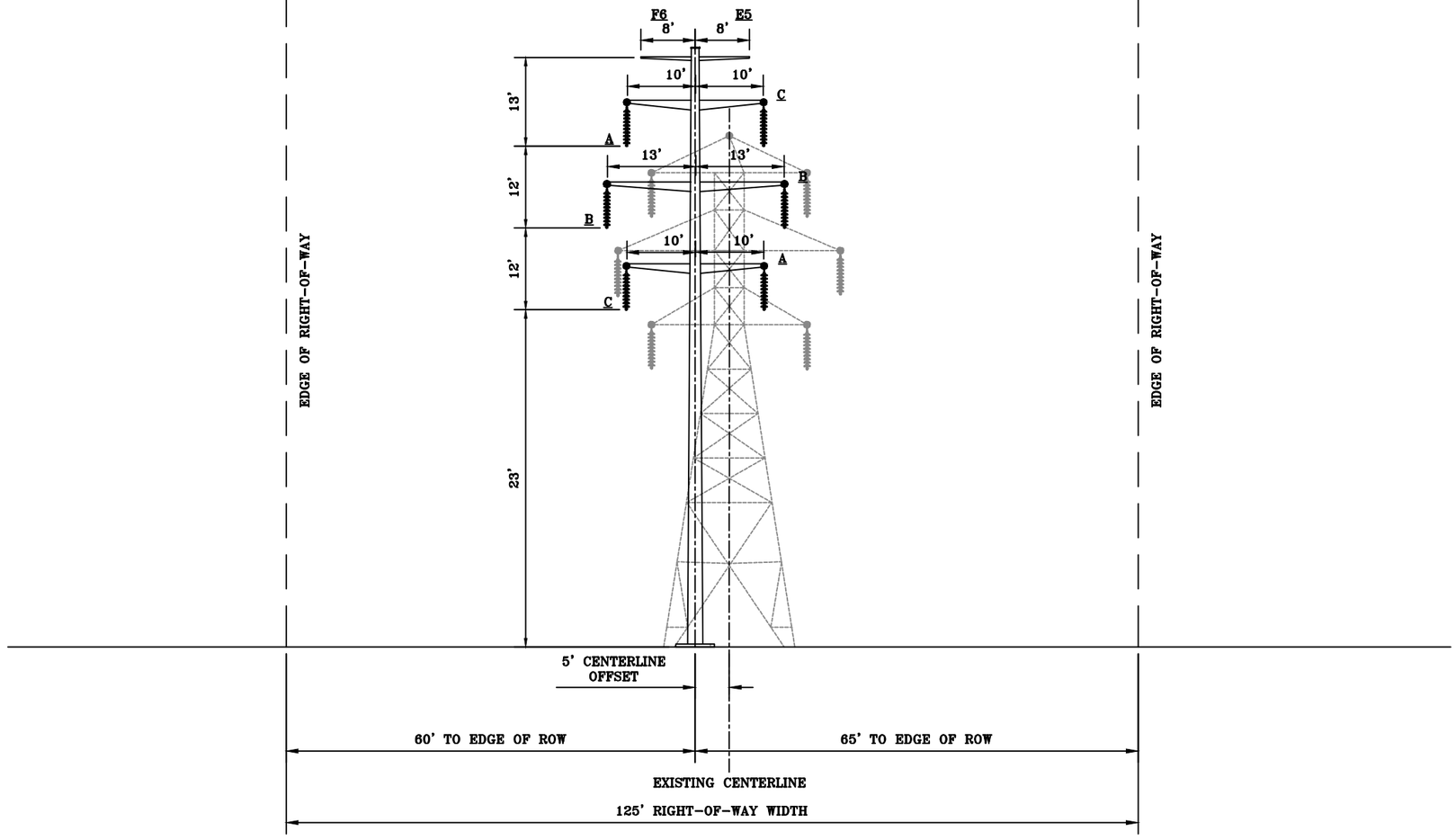
ORIGINAL	
DATE	11/03/23
DESIGNED	AM
CHECKED	AW
DRAWN	EAF
CHECKED	
REVIEWED	
APPROVED	LMD

INCHES

B-13148-NE

PROPOSED 115kV MONOPOLE
EXISTING 69kV TO BE REMOVED
(SEE NOTE 1)



CROSS SECTION 2

LOOKING AHEAD ON LINE TOWARDS DEERFIELD #4 SUB

SEE EMF OVERVIEW 1 FOR STRUCTURE LOCATIONS

NOTES:
1. PROPOSED E5/F6 LINES SHALL BE OPERATED AT 69kV BUT DESIGNED TO ACCOMMODATE 115kV. EMF ANALYSIS REQUIRED AT BOTH 69kV AND 115kV VOLTAGES.
2. SEE TABLES IN APPENDIX FOR EXISTING STRUCTURE GEOMETRY.
3. PHASE SPACING FROM CIRCUIT TO CIRCUIT MAY SLIGHTLY VARY FROM DIMENSIONS SHOWN DEPENDING ON PROPOSED POLE DIAMETERS, WHICH HAVE NOT YET BEEN DETERMINED.
4. DEADEND STRUCTURE LOCATIONS WILL HAVE SLIGHT VARIATION IN ARM LENGTH DUE TO LINE ANGLE.
5. DISTRIBUTION LINES ARE LOCATED ADJACENT TO SOME SPANS ON THE MAIN LINE, BUT ARE NOT INFREQUENT AND INTERMITTENT AND ARE THEREFORE NOT DEPICTED IN THE CROSS SECTION.
6. DUE TO CONSTRUCTION CONSIDERATIONS AT ANGLES, STRUCTURE PLACEMENT IN RIGHT-OF-WAY VARIES IN THESE LOCATIONS. THE CROSS SECTION SHOWN REPRESENTS MOST LOCATION ASSOCIATED WITH THIS CROSS SECTION. HOWEVER, ANGLE STRUCTURES MAY SEE LEFT EDGE OF RIGHT-OF-WAY REDUCED TO UP TO APPROXIMATELY 30 FT.
7. EXISTING RIGHT-OF-WAY WIDTH IN MANY AREAS OF THE LINE IS UNKNOWN OR UNDEFINED. THESE AREAS ARE ASSUMED TO HAVE A 125 FT WIDTH, CENTERED ON THE EXISTING LINE, BASED ON FEEDBACK FROM REAL ESTATE.

NOT FOR CONSTRUCTION

nationalgrid

E5/F6 LINE REBUILD & UPGRADE
MILLBURY SUB TO DEERFIELD #4 SUB
69kV TRANSMISSION LINE
EMF CROSS SECTION DRAWINGS

SCALE: NTS REV: 1 SHEET 2 OF 8 DATE: 11/03/23

B-13148-NE

INCHES ON ORIGINAL

REVISIONS

REV.	DATE	DESCRIPTION	MADE	CHECKED	INSPECTED	APPROVED	APPROVED
1	11/03/23	ISSUED WITH EMF BID PACKAGE	AM	AW		LMD	
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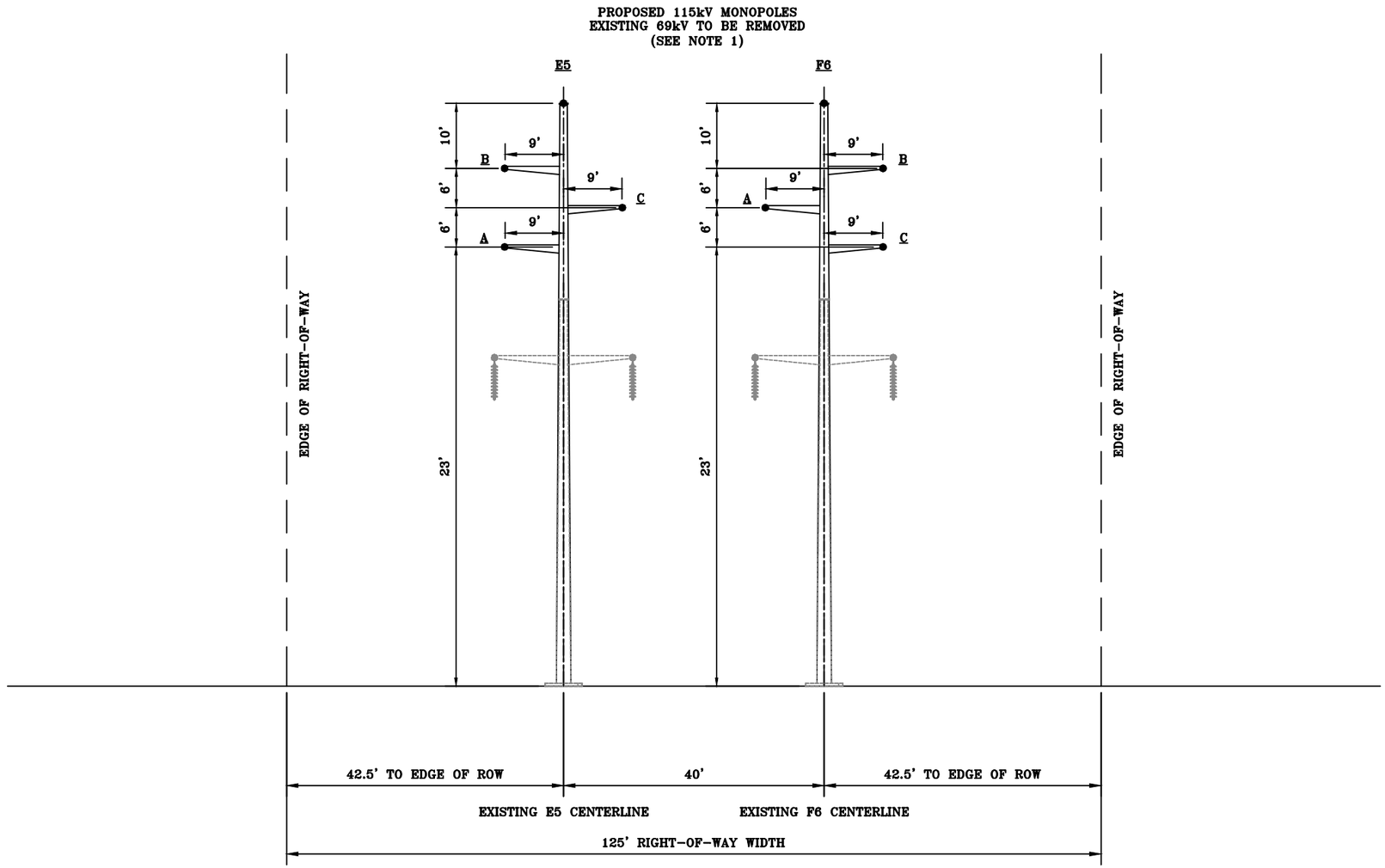
ORIGINAL

DATE 11/03/23	
DESIGNED	AM
CHECKED	AW
DRAWN	EAF
CHECKED	
REVIEWED	
APPROVED	LMD

INCHES ON ORIGINAL

B-13148-NE



CROSS SECTION 3

LOOKING AHEAD ON LINE TOWARDS DEERFIELD #3 SUB

SEE EMF OVERVIEW MAP FOR STRUCTURE LOCATIONS

NOTES:
1. PROPOSED E5/F6 LINES SHALL BE OPERATED AT 69 kV BUT DESIGNED TO ACCOMMODATE 115kV. EMF ANALYSIS REQUIRED AT BOTH 69kV AND 115kV VOLTAGES.
2. SEE TABLES IN APPENDIX FOR EXISTING STRUCTURE GEOMETRY.
3. PHASE SPACING FROM CIRCUIT TO CIRCUIT MAY SLIGHTLY VARY FROM DIMENSIONS SHOWN DEPENDING ON PROPOSED POLE DIAMETERS, WHICH HAVE NOT YET BEEN DETERMINED.

NOT FOR CONSTRUCTION

nationalgrid

E5/F6 LINE REBUILD & UPGRADE
MILLBURY SUB TO DEERFIELD #4 SUB
69kV TRANSMISSION LINE
EMF CROSS SECTION DRAWINGS

SCALE: NTS REV: 1 SHEET 3 OF 8 DATE: 11/03/23

INCHES ON ORIGINAL

B-13148-NE

REVISIONS							
REV.	DATE	DESCRIPTION	MADE	CHECKED	INSPECTED	APPROVED	APPROVED
1	11/03/23	ISSUED WITH EMF BID PACKAGE	AM	AW		LMD	
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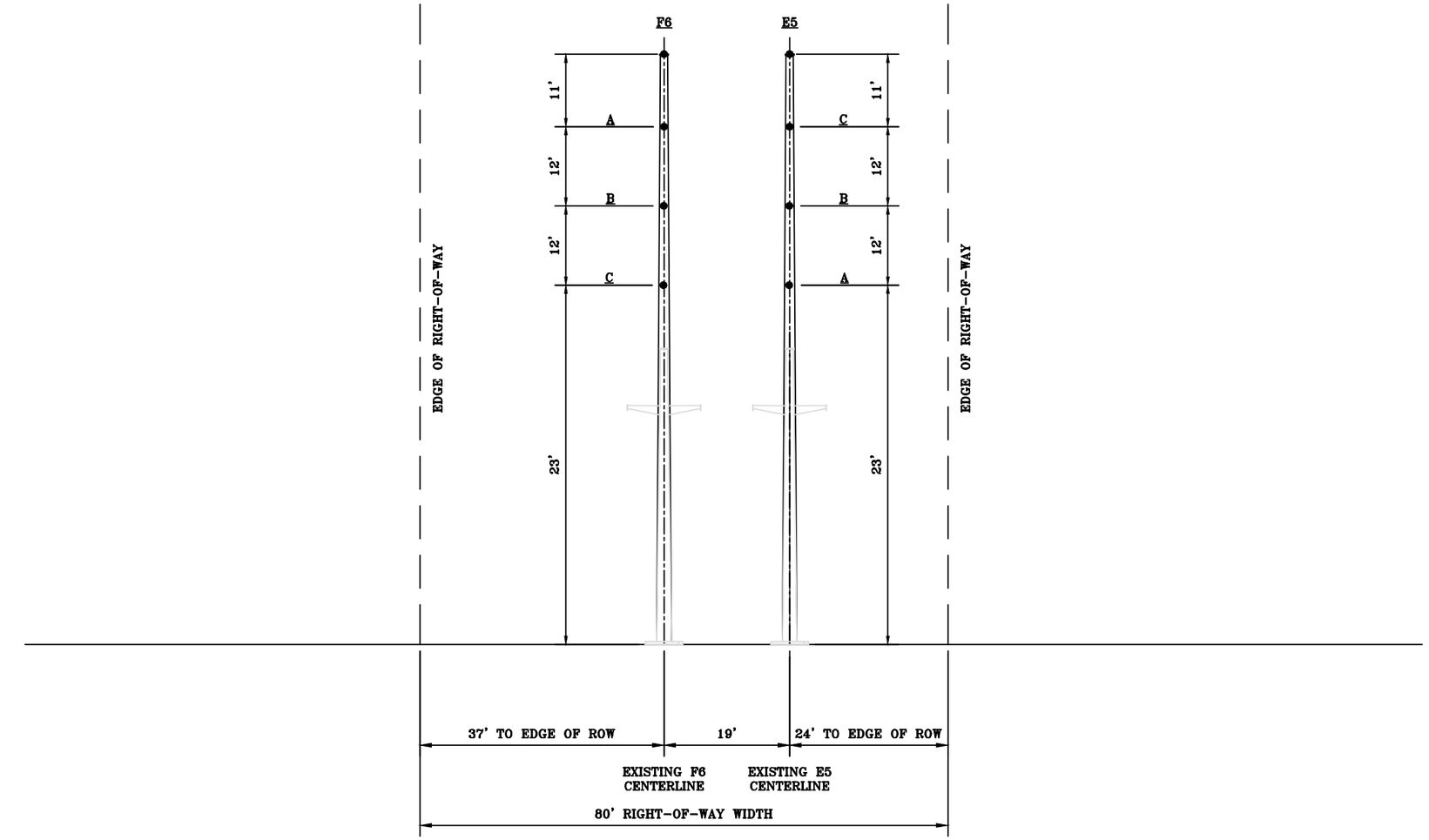
ORIGINAL		
DATE	11/03/23	
DESIGNED	AM	
CHECKED	AW	
DRAWN	EAF	
CHECKED		
REVIEWED		
APPROVED	LMD	

INCHES ON ORIGINAL

B-13148-NE

PROPOSED 115kV MONOPOLES
EXISTING 69kV TO BE REMOVED
(SEE NOTE 1)



CROSS SECTION 4
LOOKING AHEAD ON LINE TOWARDS QUABBIN SUB
SEE EMF OVERVIEW MAP FOR STRUCTURE LOCATIONS

NOTES:
1. PROPOSED E5/F6 LINES SHALL BE OPERATED AT 69kV BUT DESIGNED TO ACCOMMODATE 115kV. EMF ANALYSIS REQUIRED AT BOTH 69kV AND 115kV VOLTAGES.
2. SEE TABLES IN APPENDIX FOR EXISTING STRUCTURE GEOMETRY.
3. PHASE SPACING FROM CIRCUIT TO CIRCUIT MAY SLIGHTLY VARY FROM DIMENSIONS SHOWN DEPENDING ON PROPOSED POLE DIAMETERS, WHICH HAVE NOT YET BEEN DETERMINED.

NOT FOR CONSTRUCTION

nationalgrid

E5/F6 LINE REBUILD & UPGRADE
MILLBURY SUB TO DEERFIELD #4 SUB
69kV TRANSMISSION LINE
EMF CROSS SECTION DRAWINGS

SCALE: NTS REV: 1 SHEET 4 OF 8 DATE: 11/03/23

INCHES ON ORIGINAL

B-13148-NE

REVISIONS

REV.	DATE	DESCRIPTION	MADE	CHECKED	INSPECTED	APPROVED	APPROVED
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ORIGINAL

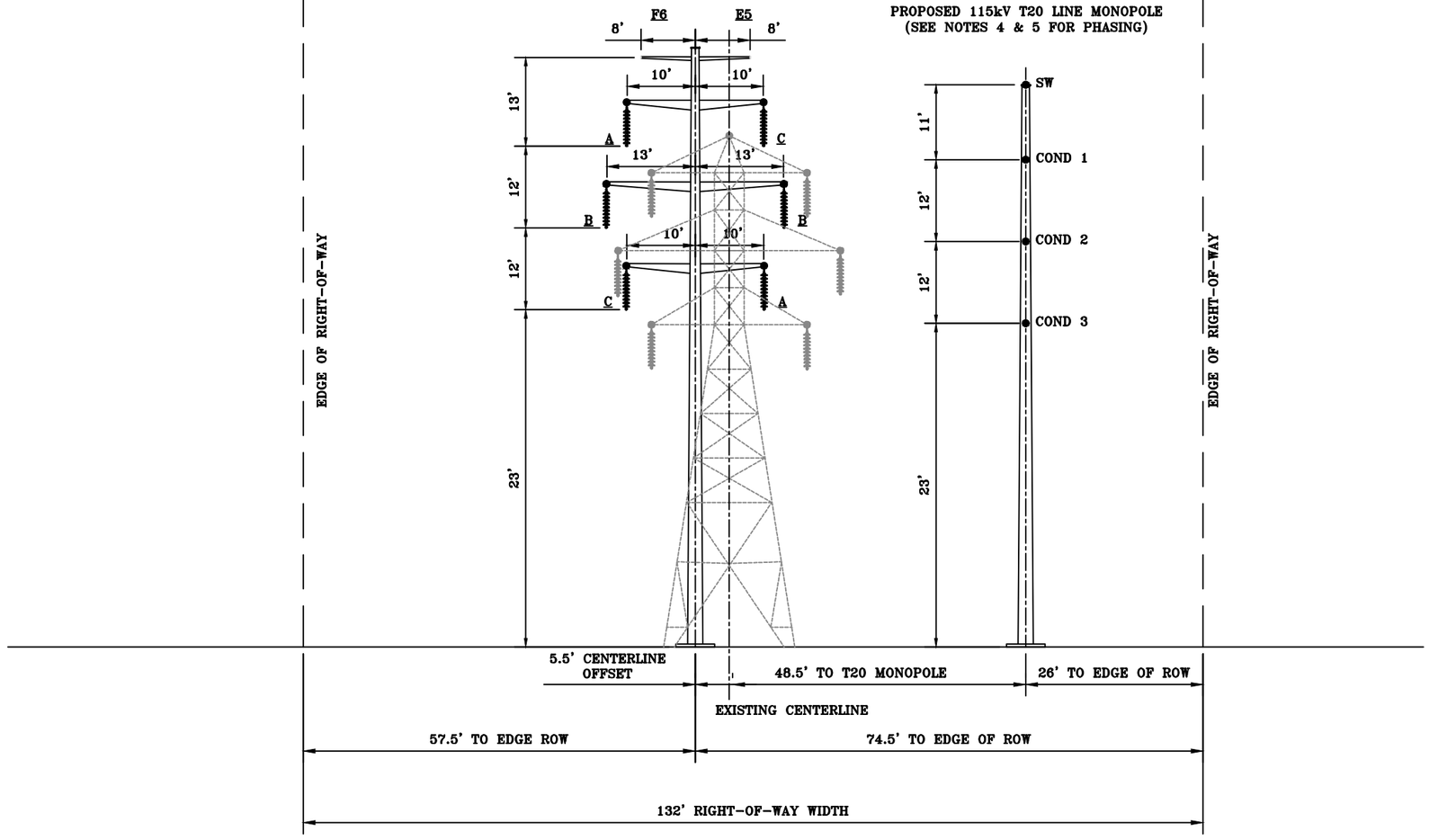
DATE	11/03/23	
DESIGNED	AM	
CHECKED	AW	
DRAWN	EAF	
CHECKED		
REVIEWED		
APPROVED	LMD	

INCHES ON ORIGINAL

B-13148-NE

PROPOSED 115kV MONOPOLE
EXISTING 69kV TO BE REMOVED
(SEE NOTE 1)

PROPOSED 115kV T20 LINE MONOPOLE
(SEE NOTES 4 & 5 FOR PHASING)



CROSS SECTION 5
LOOKING AHEAD ON LINE TOWARDS HARRINGTON SWITCHYARD
SEE EMF OVERVIEW MAP FOR STRUCTURE LOCATIONS

NOTES:
1. PROPOSED E5/F6 LINES SHALL BE OPERATED AT 69kV BUT DESIGNED TO ACCOMMODATE 115kV. EMF ANALYSIS REQUIRED AT BOTH 69kV AND 115kV VOLTAGES.
2. SEE TABLES IN APPENDIX FOR EXISTING STRUCTURE GEOMETRY.
3. PHASE SPACING FROM CIRCUIT TO CIRCUIT MAY SLIGHTLY VARY FROM DIMENSIONS SHOWN DEPENDING ON PROPOSED POLE DIAMETERS, WHICH HAVE NOT YET BEEN DETERMINED.
4. THE T20 LINE WILL OPERATE AT 69kV BUT DESIGNED TO ACCOMMODATE 115kV. EMF ANALYSIS SHOULD ASSUME 115kV OPERATION. PHASING OF THIS LINE IS UNKNOWN. FOR THE PURPOSE OF THE ANALYSIS, THE PHASING CONFIGURATION WHICH GENERATES THE LARGEST EMF SHALL BE CONSIDERED,
5. T20 STRUCTURE FRAMING AND CENTERLINE DETAILS ARE PRELIMINARY.

NOT FOR CONSTRUCTION

nationalgrid

E5/F6 LINE REBUILD & UPGRADE
MILLBURY SUB TO DEERFIELD #4 SUB
69kV TRANSMISSION LINE
EMF CROSS SECTION DRAWINGS

SCALE: NTS REV: 1 SHEET 5 OF 8 DATE: 11/03/23

B-13148-NE

INCHES ON ORIGINAL

REVISIONS						
REV.	DATE	DESCRIPTION	MADE	CHECKED	INSPECTED	APPROVED	APPROVED
1	11/03/23	ISSUED WITH EMF BID PACKAGE	AM	AW		LMD	
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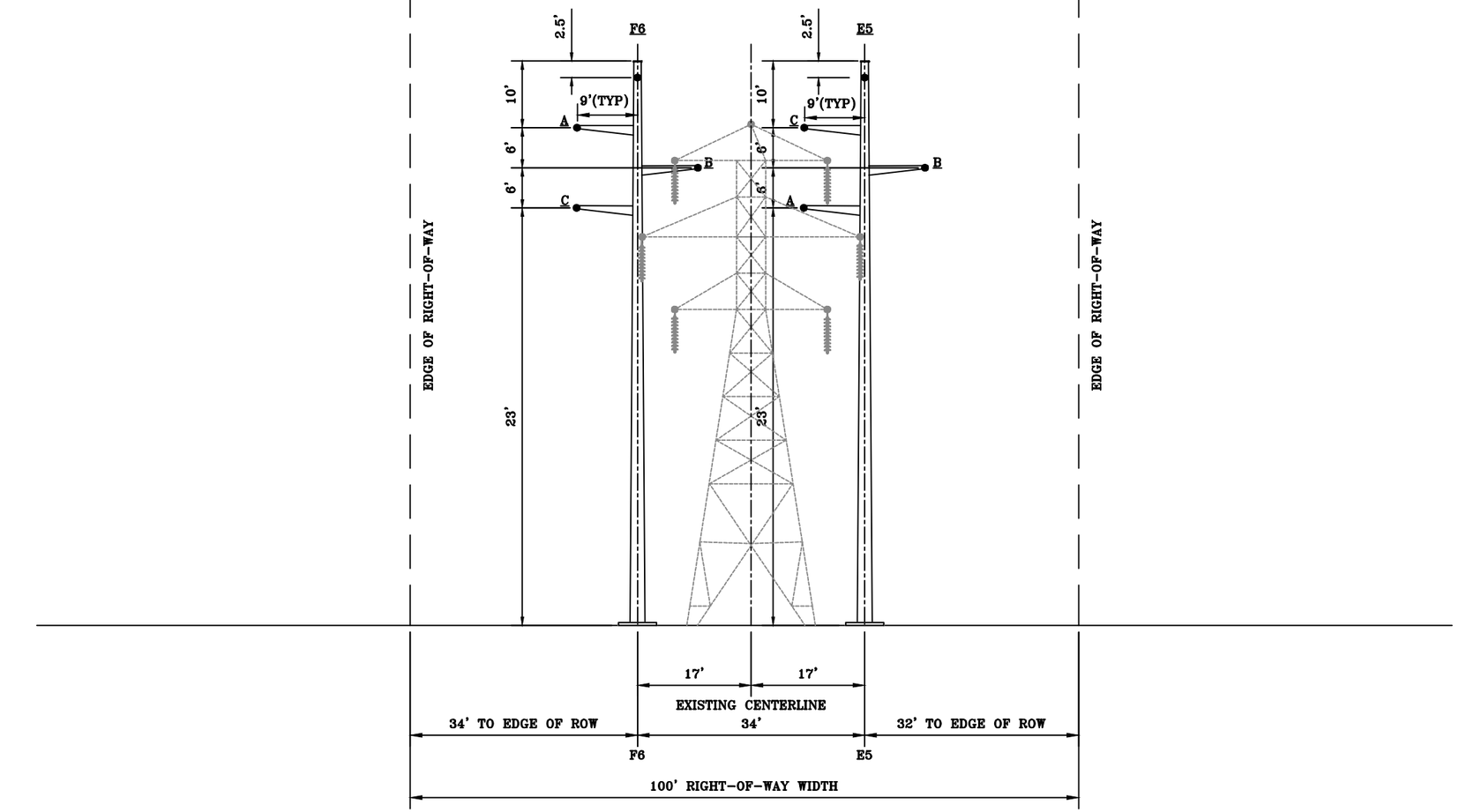
ORIGINAL

DATE 11/03/23	
DESIGNED	AM
CHECKED	AW
DRAWN	EAF
CHECKED	
REVIEWED	
APPROVED	LMD

INCHES ON ORIGINAL

B-13148-NE

PROPOSED 115kV MONOPOLES
EXISTING 69kV TO BE REMOVED
(SEE NOTE 1)



CROSS SECTION 6
LOOKING AHEAD ON LINE TOWARDS DEERFIELD #4 SUB
SEE EMF OVERVIEW MAP FOR STRUCTURE LOCATIONS

NOTES:
1. PROPOSED E5/F6 LINES SHALL BE OPERATED AT 69kV BUT DESIGNED TO ACCOMMODATE 115kV. EMF ANALYSIS REQUIRED AT BOTH 69kV AND 115kV VOLTAGES.
2. SEE TABLES IN APPENDIX FOR EXISTING STRUCTURE GEOMETRY.
3. PHASE SPACING FROM CIRCUIT TO CIRCUIT MAY SLIGHTLY VARY FROM DIMENSIONS SHOWN DEPENDING ON PROPOSED POLE DIAMETERS, WHICH HAVE NOT YET BEEN DETERMINED.

NOT FOR CONSTRUCTION

nationalgrid

E5/F6 LINE REBUILD & UPGRADE
MILLBURY SUB TO DEERFIELD #4 SUB
69kV TRANSMISSION LINE
EMF CROSS SECTION DRAWINGS

SCALE: NTS REV: 1 SHEET 6 OF 8 DATE: 11/03/23

INCHES ON ORIGINAL

B-13148-NE

REVISIONS

REV.	DATE	DESCRIPTION	MADE	CHECKED	INSPECTED	APPROVED	APPROVED
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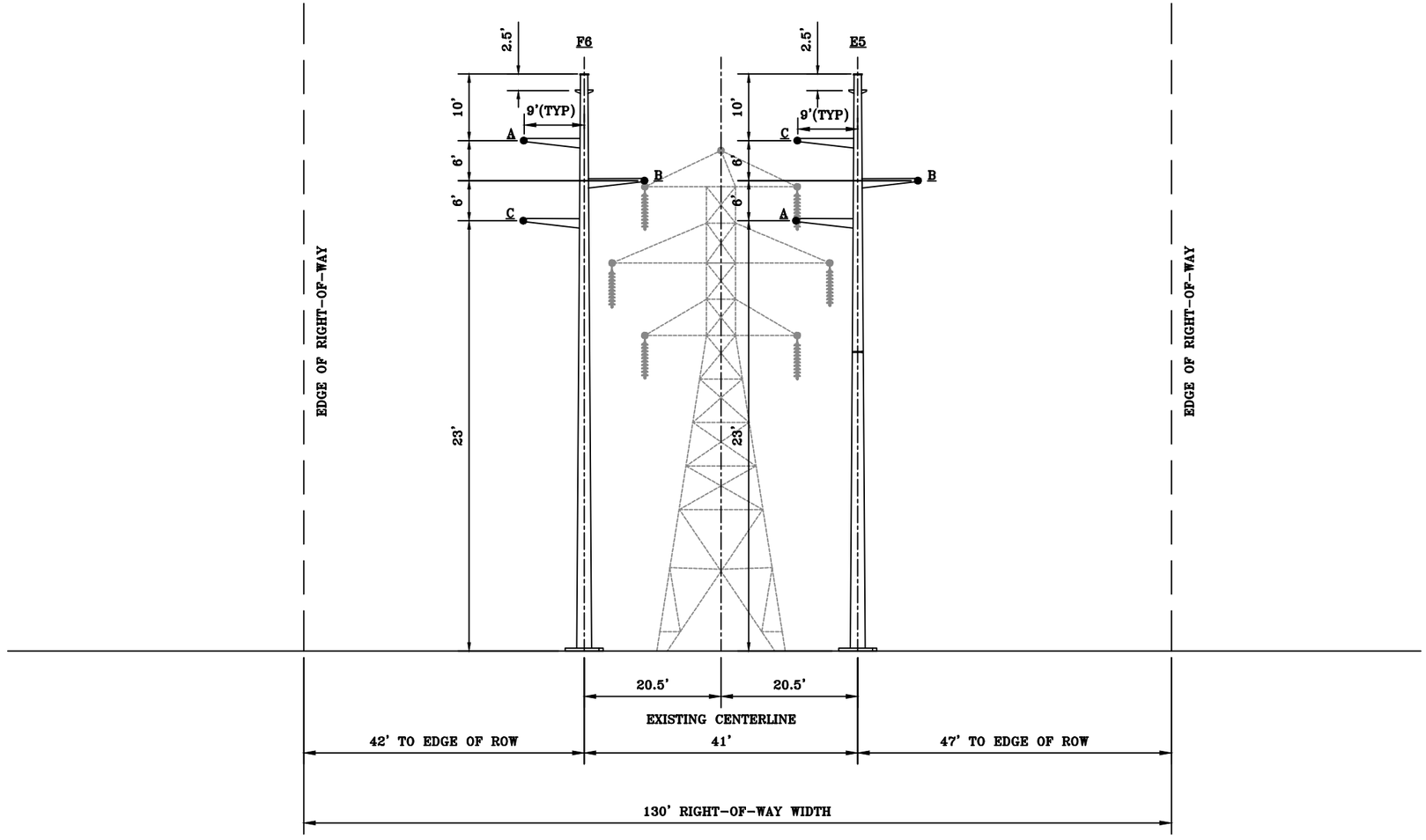
ORIGINAL

DATE	11/03/23
DESIGNED	AM
CHECKED	AW
DRAWN	EAF
CHECKED	
REVIEWED	
APPROVED	LMD

INCHES ON ORIGINAL

B-13148-NE

PROPOSED 115kV MONOPOLES
EXISTING 69kV TO BE REMOVED
(SEE NOTE 1)



CROSS SECTION 7
LOOKING AHEAD ON LINE TOWARDS DEERFIELD #4 SUB
SEE EMF OVERVIEW MAP FOR STRUCTURE LOCATIONS

NOTES:
1. PROPOSED E5/F6 LINES SHALL BE OPERATED AT 69kV BUT DESIGNED TO ACCOMMODATE 115kV. EMF ANALYSIS REQUIRED AT BOTH 69kV AND 115kV VOLTAGES.
2. SEE TABLES IN APPENDIX FOR EXISTING STRUCTURE GEOMETRY.
3. PHASE SPACING FROM CIRCUIT TO CIRCUIT MAY SLIGHTLY VARY FROM DIMENSIONS SHOWN DEPENDING ON PROPOSED POLE DIAMETERS, WHICH HAVE NOT YET BEEN DETERMINED.

NOT FOR CONSTRUCTION

nationalgrid

E5/F6 LINE REBUILD & UPGRADE
MILLBURY SUB TO DEERFIELD #4 SUB
69kV TRANSMISSION LINE
EMF CROSS SECTION DRAWINGS

SCALE: NTS REV: 1 SHEET 7 OF 8 DATE: 11/03/23

INCHES ON ORIGINAL

B-13148-NE

REVISIONS

REV.	DATE	DESCRIPTION	MADE	CHECKED	INSPECTED	APPROVED	APPROVED
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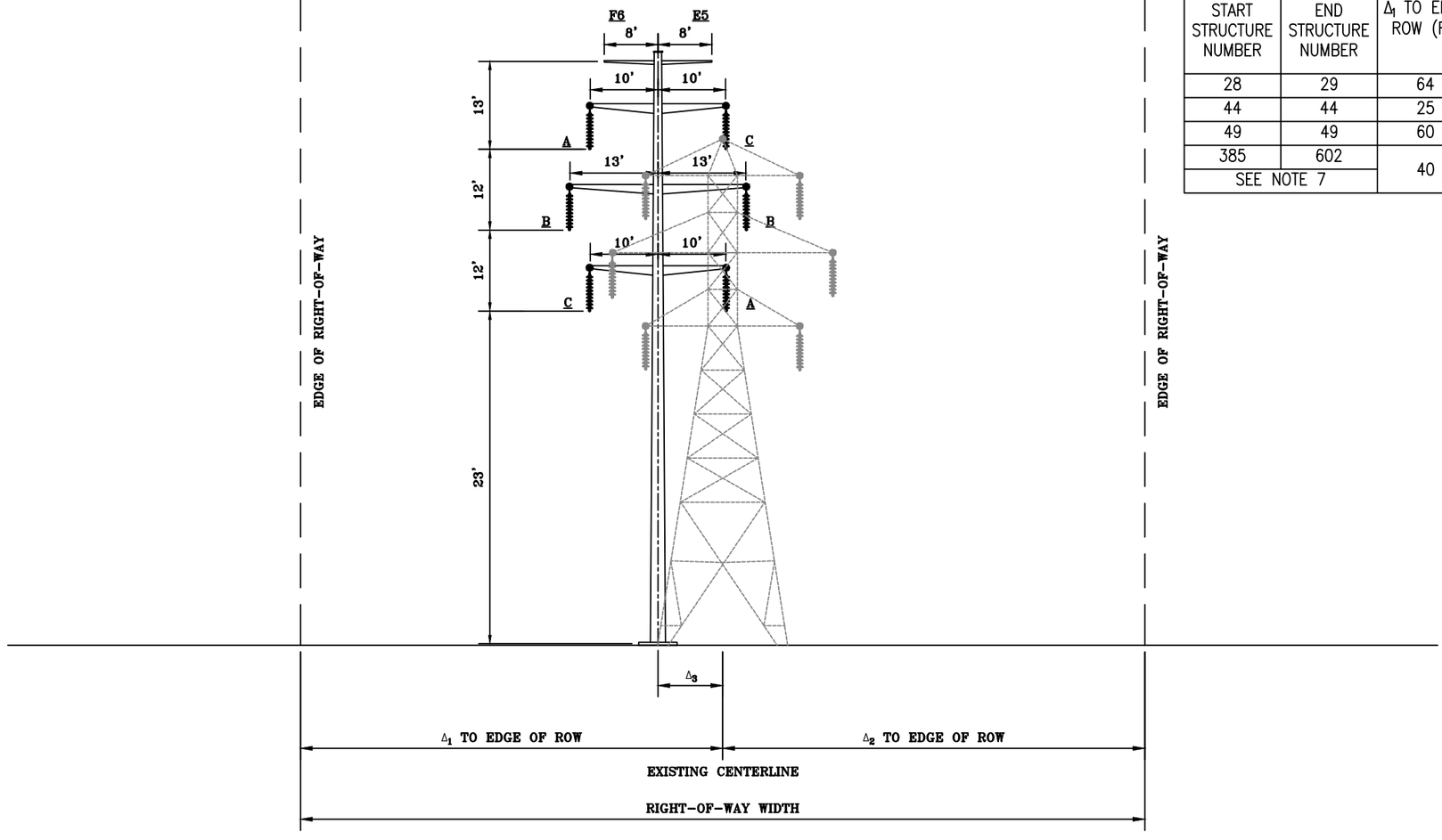
ORIGINAL

DATE	11/03/23	
DESIGNED	AM	1
CHECKED	AW	2
DRAWN	EAF	3
CHECKED		4
REVIEWED		5
APPROVED	LMD	6

B-13148-NE

PROPOSED 115kV MONOPOLE
EXISTING 69kV TO BE REMOVED
(SEE NOTE 1)



PROPOSED START STRUCTURE NUMBER	PROPOSED END STRUCTURE NUMBER	Δ_1 TO EDGE ROW (FT)	Δ_2 TO EDGE ROW (FT)	ROW WIDTH (FT)	PROPOSED STRUCTURE CENTERLINE OFFSET (Δ_3) (FT)
28	29	64	41	105	4.5
44	44	25	55	80	2
49	49	60	40	100	5
385	602	40	60	100	10
SEE NOTE 7					

CROSS SECTION 8
LOOKING AHEAD ON LINE TOWARDS DEERFIELD #4 SUB
SEE EMF OVERVIEW MAP FOR STRUCTURE LOCATIONS

NOTES:
1. PROPOSED E5/F6 LINES SHALL BE OPERATED AT 69kV BUT DESIGNED TO ACCOMMODATE 115kV. EMF ANALYSIS REQUIRED AT BOTH 69kV AND 115kV VOLTAGES.
2. SEE TABLES IN APPENDIX FOR EXISTING STRUCTURE GEOMETRY.
3. PHASE SPACING FROM CIRCUIT TO CIRCUIT MAY SLIGHTLY VARY FROM DIMENSIONS SHOWN DEPENDING ON PROPOSED POLE DIAMETERS, WHICH HAVE NOT YET BEEN DETERMINED.
4. DEADEND STRUCTURE LOCATIONS WILL HAVE SLIGHT VARIATION IN ARM LENGTH DUE TO LINE ANGLE.
5. DISTRIBUTION LINES ADJACENT TO SOME SPANS ON THE MAIN LINE, BUT ARE INFREQUENT AND INTERMITTENT AND ARE THEREFORE NOT DEPICTED IN THE CROSS SECTION.
6. LOCATIONS IN TABLE ABOVE ONLY CONSIDER UNIQUE RIGHT-OF-WAY AREAS WHERE WIDTH IS LESS THAN 125 FT. WIDER EASEMENTS ARE NOT LISTED AS THE EMF AT EDGE OF RIGHT-OF-WAY WOULD BE REDUCED COMPARED TO THE SCENARIO SHOWN IN SHEET 2. REDUCED EASEMENT WIDTH SOUTHEAST OF PONDVILLE SUSTATION NOT INCLUDED DUE TO EASEMENT ACQISITION BEING UNDERWAY.
7. 100 FT ROW OCCURS INTERMITTENTLY FROM STR.385 TO STR.602.

NOT FOR CONSTRUCTION

nationalgrid

E5/F6 LINE REBUILD & UPGRADE
MILLBURY SUB TO DEERFIELD #4 SUB
69kV TRANSMISSION LINE
EMF CROSS SECTION DRAWINGS

SCALE: NTS REV: 1 SHEET 8 OF 8 DATE: 11/03/23

B-13148-NE

INCHES ON ORIGINAL

REVISIONS						
REV.	DATE	DESCRIPTION	MADE	CHECKED	INSPECTED	APPROVED	APPROVED
1	11/03/23	ISSUED WITH EMF BID PACKAGE	AM	AW			LMD
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ORIGINAL		
DATE	11/03/23	
DESIGNED	AM	
CHECKED	AW	
DRAWN	EAF	
CHECKED		
REVIEWED		
APPROVED	LMD	

Appendix B – ENF Distribution List

Environmental Notification Form (ENF)

Central To Western Massachusetts Energy Improvement Project

Distribution List

Massachusetts Environmental Policy Act (MEPA) Distribution List

Agency	Email Address	Address
Massachusetts Environmental Policy Act (MEPA) Office	MEPA@mass.gov	**MEPA Office** 100 Cambridge Street, Suite 900 Boston, MA 02114
Department of Environmental Protection, Boston Office	helena.boccadoro@mass.gov	**Commissioner's Office** One Winter Street Boston, MA 02108
Department of Environmental Protection, Appropriate Regional Office and to each program from which a permit will be sought	Catherine.Skiba@mass.gov Sean.Gonsalves@mass.gov	**DEP/Western Regional Office** Attn: MEPA Coordinator State House West - 4th floor 436 Dwight Street Springfield, MA 01103
	andrea.briggs@mass.gov	**DEP/Central Regional Office** Attn: MEPA Coordinator 8 New Bond Street Worcester, MA 01606
Massachusetts Department of Transportation - Boston	MassDOTPPDU@dot.state.ma.us	**Public/Private Development Unit** 10 Park Plaza, Suite #4150 Boston, MA 02116
Massachusetts Department of Transportation – District Office	patrick.tierney@dot.state.ma.us	**District #1** Attn: MEPA Coordinator 270 Main Street Lenox, MA 01240
	bao.lang@dot.state.ma.us garrett.postema@dot.state.ma.us	**District #2** Attn: MEPA Coordinator 811 North King Street Northampton, MA 01060
	Kevin.R.Robenhymer@dot.state.ma.us Eric.Nascimento@dot.state.ma.us	**District #3** Attn: MEPA Coordinator 499 Plantation Parkway Worcester, MA 01605
Massachusetts Historical Commission	Mail one hard copy of the filing to MHC	**The MA Archives Building** 220 Morrissey Boulevard Boston, MA 02125
Applicable Regional Planning Agency	mepafiling@cmrpc.org	**Central Massachusetts Regional Planning Commission (CMRPC)**
	KMacPhee@frcog.org PSloan@frcog.org Mail two hard copies to FRCoG	**Franklin Regional Council of Governments (FRCoG)** Attn: Kimberly MacPhee and Peggy Sloan 12 Olive Street Greenfield, MA 01301

If the Project is located within five miles of an Environmental Justice Population	MEPA-EJ@mass.gov	**MEPA Office** Attn: EEA Environmental Justice Director 100 Cambridge Street, Suite 900 Boston, MA 02144
If the Project site is within or contains designated significant or estimated habitat, or priority sites of endangered or threatened species or species of special concern in accordance with the Massachusetts Endangered Species Act	melany.cheeseman@mass.gov emily.holt@mass.gov	**Natural Heritage and Endangered Species Program** Division of Fisheries & Wildlife 1 Rabbit Hill Road Westborough, MA 01581
If the Project affects DCR roadways, watersheds or other properties or an ACEC	andy.backman@mass.gov	**DCR** Attn: MEPA Coordinator 251 Causeway Street, Suite 600 Boston, MA 02114
If the Project implicates public health impacts	dphtoxicology@massmail.state.ma.us	**Department of Public Health** Director of Environmental Health 250 Washington Street Boston, MA 02115
If the Project is subject to Greenhouse Gas Emissions Policy or to review by Energy Facilities Siting Board	andrew.greene@mass.gov geneen.bartley@mass.gov	**Energy Facilities Siting Board** Attn: MEPA Coordinator One South Station Boston, MA 02110
	paul.ormond@mass.gov	**Department of Energy Resources** Attn: MEPA Coordinator 100 Cambridge Street, 10th floor Boston, MA 02114

Municipality Contacts

Municipality	Email Address	Address
Millbury	Board of Selectmen afleming@millburyma.gov	127 Elm Street Millbury, MA 01527
	Board of Health millburyboh@millburyma.gov jschold@millburyma.gov	
	Planning Board cmccormack@millburyma.gov	
	Conservation Commission rfoley@millburyma.gov	
	Millbury Public Library adallair@millburyma.gov	128 Elm Street Millbury, MA 01527
Auburn[1]	Select Board srufli@town.auburn.ma.us	104 Central Street Auburn, MA 01501
	Board of Health *Email not Provided*	
	Conservation Commission *Email not Provided*	
	Planning Board *Email not Provided*	
	Auburn Public Library *Email not Provided*	369 Southbridge Street Auburn, MA 01501
Leicester	Board of Health daglef@leicesterma.org	7 Washburn Square Leicester, MA 01524
	Conservation Commission conservation@leicesterma.org	3 Washburn Square Leicester, MA 01524
	Land Use & Planning Board planning@leicesterma.org	
	Select Board Selectboard@leicesterma.org	
	Leicester Public Library library@leicesterma.org	1136 Main Street Leicester, MA 01524

[1] Online Contact Form: https://www.auburnma.gov/formcenter/Contact-Us-Forms-10/Contact-Us-Auburn-Public-Library-61

Spencer	Board of Health ldaoust@spencerma.gov	157 Main Street Spencer, MA 01562
	Board of Selectmen jhoward@spencerma.gov	
	Planning Board mgervais@spencerma.gov	
	Conservation Commission conservation@spencerma.gov	
	Richard Sugden Library cdonahue@cwmars.org	8 Pleasant Street Spencer, MA 01562
East Brookfield[2]	Board of Health ebboh0343@eastbrookfieldma.us	122 Connie Mack Drive East Brookfield, MA 01515
	Conservation Commission conservation@eastbrookfieldma.us	
	Board of Selectmen ebbos300@eastbrookfieldma.us	
	Planning Board *Not Available*	
	East Brookfield Public Library ebplibrary@gmail.com	
North Brookfield	Board of Health health@northbrookfield.net	215 North Main Street North Brookfield, MA 01535
	Conservation Commission concomm01535@gmail.com	
	Board of Selectmen selectman@northbrookfield.net	
	Planning Board whking2005@gmail.com	
	Haston Free Public Library hastonfreepubliclibrary@gmail.com	161 N Main Street North Brookfield, MA 01535

[2] Online Form: https://www.eastbrookfieldma.us/home/webforms/contact-us

West Brookfield	Board of Health boh@wbrookfield.com	2 East Main Street West Brookfield, MA 01585
	Board of Selectmen bos@wbrookfield.com	
	Conservation Commission pskowyra@wbrookfield.com	
	Planning Board mczub@wbrookfield.com	
	Merriam-Gilbert Public Library merriamgilbert@gmail.com	3 W Main Street West Brookfield, MA 01585
Ware	Health Department acrete@townofware.com	Town Hall 126 Main Street Ware, MA 01082
	Selectboard sbeckley@townofware.com	
	Conservation Commission jprenosil@townofware.com	
	Planning & Community Development Department klucis@townofware.com	
	Young Men's Library Association hreed@cwmars.org	37 Main Street Ware, MA 01082
Belchertown	Health Department (see Town of Ware's Health Department contact)	Town Hall 2 Jabish Street Belchertown, MA 01007-0670
	Conservation Commission conservation@belchertown.org	
	Planning Board planning@belchertown.org	
	Select Board selectboard@belchertown.org	The Finnerty House One South Main Street Belchertown, MA 01007
	Clapp Memorial Library charbeson@cwmars.org	19 S Main Street Belchertown, MA 01007

Pelham	Health Department (see Town of Ware's Health Department contact)	Town Hall 126 Main Street Suite-D Ware, MA 01082
	Conservation Commission conservation@pelhamma.gov	351 Amherst Road Pelham, MA 01002
	Planning Board planning@pelhamma.gov	
	Select Board executiveassistant@pelhamma.gov	
	Pelham Free Public Library library.pelham@gmail.com	2 S Valley Rd, Pelham, MA 01002
Shutesbury	Board of Health boardhealth@shutesbury.org	1 Cooleyville Road, Shutesbury, MA 01072
	Planning Board planning@shutesbury.org	
	Select Board selectboard@shutesbury.org	
	Conservation Commission concom@shutesbury.org	
	M N Spear Memorial Library library.director@shutesbury.org	10 Cooleyville Rd, Shutesbury, MA 01072
Leverett	Board of Health boardofhealth@leverett.ma.us	9 Montague Road Leverett, MA 01054
	Select Board selectboard@leverett.ma.us	
	Planning Board planningbd@leverett.ma.us	
	Conservation Commission concom@leverett.ma.us	
	Leverett Library leverettlibrary@gmail.com	75 Montague Road Leverett, MA 01054

Sunderland[3]	Board of Health *Not Available*	12 School Street Sunderland, MA 01375
	Conservation Commission conservation@townofsunderland.us	
	Planning Board droscoe@pvpc.org	
	Selectboard *Not Available*	
	Sunderland Public Library director@sunderlandpubliclibrary.org	20 School Street Sunderland, MA 01375
Deerfield	Board of Health assistanthealthagent@town.deerfield.ma.us	8 Conway Street Deerfield Municipal Offices South Deerfield, MA 01373
	Conservation Commission bldgasst@town.deerfield.ma.us	
	Planning Board (see Town of Deerfield's Conservation Commission contact)	
	Selectboard thilchey@town.deerfield.ma.us	
	Tilton Library tiltonlibrary@cwmars.org	75 N Main Street South Deerfield, MA 01373
Conway	Board of Health boardofhealth@conwayma.gov	32 Main Street PO Box 240 Conway, MA 01341
	Conservation Commission concomm@conwayma.gov	
	Planning Board planningboard@conwayma.gov	
	Select Board cwaldo@conwayma.gov	Town Hall 5 Academy Hill Road Conway, MA 01341
	Field Memorial Library director@fieldmemoriallibrary.org	1 Elm Street Conway, MA 01341

[3] Online Form: https://www.townofsunderland.us/user/38/contact

Shelburne	Board of Health Boardofhealth@townofshelburnema.gov	51 Bridge Street Shelburne, MA 01370
	Conservation Commission conservation@townofshelburnema.gov	
	Planning Board Planningboard@townofshelburnema.gov	
	Selectboard townadmin@townofshelburnema.gov	51 Bridge Street, Shelburne, MA 01370
	Shelburne Free Public Library eantaya@cwmars.org	233 Shelburne Center Road, Shelburne Falls, MA 01370
	Arms Library armslibrary@gmail.com	60 Bridge Street, Shelburne Falls, MA 01370
NEP will make an attempt to provide a copy of the ENF Form through online portals when applicable.		

Environmental Justice (EJ) Reference List

First Name	Last Name	Title	Phone	Email	Affiliation
Heather	Clish	Director of Conservation & Recreation Policy	(617) 523-0655	hclish@outdoors.org	Appalachian Mountain Club
Kerry	Bowie	Board President	Not Provided	kerry@msaadapartners.com	Browning the GreenSpace
Alma	Gordon	President	Not Provided	tribalcouncil@chappaquiddickwampanoag.org	Chappaquiddick Tribe of the Wampanoag Nation
Patricia	D. Rocker	Council Chair	Not Provided	rockerpatriciad@verizon.net	Chappaquiddick Tribe of the Wampanoag Nation, Whale Clan
Cindy	Luppi	New England Director	(617) 338-8131 x208	cluppi@cleanwater.org	Clean Water Action
Sylvia	Broude	Executive Director	(617) 292-4821	sylvia@communityactionworks.org	Community Action Works
Ryan	Odonnell	Water Quality Monitoring Coordinator	Not Provided	rodonnell@ctriver.org	Connecticut River Conservancy
Ryan	Odonnell	Water Quality Monitoring Coordinator	Not Provided	rodonnell@ctriver.org	Connecticut River Conservancy
Johannes	Epke	Staff Attorney	(617) 850-1761	jepke@clf.org	Conservation Law Foundation
Britteny	Jenkins	Vice President		Bjenkins@clf.org	Conservation Law Foundation
Ben	Hellerstein	MA State Director	(617) 747-4368	ben@environmentmassachusetts.org	Environment Massachusetts
Amy	Boyd Rabin	Vice President of Policy	(617) 221-8258	aboydrabin@environmentalleague.org	Environmental League of Massachusetts
Zahra	Saifee	Policy & Advocacy Coordinator	(435) 632-9482	zsaifee@environmentalleague.org	Environmental League of Massachusetts
Melissa	Ferretti	Chair	(508) 304-5023	melissa@herringpondtribe.org	Herring Pond Wampanoag Tribe

Mark	Wamsley	Conservation Director	Not Provided	mark@kestreltrust.org	Kestrel Land Trust
Brian	Weeden	Chair	(774) 413-0520	Brian.Weeden@mwtribe-nsn.gov	Mashpee Wampanoag Tribe
David	Weeden	THPO/Director	(774) 327.0068	David.Weeden@mwtribe-nsn.gov	Mashpee Wampanoag Tribe
Nakia	Hendricks Jr.	Office Manager	Not Provided	106Review@mwtribe-nsn.gov	Mashpee Wampanoag Tribe
Heidi	Ricci	Director of Policy	Not Provided	hricci@massaudubon.org	Mass Audubon
Robb	Johnson	Executive Director	(978) 443-2233	robb@massland.org	Mass Land Trust Coalition
Julia	Blatt	Executive Director	(617) 714-4272	juliablatt@massriversalliance.org	Mass Rivers Alliance
John	Peters, Jr.	Executive Director	(617) 573-1292	john.peters@mass.gov	Massachusetts Commission on Indian Affairs (MCIA)
Elizabeth	Solomon	Not Provided	Not Provided	Solomon.Elizabeth@gmail.com	Massachusetts Tribe at Ponkapoag
Lena Miles	Entin Gresham	Interim Co-Directors	Not Provided	Lena@N2NMa.org Miles@N2NMa.org	Neighbor to Neighbor Mass.
Cheryll	Toney Holley	Chair	(774) 317-9138	crwritings@aol.com	Nipmuc Nation (Hassanamisco Nipmucs)
Raquel	Halsey	Executive Director	(617) 232-0343	rhalsey@naicob.org	North American Indian Center of Boston
Rob	Moir	Executive Director	Not Provided	rob@oceanriver.org	Ocean River Institute
Cora	Pierce	Not Provided	Not Provided	Coradot@yahoo.com	Pocassett Wampanoag Tribe
Sarita	Hudson	Director Programs & Development	(413) 794-7739	shudson@publichealthwm.org	Public Health Institute of Western Mass
Sarita	Hudson	Director Programs & Development	(413) 794-7739	shudson@publichealthwm.org	Public Health Institute of Western Mass
Vickash	Mohanka	Director, MA Chapter	Not Provided	vick.mohanka@sierraclub.org	Sierra Club MA

Stockbridge-Munsee Tribe		Historic Preservation Manager	(413) 884-6048	THPO@Mohican-nsn.gov	Stockbridge-Munsee Tribe
Jodi	Valenta	Massachusetts State Director	(617) 367-6200	Jodi.Valenta@tpl.org	The Trust for Public Land
Claire	B.W. Muller	Movement Building Director	(508) 308-9261	claire@uumassaction.org	Unitarian Universalist Mass Action Network
Bettina	Washington	Tribal Historic Preservation Officer	(508) 560-9014	thpo@wampanoagtribe-nsn.gov	Wampanoag Tribe of Gay Head (Aquinnah)

Appendix C – RMAT Tool

Environmental Notification Form (ENF)

Central To Western Massachusetts Energy Improvement Project

RMAT Report

Town of Auburn

Climate Resilience Design Standards Tool Project Report

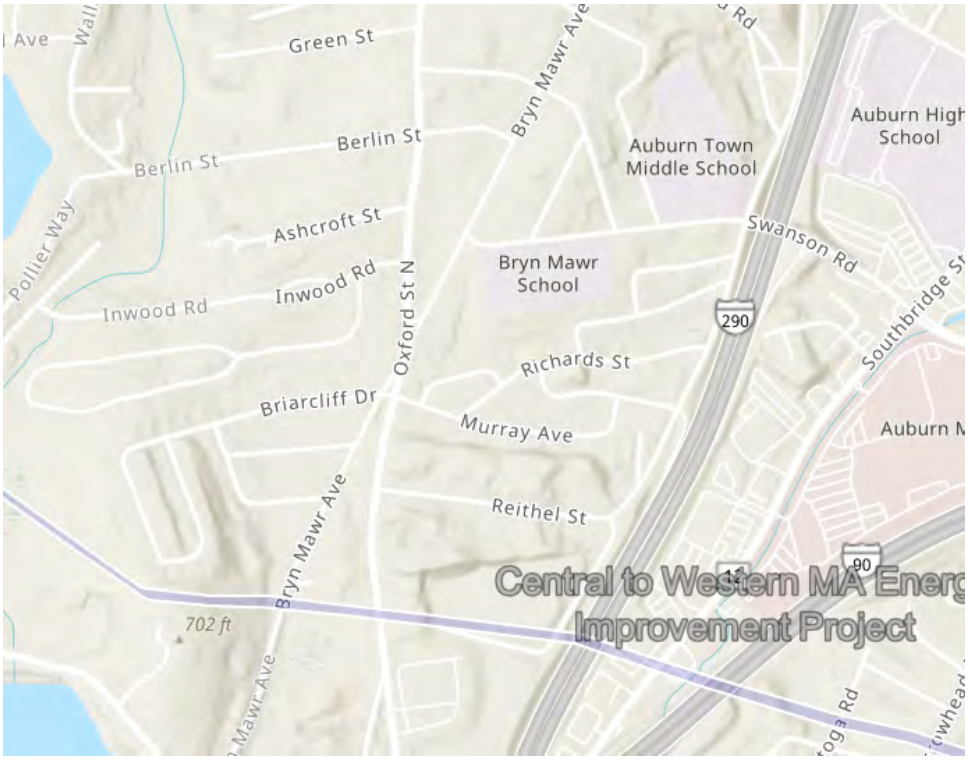
Central to Western MA Energy Improvement Project
Date Created: 5/16/2024 1:26:45 PM
Created By: JP
Date Report Generated: 5/18/2024 6:54:00 PM
Tool Version: Version 1.2
Project Contact Information: Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)

Project Summary

Link to Project

Estimated Capital Cost: $100000000.00
End of Useful Life Year: 2075
Project within mapped Environmental Justice neighborhood: Yes

Ecosystem Service Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	High Exposure
Extreme Precipitation - Riverine Flooding	High Exposure
Extreme Heat	High Exposure



Asset Preliminary Climate Risk Rating Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Infrastructure	Low Risk	High Risk	High Risk	High Risk

Climate Resilience Design Standards Summary

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Infrastructure					
Extreme Precipitation					
Infrastructure	2070			50-yr (2%)	Tier 3
Extreme Heat					
Infrastructure	2070		90th		Tier 3

Scoring Rationale - Project Exposure Score

The purpose of the Exposure Score output is to provide a preliminary assessment of whether the overall project site and subsequent assets are exposed to impacts of natural hazard events and/or future impacts of climate change. For each climate parameter, the Tool will calculate one of the following exposure ratings: Not Exposed, Low Exposure, Moderate Exposure, or High Exposure. The rationale behind the exposure rating is provided below.

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "High Exposure" because of the following:

- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site
- No increase to impervious area
- Existing impervious area of the project site is between 10% and 50%

Extreme Precipitation - Riverine Flooding

This project received a "High Exposure" because of the following:

- Project site has a history of riverine flooding
- Part of the project is within a mapped FEMA floodplain, outside of the Massachusetts Coast Flood Risk Model (MC-FRM)
- Part of the project is within 100ft of a waterbody
- Project is not likely susceptible to riverine erosion

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Existing trees are being removed as part of the proposed project
- Existing impervious area of the project site is between 10% and 50%
- Located within 100 ft of existing water body
- No increase to the impervious area of the project site

Scoring Rationale - Asset Preliminary Climate Risk Rating

A Preliminary Climate Risk Rating is determined for each infrastructure and building asset by considering the overall project Exposure Score and responses to Step 4 questions provided by the user in the Tool. Natural Resource assets do not receive a risk rating. The following factors are what influenced the risk ratings for each asset.

Asset - Infrastructure
Primary asset criticality factors influencing risk ratings for this asset:

- Asset may inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event
- Loss/inoperability of the asset would have regional impacts
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- Spills and/or releases of hazardous materials would be relatively easy to clean up

Project Climate Resilience Design Standards Output

Climate Resilience Design Standards and Guidance are recommended for each asset and climate parameter. The Design Standards for each climate parameter include the following: recommended planning horizon (target and/or intermediate), recommended return period (Sea Level Rise/Storm Surge and Precipitation) or percentile (Heat), and a list of applicable design criteria that are likely to be affected by climate change. Some design criteria have numerical values associated with the recommended return period and planning horizon, while others have tiered methodologies with step-by-step instructions on how to estimate design values given the other recommended design standards.

Asset: Infrastructure — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: NOT APPLICABLE

Projected Water Surface Elevation: NOT APPLICABLE

Projected Wave Action Water Elevation: NOT APPLICABLE

Projected Wave Heights: NOT APPLICABLE

Projected Duration of Flooding: NOT APPLICABLE

Projected Design Flood Velocity: NOT APPLICABLE

Projected Scour & Erosion: NOT APPLICABLE

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 50-yr (2%)

LIMITATIONS: The recommended Standards for Total Precipitation Depth & Peak Intensity are determined by the user drawn polygon and relationships as defined in the Supporting Documents. The projected Total Precipitation Depth values provided through the Tool are based on the climate projections developed by Cornell University as part of EEA's Massachusetts Climate and Hydrologic Risk Project, GIS-based data as of 10/15/21. For additional information on the methodology of these precipitation outputs, see Supporting Documents.

While Total Precipitation Depth & Peak Intensity for 24-hour Design Storms are useful to inform planning and design, it is recommended to also consider additional longer- and shorter-duration precipitation events and intensities in accordance with best practices. Longer-duration, lower-intensity storms allow time for infiltration and reduce the load on infrastructure over the duration of the storm. Shorter-duration, higher-intensity storms often have higher runoff volumes because the water does not have enough time to infiltrate infrastructure systems (e.g., catch basins) and may overflow or back up during such storms, resulting in flooding. In the Northeast, short-duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. While the Tool does not provide recommended design standards for these scenarios, users should still consider both short- and long-duration precipitation events and how they may impact the asset.

The projected values, standards, and guidance provided within this Tool may be used to inform plans and designs, but they do not provide guarantees for future conditions or resilience. The projected values are not to be considered final or appropriate for construction documents without supporting engineering analyses. The guidance provided within this Tool is intended to be general and users are encouraged to do their own due diligence

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: APPLICABLE

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Infrastructure	2070	50-Year (2%)	9.3	Downloadable Methodology PDF

Projected Riverine Peak Discharge & Peak Flood Elevation: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Extreme Heat High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Heat Index: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Growing Degree Days: NOT APPLICABLE

Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Number of Heat Waves Per Year & Average Heat Wave Duration: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Cooling Degree Days & Heating Degree Days (base = 65°F): NOT APPLICABLE

Project Inputs

Core Project Information

Name:	Central to Western MA Energy Improvement Project
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2075
Location of Project:	Auburn
Estimated Capital Cost:	$100,000,000
Who is the Submitting Entity?	Private Other National Grid Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Permitting
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	NEP owns and operates double-circuit 69 kV lines (E5 and F6 lines) that begins at the Deerfield #4 Substation in Shelburne through Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn, and terminating at the Milbury #305 Substation in Millbury. Tap lines consist of the existing Quabbin Switch Tap (E5W/F6W) in Belchertown, Deerfield #3 in Shelburne, Pondville Sub Tap in Auburn, Leicester Sub Tap in Leicester, and Lashway Sub Tap in North Brookfield. The E5/F6 lines were constructed in the early 1900s and refurbished in 2001. Structures and wires are in need of replacement due to asset condition and aging infrastructure. In addition, the access conditions vary considerably throughout the ROW. Although the new E5/F6 Transmission Lines will operate at 69 kV when they are first placed into service, they are being designed and built to support operation at 115 kV at some point during their expected life.
Project Submission Comments:	

Project Ecosystem Service Benefits

Factors Influencing Output

- ✓ Project filters stormwater using green infrastructure
- ✓ Project provides pollinator habitat
- ✓ Project provides recreation

Factors to Improve Output

- ✓ Incorporate strategies that reduce carbon emissions
- ✓ Identify opportunities to prevent pollutants from impacting ecosystems

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	No
Filters stormwater using green infrastructure	Yes
Improves water quality	No
Promotes decarbonization	Maybe
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	Maybe
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	Yes
Provides recreation	Yes

Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	Unsure
Does the project site have a history of riverine flooding?	Yes
Does the project result in a net increase in impervious area of the site?	No
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Infrastructure
Asset Type: Utility Infrastructure
Asset Sub-Type: Energy (electric, gas, petroleum, renewable)
Construction Type: Major Repair/Retrofit
Construction Year: 2025
Useful Life: 50

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure may be inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event.

Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)

Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Less than 100,000 people

Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

Will the infrastructure reduce the risk of flooding?
No

If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses

If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
Spills and/or releases of hazardous materials are expected with relatively easy cleanup

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate

If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million

Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrasturcture may reduce the ability to maintain most government services, while some sevices will still exist

What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

Town of Belchertown

Climate Resilience Design Standards Tool Project Report

Central to Western MA Energy Improvement Project

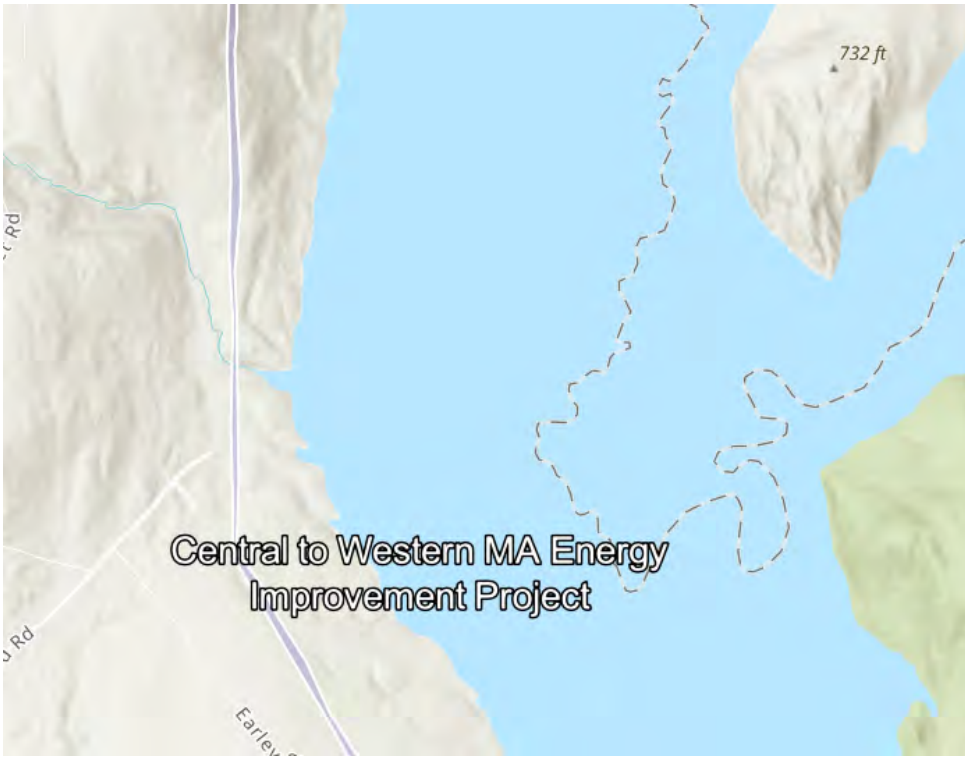
Date Created: 5/18/2024 1:17:38 PM
Created By: JP
Date Report Generated: 5/18/2024 1:35:16 PM
Tool Version: Version 1.2
Project Contact Information: Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)

Project Summary

Link to Project

Estimated Capital Cost: $100000000.00
End of Useful Life Year: 2075
Project within mapped Environmental Justice neighborhood: No

Ecosystem Service Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	Moderate Exposure
Extreme Precipitation - Riverine Flooding	High Exposure
Extreme Heat	High Exposure



Asset Preliminary Climate Risk Rating Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Infrastructure	Low Risk	High Risk	High Risk	High Risk

Climate Resilience Design Standards Summary

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Infrastructure					
Extreme Precipitation					
Infrastructure	2070			50-yr (2%)	Tier 3
Extreme Heat					
Infrastructure	2070		90th		Tier 3

Scoring Rationale - Project Exposure Score

The purpose of the Exposure Score output is to provide a preliminary assessment of whether the overall project site and subsequent assets are exposed to impacts of natural hazard events and/or future impacts of climate change. For each climate parameter, the Tool will calculate one of the following exposure ratings: Not Exposed, Low Exposure, Moderate Exposure, or High Exposure. The rationale behind the exposure rating is provided below.

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "Moderate Exposure" because of the following:

- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site
- No increase to impervious area
- Existing impervious area of the project site is less than 10%

Extreme Precipitation - Riverine Flooding

This project received a "High Exposure" because of the following:

- Project site has a history of riverine flooding
- Part of the project is within a mapped FEMA floodplain, outside of the Massachusetts Coast Flood Risk Model (MC-FRM)
- Part of the project is within 100ft of a waterbody
- Project is not likely susceptible to riverine erosion

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Existing trees are being removed as part of the proposed project
- Between 10% and 40% of the existing project site has canopy cover
- Located within 100 ft of existing water body
- No increase to the impervious area of the project site

Scoring Rationale - Asset Preliminary Climate Risk Rating

A Preliminary Climate Risk Rating is determined for each infrastructure and building asset by considering the overall project Exposure Score and responses to Step 4 questions provided by the user in the Tool. Natural Resource assets do not receive a risk rating. The following factors are what influenced the risk ratings for each asset.

Asset - Infrastructure
Primary asset criticality factors influencing risk ratings for this asset:

- Asset may inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event
- Loss/inoperability of the asset would have regional impacts
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- Spills and/or releases of hazardous materials would be relatively easy to clean up

Project Climate Resilience Design Standards Output

Climate Resilience Design Standards and Guidance are recommended for each asset and climate parameter. The Design Standards for each climate parameter include the following: recommended planning horizon (target and/or intermediate), recommended return period (Sea Level Rise/Storm Surge and Precipitation) or percentile (Heat), and a list of applicable design criteria that are likely to be affected by climate change. Some design criteria have numerical values associated with the recommended return period and planning horizon, while others have tiered methodologies with step-by-step instructions on how to estimate design values given the other recommended design standards.

Asset: Infrastructure — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: NOT APPLICABLE

Projected Water Surface Elevation: NOT APPLICABLE

Projected Wave Action Water Elevation: NOT APPLICABLE

Projected Wave Heights: NOT APPLICABLE

Projected Duration of Flooding: NOT APPLICABLE

Projected Design Flood Velocity: NOT APPLICABLE

Projected Scour & Erosion: NOT APPLICABLE

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 50-yr (2%)

LIMITATIONS: The recommended Standards for Total Precipitation Depth & Peak Intensity are determined by the user drawn polygon and relationships as defined in the Supporting Documents. The projected Total Precipitation Depth values provided through the Tool are based on the climate projections developed by Cornell University as part of EEA's Massachusetts Climate and Hydrologic Risk Project, GIS-based data as of 10/15/21. For additional information on the methodology of these precipitation outputs, see Supporting Documents.

While Total Precipitation Depth & Peak Intensity for 24-hour Design Storms are useful to inform planning and design, it is recommended to also consider additional longer- and shorter-duration precipitation events and intensities in accordance with best practices. Longer-duration, lower-intensity storms allow time for infiltration and reduce the load on infrastructure over the duration of the storm. Shorter-duration, higher-intensity storms often have higher runoff volumes because the water does not have enough time to infiltrate infrastructure systems (e.g., catch basins) and may overflow or back up during such storms, resulting in flooding. In the Northeast, short-duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. While the Tool does not provide recommended design standards for these scenarios, users should still consider both short- and long-duration precipitation events and how they may impact the asset.

The projected values, standards, and guidance provided within this Tool may be used to inform plans and designs, but they do not provide guarantees for future conditions or resilience. The projected values are not to be considered final or appropriate for construction documents without supporting engineering analyses. The guidance provided within this Tool is intended to be general and users are encouraged to do their own due diligence

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: APPLICABLE

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Infrastructure	2070	50-Year (2%)	9.3	Downloadable Methodology PDF

Projected Riverine Peak Discharge & Peak Flood Elevation: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Extreme Heat High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Heat Index: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Growing Degree Days: NOT APPLICABLE

Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Number of Heat Waves Per Year & Average Heat Wave Duration: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Cooling Degree Days & Heating Degree Days (base = 65°F): NOT APPLICABLE

Project Inputs

Core Project Information

Name:	Central to Western MA Energy Improvement Project
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2075
Location of Project:	Belchertown
Estimated Capital Cost:	$100,000,000
Who is the Submitting Entity?	Private Other National Grid Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Permitting
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	NEP owns and operates double-circuit 69 kV lines (E5 and F6 lines) that begins at the Deerfield #4 Substation in Shelburne through Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn, and terminating at the Milbury #305 Substation in Millbury. Tap lines consist of the existing Quabbin Switch Tap (E5W/F6W) in Belchertown, Deerfield #3 in Shelburne, Pondville Sub Tap in Auburn, Leicester Sub Tap in Leicester, and Lashway Sub Tap in North Brookfield. The E5/F6 lines were constructed in the early 1900s and refurbished in 2001. Structures and wires are in need of replacement due to asset condition and aging infrastructure. In addition, the access conditions vary considerably throughout the ROW. Although the new E5/F6 Transmission Lines will operate at 69 kV when they are first placed into service, they are being designed and built to support operation at 115 kV at some point during their expected life.

Project Submission Comments:

Project Ecosystem Service Benefits

Factors Influencing Output

- ✓ Project filters stormwater using green infrastructure
- ✓ Project provides pollinator habitat
- ✓ Project provides recreation

Factors to Improve Output

- ✓ Incorporate strategies that reduce carbon emissions
- ✓ Identify opportunities to prevent pollutants from impacting ecosystems

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	No
Filters stormwater using green infrastructure	Yes
Improves water quality	No
Promotes decarbonization	Maybe
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	Maybe
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	Yes
Provides recreation	Yes

Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	Unsure
Does the project site have a history of riverine flooding?	Yes
Does the project result in a net increase in impervious area of the site?	No
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Infrastructure
Asset Type: Utility Infrastructure
Asset Sub-Type: Energy (electric, gas, petroleum, renewable)
Construction Type: Major Repair/Retrofit
Construction Year: 2025
Useful Life: 50

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure may be inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event.

Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)

Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Less than 100,000 people

Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

Will the infrastructure reduce the risk of flooding?
No

If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses

If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
Spills and/or releases of hazardous materials are expected with relatively easy cleanup

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate

If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million

Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrasturcture may reduce the ability to maintain most government services, while some sevices will still exist

What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

Town of Conway

Climate Resilience Design Standards Tool Project Report

Central to Western MA Energy Improvement Project
Date Created: 5/16/2024 6:18:00 PM
Created By: JP
Date Report Generated: 5/18/2024 12:04:43 PM
Tool Version: Version 1.2
Project Contact Information: Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)

Project Summary

Link to Project

Estimated Capital Cost: $100000000.00
End of Useful Life Year: 2075
Project within mapped Environmental Justice neighborhood: No

Ecosystem Service Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	Moderate Exposure
Extreme Precipitation - Riverine Flooding	High Exposure
Extreme Heat	High Exposure



Asset Preliminary Climate Risk Rating Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Infrastructure	Low Risk	High Risk	High Risk	High Risk

Climate Resilience Design Standards Summary

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Infrastructure					
Extreme Precipitation					
Infrastructure	2070			50-yr (2%)	Tier 3
Extreme Heat					
Infrastructure	2070		90th		Tier 3

Scoring Rationale - Project Exposure Score

The purpose of the Exposure Score output is to provide a preliminary assessment of whether the overall project site and subsequent assets are exposed to impacts of natural hazard events and/or future impacts of climate change. For each climate parameter, the Tool will calculate one of the following exposure ratings: Not Exposed, Low Exposure, Moderate Exposure, or High Exposure. The rationale behind the exposure rating is provided below.

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "Moderate Exposure" because of the following:

- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site
- No increase to impervious area
- Existing impervious area of the project site is less than 10%

Extreme Precipitation - Riverine Flooding

This project received a "High Exposure" because of the following:

- Project site has a history of riverine flooding
- Part of the project is within 100ft of a waterbody
- Project is potentially susceptible to riverine erosion
- The project is not within a mapped FEMA floodplain [outside of the Massachusetts Coast Flood Risk Model (MC-FRM)]

Extreme Heat

This project received a "High Exposure" because of the following:

- Existing trees are being removed as part of the proposed project
- Between 10% and 40% of the existing project site has canopy cover
- 10 to 30 day increase in days over 90 deg. F within project's useful life
- Located within 100 ft of existing water body
- No increase to the impervious area of the project site

Scoring Rationale - Asset Preliminary Climate Risk Rating

A Preliminary Climate Risk Rating is determined for each infrastructure and building asset by considering the overall project Exposure Score and responses to Step 4 questions provided by the user in the Tool. Natural Resource assets do not receive a risk rating. The following factors are what influenced the risk ratings for each asset.

Asset - Infrastructure
Primary asset criticality factors influencing risk ratings for this asset:

- Asset may inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event
- Loss/inoperability of the asset would have regional impacts
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- Spills and/or releases of hazardous materials would be relatively easy to clean up

Project Climate Resilience Design Standards Output

Climate Resilience Design Standards and Guidance are recommended for each asset and climate parameter. The Design Standards for each climate parameter include the following: recommended planning horizon (target and/or intermediate), recommended return period (Sea Level Rise/Storm Surge and Precipitation) or percentile (Heat), and a list of applicable design criteria that are likely to be affected by climate change. Some design criteria have numerical values associated with the recommended return period and planning horizon, while others have tiered methodologies with step-by-step instructions on how to estimate design values given the other recommended design standards.

Asset: Infrastructure — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: NOT APPLICABLE

Projected Water Surface Elevation: NOT APPLICABLE

Projected Wave Action Water Elevation: NOT APPLICABLE

Projected Wave Heights: NOT APPLICABLE

Projected Duration of Flooding: NOT APPLICABLE

Projected Design Flood Velocity: NOT APPLICABLE

Projected Scour & Erosion: NOT APPLICABLE

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 50-yr (2%)

LIMITATIONS: The recommended Standards for Total Precipitation Depth & Peak Intensity are determined by the user drawn polygon and relationships as defined in the Supporting Documents. The projected Total Precipitation Depth values provided through the Tool are based on the climate projections developed by Cornell University as part of EEA's Massachusetts Climate and Hydrologic Risk Project, GIS-based data as of 10/15/21. For additional information on the methodology of these precipitation outputs, see Supporting Documents.

While Total Precipitation Depth & Peak Intensity for 24-hour Design Storms are useful to inform planning and design, it is recommended to also consider additional longer- and shorter-duration precipitation events and intensities in accordance with best practices. Longer-duration, lower-intensity storms allow time for infiltration and reduce the load on infrastructure over the duration of the storm. Shorter-duration, higher-intensity storms often have higher runoff volumes because the water does not have enough time to infiltrate infrastructure systems (e.g., catch basins) and may overflow or back up during such storms, resulting in flooding. In the Northeast, short-duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. While the Tool does not provide recommended design standards for these scenarios, users should still consider both short- and long-duration precipitation events and how they may impact the asset.

The projected values, standards, and guidance provided within this Tool may be used to inform plans and designs, but they do not provide guarantees for future conditions or resilience. The projected values are not to be considered final or appropriate for construction documents without supporting engineering analyses. The guidance provided within this Tool is intended to be general and users are encouraged to do their own due diligence

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: APPLICABLE

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Infrastructure	2070	50-Year (2%)	8.8	Downloadable Methodology PDF

Projected Riverine Peak Discharge & Peak Flood Elevation: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Extreme Heat High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Heat Index: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Growing Degree Days: NOT APPLICABLE

Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Number of Heat Waves Per Year & Average Heat Wave Duration: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Cooling Degree Days & Heating Degree Days (base = 65°F): NOT APPLICABLE

Project Inputs

Core Project Information

Name:	Central to Western MA Energy Improvement Project
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2075
Location of Project:	Conway
Estimated Capital Cost:	$100,000,000
Who is the Submitting Entity?	Private Other National Grid Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Permitting
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	NEP owns and operates double-circuit 69 kV lines (E5 and F6 lines) that begins at the Deerfield #4 Substation in Shelburne through Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn, and terminating at the Milbury #305 Substation in Millbury. Tap lines consist of the existing Quabbin Switch Tap (E5W/F6W) in Belchertown, Deerfield #3 in Shelburne, Pondville Sub Tap in Auburn, Leicester Sub Tap in Leicester, and Lashway Sub Tap in North Brookfield. The E5/F6 lines were constructed in the early 1900s and refurbished in 2001. Structures and wires are in need of replacement due to asset condition and aging infrastructure. In addition, the access conditions vary considerably throughout the ROW. Although the new E5/F6 Transmission Lines will operate at 69 kV when they are first placed into service, they are being designed and built to support operation at 115 kV at some point during their expected life.

Project Submission Comments:

Project Ecosystem Service Benefits

Factors Influencing Output

- ✓ Project filters stormwater using green infrastructure
- ✓ Project provides pollinator habitat
- ✓ Project provides recreation

Factors to Improve Output

- ✓ Incorporate strategies that reduce carbon emissions
- ✓ Identify opportunities to prevent pollutants from impacting ecosystems

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	No
Filters stormwater using green infrastructure	Yes
Improves water quality	No
Promotes decarbonization	Maybe
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	Maybe
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	Yes
Provides recreation	Yes

Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	Unsure
Does the project site have a history of riverine flooding?	Yes
Does the project result in a net increase in impervious area of the site?	No
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Infrastructure
Asset Type: Utility Infrastructure
Asset Sub-Type: Energy (electric, gas, petroleum, renewable)
Construction Type: Major Repair/Retrofit
Construction Year: 2025
Useful Life: 50

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure may be inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event.

Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)

Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Less than 100,000 people

Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

Will the infrastructure reduce the risk of flooding?
No

If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses

If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
Spills and/or releases of hazardous materials are expected with relatively easy cleanup

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate

If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million

Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrasturcture may reduce the ability to maintain most government services, while some sevices will still exist

What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

Town of Deerfield

Climate Resilience Design Standards Tool Project Report

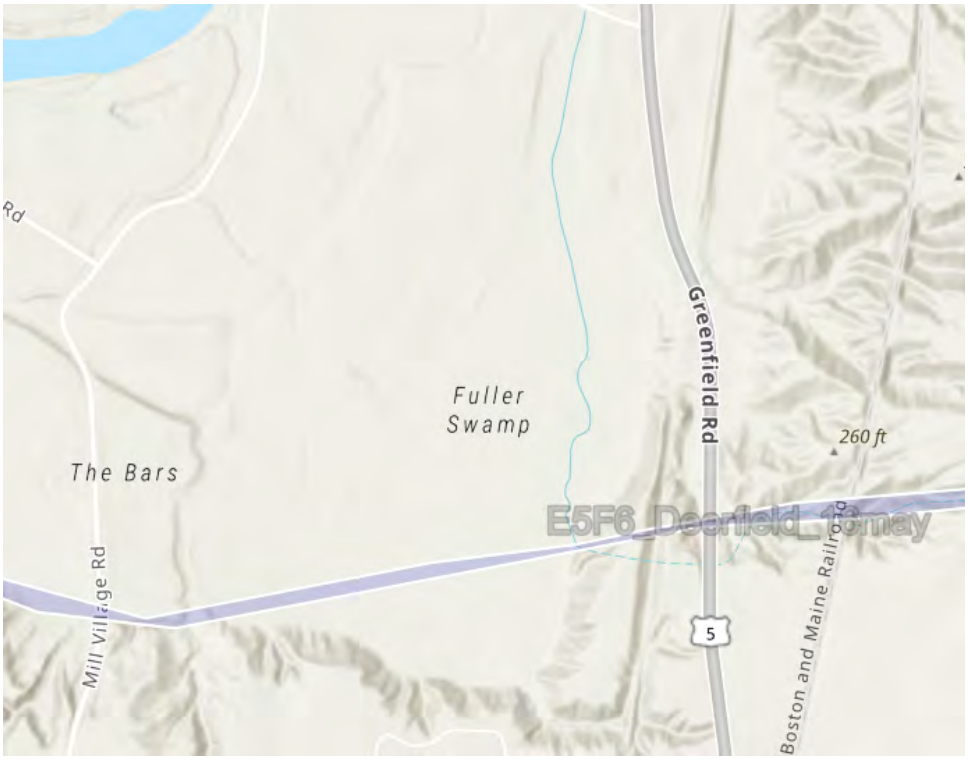
E5F6_Deerfield_16may
Date Created: 5/16/2024 6:21:01 PM
Created By: JP
Date Report Generated: 5/16/2024 6:52:41 PM
Tool Version: Version 1.2
Project Contact Information: Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)

Project Summary

Link to Project

Estimated Capital Cost: $100000000.00
End of Useful Life Year: 2075
Project within mapped Environmental Justice neighborhood: No

Ecosystem Service Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	Moderate Exposure
Extreme Precipitation - Riverine Flooding	High Exposure
Extreme Heat	High Exposure



Asset Preliminary Climate Risk Rating Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Infrastructure	Low Risk	High Risk	High Risk	High Risk

Climate Resilience Design Standards Summary

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Infrastructure					
Extreme Precipitation					
Infrastructure	2070			50-yr (2%)	Tier 3
Extreme Heat					
Infrastructure	2070		90th		Tier 3

Scoring Rationale - Project Exposure Score

The purpose of the Exposure Score output is to provide a preliminary assessment of whether the overall project site and subsequent assets are exposed to impacts of natural hazard events and/or future impacts of climate change. For each climate parameter, the Tool will calculate one of the following exposure ratings: Not Exposed, Low Exposure, Moderate Exposure, or High Exposure. The rationale behind the exposure rating is provided below.

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "Moderate Exposure" because of the following:

- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site
- No increase to impervious area
- Existing impervious area of the project site is less than 10%

Extreme Precipitation - Riverine Flooding

This project received a "High Exposure" because of the following:

- Project site has a history of riverine flooding
- Part of the project is within 100ft of a waterbody
- Project is potentially susceptible to riverine erosion
- The project is not within a mapped FEMA floodplain [outside of the Massachusetts Coast Flood Risk Model (MC-FRM)]

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Existing trees are being removed as part of the proposed project
- Existing impervious area of the project site is less than 10%
- Located within 100 ft of existing water body
- No increase to the impervious area of the project site

Scoring Rationale - Asset Preliminary Climate Risk Rating

A Preliminary Climate Risk Rating is determined for each infrastructure and building asset by considering the overall project Exposure Score and responses to Step 4 questions provided by the user in the Tool. Natural Resource assets do not receive a risk rating. The following factors are what influenced the risk ratings for each asset.

Asset - Infrastructure
Primary asset criticality factors influencing risk ratings for this asset:

- Asset may inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event
- Loss/inoperability of the asset would have regional impacts
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- Spills and/or releases of hazardous materials would be relatively easy to clean up

Project Climate Resilience Design Standards Output

Climate Resilience Design Standards and Guidance are recommended for each asset and climate parameter. The Design Standards for each climate parameter include the following: recommended planning horizon (target and/or intermediate), recommended return period (Sea Level Rise/Storm Surge and Precipitation) or percentile (Heat), and a list of applicable design criteria that are likely to be affected by climate change. Some design criteria have numerical values associated with the recommended return period and planning horizon, while others have tiered methodologies with step-by-step instructions on how to estimate design values given the other recommended design standards.

Asset: Infrastructure — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: NOT APPLICABLE

Projected Water Surface Elevation: NOT APPLICABLE

Projected Wave Action Water Elevation: NOT APPLICABLE

Projected Wave Heights: NOT APPLICABLE

Projected Duration of Flooding: NOT APPLICABLE

Projected Design Flood Velocity: NOT APPLICABLE

Projected Scour & Erosion: NOT APPLICABLE

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 50-yr (2%)

LIMITATIONS: The recommended Standards for Total Precipitation Depth & Peak Intensity are determined by the user drawn polygon and relationships as defined in the Supporting Documents. The projected Total Precipitation Depth values provided through the Tool are based on the climate projections developed by Cornell University as part of EEA's Massachusetts Climate and Hydrologic Risk Project, GIS-based data as of 10/15/21. For additional information on the methodology of these precipitation outputs, see Supporting Documents.

While Total Precipitation Depth & Peak Intensity for 24-hour Design Storms are useful to inform planning and design, it is recommended to also consider additional longer- and shorter-duration precipitation events and intensities in accordance with best practices. Longer-duration, lower-intensity storms allow time for infiltration and reduce the load on infrastructure over the duration of the storm. Shorter-duration, higher-intensity storms often have higher runoff volumes because the water does not have enough time to infiltrate infrastructure systems (e.g., catch basins) and may overflow or back up during such storms, resulting in flooding. In the Northeast, short-duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. While the Tool does not provide recommended design standards for these scenarios, users should still consider both short- and long-duration precipitation events and how they may impact the asset.

The projected values, standards, and guidance provided within this Tool may be used to inform plans and designs, but they do not provide guarantees for future conditions or resilience. The projected values are not to be considered final or appropriate for construction documents without supporting engineering analyses. The guidance provided within this Tool is intended to be general and users are encouraged to do their own due diligence

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: APPLICABLE

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Infrastructure	2070	50-Year (2%)	8.9	Downloadable Methodology PDF

Projected Riverine Peak Discharge & Peak Flood Elevation: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Extreme Heat High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Heat Index: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Growing Degree Days: NOT APPLICABLE

Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Number of Heat Waves Per Year & Average Heat Wave Duration: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Cooling Degree Days & Heating Degree Days (base = 65°F): NOT APPLICABLE

Project Inputs

Core Project Information

Name:	E5F6_Deerfield_16may
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2075
Location of Project:	Deerfield
Estimated Capital Cost:	$100,000,000
Who is the Submitting Entity?	Private Other National Grid Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Permitting
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	NEP owns and operates double-circuit 69 kV lines (E5 and F6 lines) that begins at the Deerfield #4 Substation in Shelburne through Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn, and terminating at the Milbury #305 Substation in Millbury. Tap lines consist of the existing Quabbin Switch Tap (E5W/F6W) in Belchertown, Deerfield #3 in Shelburne, Pondville Sub Tap in Auburn, Leicester Sub Tap in Leicester, and Lashway Sub Tap in North Brookfield. The E5/F6 lines were constructed in the early 1900s and refurbished in 2001. Structures and wires are in need of replacement due to asset condition and aging infrastructure. In addition, the access conditions vary considerably throughout the ROW. Although the new E5/F6 Transmission Lines will operate at 69 kV when they are first placed into service, they are being designed and built to support operation at 115 kV at some point during their expected life.

Project Submission Comments:

Project Ecosystem Service Benefits

Factors Influencing Output

- ✓ Project filters stormwater using green infrastructure
- ✓ Project provides pollinator habitat
- ✓ Project provides recreation

Factors to Improve Output

- ✓ Incorporate strategies that reduce carbon emissions
- ✓ Identify opportunities to prevent pollutants from impacting ecosystems

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	No
Filters stormwater using green infrastructure	Yes
Improves water quality	No
Promotes decarbonization	Maybe
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	Maybe
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	Yes
Provides recreation	Yes

Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	Unsure
Does the project site have a history of riverine flooding?	Yes
Does the project result in a net increase in impervious area of the site?	No
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Infrastructure
Asset Type: Utility Infrastructure
Asset Sub-Type: Energy (electric, gas, petroleum, renewable)
Construction Type: Major Repair/Retrofit
Construction Year: 2025
Useful Life: 50

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure may be inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event.

Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)

Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Less than 100,000 people

Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

Will the infrastructure reduce the risk of flooding?
No

If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses

If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
Spills and/or releases of hazardous materials are expected with relatively easy cleanup

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate

If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million

Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrasturcture may reduce the ability to maintain most government services, while some sevices will still exist

What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

Town of East Brookfield

Climate Resilience Design Standards Tool Project Report

Central to Western MA Energy Improvement Project_EB
Date Created: 5/18/2024 4:02:41 PM Created By: JP
Date Report Generated: 5/18/2024 4:20:29 PM Tool Version: Version 1.2
Project Contact Information: Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)

Project Summary

Link to Project

Estimated Capital Cost: $100000000.00
End of Useful Life Year: 2075
Project within mapped Environmental Justice neighborhood: No

Ecosystem Service Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	Moderate Exposure
Extreme Precipitation - Riverine Flooding	High Exposure
Extreme Heat	High Exposure



Asset Preliminary Climate Risk Rating Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Infrastructure	Low Risk	High Risk	High Risk	High Risk

Climate Resilience Design Standards Summary

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Infrastructure					
Extreme Precipitation					
Infrastructure	2070			50-yr (2%)	Tier 3
Extreme Heat					
Infrastructure	2070		90th		Tier 3

Scoring Rationale - Project Exposure Score

The purpose of the Exposure Score output is to provide a preliminary assessment of whether the overall project site and subsequent assets are exposed to impacts of natural hazard events and/or future impacts of climate change. For each climate parameter, the Tool will calculate one of the following exposure ratings: Not Exposed, Low Exposure, Moderate Exposure, or High Exposure. The rationale behind the exposure rating is provided below.

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "Moderate Exposure" because of the following:

- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site
- No increase to impervious area
- Existing impervious area of the project site is less than 10%

Extreme Precipitation - Riverine Flooding

This project received a "High Exposure" because of the following:

- Project site has a history of riverine flooding
- Part of the project is within a mapped FEMA floodplain, outside of the Massachusetts Coast Flood Risk Model (MC-FRM)
- Part of the project is within 100ft of a waterbody
- Project is not likely susceptible to riverine erosion

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Existing trees are being removed as part of the proposed project
- Less than 10% of the existing project site has canopy cover
- Located within 100 ft of existing water body
- No increase to the impervious area of the project site

Scoring Rationale - Asset Preliminary Climate Risk Rating

A Preliminary Climate Risk Rating is determined for each infrastructure and building asset by considering the overall project Exposure Score and responses to Step 4 questions provided by the user in the Tool. Natural Resource assets do not receive a risk rating. The following factors are what influenced the risk ratings for each asset.

Asset - Infrastructure
Primary asset criticality factors influencing risk ratings for this asset:

- Asset may inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event
- Loss/inoperability of the asset would have regional impacts
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- Spills and/or releases of hazardous materials would be relatively easy to clean up

Project Climate Resilience Design Standards Output

Climate Resilience Design Standards and Guidance are recommended for each asset and climate parameter. The Design Standards for each climate parameter include the following: recommended planning horizon (target and/or intermediate), recommended return period (Sea Level Rise/Storm Surge and Precipitation) or percentile (Heat), and a list of applicable design criteria that are likely to be affected by climate change. Some design criteria have numerical values associated with the recommended return period and planning horizon, while others have tiered methodologies with step-by-step instructions on how to estimate design values given the other recommended design standards.

Asset: Infrastructure — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: NOT APPLICABLE

Projected Water Surface Elevation: NOT APPLICABLE

Projected Wave Action Water Elevation: NOT APPLICABLE

Projected Wave Heights: NOT APPLICABLE

Projected Duration of Flooding: NOT APPLICABLE

Projected Design Flood Velocity: NOT APPLICABLE

Projected Scour & Erosion: NOT APPLICABLE

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 50-yr (2%)

LIMITATIONS: The recommended Standards for Total Precipitation Depth & Peak Intensity are determined by the user drawn polygon and relationships as defined in the Supporting Documents. The projected Total Precipitation Depth values provided through the Tool are based on the climate projections developed by Cornell University as part of EEA's Massachusetts Climate and Hydrologic Risk Project, GIS-based data as of 10/15/21. For additional information on the methodology of these precipitation outputs, see Supporting Documents.

While Total Precipitation Depth & Peak Intensity for 24-hour Design Storms are useful to inform planning and design, it is recommended to also consider additional longer- and shorter-duration precipitation events and intensities in accordance with best practices. Longer-duration, lower-intensity storms allow time for infiltration and reduce the load on infrastructure over the duration of the storm. Shorter-duration, higher-intensity storms often have higher runoff volumes because the water does not have enough time to infiltrate infrastructure systems (e.g., catch basins) and may overflow or back up during such storms, resulting in flooding. In the Northeast, short-duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. While the Tool does not provide recommended design standards for these scenarios, users should still consider both short- and long-duration precipitation events and how they may impact the asset.

The projected values, standards, and guidance provided within this Tool may be used to inform plans and designs, but they do not provide guarantees for future conditions or resilience. The projected values are not to be considered final or appropriate for construction documents without supporting engineering analyses. The guidance provided within this Tool is intended to be general and users are encouraged to do their own due diligence

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: APPLICABLE

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Infrastructure	2070	50-Year (2%)	9.2	Downloadable Methodology PDF

Projected Riverine Peak Discharge & Peak Flood Elevation: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Extreme Heat High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Heat Index: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Growing Degree Days: NOT APPLICABLE

Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Number of Heat Waves Per Year & Average Heat Wave Duration: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Cooling Degree Days & Heating Degree Days (base = 65°F): NOT APPLICABLE

Project Inputs

Core Project Information

Name:	Central to Western MA Energy Improvement Project_EB
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2075
Location of Project:	Brookfield
Estimated Capital Cost:	$100,000,000
Who is the Submitting Entity?	Private Other National Grid Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Permitting
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	NEP owns and operates double-circuit 69 kV lines (E5 and F6 lines) that begins at the Deerfield #4 Substation in Shelburne through Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn, and terminating at the Milbury #305 Substation in Millbury. Tap lines consist of the existing Quabbin Switch Tap (E5W/F6W) in Belchertown, Deerfield #3 in Shelburne, Pondville Sub Tap in Auburn, Leicester Sub Tap in Leicester, and Lashway Sub Tap in North Brookfield. The E5/F6 lines were constructed in the early 1900s and refurbished in 2001. Structures and wires are in need of replacement due to asset condition and aging infrastructure. In addition, the access conditions vary considerably throughout the ROW. Although the new E5/F6 Transmission Lines will operate at 69 kV when they are first placed into service, they are being designed and built to support operation at 115 kV at some point during their expected life.
Project Submission Comments:	

Project Ecosystem Service Benefits

Factors Influencing Output

- ✓ Project filters stormwater using green infrastructure
- ✓ Project provides pollinator habitat
- ✓ Project provides recreation

Factors to Improve Output

- ✓ Incorporate strategies that reduce carbon emissions
- ✓ Identify opportunities to prevent pollutants from impacting ecosystems

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	No
Filters stormwater using green infrastructure	Yes
Improves water quality	No
Promotes decarbonization	Maybe
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	Maybe
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	Yes
Provides recreation	Yes

Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	Unsure
Does the project site have a history of riverine flooding?	Yes
Does the project result in a net increase in impervious area of the site?	No
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Infrastructure
Asset Type: Utility Infrastructure
Asset Sub-Type: Energy (electric, gas, petroleum, renewable)
Construction Type: Major Repair/Retrofit
Construction Year: 2025
Useful Life: 50

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure may be inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event.

Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)

Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Less than 100,000 people

Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

Will the infrastructure reduce the risk of flooding?
No

If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses

If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
Spills and/or releases of hazardous materials are expected with relatively easy cleanup

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate

If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million

Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrasturcture may reduce the ability to maintain most government services, while some sevices will still exist

What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

Town of Leicester

Climate Resilience Design Standards Tool Project Report

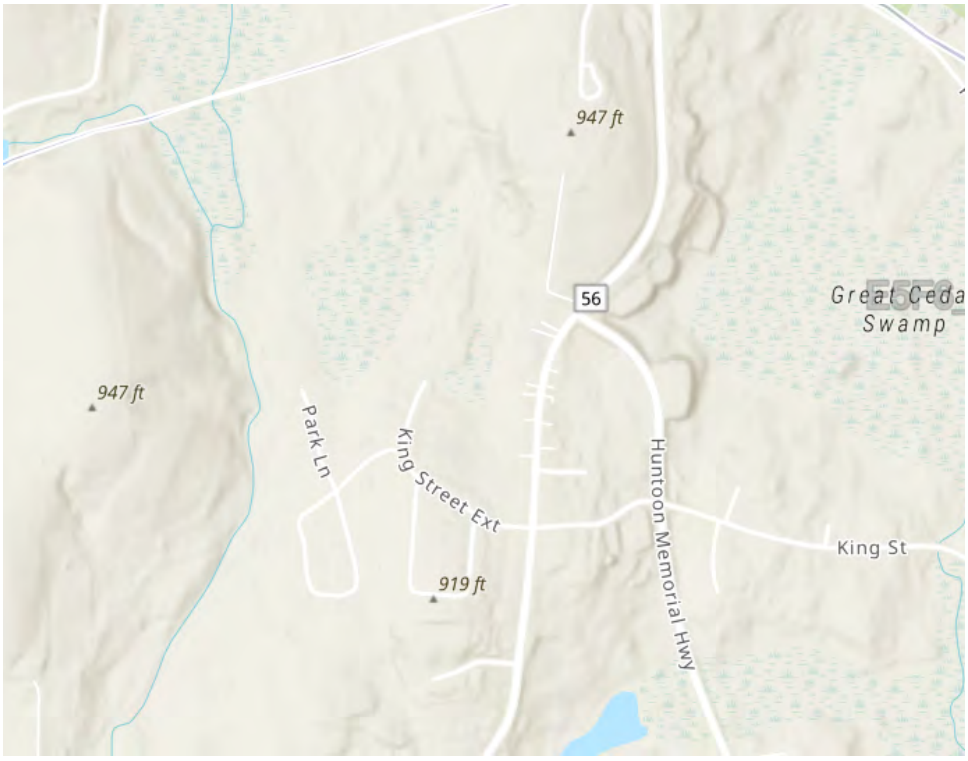
Central to Western MA Energy Improvement Project
Date Created: 5/18/2024 6:14:46 PM
Created By: JP
Date Report Generated: 5/18/2024 6:29:51 PM
Tool Version: Version 1.2
Project Contact Information: Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)

Project Summary

Link to Project

Estimated Capital Cost: $100000000.00
End of Useful Life Year: 2075
Project within mapped Environmental Justice neighborhood: Yes

Ecosystem Service Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	Moderate Exposure
Extreme Precipitation - Riverine Flooding	High Exposure
Extreme Heat	High Exposure



Asset Preliminary Climate Risk Rating Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Infrastructure	Low Risk	High Risk	High Risk	High Risk

Climate Resilience Design Standards Summary

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Infrastructure					
Extreme Precipitation					
Infrastructure	2070			50-yr (2%)	Tier 3
Extreme Heat					
Infrastructure	2070		90th		Tier 3

Scoring Rationale - Project Exposure Score

The purpose of the Exposure Score output is to provide a preliminary assessment of whether the overall project site and subsequent assets are exposed to impacts of natural hazard events and/or future impacts of climate change. For each climate parameter, the Tool will calculate one of the following exposure ratings: Not Exposed, Low Exposure, Moderate Exposure, or High Exposure. The rationale behind the exposure rating is provided below.

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "Moderate Exposure" because of the following:

- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site
- No increase to impervious area
- Existing impervious area of the project site is less than 10%

Extreme Precipitation - Riverine Flooding

This project received a "High Exposure" because of the following:

- Project site has a history of riverine flooding
- Part of the project is within a mapped FEMA floodplain, outside of the Massachusetts Coast Flood Risk Model (MC-FRM)
- Part of the project is within 200ft of a waterbody and less than 30ft above the waterbody
- Project is not likely susceptible to riverine erosion

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Existing trees are being removed as part of the proposed project
- Less than 10% of the existing project site has canopy cover
- Located within 100 ft of existing water body
- No increase to the impervious area of the project site

Scoring Rationale - Asset Preliminary Climate Risk Rating

A Preliminary Climate Risk Rating is determined for each infrastructure and building asset by considering the overall project Exposure Score and responses to Step 4 questions provided by the user in the Tool. Natural Resource assets do not receive a risk rating. The following factors are what influenced the risk ratings for each asset.

Asset - Infrastructure
Primary asset criticality factors influencing risk ratings for this asset:

- Asset may inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event
- Loss/inoperability of the asset would have regional impacts
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- Spills and/or releases of hazardous materials would be relatively easy to clean up

Project Climate Resilience Design Standards Output

Climate Resilience Design Standards and Guidance are recommended for each asset and climate parameter. The Design Standards for each climate parameter include the following: recommended planning horizon (target and/or intermediate), recommended return period (Sea Level Rise/Storm Surge and Precipitation) or percentile (Heat), and a list of applicable design criteria that are likely to be affected by climate change. Some design criteria have numerical values associated with the recommended return period and planning horizon, while others have tiered methodologies with step-by-step instructions on how to estimate design values given the other recommended design standards.

Asset: Infrastructure — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: NOT APPLICABLE

Projected Water Surface Elevation: NOT APPLICABLE

Projected Wave Action Water Elevation: NOT APPLICABLE

Projected Wave Heights: NOT APPLICABLE

Projected Duration of Flooding: NOT APPLICABLE

Projected Design Flood Velocity: NOT APPLICABLE

Projected Scour & Erosion: NOT APPLICABLE

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 50-yr (2%)

LIMITATIONS: The recommended Standards for Total Precipitation Depth & Peak Intensity are determined by the user drawn polygon and relationships as defined in the Supporting Documents. The projected Total Precipitation Depth values provided through the Tool are based on the climate projections developed by Cornell University as part of EEA's Massachusetts Climate and Hydrologic Risk Project, GIS-based data as of 10/15/21. For additional information on the methodology of these precipitation outputs, see Supporting Documents.

While Total Precipitation Depth & Peak Intensity for 24-hour Design Storms are useful to inform planning and design, it is recommended to also consider additional longer- and shorter-duration precipitation events and intensities in accordance with best practices. Longer-duration, lower-intensity storms allow time for infiltration and reduce the load on infrastructure over the duration of the storm. Shorter-duration, higher-intensity storms often have higher runoff volumes because the water does not have enough time to infiltrate infrastructure systems (e.g., catch basins) and may overflow or back up during such storms, resulting in flooding. In the Northeast, short-duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. While the Tool does not provide recommended design standards for these scenarios, users should still consider both short- and long-duration precipitation events and how they may impact the asset.

The projected values, standards, and guidance provided within this Tool may be used to inform plans and designs, but they do not provide guarantees for future conditions or resilience. The projected values are not to be considered final or appropriate for construction documents without supporting engineering analyses. The guidance provided within this Tool is intended to be general and users are encouraged to do their own due diligence

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: APPLICABLE

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Infrastructure	2070	50-Year (2%)	9.2	Downloadable Methodology PDF

Projected Riverine Peak Discharge & Peak Flood Elevation: NOT APPLICABLE

Extreme Heat — High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Heat Index: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Growing Degree Days: NOT APPLICABLE

Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Number of Heat Waves Per Year & Average Heat Wave Duration: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Cooling Degree Days & Heating Degree Days (base = 65°F): NOT APPLICABLE

Project Inputs

Core Project Information

Name:	Central to Western MA Energy Improvement Project
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2075
Location of Project:	Leicester
Estimated Capital Cost:	$100,000,000
Who is the Submitting Entity?	Private Other National Grid Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Permitting
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	NEP owns and operates double-circuit 69 kV lines (E5 and F6 lines) that begins at the Deerfield #4 Substation in Shelburne through Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn, and terminating at the Milbury #305 Substation in Millbury. Tap lines consist of the existing Quabbin Switch Tap (E5W/F6W) in Belchertown, Deerfield #3 in Shelburne, Pondville Sub Tap in Auburn, Leicester Sub Tap in Leicester, and Lashway Sub Tap in North Brookfield. The E5/F6 lines were constructed in the early 1900s and refurbished in 2001. Structures and wires are in need of replacement due to asset condition and aging infrastructure. In addition, the access conditions vary considerably throughout the ROW. Although the new E5/F6 Transmission Lines will operate at 69 kV when they are first placed into service, they are being designed and built to support operation at 115 kV at some point during their expected life.
Project Submission Comments:	

Project Ecosystem Service Benefits

Factors Influencing Output

- ✓ Project filters stormwater using green infrastructure
- ✓ Project provides pollinator habitat
- ✓ Project provides recreation

Factors to Improve Output

- ✓ Incorporate strategies that reduce carbon emissions
- ✓ Identify opportunities to prevent pollutants from impacting ecosystems

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	No
Filters stormwater using green infrastructure	Yes
Improves water quality	No
Promotes decarbonization	Maybe
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	Maybe
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	Yes
Provides recreation	Yes

Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	Unsure
Does the project site have a history of riverine flooding?	Yes
Does the project result in a net increase in impervious area of the site?	No
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Infrastructure
Asset Type: Utility Infrastructure
Asset Sub-Type: Energy (electric, gas, petroleum, renewable)
Construction Type: Major Repair/Retrofit
Construction Year: 2025
Useful Life: 50

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure may be inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event.

Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)

Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Less than 100,000 people

Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

Will the infrastructure reduce the risk of flooding?
No

If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses

If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
Spills and/or releases of hazardous materials are expected with relatively easy cleanup

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate

If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million

Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrasturcture may reduce the ability to maintain most government services, while some sevices will still exist

What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

Town of Leverett

Climate Resilience Design Standards Tool Project Report

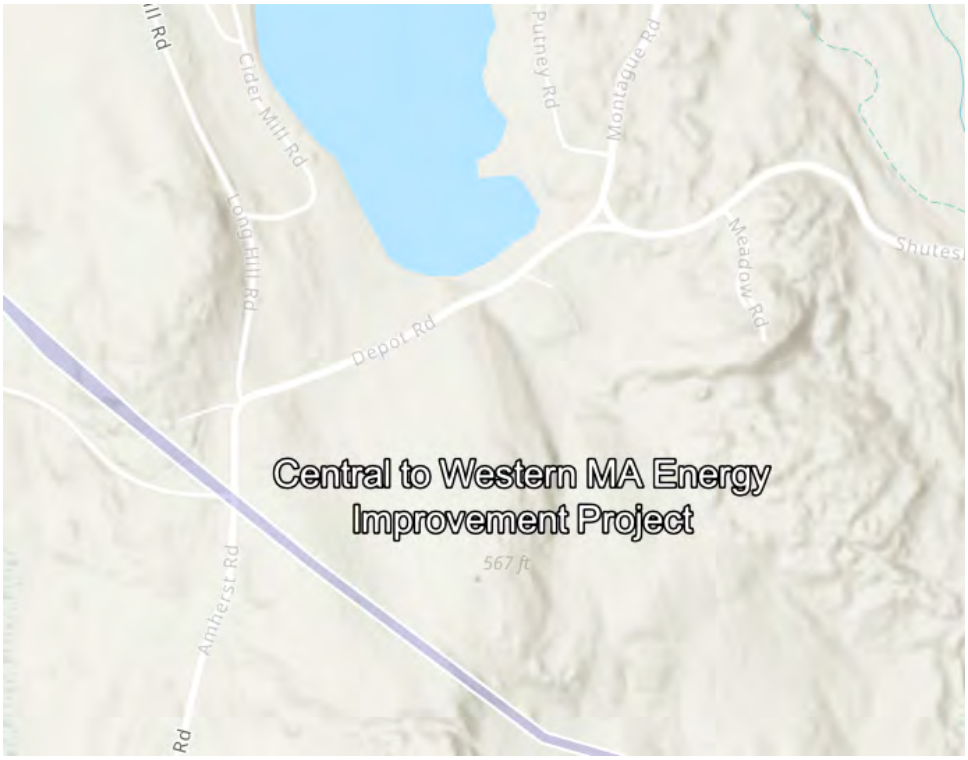
Central to Western MA Energy Improvement Project
Date Created: 5/17/2024 10:47:54 AM
Created By: JP
Date Report Generated: 5/18/2024 10:48:55 AM
Tool Version: Version 1.2
Project Contact Information: Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)

Project Summary

Link to Project

Estimated Capital Cost: $100000000.00
End of Useful Life Year: 2075
Project within mapped Environmental Justice neighborhood: Yes

Ecosystem Service Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	Moderate Exposure
Extreme Precipitation - Riverine Flooding	High Exposure
Extreme Heat	High Exposure



Asset Preliminary Climate Risk Rating Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Infrastructure	Low Risk	High Risk	High Risk	High Risk

Climate Resilience Design Standards Summary

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Infrastructure					
Extreme Precipitation					
Infrastructure	2070			50-yr (2%)	Tier 3
Extreme Heat					
Infrastructure	2070		90th		Tier 3

Scoring Rationale - Project Exposure Score

The purpose of the Exposure Score output is to provide a preliminary assessment of whether the overall project site and subsequent assets are exposed to impacts of natural hazard events and/or future impacts of climate change. For each climate parameter, the Tool will calculate one of the following exposure ratings: Not Exposed, Low Exposure, Moderate Exposure, or High Exposure. The rationale behind the exposure rating is provided below.

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "Moderate Exposure" because of the following:

- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site
- No increase to impervious area
- Existing impervious area of the project site is less than 10%

Extreme Precipitation - Riverine Flooding

This project received a "High Exposure" because of the following:

- Project site has a history of riverine flooding
- Part of the project is within 500ft of a waterbody and less than 20ft above the waterbody
- The project is not within a mapped FEMA floodplain [outside of the Massachusetts Coast Flood Risk Model (MC-FRM)]
- Project is not likely susceptible to riverine erosion

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Existing trees are being removed as part of the proposed project
- Between 10% and 40% of the existing project site has canopy cover
- Located within 100 ft of existing water body
- No increase to the impervious area of the project site

Scoring Rationale - Asset Preliminary Climate Risk Rating

A Preliminary Climate Risk Rating is determined for each infrastructure and building asset by considering the overall project Exposure Score and responses to Step 4 questions provided by the user in the Tool. Natural Resource assets do not receive a risk rating. The following factors are what influenced the risk ratings for each asset.

Asset - Infrastructure
Primary asset criticality factors influencing risk ratings for this asset:

- Asset may inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event
- Loss/inoperability of the asset would have regional impacts
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- Spills and/or releases of hazardous materials would be relatively easy to clean up

Project Climate Resilience Design Standards Output

Climate Resilience Design Standards and Guidance are recommended for each asset and climate parameter. The Design Standards for each climate parameter include the following: recommended planning horizon (target and/or intermediate), recommended return period (Sea Level Rise/Storm Surge and Precipitation) or percentile (Heat), and a list of applicable design criteria that are likely to be affected by climate change. Some design criteria have numerical values associated with the recommended return period and planning horizon, while others have tiered methodologies with step-by-step instructions on how to estimate design values given the other recommended design standards.

Asset: Infrastructure — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: NOT APPLICABLE

Projected Water Surface Elevation: NOT APPLICABLE

Projected Wave Action Water Elevation: NOT APPLICABLE

Projected Wave Heights: NOT APPLICABLE

Projected Duration of Flooding: NOT APPLICABLE

Projected Design Flood Velocity: NOT APPLICABLE

Projected Scour & Erosion: NOT APPLICABLE

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 50-yr (2%)

LIMITATIONS: The recommended Standards for Total Precipitation Depth & Peak Intensity are determined by the user drawn polygon and relationships as defined in the Supporting Documents. The projected Total Precipitation Depth values provided through the Tool are based on the climate projections developed by Cornell University as part of EEA's Massachusetts Climate and Hydrologic Risk Project, GIS-based data as of 10/15/21. For additional information on the methodology of these precipitation outputs, see Supporting Documents.

While Total Precipitation Depth & Peak Intensity for 24-hour Design Storms are useful to inform planning and design, it is recommended to also consider additional longer- and shorter-duration precipitation events and intensities in accordance with best practices. Longer-duration, lower-intensity storms allow time for infiltration and reduce the load on infrastructure over the duration of the storm. Shorter-duration, higher-intensity storms often have higher runoff volumes because the water does not have enough time to infiltrate infrastructure systems (e.g., catch basins) and may overflow or back up during such storms, resulting in flooding. In the Northeast, short-duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. While the Tool does not provide recommended design standards for these scenarios, users should still consider both short- and long-duration precipitation events and how they may impact the asset.

The projected values, standards, and guidance provided within this Tool may be used to inform plans and designs, but they do not provide guarantees for future conditions or resilience. The projected values are not to be considered final or appropriate for construction documents without supporting engineering analyses. The guidance provided within this Tool is intended to be general and users are encouraged to do their own due diligence

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: APPLICABLE

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Infrastructure	2070	50-Year (2%)	9.3	Downloadable Methodology PDF

Projected Riverine Peak Discharge & Peak Flood Elevation: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Extreme Heat High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Heat Index: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Growing Degree Days: NOT APPLICABLE

Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Number of Heat Waves Per Year & Average Heat Wave Duration: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Cooling Degree Days & Heating Degree Days (base = 65°F): NOT APPLICABLE

Project Inputs

Core Project Information

Name:	Central to Western MA Energy Improvement Project
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2075
Location of Project:	Leverett
Estimated Capital Cost:	$100,000,000
Who is the Submitting Entity?	Private Other National Grid Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Permitting
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	NEP owns and operates double-circuit 69 kV lines (E5 and F6 lines) that begins at the Deerfield #4 Substation in Shelburne through Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn, and terminating at the Milbury #305 Substation in Millbury. Tap lines consist of the existing Quabbin Switch Tap (E5W/F6W) in Belchertown, Deerfield #3 in Shelburne, Pondville Sub Tap in Auburn, Leicester Sub Tap in Leicester, and Lashway Sub Tap in North Brookfield. The E5/F6 lines were constructed in the early 1900s and refurbished in 2001. Structures and wires are in need of replacement due to asset condition and aging infrastructure. In addition, the access conditions vary considerably throughout the ROW. Although the new E5/F6 Transmission Lines will operate at 69 kV when they are first placed into service, they are being designed and built to support operation at 115 kV at some point during their expected life.

Project Submission Comments:

Project Ecosystem Service Benefits

Factors Influencing Output

- ✓ Project filters stormwater using green infrastructure
- ✓ Project provides pollinator habitat
- ✓ Project provides recreation

Factors to Improve Output

- ✓ Incorporate strategies that reduce carbon emissions
- ✓ Identify opportunities to prevent pollutants from impacting ecosystems

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	No
Filters stormwater using green infrastructure	Yes
Improves water quality	No
Promotes decarbonization	Maybe
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	Maybe
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	Yes
Provides recreation	Yes

Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	Unsure
Does the project site have a history of riverine flooding?	Yes
Does the project result in a net increase in impervious area of the site?	No
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Infrastructure
Asset Type: Utility Infrastructure
Asset Sub-Type: Energy (electric, gas, petroleum, renewable)
Construction Type: Major Repair/Retrofit
Construction Year: 2025
Useful Life: 50

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure may be inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event.

Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)

Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Less than 100,000 people

Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

Will the infrastructure reduce the risk of flooding?
No

If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses

If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
Spills and/or releases of hazardous materials are expected with relatively easy cleanup

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate

If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million

Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrasturcture may reduce the ability to maintain most government services, while some sevices will still exist

What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

Town of Millbury

Climate Resilience Design Standards Tool Project Report

Central to Western MA Energy Improvement Project
Date Created: 5/18/2024 6:57:32 PM
Created By: JP
Date Report Generated: 5/18/2024 7:09:42 PM
Tool Version: Version 1.2
Project Contact Information: Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)

Project Summary

Link to Project

Estimated Capital Cost: $100000000.00
End of Useful Life Year: 2075
Project within mapped Environmental Justice neighborhood: Yes

Ecosystem Service Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	Moderate Exposure
Extreme Precipitation - Riverine Flooding	High Exposure
Extreme Heat	High Exposure



Asset Preliminary Climate Risk Rating Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Infrastructure	Low Risk	High Risk	High Risk	High Risk

Climate Resilience Design Standards Summary

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Infrastructure					
Extreme Precipitation					
Infrastructure	2070			50-yr (2%)	Tier 3
Extreme Heat					
Infrastructure	2070		90th		Tier 3

Scoring Rationale - Project Exposure Score

The purpose of the Exposure Score output is to provide a preliminary assessment of whether the overall project site and subsequent assets are exposed to impacts of natural hazard events and/or future impacts of climate change. For each climate parameter, the Tool will calculate one of the following exposure ratings: Not Exposed, Low Exposure, Moderate Exposure, or High Exposure. The rationale behind the exposure rating is provided below.

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "Moderate Exposure" because of the following:

- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site
- No increase to impervious area
- Existing impervious area of the project site is less than 10%

Extreme Precipitation - Riverine Flooding

This project received a "High Exposure" because of the following:

- Project site has a history of riverine flooding
- Part of the project is within a mapped FEMA floodplain, outside of the Massachusetts Coast Flood Risk Model (MC-FRM)
- Part of the project is within 100ft of a waterbody
- Project is not likely susceptible to riverine erosion

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Existing trees are being removed as part of the proposed project
- Between 10% and 40% of the existing project site has canopy cover
- Located within 100 ft of existing water body
- No increase to the impervious area of the project site

Scoring Rationale - Asset Preliminary Climate Risk Rating

A Preliminary Climate Risk Rating is determined for each infrastructure and building asset by considering the overall project Exposure Score and responses to Step 4 questions provided by the user in the Tool. Natural Resource assets do not receive a risk rating. The following factors are what influenced the risk ratings for each asset.

Asset - Infrastructure
Primary asset criticality factors influencing risk ratings for this asset:

- Asset may inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event
- Loss/inoperability of the asset would have regional impacts
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- Spills and/or releases of hazardous materials would be relatively easy to clean up

Project Climate Resilience Design Standards Output

Climate Resilience Design Standards and Guidance are recommended for each asset and climate parameter. The Design Standards for each climate parameter include the following: recommended planning horizon (target and/or intermediate), recommended return period (Sea Level Rise/Storm Surge and Precipitation) or percentile (Heat), and a list of applicable design criteria that are likely to be affected by climate change. Some design criteria have numerical values associated with the recommended return period and planning horizon, while others have tiered methodologies with step-by-step instructions on how to estimate design values given the other recommended design standards.

Asset: Infrastructure — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: NOT APPLICABLE

Projected Water Surface Elevation: NOT APPLICABLE

Projected Wave Action Water Elevation: NOT APPLICABLE

Projected Wave Heights: NOT APPLICABLE

Projected Duration of Flooding: NOT APPLICABLE

Projected Design Flood Velocity: NOT APPLICABLE

Projected Scour & Erosion: NOT APPLICABLE

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 50-yr (2%)

LIMITATIONS: The recommended Standards for Total Precipitation Depth & Peak Intensity are determined by the user drawn polygon and relationships as defined in the Supporting Documents. The projected Total Precipitation Depth values provided through the Tool are based on the climate projections developed by Cornell University as part of EEA's Massachusetts Climate and Hydrologic Risk Project, GIS-based data as of 10/15/21. For additional information on the methodology of these precipitation outputs, see Supporting Documents.

While Total Precipitation Depth & Peak Intensity for 24-hour Design Storms are useful to inform planning and design, it is recommended to also consider additional longer- and shorter-duration precipitation events and intensities in accordance with best practices. Longer-duration, lower-intensity storms allow time for infiltration and reduce the load on infrastructure over the duration of the storm. Shorter-duration, higher-intensity storms often have higher runoff volumes because the water does not have enough time to infiltrate infrastructure systems (e.g., catch basins) and may overflow or back up during such storms, resulting in flooding. In the Northeast, short-duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. While the Tool does not provide recommended design standards for these scenarios, users should still consider both short- and long-duration precipitation events and how they may impact the asset.

The projected values, standards, and guidance provided within this Tool may be used to inform plans and designs, but they do not provide guarantees for future conditions or resilience. The projected values are not to be considered final or appropriate for construction documents without supporting engineering analyses. The guidance provided within this Tool is intended to be general and users are encouraged to do their own due diligence

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: APPLICABLE

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Infrastructure	2070	50-Year (2%)	9.4	Downloadable Methodology PDF

Projected Riverine Peak Discharge & Peak Flood Elevation: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Extreme Heat High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Heat Index: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Growing Degree Days: NOT APPLICABLE

Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Number of Heat Waves Per Year & Average Heat Wave Duration: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Cooling Degree Days & Heating Degree Days (base = 65°F): NOT APPLICABLE

Project Inputs

Core Project Information

Name:	Central to Western MA Energy Improvement Project
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2075
Location of Project:	Millbury
Estimated Capital Cost:	$100,000,000
Who is the Submitting Entity?	Private Other National Grid Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Permitting
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	NEP owns and operates double-circuit 69 kV lines (E5 and F6 lines) that begins at the Deerfield #4 Substation in Shelburne through Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn, and terminating at the Milbury #305 Substation in Millbury. Tap lines consist of the existing Quabbin Switch Tap (E5W/F6W) in Belchertown, Deerfield #3 in Shelburne, Pondville Sub Tap in Auburn, Leicester Sub Tap in Leicester, and Lashway Sub Tap in North Brookfield. The E5/F6 lines were constructed in the early 1900s and refurbished in 2001. Structures and wires are in need of replacement due to asset condition and aging infrastructure. In addition, the access conditions vary considerably throughout the ROW. Although the new E5/F6 Transmission Lines will operate at 69 kV when they are first placed into service, they are being designed and built to support operation at 115 kV at some point during their expected life.

Project Submission Comments:

Project Ecosystem Service Benefits

Factors Influencing Output

- ✓ Project filters stormwater using green infrastructure
- ✓ Project provides pollinator habitat
- ✓ Project provides recreation

Factors to Improve Output

- ✓ Incorporate strategies that reduce carbon emissions
- ✓ Identify opportunities to prevent pollutants from impacting ecosystems

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	No
Filters stormwater using green infrastructure	Yes
Improves water quality	No
Promotes decarbonization	Maybe
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	Maybe
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	Yes
Provides recreation	Yes

Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	Unsure
Does the project site have a history of riverine flooding?	Yes
Does the project result in a net increase in impervious area of the site?	No
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Infrastructure
Asset Type: Utility Infrastructure
Asset Sub-Type: Energy (electric, gas, petroleum, renewable)
Construction Type: Major Repair/Retrofit
Construction Year: 2025
Useful Life: 50

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure may be inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event.

Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)

Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Less than 100,000 people

Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

Will the infrastructure reduce the risk of flooding?
No

If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses

If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
Spills and/or releases of hazardous materials are expected with relatively easy cleanup

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate

If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million

Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrasturcture may reduce the ability to maintain most government services, while some sevices will still exist

What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

Town of North Brookfield

Climate Resilience Design Standards Tool Project Report

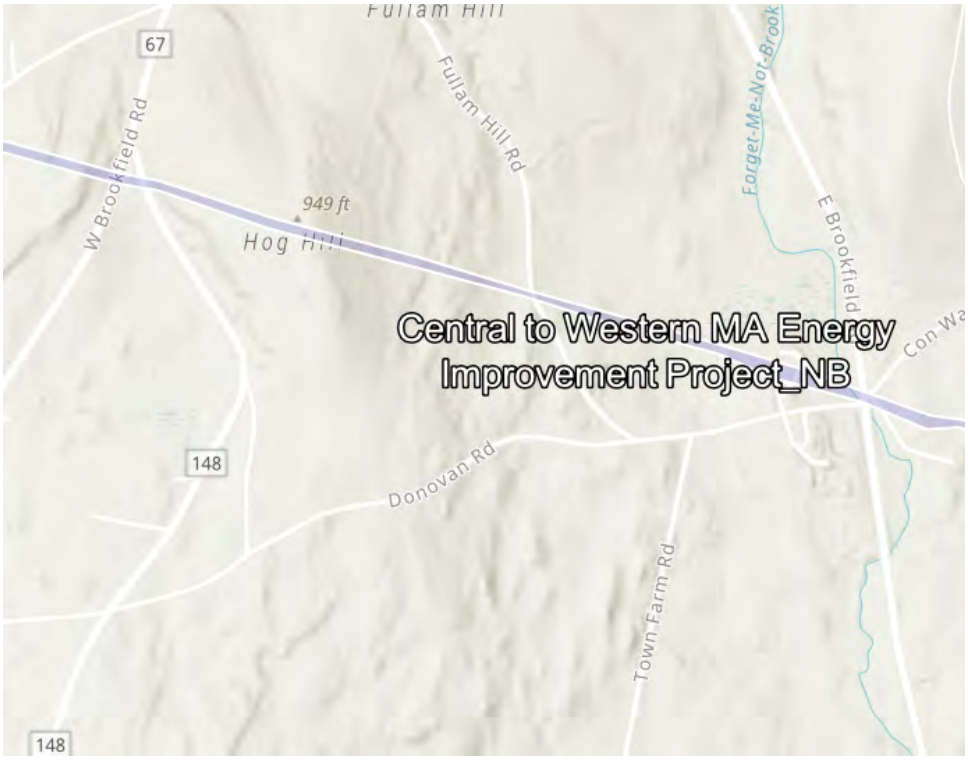
Central to Western MA Energy Improvement Project_NB
Date Created: 5/18/2024 3:37:19 PM
Created By: JP
Date Report Generated: 5/18/2024 7:10:49 PM
Tool Version: Version 1.2
Project Contact Information: Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)

Project Summary

Link to Project

Estimated Capital Cost: $100000000.00
End of Useful Life Year: 2075
Project within mapped Environmental Justice neighborhood: No

Ecosystem Service Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	Moderate Exposure
Extreme Precipitation - Riverine Flooding	High Exposure
Extreme Heat	High Exposure



Asset Preliminary Climate Risk Rating Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Infrastructure	Low Risk	High Risk	High Risk	High Risk

Climate Resilience Design Standards Summary

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Infrastructure					
Extreme Precipitation					
Infrastructure	2070			50-yr (2%)	Tier 3
Extreme Heat					
Infrastructure	2070		90th		Tier 3

Scoring Rationale - Project Exposure Score

The purpose of the Exposure Score output is to provide a preliminary assessment of whether the overall project site and subsequent assets are exposed to impacts of natural hazard events and/or future impacts of climate change. For each climate parameter, the Tool will calculate one of the following exposure ratings: Not Exposed, Low Exposure, Moderate Exposure, or High Exposure. The rationale behind the exposure rating is provided below.

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "Moderate Exposure" because of the following:

- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site
- No increase to impervious area
- Existing impervious area of the project site is less than 10%

Extreme Precipitation - Riverine Flooding

This project received a "High Exposure" because of the following:

- Project site has a history of riverine flooding
- Part of the project is within a mapped FEMA floodplain, outside of the Massachusetts Coast Flood Risk Model (MC-FRM)
- Project is more than 500ft from a waterbody
- Project is not likely susceptible to riverine erosion

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Existing trees are being removed as part of the proposed project
- Less than 10% of the existing project site has canopy cover
- Located within 100 ft of existing water body
- No increase to the impervious area of the project site

Scoring Rationale - Asset Preliminary Climate Risk Rating

A Preliminary Climate Risk Rating is determined for each infrastructure and building asset by considering the overall project Exposure Score and responses to Step 4 questions provided by the user in the Tool. Natural Resource assets do not receive a risk rating. The following factors are what influenced the risk ratings for each asset.

Asset - Infrastructure
Primary asset criticality factors influencing risk ratings for this asset:

- Asset may inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event
- Loss/inoperability of the asset would have regional impacts
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- Spills and/or releases of hazardous materials would be relatively easy to clean up

Project Climate Resilience Design Standards Output

Climate Resilience Design Standards and Guidance are recommended for each asset and climate parameter. The Design Standards for each climate parameter include the following: recommended planning horizon (target and/or intermediate), recommended return period (Sea Level Rise/Storm Surge and Precipitation) or percentile (Heat), and a list of applicable design criteria that are likely to be affected by climate change. Some design criteria have numerical values associated with the recommended return period and planning horizon, while others have tiered methodologies with step-by-step instructions on how to estimate design values given the other recommended design standards.

Asset: Infrastructure — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: NOT APPLICABLE

Projected Water Surface Elevation: NOT APPLICABLE

Projected Wave Action Water Elevation: NOT APPLICABLE

Projected Wave Heights: NOT APPLICABLE

Projected Duration of Flooding: NOT APPLICABLE

Projected Design Flood Velocity: NOT APPLICABLE

Projected Scour & Erosion: NOT APPLICABLE

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 50-yr (2%)

LIMITATIONS: The recommended Standards for Total Precipitation Depth & Peak Intensity are determined by the user drawn polygon and relationships as defined in the Supporting Documents. The projected Total Precipitation Depth values provided through the Tool are based on the climate projections developed by Cornell University as part of EEA's Massachusetts Climate and Hydrologic Risk Project, GIS-based data as of 10/15/21. For additional information on the methodology of these precipitation outputs, see Supporting Documents.

While Total Precipitation Depth & Peak Intensity for 24-hour Design Storms are useful to inform planning and design, it is recommended to also consider additional longer- and shorter-duration precipitation events and intensities in accordance with best practices. Longer-duration, lower-intensity storms allow time for infiltration and reduce the load on infrastructure over the duration of the storm. Shorter-duration, higher-intensity storms often have higher runoff volumes because the water does not have enough time to infiltrate infrastructure systems (e.g., catch basins) and may overflow or back up during such storms, resulting in flooding. In the Northeast, short-duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. While the Tool does not provide recommended design standards for these scenarios, users should still consider both short- and long-duration precipitation events and how they may impact the asset.

The projected values, standards, and guidance provided within this Tool may be used to inform plans and designs, but they do not provide guarantees for future conditions or resilience. The projected values are not to be considered final or appropriate for construction documents without supporting engineering analyses. The guidance provided within this Tool is intended to be general and users are encouraged to do their own due diligence

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: APPLICABLE

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Infrastructure	2070	50-Year (2%)	9.1	Downloadable Methodology PDF

Projected Riverine Peak Discharge & Peak Flood Elevation: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Extreme Heat High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Heat Index: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Growing Degree Days: NOT APPLICABLE

Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Number of Heat Waves Per Year & Average Heat Wave Duration: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Cooling Degree Days & Heating Degree Days (base = 65°F): NOT APPLICABLE

Project Inputs

Core Project Information

Name:	Central to Western MA Energy Improvement Project_NB
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2075
Location of Project:	Brookfield
Estimated Capital Cost:	$100,000,000
Who is the Submitting Entity?	Private Other National Grid Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Permitting
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	NEP owns and operates double-circuit 69 kV lines (E5 and F6 lines) that begins at the Deerfield #4 Substation in Shelburne through Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn, and terminating at the Milbury #305 Substation in Millbury. Tap lines consist of the existing Quabbin Switch Tap (E5W/F6W) in Belchertown, Deerfield #3 in Shelburne, Pondville Sub Tap in Auburn, Leicester Sub Tap in Leicester, and Lashway Sub Tap in North Brookfield. The E5/F6 lines were constructed in the early 1900s and refurbished in 2001. Structures and wires are in need of replacement due to asset condition and aging infrastructure. In addition, the access conditions vary considerably throughout the ROW. Although the new E5/F6 Transmission Lines will operate at 69 kV when they are first placed into service, they are being designed and built to support operation at 115 kV at some point during their expected life.

Project Submission Comments:

Project Ecosystem Service Benefits

Factors Influencing Output

- ✓ Project filters stormwater using green infrastructure
- ✓ Project provides pollinator habitat
- ✓ Project provides recreation

Factors to Improve Output

- ✓ Incorporate strategies that reduce carbon emissions
- ✓ Identify opportunities to prevent pollutants from impacting ecosystems

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	No
Filters stormwater using green infrastructure	Yes
Improves water quality	No
Promotes decarbonization	Maybe
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	Maybe
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	Yes
Provides recreation	Yes

Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	Unsure
Does the project site have a history of riverine flooding?	Yes
Does the project result in a net increase in impervious area of the site?	No
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Infrastructure
Asset Type: Utility Infrastructure
Asset Sub-Type: Energy (electric, gas, petroleum, renewable)
Construction Type: Major Repair/Retrofit
Construction Year: 2025
Useful Life: 50

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure may be inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event.

Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)

Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Less than 100,000 people

Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

Will the infrastructure reduce the risk of flooding?
No

If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses

If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
Spills and/or releases of hazardous materials are expected with relatively easy cleanup

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate

If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million

Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrasturcture may reduce the ability to maintain most government services, while some sevices will still exist

What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

Town of Pelham

Climate Resilience Design Standards Tool Project Report

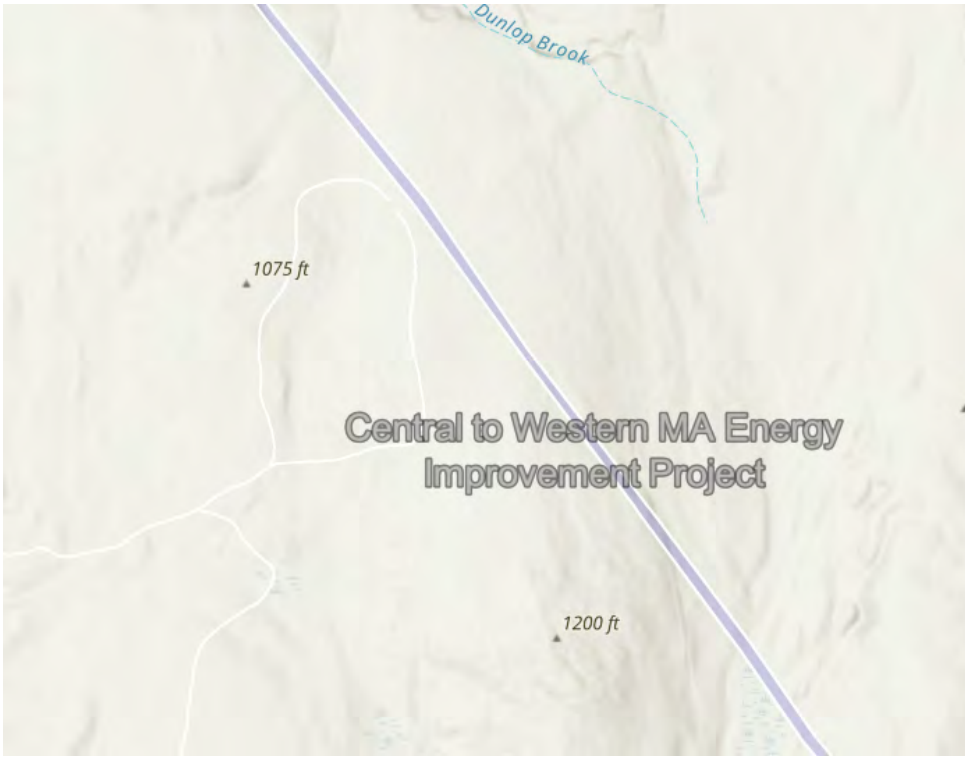
Central to Western MA Energy Improvement Project
Date Created: 5/18/2024 12:52:19 PM
Created By: JP
Date Report Generated: 5/18/2024 1:12:54 PM
Tool Version: Version 1.2
Project Contact Information: Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)

Project Summary

Link to Project

Estimated Capital Cost: $100000000.00
End of Useful Life Year: 2075
Project within mapped Environmental Justice neighborhood: No

Ecosystem Service Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	Moderate Exposure
Extreme Precipitation - Riverine Flooding	High Exposure
Extreme Heat	High Exposure



Asset Preliminary Climate Risk Rating Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Infrastructure	Low Risk	High Risk	High Risk	High Risk

Climate Resilience Design Standards Summary

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Infrastructure					
Extreme Precipitation					
Infrastructure	2070			50-yr (2%)	Tier 3
Extreme Heat					
Infrastructure	2070		90th		Tier 3

Scoring Rationale - Project Exposure Score

The purpose of the Exposure Score output is to provide a preliminary assessment of whether the overall project site and subsequent assets are exposed to impacts of natural hazard events and/or future impacts of climate change. For each climate parameter, the Tool will calculate one of the following exposure ratings: Not Exposed, Low Exposure, Moderate Exposure, or High Exposure. The rationale behind the exposure rating is provided below.

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "Moderate Exposure" because of the following:

- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site
- No increase to impervious area
- Existing impervious area of the project site is less than 10%

Extreme Precipitation - Riverine Flooding

This project received a "High Exposure" because of the following:

- Project site has a history of riverine flooding
- Part of the project is within a mapped FEMA floodplain, outside of the Massachusetts Coast Flood Risk Model (MC-FRM)
- Part of the project is within 200ft of a waterbody and less than 30ft above the waterbody
- Project is not likely susceptible to riverine erosion

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Existing trees are being removed as part of the proposed project
- Between 10% and 40% of the existing project site has canopy cover
- Located within 100 ft of existing water body
- No increase to the impervious area of the project site

Scoring Rationale - Asset Preliminary Climate Risk Rating

A Preliminary Climate Risk Rating is determined for each infrastructure and building asset by considering the overall project Exposure Score and responses to Step 4 questions provided by the user in the Tool. Natural Resource assets do not receive a risk rating. The following factors are what influenced the risk ratings for each asset.

Asset - Infrastructure
Primary asset criticality factors influencing risk ratings for this asset:

- Asset may inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event
- Loss/inoperability of the asset would have regional impacts
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- Spills and/or releases of hazardous materials would be relatively easy to clean up

Project Climate Resilience Design Standards Output

Climate Resilience Design Standards and Guidance are recommended for each asset and climate parameter. The Design Standards for each climate parameter include the following: recommended planning horizon (target and/or intermediate), recommended return period (Sea Level Rise/Storm Surge and Precipitation) or percentile (Heat), and a list of applicable design criteria that are likely to be affected by climate change. Some design criteria have numerical values associated with the recommended return period and planning horizon, while others have tiered methodologies with step-by-step instructions on how to estimate design values given the other recommended design standards.

Asset: Infrastructure — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: NOT APPLICABLE

Projected Water Surface Elevation: NOT APPLICABLE

Projected Wave Action Water Elevation: NOT APPLICABLE

Projected Wave Heights: NOT APPLICABLE

Projected Duration of Flooding: NOT APPLICABLE

Projected Design Flood Velocity: NOT APPLICABLE

Projected Scour & Erosion: NOT APPLICABLE

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 50-yr (2%)

LIMITATIONS: The recommended Standards for Total Precipitation Depth & Peak Intensity are determined by the user drawn polygon and relationships as defined in the Supporting Documents. The projected Total Precipitation Depth values provided through the Tool are based on the climate projections developed by Cornell University as part of EEA's Massachusetts Climate and Hydrologic Risk Project, GIS-based data as of 10/15/21. For additional information on the methodology of these precipitation outputs, see Supporting Documents.

While Total Precipitation Depth & Peak Intensity for 24-hour Design Storms are useful to inform planning and design, it is recommended to also consider additional longer- and shorter-duration precipitation events and intensities in accordance with best practices. Longer-duration, lower-intensity storms allow time for infiltration and reduce the load on infrastructure over the duration of the storm. Shorter-duration, higher-intensity storms often have higher runoff volumes because the water does not have enough time to infiltrate infrastructure systems (e.g., catch basins) and may overflow or back up during such storms, resulting in flooding. In the Northeast, short-duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. While the Tool does not provide recommended design standards for these scenarios, users should still consider both short- and long-duration precipitation events and how they may impact the asset.

The projected values, standards, and guidance provided within this Tool may be used to inform plans and designs, but they do not provide guarantees for future conditions or resilience. The projected values are not to be considered final or appropriate for construction documents without supporting engineering analyses. The guidance provided within this Tool is intended to be general and users are encouraged to do their own due diligence

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: APPLICABLE

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Infrastructure	2070	50-Year (2%)	9.6	Downloadable Methodology PDF

Projected Riverine Peak Discharge & Peak Flood Elevation: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Extreme Heat High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Heat Index: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Growing Degree Days: NOT APPLICABLE

Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Number of Heat Waves Per Year & Average Heat Wave Duration: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Cooling Degree Days & Heating Degree Days (base = 65°F): NOT APPLICABLE

Project Inputs

Core Project Information

Name:	Central to Western MA Energy Improvement Project
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2075
Location of Project:	Pelham
Estimated Capital Cost:	$100,000,000
Who is the Submitting Entity?	Private Other National Grid Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Permitting
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	NEP owns and operates double-circuit 69 kV lines (E5 and F6 lines) that begins at the Deerfield #4 Substation in Shelburne through Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn, and terminating at the Milbury #305 Substation in Millbury. Tap lines consist of the existing Quabbin Switch Tap (E5W/F6W) in Belchertown, Deerfield #3 in Shelburne, Pondville Sub Tap in Auburn, Leicester Sub Tap in Leicester, and Lashway Sub Tap in North Brookfield. The E5/F6 lines were constructed in the early 1900s and refurbished in 2001. Structures and wires are in need of replacement due to asset condition and aging infrastructure. In addition, the access conditions vary considerably throughout the ROW. Although the new E5/F6 Transmission Lines will operate at 69 kV when they are first placed into service, they are being designed and built to support operation at 115 kV at some point during their expected life.

Project Submission Comments:

Project Ecosystem Service Benefits

Factors Influencing Output

- ✓ Project filters stormwater using green infrastructure
- ✓ Project provides pollinator habitat
- ✓ Project provides recreation

Factors to Improve Output

- ✓ Incorporate strategies that reduce carbon emissions
- ✓ Identify opportunities to prevent pollutants from impacting ecosystems

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	No
Filters stormwater using green infrastructure	Yes
Improves water quality	No
Promotes decarbonization	Maybe
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	Maybe
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	Yes
Provides recreation	Yes

Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	Unsure
Does the project site have a history of riverine flooding?	Yes
Does the project result in a net increase in impervious area of the site?	No
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Infrastructure
Asset Type: Utility Infrastructure
Asset Sub-Type: Energy (electric, gas, petroleum, renewable)
Construction Type: Major Repair/Retrofit
Construction Year: 2025
Useful Life: 50

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure may be inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event.

Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)

Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Less than 100,000 people

Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

Will the infrastructure reduce the risk of flooding?
No

If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses

If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
Spills and/or releases of hazardous materials are expected with relatively easy cleanup

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate

If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million

Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrasturcture may reduce the ability to maintain most government services, while some sevices will still exist

What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

Town of Shelburne

Climate Resilience Design Standards Tool Project Report

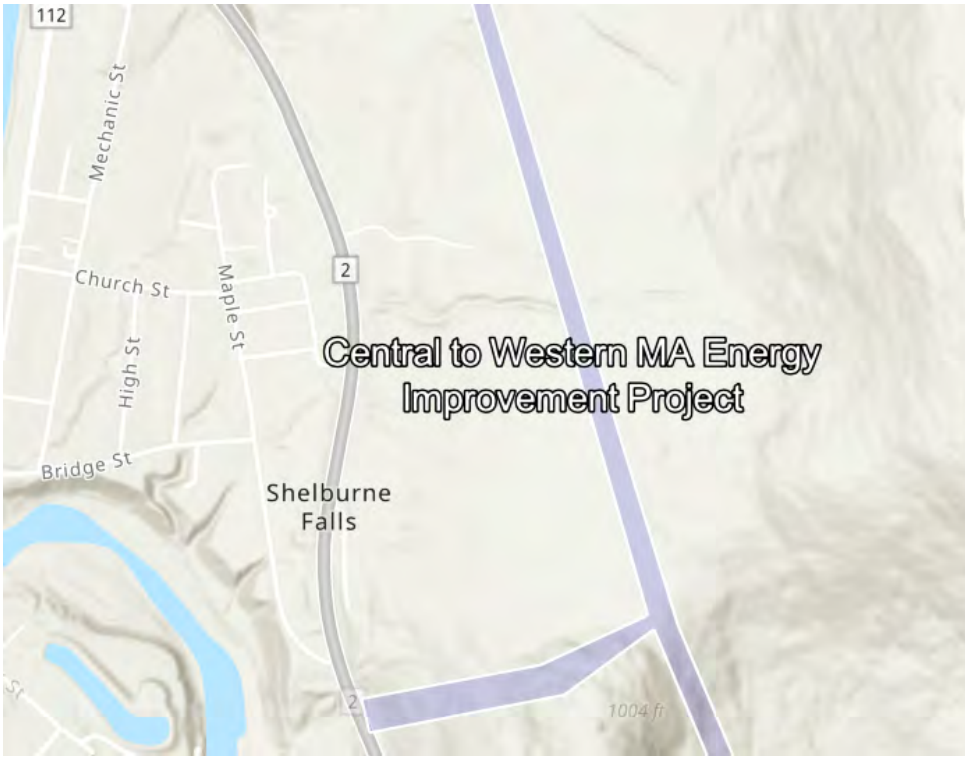
Central to Western MA Energy Improvement Project
Date Created: 5/16/2024 1:45:10 PM
Created By: JP
Date Report Generated: 5/16/2024 4:04:10 PM
Tool Version: Version 1.2
Project Contact Information: Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)

Project Summary

Link to Project

Estimated Capital Cost: $100000000.00
End of Useful Life Year: 2075
Project within mapped Environmental Justice neighborhood: Yes

Ecosystem Service Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	High Exposure
Extreme Precipitation - Riverine Flooding	High Exposure
Extreme Heat	High Exposure



Asset Preliminary Climate Risk Rating Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Infrastructure	Low Risk	High Risk	High Risk	High Risk

Climate Resilience Design Standards Summary

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Infrastructure					
Extreme Precipitation					
Infrastructure	2070			50-yr (2%)	Tier 3
Extreme Heat					
Infrastructure	2070		90th		Tier 3

Scoring Rationale - Project Exposure Score

The purpose of the Exposure Score output is to provide a preliminary assessment of whether the overall project site and subsequent assets are exposed to impacts of natural hazard events and/or future impacts of climate change. For each climate parameter, the Tool will calculate one of the following exposure ratings: Not Exposed, Low Exposure, Moderate Exposure, or High Exposure. The rationale behind the exposure rating is provided below.

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "High Exposure" because of the following:

- Increased impervious area
- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site
- Existing impervious area of the project site is less than 10%

Extreme Precipitation - Riverine Flooding

This project received a "High Exposure" because of the following:

- Project site has a history of riverine flooding
- Project is potentially susceptible to riverine erosion
- The project is not within a mapped FEMA floodplain [outside of the Massachusetts Coast Flood Risk Model (MC-FRM)]
- Project is more than 500ft from a waterbody

Extreme Heat

This project received a "High Exposure" because of the following:

- Increased impervious area
- Existing trees are being removed as part of the proposed project
- Existing impervious area of the project site is less than 10%
- 10 to 30 day increase in days over 90 deg. F within project's useful life
- Located within 100 ft of existing water body

Scoring Rationale - Asset Preliminary Climate Risk Rating

A Preliminary Climate Risk Rating is determined for each infrastructure and building asset by considering the overall project Exposure Score and responses to Step 4 questions provided by the user in the Tool. Natural Resource assets do not receive a risk rating. The following factors are what influenced the risk ratings for each asset.

Asset - Infrastructure
Primary asset criticality factors influencing risk ratings for this asset:

- Asset may inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event
- Loss/inoperability of the asset would have regional impacts
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- Spills and/or releases of hazardous materials would be relatively easy to clean up

Project Climate Resilience Design Standards Output

Climate Resilience Design Standards and Guidance are recommended for each asset and climate parameter. The Design Standards for each climate parameter include the following: recommended planning horizon (target and/or intermediate), recommended return period (Sea Level Rise/Storm Surge and Precipitation) or percentile (Heat), and a list of applicable design criteria that are likely to be affected by climate change. Some design criteria have numerical values associated with the recommended return period and planning horizon, while others have tiered methodologies with step-by-step instructions on how to estimate design values given the other recommended design standards.

Asset: Infrastructure — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: NOT APPLICABLE

Projected Water Surface Elevation: NOT APPLICABLE

Projected Wave Action Water Elevation: NOT APPLICABLE

Projected Wave Heights: NOT APPLICABLE

Projected Duration of Flooding: NOT APPLICABLE

Projected Design Flood Velocity: NOT APPLICABLE

Projected Scour & Erosion: NOT APPLICABLE

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 50-yr (2%)

LIMITATIONS: The recommended Standards for Total Precipitation Depth & Peak Intensity are determined by the user drawn polygon and relationships as defined in the Supporting Documents. The projected Total Precipitation Depth values provided through the Tool are based on the climate projections developed by Cornell University as part of EEA's Massachusetts Climate and Hydrologic Risk Project, GIS-based data as of 10/15/21. For additional information on the methodology of these precipitation outputs, see Supporting Documents.

While Total Precipitation Depth & Peak Intensity for 24-hour Design Storms are useful to inform planning and design, it is recommended to also consider additional longer- and shorter-duration precipitation events and intensities in accordance with best practices. Longer-duration, lower-intensity storms allow time for infiltration and reduce the load on infrastructure over the duration of the storm. Shorter-duration, higher-intensity storms often have higher runoff volumes because the water does not have enough time to infiltrate infrastructure systems (e.g., catch basins) and may overflow or back up during such storms, resulting in flooding. In the Northeast, short-duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. While the Tool does not provide recommended design standards for these scenarios, users should still consider both short- and long-duration precipitation events and how they may impact the asset.

The projected values, standards, and guidance provided within this Tool may be used to inform plans and designs, but they do not provide guarantees for future conditions or resilience. The projected values are not to be considered final or appropriate for construction documents without supporting engineering analyses. The guidance provided within this Tool is intended to be general and users are encouraged to do their own due diligence

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: APPLICABLE

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Infrastructure	2070	50-Year (2%)	8.7	Downloadable Methodology PDF

Projected Riverine Peak Discharge & Peak Flood Elevation: NOT APPLICABLE

Extreme Heat — High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Heat Index: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Growing Degree Days: NOT APPLICABLE

Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Number of Heat Waves Per Year & Average Heat Wave Duration: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Cooling Degree Days & Heating Degree Days (base = 65°F): NOT APPLICABLE

Project Inputs

Core Project Information

Name:	Central to Western MA Energy Improvement Project
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2075
Location of Project:	Shelburne
Estimated Capital Cost:	$100,000,000
Who is the Submitting Entity?	Private Other National Grid Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Permitting
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	NEP owns and operates double circuit 69 kV lines (E5 and F6 lines) that begins at the Deerfield #4 Substation in Shelburne through Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn, and terminating at the Millbury #305 Substation in Millbury. Tap lines consist of the existing Quabbin Switch Tap (E5W/F6W) in Belchertown, Deerfield #3 in Shelburne, Pondville Sub Tap in Auburn, Leicester Sub Tap in Leicester, and Lashway Sub Tap in North Brookfield. The E5/F6 lines were constructed in the early 1900s and refurbished in 2001. Structures and wires need replacement due to asset condition and aging infrastructure. In addition, the access conditions vary considerably throughout the ROW. Although the new E5/F6 Transmission Lines will operate at 69 kV when they are first placed into service, they are being designed and built to support operation at 115 kV at some point during their expected life.

Project Submission Comments:

Project Ecosystem Service Benefits

Factors Influencing Output

- ✓ Project filters stormwater using green infrastructure
- ✓ Project provides pollinator habitat
- ✓ Project provides recreation

Factors to Improve Output

- ✓ Incorporate strategies that reduce carbon emissions
- ✓ Identify opportunities to prevent pollutants from impacting ecosystems

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	No
Filters stormwater using green infrastructure	Yes
Improves water quality	No
Promotes decarbonization	Maybe
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	Maybe
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	Yes
Provides recreation	Yes

Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	Unsure
Does the project site have a history of riverine flooding?	Yes
Does the project result in a net increase in impervious area of the site?	Yes
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Infrastructure
Asset Type: Utility Infrastructure
Asset Sub-Type: Energy (electric, gas, petroleum, renewable)
Construction Type: Major Repair/Retrofit
Construction Year: 2025
Useful Life: 50

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure may be inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event.

Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)

Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Less than 100,000 people

Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

Will the infrastructure reduce the risk of flooding?
No

If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses

If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
Spills and/or releases of hazardous materials are expected with relatively easy cleanup

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate

If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million

Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrasturcture may reduce the ability to maintain most government services, while some sevices will still exist

What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

Town of Shutesbury

Climate Resilience Design Standards Tool Project Report

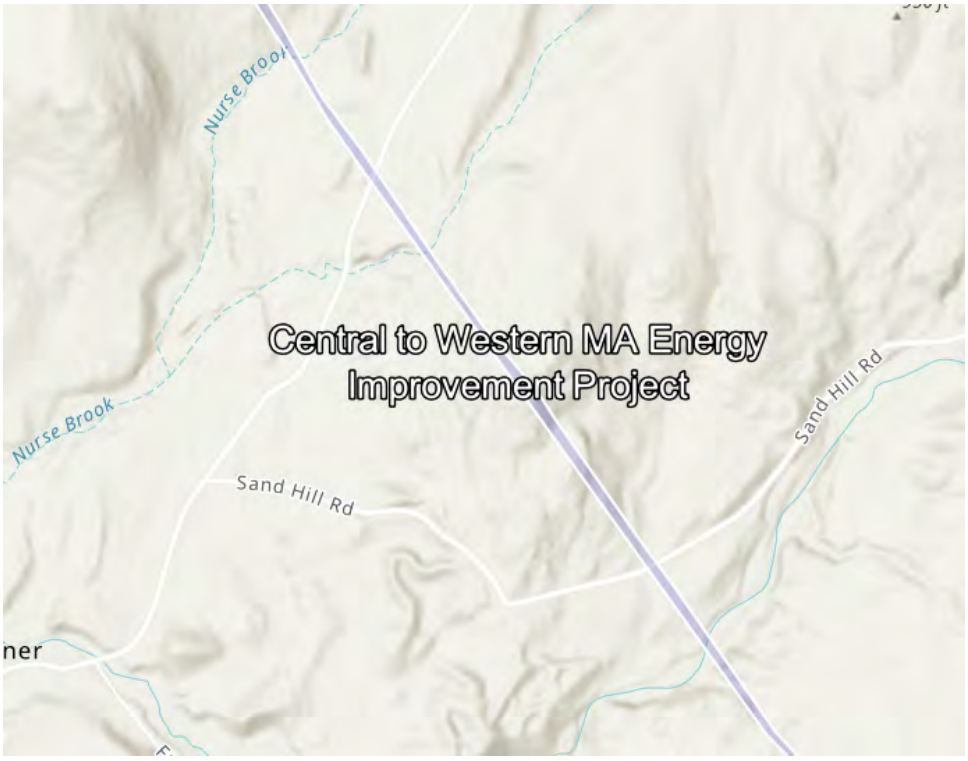
Central to Western MA Energy Improvement Project
Date Created: 5/18/2024 12:23:28 PM
Created By: JP
Date Report Generated: 5/18/2024 12:47:15 PM
Tool Version: Version 1.2
Project Contact Information: Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)

Project Summary

Link to Project

Estimated Capital Cost: $100000000.00
End of Useful Life Year: 2075
Project within mapped Environmental Justice neighborhood: No

Ecosystem Service Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	Moderate Exposure
Extreme Precipitation - Riverine Flooding	High Exposure
Extreme Heat	High Exposure



Asset Preliminary Climate Risk Rating Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Infrastructure	Low Risk	High Risk	High Risk	High Risk

Climate Resilience Design Standards Summary

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Infrastructure					
Extreme Precipitation					
Infrastructure	2070			50-yr (2%)	Tier 3
Extreme Heat					
Infrastructure	2070		90th		Tier 3

Scoring Rationale - Project Exposure Score

The purpose of the Exposure Score output is to provide a preliminary assessment of whether the overall project site and subsequent assets are exposed to impacts of natural hazard events and/or future impacts of climate change. For each climate parameter, the Tool will calculate one of the following exposure ratings: Not Exposed, Low Exposure, Moderate Exposure, or High Exposure. The rationale behind the exposure rating is provided below.

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "Moderate Exposure" because of the following:

- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site
- No increase to impervious area
- Existing impervious area of the project site is less than 10%

Extreme Precipitation - Riverine Flooding

This project received a "High Exposure" because of the following:

- Project site has a history of riverine flooding
- Part of the project is within 100ft of a waterbody
- The project is not within a mapped FEMA floodplain [outside of the Massachusetts Coast Flood Risk Model (MC-FRM)]
- Project is not likely susceptible to riverine erosion

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Existing trees are being removed as part of the proposed project
- Between 10% and 40% of the existing project site has canopy cover
- Located within 100 ft of existing water body
- No increase to the impervious area of the project site

Scoring Rationale - Asset Preliminary Climate Risk Rating

A Preliminary Climate Risk Rating is determined for each infrastructure and building asset by considering the overall project Exposure Score and responses to Step 4 questions provided by the user in the Tool. Natural Resource assets do not receive a risk rating. The following factors are what influenced the risk ratings for each asset.

Asset - Infrastructure
Primary asset criticality factors influencing risk ratings for this asset:

- Asset may inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event
- Loss/inoperability of the asset would have regional impacts
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- Spills and/or releases of hazardous materials would be relatively easy to clean up

Project Climate Resilience Design Standards Output

Climate Resilience Design Standards and Guidance are recommended for each asset and climate parameter. The Design Standards for each climate parameter include the following: recommended planning horizon (target and/or intermediate), recommended return period (Sea Level Rise/Storm Surge and Precipitation) or percentile (Heat), and a list of applicable design criteria that are likely to be affected by climate change. Some design criteria have numerical values associated with the recommended return period and planning horizon, while others have tiered methodologies with step-by-step instructions on how to estimate design values given the other recommended design standards.

Asset: Infrastructure — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: NOT APPLICABLE

Projected Water Surface Elevation: NOT APPLICABLE

Projected Wave Action Water Elevation: NOT APPLICABLE

Projected Wave Heights: NOT APPLICABLE

Projected Duration of Flooding: NOT APPLICABLE

Projected Design Flood Velocity: NOT APPLICABLE

Projected Scour & Erosion: NOT APPLICABLE

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 50-yr (2%)

LIMITATIONS: The recommended Standards for Total Precipitation Depth & Peak Intensity are determined by the user drawn polygon and relationships as defined in the Supporting Documents. The projected Total Precipitation Depth values provided through the Tool are based on the climate projections developed by Cornell University as part of EEA's Massachusetts Climate and Hydrologic Risk Project, GIS-based data as of 10/15/21. For additional information on the methodology of these precipitation outputs, see Supporting Documents.

While Total Precipitation Depth & Peak Intensity for 24-hour Design Storms are useful to inform planning and design, it is recommended to also consider additional longer- and shorter-duration precipitation events and intensities in accordance with best practices. Longer-duration, lower-intensity storms allow time for infiltration and reduce the load on infrastructure over the duration of the storm. Shorter-duration, higher-intensity storms often have higher runoff volumes because the water does not have enough time to infiltrate infrastructure systems (e.g., catch basins) and may overflow or back up during such storms, resulting in flooding. In the Northeast, short-duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. While the Tool does not provide recommended design standards for these scenarios, users should still consider both short- and long-duration precipitation events and how they may impact the asset.

The projected values, standards, and guidance provided within this Tool may be used to inform plans and designs, but they do not provide guarantees for future conditions or resilience. The projected values are not to be considered final or appropriate for construction documents without supporting engineering analyses. The guidance provided within this Tool is intended to be general and users are encouraged to do their own due diligence

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: APPLICABLE

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Infrastructure	2070	50-Year (2%)	9.4	Downloadable Methodology PDF

Projected Riverine Peak Discharge & Peak Flood Elevation: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Extreme Heat High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Heat Index: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Growing Degree Days: NOT APPLICABLE

Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Number of Heat Waves Per Year & Average Heat Wave Duration: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Cooling Degree Days & Heating Degree Days (base = 65°F): NOT APPLICABLE

Project Inputs

Core Project Information

Name:	Central to Western MA Energy Improvement Project
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2075
Location of Project:	Shutesbury
Estimated Capital Cost:	$100,000,000
Who is the Submitting Entity?	Private Other National Grid Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Permitting
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	NEP owns and operates double-circuit 69 kV lines (E5 and F6 lines) that begins at the Deerfield #4 Substation in Shelburne through Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn, and terminating at the Milbury #305 Substation in Millbury. Tap lines consist of the existing Quabbin Switch Tap (E5W/F6W) in Belchertown, Deerfield #3 in Shelburne, Pondville Sub Tap in Auburn, Leicester Sub Tap in Leicester, and Lashway Sub Tap in North Brookfield. The E5/F6 lines were constructed in the early 1900s and refurbished in 2001. Structures and wires are in need of replacement due to asset condition and aging infrastructure. In addition, the access conditions vary considerably throughout the ROW. Although the new E5/F6 Transmission Lines will operate at 69 kV when they are first placed into service, they are being designed and built to support operation at 115 kV at some point during their expected life.

Project Submission Comments:

Project Ecosystem Service Benefits

Factors Influencing Output

- ✓ Project filters stormwater using green infrastructure
- ✓ Project provides pollinator habitat
- ✓ Project provides recreation

Factors to Improve Output

- ✓ Incorporate strategies that reduce carbon emissions
- ✓ Identify opportunities to prevent pollutants from impacting ecosystems

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	No
Filters stormwater using green infrastructure	Yes
Improves water quality	No
Promotes decarbonization	Maybe
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	Maybe
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	Yes
Provides recreation	Yes

Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	Unsure
Does the project site have a history of riverine flooding?	Yes
Does the project result in a net increase in impervious area of the site?	No
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Infrastructure
Asset Type: Utility Infrastructure
Asset Sub-Type: Energy (electric, gas, petroleum, renewable)
Construction Type: Major Repair/Retrofit
Construction Year: 2025
Useful Life: 50

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure may be inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event.

Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)

Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Less than 100,000 people

Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

Will the infrastructure reduce the risk of flooding?
No

If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses

If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
Spills and/or releases of hazardous materials are expected with relatively easy cleanup

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate

If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million

Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrasturcture may reduce the ability to maintain most government services, while some sevices will still exist

What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

Town of Spencer

Climate Resilience Design Standards Tool Project Report

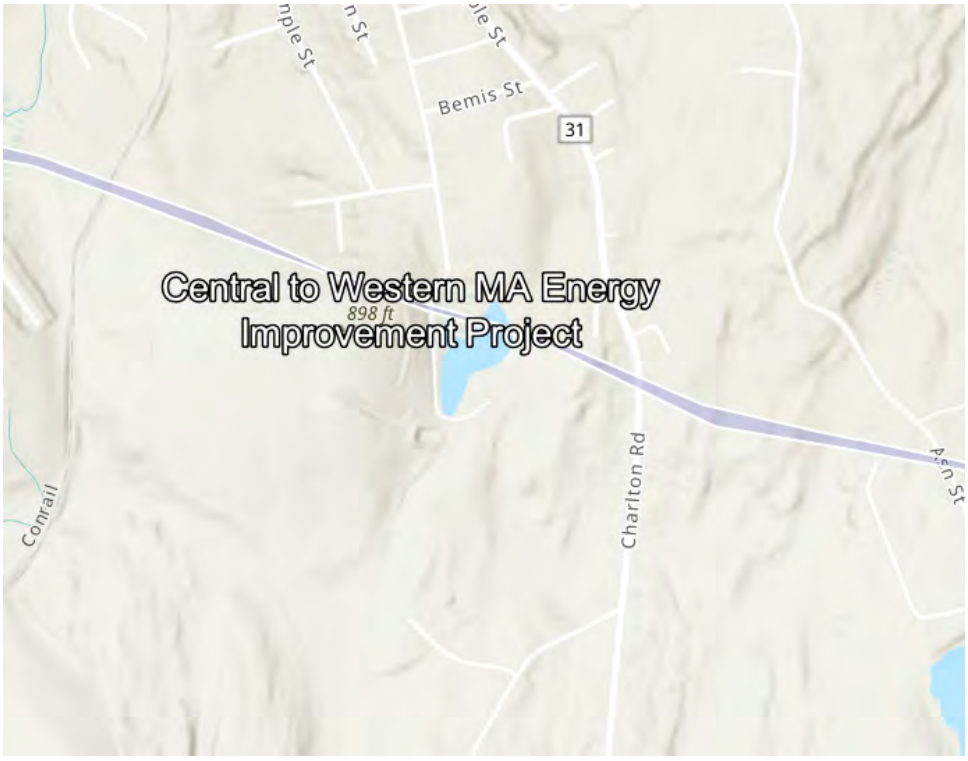
Central to Western MA Energy Improvement Project
Date Created: 5/18/2024 5:45:16 PM
Created By: JP
Date Report Generated: 5/18/2024 6:10:10 PM
Tool Version: Version 1.2
Project Contact Information: Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)

Project Summary

Link to Project

Estimated Capital Cost: $100000000.00
End of Useful Life Year: 2075
Project within mapped Environmental Justice neighborhood: Yes

Ecosystem Service Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	Moderate Exposure
Extreme Precipitation - Riverine Flooding	High Exposure
Extreme Heat	High Exposure



Asset Preliminary Climate Risk Rating Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Infrastructure	Low Risk	High Risk	High Risk	High Risk

Climate Resilience Design Standards Summary

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Infrastructure					
Extreme Precipitation					
Infrastructure	2070			50-yr (2%)	Tier 3
Extreme Heat					
Infrastructure	2070		90th		Tier 3

Scoring Rationale - Project Exposure Score

The purpose of the Exposure Score output is to provide a preliminary assessment of whether the overall project site and subsequent assets are exposed to impacts of natural hazard events and/or future impacts of climate change. For each climate parameter, the Tool will calculate one of the following exposure ratings: Not Exposed, Low Exposure, Moderate Exposure, or High Exposure. The rationale behind the exposure rating is provided below.

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "Moderate Exposure" because of the following:

- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site
- No increase to impervious area
- Existing impervious area of the project site is less than 10%

Extreme Precipitation - Riverine Flooding

This project received a "High Exposure" because of the following:

- Project site has a history of riverine flooding
- Part of the project is within a mapped FEMA floodplain, outside of the Massachusetts Coast Flood Risk Model (MC-FRM)
- Part of the project is within 100ft of a waterbody
- Project is not likely susceptible to riverine erosion

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Existing trees are being removed as part of the proposed project
- Between 10% and 40% of the existing project site has canopy cover
- Located within 100 ft of existing water body
- No increase to the impervious area of the project site

Scoring Rationale - Asset Preliminary Climate Risk Rating

A Preliminary Climate Risk Rating is determined for each infrastructure and building asset by considering the overall project Exposure Score and responses to Step 4 questions provided by the user in the Tool. Natural Resource assets do not receive a risk rating. The following factors are what influenced the risk ratings for each asset.

Asset - Infrastructure
Primary asset criticality factors influencing risk ratings for this asset:

- Asset may inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event
- Loss/inoperability of the asset would have regional impacts
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- Spills and/or releases of hazardous materials would be relatively easy to clean up

Project Climate Resilience Design Standards Output

Climate Resilience Design Standards and Guidance are recommended for each asset and climate parameter. The Design Standards for each climate parameter include the following: recommended planning horizon (target and/or intermediate), recommended return period (Sea Level Rise/Storm Surge and Precipitation) or percentile (Heat), and a list of applicable design criteria that are likely to be affected by climate change. Some design criteria have numerical values associated with the recommended return period and planning horizon, while others have tiered methodologies with step-by-step instructions on how to estimate design values given the other recommended design standards.

Asset: Infrastructure — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: NOT APPLICABLE

Projected Water Surface Elevation: NOT APPLICABLE

Projected Wave Action Water Elevation: NOT APPLICABLE

Projected Wave Heights: NOT APPLICABLE

Projected Duration of Flooding: NOT APPLICABLE

Projected Design Flood Velocity: NOT APPLICABLE

Projected Scour & Erosion: NOT APPLICABLE

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 50-yr (2%)

LIMITATIONS: The recommended Standards for Total Precipitation Depth & Peak Intensity are determined by the user drawn polygon and relationships as defined in the Supporting Documents. The projected Total Precipitation Depth values provided through the Tool are based on the climate projections developed by Cornell University as part of EEA's Massachusetts Climate and Hydrologic Risk Project, GIS-based data as of 10/15/21. For additional information on the methodology of these precipitation outputs, see Supporting Documents.

While Total Precipitation Depth & Peak Intensity for 24-hour Design Storms are useful to inform planning and design, it is recommended to also consider additional longer- and shorter-duration precipitation events and intensities in accordance with best practices. Longer-duration, lower-intensity storms allow time for infiltration and reduce the load on infrastructure over the duration of the storm. Shorter-duration, higher-intensity storms often have higher runoff volumes because the water does not have enough time to infiltrate infrastructure systems (e.g., catch basins) and may overflow or back up during such storms, resulting in flooding. In the Northeast, short-duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. While the Tool does not provide recommended design standards for these scenarios, users should still consider both short- and long-duration precipitation events and how they may impact the asset.

The projected values, standards, and guidance provided within this Tool may be used to inform plans and designs, but they do not provide guarantees for future conditions or resilience. The projected values are not to be considered final or appropriate for construction documents without supporting engineering analyses. The guidance provided within this Tool is intended to be general and users are encouraged to do their own due diligence

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: APPLICABLE

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Infrastructure	2070	50-Year (2%)	9.2	Downloadable Methodology PDF

Projected Riverine Peak Discharge & Peak Flood Elevation: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Extreme Heat High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Heat Index: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Growing Degree Days: NOT APPLICABLE

Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Number of Heat Waves Per Year & Average Heat Wave Duration: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Cooling Degree Days & Heating Degree Days (base = 65°F): NOT APPLICABLE

Project Inputs

Core Project Information

Name:	Central to Western MA Energy Improvement Project
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2075
Location of Project:	Spencer
Estimated Capital Cost:	$100,000,000
Who is the Submitting Entity?	Private Other National Grid Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Permitting
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	NEP owns and operates double-circuit 69 kV lines (E5 and F6 lines) that begins at the Deerfield #4 Substation in Shelburne through Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn, and terminating at the Milbury #305 Substation in Millbury. Tap lines consist of the existing Quabbin Switch Tap (E5W/F6W) in Belchertown, Deerfield #3 in Shelburne, Pondville Sub Tap in Auburn, Leicester Sub Tap in Leicester, and Lashway Sub Tap in North Brookfield. The E5/F6 lines were constructed in the early 1900s and refurbished in 2001. Structures and wires are in need of replacement due to asset condition and aging infrastructure. In addition, the access conditions vary considerably throughout the ROW. Although the new E5/F6 Transmission Lines will operate at 69 kV when they are first placed into service, they are being designed and built to support operation at 115 kV at some point during their expected life.
Project Submission Comments:	

Project Ecosystem Service Benefits

Factors Influencing Output

- ✓ Project filters stormwater using green infrastructure
- ✓ Project provides pollinator habitat
- ✓ Project provides recreation

Factors to Improve Output

- ✓ Incorporate strategies that reduce carbon emissions
- ✓ Identify opportunities to prevent pollutants from impacting ecosystems

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	No
Filters stormwater using green infrastructure	Yes
Improves water quality	No
Promotes decarbonization	Maybe
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	Maybe
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	Yes
Provides recreation	Yes

Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	Unsure
Does the project site have a history of riverine flooding?	Yes
Does the project result in a net increase in impervious area of the site?	No
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Infrastructure
Asset Type: Utility Infrastructure
Asset Sub-Type: Energy (electric, gas, petroleum, renewable)
Construction Type: Major Repair/Retrofit
Construction Year: 2025
Useful Life: 50

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure may be inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event.

Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)

Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Less than 100,000 people

Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

Will the infrastructure reduce the risk of flooding?
No

If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses

If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
Spills and/or releases of hazardous materials are expected with relatively easy cleanup

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate

If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million

Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrasturcture may reduce the ability to maintain most government services, while some sevices will still exist

What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

Town of Sunderland

Climate Resilience Design Standards Tool Project Report

Climate Resilience Design Standards Tool Project Report
Date Created: 12/3/2024 10:50:48 AM
Created By: JP
Date Report Generated: 12/3/2024 4:16:52 PM
Tool Version: Version 1.2
Project Contact Information: Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)

Project Summary

Link to Project

Estimated Capital Cost: $100000000.00
End of Useful Life Year: 2075
Project within mapped Environmental Justice neighborhood: Yes

Ecosystem Service Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	Moderate Exposure
Extreme Precipitation - Riverine Flooding	High Exposure
Extreme Heat	High Exposure



Asset Preliminary Climate Risk Rating Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Infrastructure	Low Risk	High Risk	High Risk	High Risk

Climate Resilience Design Standards Summary

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Infrastructure					
Extreme Precipitation					
Infrastructure	2070			50-yr (2%)	Tier 3
Extreme Heat					
Infrastructure	2070		90th		Tier 3

Scoring Rationale - Project Exposure Score

The purpose of the Exposure Score output is to provide a preliminary assessment of whether the overall project site and subsequent assets are exposed to impacts of natural hazard events and/or future impacts of climate change. For each climate parameter, the Tool will calculate one of the following exposure ratings: Not Exposed, Low Exposure, Moderate Exposure, or High Exposure. The rationale behind the exposure rating is provided below.

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "Moderate Exposure" because of the following:

- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site
- No increase to impervious area
- Existing impervious area of the project site is less than 10%

Extreme Precipitation - Riverine Flooding

This project received a "High Exposure" because of the following:

- Project site has a history of riverine flooding
- Part of the project is within 100ft of a waterbody
- Project is potentially susceptible to riverine erosion
- The project is not within a mapped FEMA floodplain [outside of the Massachusetts Coast Flood Risk Model (MC-FRM)]

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Existing trees are being removed as part of the proposed project
- Between 10% and 40% of the existing project site has canopy cover
- Located within 100 ft of existing water body
- No increase to the impervious area of the project site

Scoring Rationale - Asset Preliminary Climate Risk Rating

A Preliminary Climate Risk Rating is determined for each infrastructure and building asset by considering the overall project Exposure Score and responses to Step 4 questions provided by the user in the Tool. Natural Resource assets do not receive a risk rating. The following factors are what influenced the risk ratings for each asset.

Asset - Infrastructure
Primary asset criticality factors influencing risk ratings for this asset:

- Asset may inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event
- Loss/inoperability of the asset would have regional impacts
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- Spills and/or releases of hazardous materials would be relatively easy to clean up

Project Climate Resilience Design Standards Output

Climate Resilience Design Standards and Guidance are recommended for each asset and climate parameter. The Design Standards for each climate parameter include the following: recommended planning horizon (target and/or intermediate), recommended return period (Sea Level Rise/Storm Surge and Precipitation) or percentile (Heat), and a list of applicable design criteria that are likely to be affected by climate change. Some design criteria have numerical values associated with the recommended return period and planning horizon, while others have tiered methodologies with step-by-step instructions on how to estimate design values given the other recommended design standards.

Asset: Infrastructure — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: NOT APPLICABLE

Projected Water Surface Elevation: NOT APPLICABLE

Projected Wave Action Water Elevation: NOT APPLICABLE

Projected Wave Heights: NOT APPLICABLE

Projected Duration of Flooding: NOT APPLICABLE

Projected Design Flood Velocity: NOT APPLICABLE

Projected Scour & Erosion: NOT APPLICABLE

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 50-yr (2%)

LIMITATIONS: The recommended Standards for Total Precipitation Depth & Peak Intensity are determined by the user drawn polygon and relationships as defined in the Supporting Documents. The projected Total Precipitation Depth values provided through the Tool are based on the climate projections developed by Cornell University as part of EEA's Massachusetts Climate and Hydrologic Risk Project, GIS-based data as of 10/15/21. For additional information on the methodology of these precipitation outputs, see Supporting Documents.

While Total Precipitation Depth & Peak Intensity for 24-hour Design Storms are useful to inform planning and design, it is recommended to also consider additional longer- and shorter-duration precipitation events and intensities in accordance with best practices. Longer-duration, lower-intensity storms allow time for infiltration and reduce the load on infrastructure over the duration of the storm. Shorter-duration, higher-intensity storms often have higher runoff volumes because the water does not have enough time to infiltrate infrastructure systems (e.g., catch basins) and may overflow or back up during such storms, resulting in flooding. In the Northeast, short-duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. While the Tool does not provide recommended design standards for these scenarios, users should still consider both short- and long-duration precipitation events and how they may impact the asset.

The projected values, standards, and guidance provided within this Tool may be used to inform plans and designs, but they do not provide guarantees for future conditions or resilience. The projected values are not to be considered final or appropriate for construction documents without supporting engineering analyses. The guidance provided within this Tool is intended to be general and users are encouraged to do their own due diligence

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: APPLICABLE

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Infrastructure	2070	50-Year (2%)	9.1	Downloadable Methodology PDF

Projected Riverine Peak Discharge & Peak Flood Elevation: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Extreme Heat High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Heat Index: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Growing Degree Days: NOT APPLICABLE

Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Number of Heat Waves Per Year & Average Heat Wave Duration: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Cooling Degree Days & Heating Degree Days (base = 65°F): NOT APPLICABLE

Project Inputs

Core Project Information

Name:	Climate Resilience Design Standards Tool Project Report
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2075
Location of Project:	Sunderland
Estimated Capital Cost:	$100,000,000
Who is the Submitting Entity?	Private Other National Grid Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Permitting
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	NEP owns and operates double-circuit 69 kV lines (E5 and F6 lines) that begins at the Deerfield #4 Substation in Shelburne through Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn, and terminating at the Milbury #305 Substation in Millbury. Tap lines consist of the existing Quabbin Switch Tap (E5W/F6W) in Belchertown, Deerfield #3 in Shelburne, Pondville Sub Tap in Auburn, Leicester Sub Tap in Leicester, and Lashway Sub Tap in North Brookfield. The E5/F6 lines were constructed in the early 1900s and refurbished in 2001. Structures and wires are in need of replacement due to asset condition and aging infrastructure. In addition, the access conditions vary considerably throughout the ROW. Although the new E5/F6 Transmission Lines will operate at 69 kV when they are first placed into service, they are being designed and built to support operation at 115 kV at some point during their expected life.

Project Submission Comments:

Project Ecosystem Service Benefits

Factors Influencing Output

- ✓ Project filters stormwater using green infrastructure
- ✓ Project provides pollinator habitat
- ✓ Project provides recreation

Factors to Improve Output

- ✓ Incorporate strategies that reduce carbon emissions
- ✓ Identify opportunities to prevent pollutants from impacting ecosystems

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	No
Filters stormwater using green infrastructure	Yes
Improves water quality	No
Promotes decarbonization	Maybe
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	Maybe
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	Yes
Provides recreation	Yes

Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	Unsure
Does the project site have a history of riverine flooding?	Yes
Does the project result in a net increase in impervious area of the site?	No
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Infrastructure
Asset Type: Utility Infrastructure
Asset Sub-Type: Energy (electric, gas, petroleum, renewable)
Construction Type: Major Repair/Retrofit
Construction Year: 2025
Useful Life: 50

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure may be inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event.

Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)

Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Less than 100,000 people

Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

Will the infrastructure reduce the risk of flooding?
No

If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses

If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
Spills and/or releases of hazardous materials are expected with relatively easy cleanup

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate

If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million

Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrasturcture may reduce the ability to maintain most government services, while some sevices will still exist

What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

Town of Ware - #1

Climate Resilience Design Standards Tool Project Report

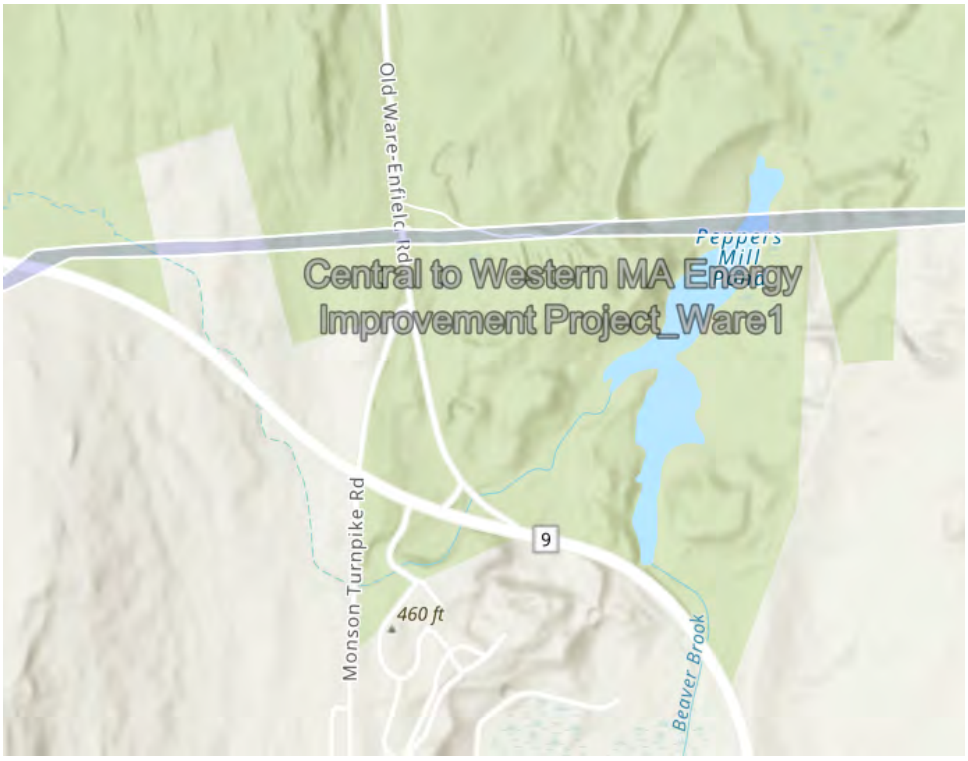
Central to Western MA Energy Improvement Project_Ware1
Date Created: 5/18/2024 1:57:34 PM
Created By: JP
Date Report Generated: 5/18/2024 2:34:05 PM
Tool Version: Version 1.2
Project Contact Information: Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)

Project Summary

Link to Project

Estimated Capital Cost: $100000000.00
End of Useful Life Year: 2075
Project within mapped Environmental Justice neighborhood: No

Ecosystem Service Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	Moderate Exposure
Extreme Precipitation - Riverine Flooding	High Exposure
Extreme Heat	High Exposure



Asset Preliminary Climate Risk Rating Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Infrastructure	Low Risk	High Risk	High Risk	High Risk

Climate Resilience Design Standards Summary

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Infrastructure					
Extreme Precipitation					
Infrastructure	2070			50-yr (2%)	Tier 3
Extreme Heat					
Infrastructure	2070		90th		Tier 3

Scoring Rationale - Project Exposure Score

The purpose of the Exposure Score output is to provide a preliminary assessment of whether the overall project site and subsequent assets are exposed to impacts of natural hazard events and/or future impacts of climate change. For each climate parameter, the Tool will calculate one of the following exposure ratings: Not Exposed, Low Exposure, Moderate Exposure, or High Exposure. The rationale behind the exposure rating is provided below.

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "Moderate Exposure" because of the following:

- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site
- No increase to impervious area
- Existing impervious area of the project site is less than 10%

Extreme Precipitation - Riverine Flooding

This project received a "High Exposure" because of the following:

- Project site has a history of riverine flooding
- Part of the project is within a mapped FEMA floodplain, outside of the Massachusetts Coast Flood Risk Model (MC-FRM)
- Part of the project is within 100ft of a waterbody
- Project is not likely susceptible to riverine erosion

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Existing trees are being removed as part of the proposed project
- Less than 10% of the existing project site has canopy cover
- Located within 100 ft of existing water body
- No increase to the impervious area of the project site

Scoring Rationale - Asset Preliminary Climate Risk Rating

A Preliminary Climate Risk Rating is determined for each infrastructure and building asset by considering the overall project Exposure Score and responses to Step 4 questions provided by the user in the Tool. Natural Resource assets do not receive a risk rating. The following factors are what influenced the risk ratings for each asset.

Asset - Infrastructure
Primary asset criticality factors influencing risk ratings for this asset:

- Asset may inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event
- Loss/inoperability of the asset would have regional impacts
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- Spills and/or releases of hazardous materials would be relatively easy to clean up

Project Climate Resilience Design Standards Output

Climate Resilience Design Standards and Guidance are recommended for each asset and climate parameter. The Design Standards for each climate parameter include the following: recommended planning horizon (target and/or intermediate), recommended return period (Sea Level Rise/Storm Surge and Precipitation) or percentile (Heat), and a list of applicable design criteria that are likely to be affected by climate change. Some design criteria have numerical values associated with the recommended return period and planning horizon, while others have tiered methodologies with step-by-step instructions on how to estimate design values given the other recommended design standards.

Asset: Infrastructure — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: NOT APPLICABLE

Projected Water Surface Elevation: NOT APPLICABLE

Projected Wave Action Water Elevation: NOT APPLICABLE

Projected Wave Heights: NOT APPLICABLE

Projected Duration of Flooding: NOT APPLICABLE

Projected Design Flood Velocity: NOT APPLICABLE

Projected Scour & Erosion: NOT APPLICABLE

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 50-yr (2%)

LIMITATIONS: The recommended Standards for Total Precipitation Depth & Peak Intensity are determined by the user drawn polygon and relationships as defined in the Supporting Documents. The projected Total Precipitation Depth values provided through the Tool are based on the climate projections developed by Cornell University as part of EEA's Massachusetts Climate and Hydrologic Risk Project, GIS-based data as of 10/15/21. For additional information on the methodology of these precipitation outputs, see Supporting Documents.

While Total Precipitation Depth & Peak Intensity for 24-hour Design Storms are useful to inform planning and design, it is recommended to also consider additional longer- and shorter-duration precipitation events and intensities in accordance with best practices. Longer-duration, lower-intensity storms allow time for infiltration and reduce the load on infrastructure over the duration of the storm. Shorter-duration, higher-intensity storms often have higher runoff volumes because the water does not have enough time to infiltrate infrastructure systems (e.g., catch basins) and may overflow or back up during such storms, resulting in flooding. In the Northeast, short-duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. While the Tool does not provide recommended design standards for these scenarios, users should still consider both short- and long-duration precipitation events and how they may impact the asset.

The projected values, standards, and guidance provided within this Tool may be used to inform plans and designs, but they do not provide guarantees for future conditions or resilience. The projected values are not to be considered final or appropriate for construction documents without supporting engineering analyses. The guidance provided within this Tool is intended to be general and users are encouraged to do their own due diligence

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: APPLICABLE

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Infrastructure	2070	50-Year (2%)	9.3	Downloadable Methodology PDF

Projected Riverine Peak Discharge & Peak Flood Elevation: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Extreme Heat High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Heat Index: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Growing Degree Days: NOT APPLICABLE

Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Number of Heat Waves Per Year & Average Heat Wave Duration: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Cooling Degree Days & Heating Degree Days (base = 65°F): NOT APPLICABLE

Project Inputs

Core Project Information

Name:	Central to Western MA Energy Improvement Project_Ware1
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2075
Location of Project:	Ware
Estimated Capital Cost:	$100,000,000
Who is the Submitting Entity?	Private Other National Grid Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Permitting
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	NEP owns and operates double-circuit 69 kV lines (E5 and F6 lines) that begins at the Deerfield #4 Substation in Shelburne through Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn, and terminating at the Milbury #305 Substation in Millbury. Tap lines consist of the existing Quabbin Switch Tap (E5W/F6W) in Belchertown, Deerfield #3 in Shelburne, Pondville Sub Tap in Auburn, Leicester Sub Tap in Leicester, and Lashway Sub Tap in North Brookfield. The E5/F6 lines were constructed in the early 1900s and refurbished in 2001. Structures and wires are in need of replacement due to asset condition and aging infrastructure. In addition, the access conditions vary considerably throughout the ROW. Although the new E5/F6 Transmission Lines will operate at 69 kV when they are first placed into service, they are being designed and built to support operation at 115 kV at some point during their expected life.
Project Submission Comments:	

Project Ecosystem Service Benefits

Factors Influencing Output

- ✓ Project filters stormwater using green infrastructure
- ✓ Project provides pollinator habitat
- ✓ Project provides recreation

Factors to Improve Output

- ✓ Incorporate strategies that reduce carbon emissions
- ✓ Identify opportunities to prevent pollutants from impacting ecosystems

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	No
Filters stormwater using green infrastructure	Yes
Improves water quality	No
Promotes decarbonization	Maybe
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	Maybe
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	Yes

Provides recreation	Yes
Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	Unsure
Does the project site have a history of riverine flooding?	Yes
Does the project result in a net increase in impervious area of the site?	No
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Infrastructure
Asset Type: Utility Infrastructure
Asset Sub-Type: Energy (electric, gas, petroleum, renewable)
Construction Type: Major Repair/Retrofit
Construction Year: 2025
Useful Life: 50

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure may be inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event.

Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)

Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Less than 100,000 people

Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

Will the infrastructure reduce the risk of flooding?
No

If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses

If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
Spills and/or releases of hazardous materials are expected with relatively easy cleanup

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate

If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million

Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrasturcture may reduce the ability to maintain most government services, while some sevices will still exist

What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

Town of Ware - #2

Climate Resilience Design Standards Tool Project Report

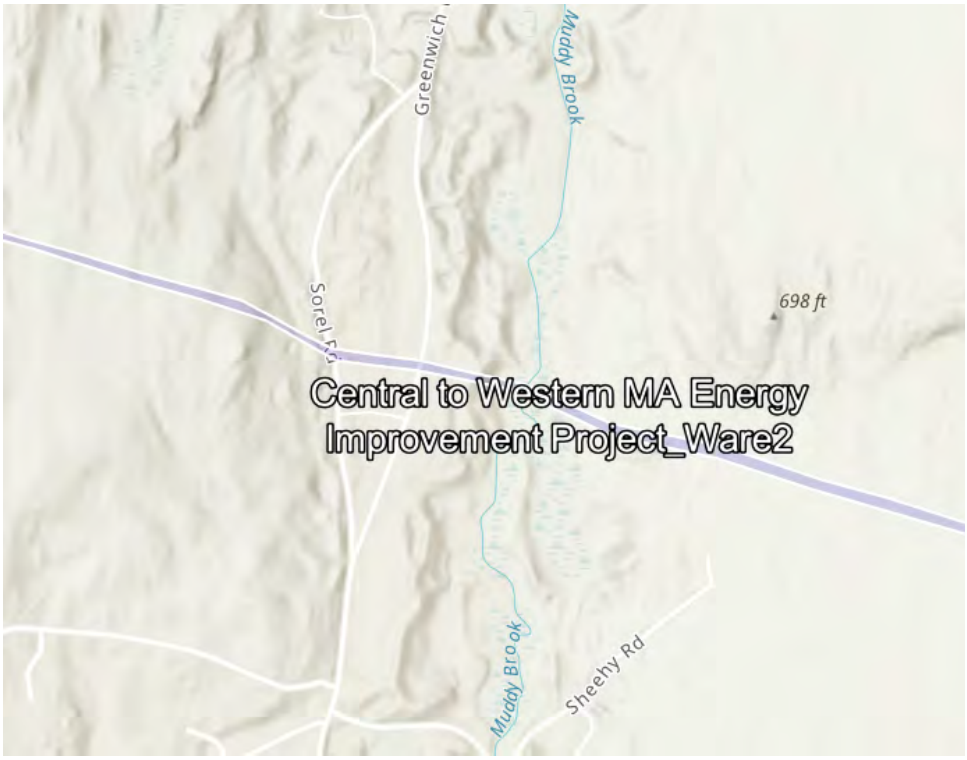
Central to Western MA Energy Improvement Project_Ware2
Date Created: 5/18/2024 2:38:33 PM Created By: JP
Date Report Generated: 5/18/2024 2:54:43 PM Tool Version: Version 1.2
Project Contact Information: Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)

Project Summary

Link to Project

Estimated Capital Cost: $100000000.00
End of Useful Life Year: 2075
Project within mapped Environmental Justice neighborhood: No

Ecosystem Service Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	Moderate Exposure
Extreme Precipitation - Riverine Flooding	High Exposure
Extreme Heat	High Exposure



Asset Preliminary Climate Risk Rating Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Infrastructure	Low Risk	High Risk	High Risk	High Risk

Climate Resilience Design Standards Summary

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Infrastructure					
Extreme Precipitation					
Infrastructure	2070			50-yr (2%)	Tier 3
Extreme Heat					
Infrastructure	2070		90th		Tier 3

Scoring Rationale - Project Exposure Score

The purpose of the Exposure Score output is to provide a preliminary assessment of whether the overall project site and subsequent assets are exposed to impacts of natural hazard events and/or future impacts of climate change. For each climate parameter, the Tool will calculate one of the following exposure ratings: Not Exposed, Low Exposure, Moderate Exposure, or High Exposure. The rationale behind the exposure rating is provided below.

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "Moderate Exposure" because of the following:

- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site
- No increase to impervious area
- Existing impervious area of the project site is less than 10%

Extreme Precipitation - Riverine Flooding

This project received a "High Exposure" because of the following:

- Project site has a history of riverine flooding
- Part of the project is within a mapped FEMA floodplain, outside of the Massachusetts Coast Flood Risk Model (MC-FRM)
- Part of the project is within 100ft of a waterbody
- Project is not likely susceptible to riverine erosion

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Existing trees are being removed as part of the proposed project
- Less than 10% of the existing project site has canopy cover
- Located within 100 ft of existing water body
- No increase to the impervious area of the project site

Scoring Rationale - Asset Preliminary Climate Risk Rating

A Preliminary Climate Risk Rating is determined for each infrastructure and building asset by considering the overall project Exposure Score and responses to Step 4 questions provided by the user in the Tool. Natural Resource assets do not receive a risk rating. The following factors are what influenced the risk ratings for each asset.

Asset - Infrastructure
Primary asset criticality factors influencing risk ratings for this asset:

- Asset may inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event
- Loss/inoperability of the asset would have regional impacts
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- Spills and/or releases of hazardous materials would be relatively easy to clean up

Project Climate Resilience Design Standards Output

Climate Resilience Design Standards and Guidance are recommended for each asset and climate parameter. The Design Standards for each climate parameter include the following: recommended planning horizon (target and/or intermediate), recommended return period (Sea Level Rise/Storm Surge and Precipitation) or percentile (Heat), and a list of applicable design criteria that are likely to be affected by climate change. Some design criteria have numerical values associated with the recommended return period and planning horizon, while others have tiered methodologies with step-by-step instructions on how to estimate design values given the other recommended design standards.

Asset: Infrastructure — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: NOT APPLICABLE

Projected Water Surface Elevation: NOT APPLICABLE

Projected Wave Action Water Elevation: NOT APPLICABLE

Projected Wave Heights: NOT APPLICABLE

Projected Duration of Flooding: NOT APPLICABLE

Projected Design Flood Velocity: NOT APPLICABLE

Projected Scour & Erosion: NOT APPLICABLE

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 50-yr (2%)

LIMITATIONS: The recommended Standards for Total Precipitation Depth & Peak Intensity are determined by the user drawn polygon and relationships as defined in the Supporting Documents. The projected Total Precipitation Depth values provided through the Tool are based on the climate projections developed by Cornell University as part of EEA's Massachusetts Climate and Hydrologic Risk Project, GIS-based data as of 10/15/21. For additional information on the methodology of these precipitation outputs, see Supporting Documents.

While Total Precipitation Depth & Peak Intensity for 24-hour Design Storms are useful to inform planning and design, it is recommended to also consider additional longer- and shorter-duration precipitation events and intensities in accordance with best practices. Longer-duration, lower-intensity storms allow time for infiltration and reduce the load on infrastructure over the duration of the storm. Shorter-duration, higher-intensity storms often have higher runoff volumes because the water does not have enough time to infiltrate infrastructure systems (e.g., catch basins) and may overflow or back up during such storms, resulting in flooding. In the Northeast, short-duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. While the Tool does not provide recommended design standards for these scenarios, users should still consider both short- and long-duration precipitation events and how they may impact the asset.

The projected values, standards, and guidance provided within this Tool may be used to inform plans and designs, but they do not provide guarantees for future conditions or resilience. The projected values are not to be considered final or appropriate for construction documents without supporting engineering analyses. The guidance provided within this Tool is intended to be general and users are encouraged to do their own due diligence

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: APPLICABLE

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Infrastructure	2070	50-Year (2%)	9.2	Downloadable Methodology PDF

Projected Riverine Peak Discharge & Peak Flood Elevation: NOT APPLICABLE

Extreme Heat — High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Heat Index: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Growing Degree Days: NOT APPLICABLE

Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Number of Heat Waves Per Year & Average Heat Wave Duration: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Cooling Degree Days & Heating Degree Days (base = 65°F): NOT APPLICABLE

Project Inputs

Core Project Information

Name:	Central to Western MA Energy Improvement Project_Ware2
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2075
Location of Project:	Ware
Estimated Capital Cost:	$100,000,000
Who is the Submitting Entity?	Private Other National Grid Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Permitting
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	NEP owns and operates double-circuit 69 kV lines (E5 and F6 lines) that begins at the Deerfield #4 Substation in Shelburne through Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn, and terminating at the Milbury #305 Substation in Millbury. Tap lines consist of the existing Quabbin Switch Tap (E5W/F6W) in Belchertown, Deerfield #3 in Shelburne, Pondville Sub Tap in Auburn, Leicester Sub Tap in Leicester, and Lashway Sub Tap in North Brookfield. The E5/F6 lines were constructed in the early 1900s and refurbished in 2001. Structures and wires are in need of replacement due to asset condition and aging infrastructure. In addition, the access conditions vary considerably throughout the ROW. Although the new E5/F6 Transmission Lines will operate at 69 kV when they are first placed into service, they are being designed and built to support operation at 115 kV at some point during their expected life.
Project Submission Comments:	

Project Ecosystem Service Benefits

Factors Influencing Output

- ✓ Project filters stormwater using green infrastructure
- ✓ Project provides pollinator habitat
- ✓ Project provides recreation

Factors to Improve Output

- ✓ Incorporate strategies that reduce carbon emissions
- ✓ Identify opportunities to prevent pollutants from impacting ecosystems

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	No
Filters stormwater using green infrastructure	Yes
Improves water quality	No
Promotes decarbonization	Maybe
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	Maybe
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	Yes

Provides recreation	Yes
Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	Unsure
Does the project site have a history of riverine flooding?	Yes
Does the project result in a net increase in impervious area of the site?	No
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Infrastructure
Asset Type: Utility Infrastructure
Asset Sub-Type: Energy (electric, gas, petroleum, renewable)
Construction Type: Major Repair/Retrofit
Construction Year: 2025
Useful Life: 50

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure may be inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event.

Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)

Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Less than 100,000 people

Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

Will the infrastructure reduce the risk of flooding?
No

If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses

If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
Spills and/or releases of hazardous materials are expected with relatively easy cleanup

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate

If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million

Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrasturcture may reduce the ability to maintain most government services, while some sevices will still exist

What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

Town of West Brookfield

Climate Resilience Design Standards Tool Project Report

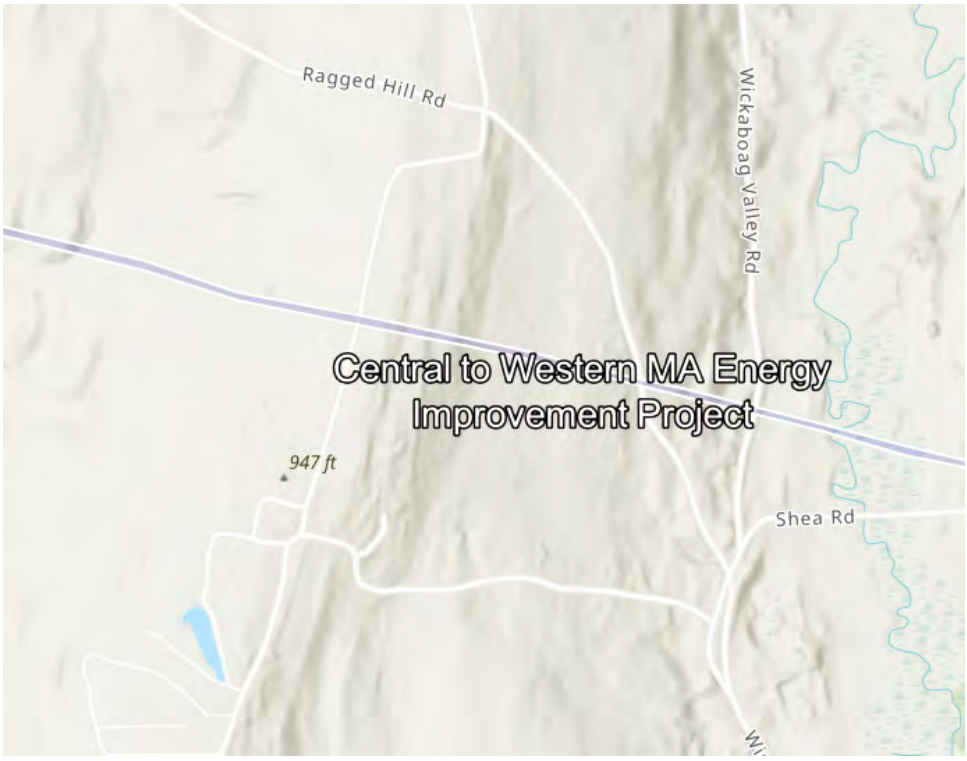
Central to Western MA Energy Improvement Project_WB
Date Created: 5/18/2024 2:59:33 PM Created By: JP
Date Report Generated: 5/18/2024 3:31:41 PM Tool Version: Version 1.2
Project Contact Information: Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)

Project Summary

Link to Project

Estimated Capital Cost: $100000000.00
End of Useful Life Year: 2075
Project within mapped Environmental Justice neighborhood: No

Ecosystem Service Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	Moderate Exposure
Extreme Precipitation - Riverine Flooding	High Exposure
Extreme Heat	High Exposure



Asset Preliminary Climate Risk Rating Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Infrastructure	Low Risk	High Risk	High Risk	High Risk

Climate Resilience Design Standards Summary

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Infrastructure					
Extreme Precipitation					
Infrastructure	2070			50-yr (2%)	Tier 3
Extreme Heat					
Infrastructure	2070		90th		Tier 3

Scoring Rationale - Project Exposure Score

The purpose of the Exposure Score output is to provide a preliminary assessment of whether the overall project site and subsequent assets are exposed to impacts of natural hazard events and/or future impacts of climate change. For each climate parameter, the Tool will calculate one of the following exposure ratings: Not Exposed, Low Exposure, Moderate Exposure, or High Exposure. The rationale behind the exposure rating is provided below.

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "Moderate Exposure" because of the following:

- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site
- No increase to impervious area
- Existing impervious area of the project site is less than 10%

Extreme Precipitation - Riverine Flooding

This project received a "High Exposure" because of the following:

- Project site has a history of riverine flooding
- Part of the project is within a mapped FEMA floodplain, outside of the Massachusetts Coast Flood Risk Model (MC-FRM)
- Part of the project is within 100ft of a waterbody
- Project is potentially susceptible to riverine erosion

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Existing trees are being removed as part of the proposed project
- Between 10% and 40% of the existing project site has canopy cover
- Located within 100 ft of existing water body
- No increase to the impervious area of the project site

Scoring Rationale - Asset Preliminary Climate Risk Rating

A Preliminary Climate Risk Rating is determined for each infrastructure and building asset by considering the overall project Exposure Score and responses to Step 4 questions provided by the user in the Tool. Natural Resource assets do not receive a risk rating. The following factors are what influenced the risk ratings for each asset.

Asset - Infrastructure
Primary asset criticality factors influencing risk ratings for this asset:

- Asset may inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event
- Loss/inoperability of the asset would have regional impacts
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- Spills and/or releases of hazardous materials would be relatively easy to clean up

Project Climate Resilience Design Standards Output

Climate Resilience Design Standards and Guidance are recommended for each asset and climate parameter. The Design Standards for each climate parameter include the following: recommended planning horizon (target and/or intermediate), recommended return period (Sea Level Rise/Storm Surge and Precipitation) or percentile (Heat), and a list of applicable design criteria that are likely to be affected by climate change. Some design criteria have numerical values associated with the recommended return period and planning horizon, while others have tiered methodologies with step-by-step instructions on how to estimate design values given the other recommended design standards.

Asset: Infrastructure — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: NOT APPLICABLE

Projected Water Surface Elevation: NOT APPLICABLE

Projected Wave Action Water Elevation: NOT APPLICABLE

Projected Wave Heights: NOT APPLICABLE

Projected Duration of Flooding: NOT APPLICABLE

Projected Design Flood Velocity: NOT APPLICABLE

Projected Scour & Erosion: NOT APPLICABLE

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 50-yr (2%)

LIMITATIONS: The recommended Standards for Total Precipitation Depth & Peak Intensity are determined by the user drawn polygon and relationships as defined in the Supporting Documents. The projected Total Precipitation Depth values provided through the Tool are based on the climate projections developed by Cornell University as part of EEA's Massachusetts Climate and Hydrologic Risk Project, GIS-based data as of 10/15/21. For additional information on the methodology of these precipitation outputs, see Supporting Documents.

While Total Precipitation Depth & Peak Intensity for 24-hour Design Storms are useful to inform planning and design, it is recommended to also consider additional longer- and shorter-duration precipitation events and intensities in accordance with best practices. Longer-duration, lower-intensity storms allow time for infiltration and reduce the load on infrastructure over the duration of the storm. Shorter-duration, higher-intensity storms often have higher runoff volumes because the water does not have enough time to infiltrate infrastructure systems (e.g., catch basins) and may overflow or back up during such storms, resulting in flooding. In the Northeast, short-duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. While the Tool does not provide recommended design standards for these scenarios, users should still consider both short- and long-duration precipitation events and how they may impact the asset.

The projected values, standards, and guidance provided within this Tool may be used to inform plans and designs, but they do not provide guarantees for future conditions or resilience. The projected values are not to be considered final or appropriate for construction documents without supporting engineering analyses. The guidance provided within this Tool is intended to be general and users are encouraged to do their own due diligence

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: APPLICABLE

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Infrastructure	2070	50-Year (2%)	9.1	Downloadable Methodology PDF

Projected Riverine Peak Discharge & Peak Flood Elevation: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Extreme Heat High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Heat Index: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Growing Degree Days: NOT APPLICABLE

Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Number of Heat Waves Per Year & Average Heat Wave Duration: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Cooling Degree Days & Heating Degree Days (base = 65°F): NOT APPLICABLE

Project Inputs

Core Project Information

Name:	Central to Western MA Energy Improvement Project_WB
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2075
Location of Project:	Brookfield
Estimated Capital Cost:	$100,000,000
Who is the Submitting Entity?	Private Other National Grid Michael Tyrrell (Michael.Tyrrell@nationalgrid.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Permitting
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	NEP owns and operates double-circuit 69 kV lines (E5 and F6 lines) that begins at the Deerfield #4 Substation in Shelburne through Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn, and terminating at the Milbury #305 Substation in Millbury. Tap lines consist of the existing Quabbin Switch Tap (E5W/F6W) in Belchertown, Deerfield #3 in Shelburne, Pondville Sub Tap in Auburn, Leicester Sub Tap in Leicester, and Lashway Sub Tap in North Brookfield. The E5/F6 lines were constructed in the early 1900s and refurbished in 2001. Structures and wires are in need of replacement due to asset condition and aging infrastructure. In addition, the access conditions vary considerably throughout the ROW. Although the new E5/F6 Transmission Lines will operate at 69 kV when they are first placed into service, they are being designed and built to support operation at 115 kV at some point during their expected life.

Project Submission Comments:

Project Ecosystem Service Benefits

Factors Influencing Output

- ✓ Project filters stormwater using green infrastructure
- ✓ Project provides pollinator habitat
- ✓ Project provides recreation

Factors to Improve Output

- ✓ Incorporate strategies that reduce carbon emissions
- ✓ Identify opportunities to prevent pollutants from impacting ecosystems

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	No
Filters stormwater using green infrastructure	Yes
Improves water quality	No
Promotes decarbonization	Maybe
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	Maybe
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	Yes
Provides recreation	Yes

Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	Unsure
Does the project site have a history of riverine flooding?	Yes
Does the project result in a net increase in impervious area of the site?	No
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Infrastructure
Asset Type: Utility Infrastructure
Asset Sub-Type: Energy (electric, gas, petroleum, renewable)
Construction Type: Major Repair/Retrofit
Construction Year: 2025
Useful Life: 50

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure may be inaccessible/inoperable during natural hazard event, but must be accessible/operable within one day after natural hazard event.

Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)

Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Less than 100,000 people

Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

Will the infrastructure reduce the risk of flooding?
No

If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses

If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
Spills and/or releases of hazardous materials are expected with relatively easy cleanup

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate

If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million

Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrasturcture may reduce the ability to maintain most government services, while some sevices will still exist

What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

Appendix D – Environmental Justice

Environmental Notification Form (ENF)

Central To Western Massachusetts Energy Improvement Project

EJ Locus Map

Screening Form

EJ Reference List

Advance Notification Submittal

Invite to Metting Submittal

Legal Ad Submittal

Appendix D – Environmental Justice
EJ Locus Map

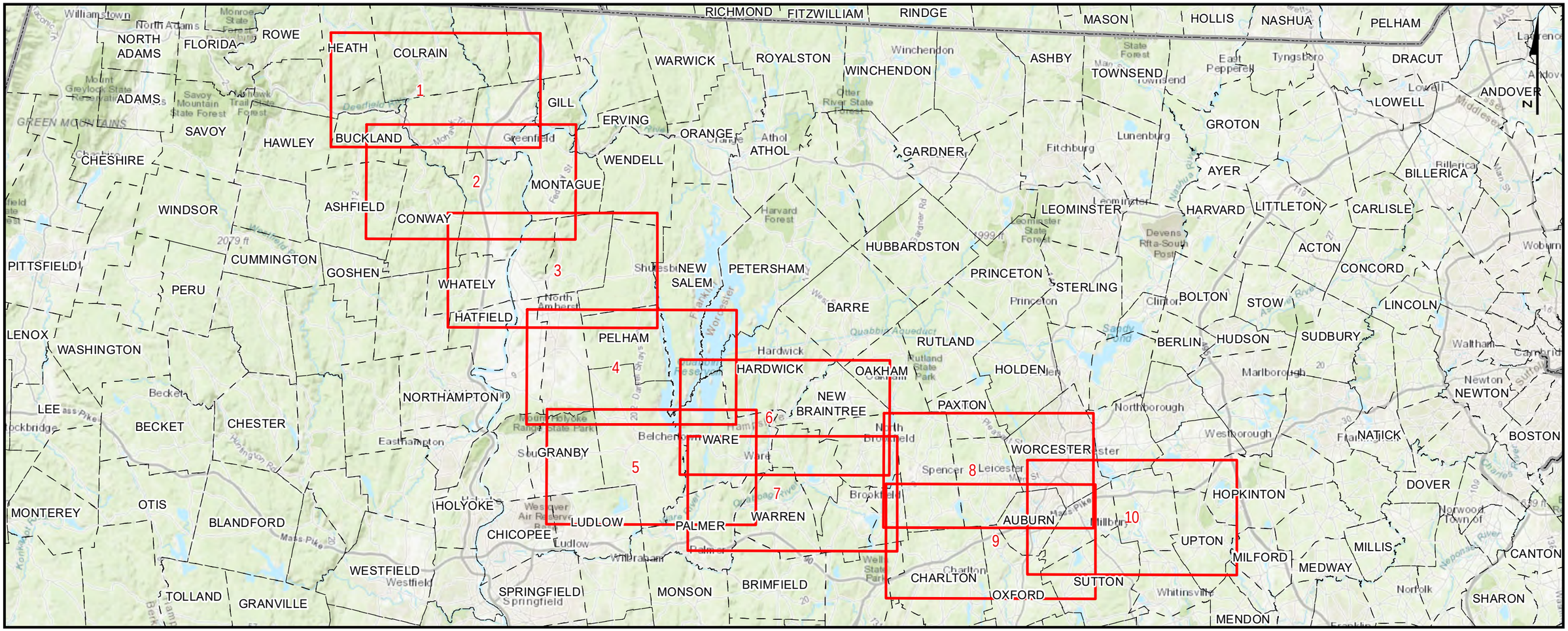
BSC Project Number: 100181.00

Central to Western Massachusetts Energy Improvement Project

Environmental Justice Populations Site Location Map

Shelburne, Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn & Millbury, MA

December 12, 2024



PREPARED FOR:

nationalgrid

170 Data Drive
Waltham, MA 02451

INDEX OF FIGURES

T1 - TITLE SHEET
S1 - SITE LOCATION MAP
1 - 10 - MAP SHEETS

ISSUED FOR PERMITTING
NOT CONSTRUCTION

PREPARED BY:

BSC GROUP

1 Mercantile Street Suite 601
Worcester, MA 01608

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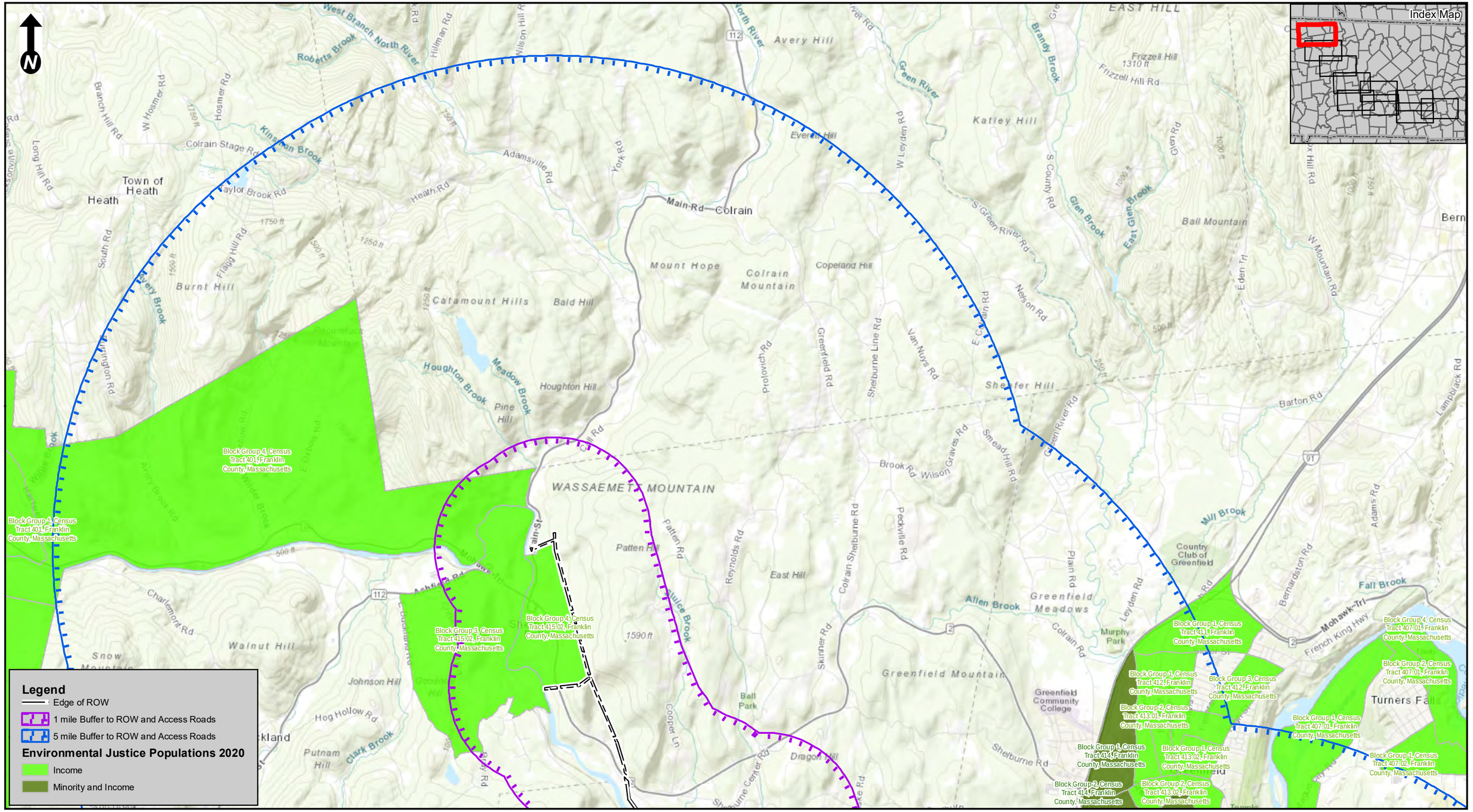
N
Index Map
Legend
Edge of ROW
1 mile Buffer to ROW and Access Roads
5 mile Buffer to ROW and Access Roads
Environmental Justice Populations 2020
Income
Minority and Income
Block Group 4, Census Tract 401, Franklin County, Massachusetts
Block Group 1, Census Tract 401, Franklin County, Massachusetts
Block Group 3, Census Tract 415.02, Franklin County, Massachusetts
Block Group 4, Census Tract 415.02, Franklin County, Massachusetts
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Block Group 3, Census Tract 412, Franklin County, Massachusetts
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Block Group 2, Census Tract 407.01, Franklin County, Massachusetts
Block Group 1, Census Tract 407.01, Franklin County, Massachusetts
Block Group 1, Census Tract 407.02, Franklin County, Massachusetts
Town of Heath
Main Rd—Colrain
Avery Hill
Everett Hill
Katley Hill
Frizzell Hill
1310 ft
Frizzell Hill Rd
Ball Mountain
Burnt Hill
Mount Hope
Colrain Mountain
Copeland Hill
Catamount Hills
Bald Hill
Houghton Hill
Pine Hill
Patten Hill
East Hill
Greenfield Meadows
Greenfield Mountain
Greenfield Community College
Country Club of Greenfield
Murphy Park
Ball Park
Walnut Hill
Johnson Hill
Snow Mountain
Putnam Hill
Dragon Hill
Turners Falls
WASSAEMETT MOUNTAIN
Roberts Brook
West Branch North River
Kinsman Brook
Adamsville Rd
Heath Rd
Colrain Stage Rd
Taylor Brook Rd
Flagg Hill Rd
Hosmer Rd
W Hosmer Rd
Branch Hill Rd
Long Hill Rd
South Rd
Hillman Rd
Wilson Hill Rd
York Rd
North River
Green River
W Leyden Rd
Brandy Brook
S County Rd
S Green River Rd
Glen Rd
Glen Brook
East Glen Brook
Eden Trl
W Mountain Rd
Nelson Rd
Barton Rd
Lampblack Rd
Meadow Brook
Houghton Brook
Prolovich Rd
Greenfield Rd
Shelburne Line Rd
Van Nuys Rd
Sheafer Hill
Brook Rd
Wilson Graves Rd
Smead Hill Rd
Sluice Brook
Patten Rd
Reynolds Rd
Colrain Shelburne Rd
Peckville Rd
Skinner Rd
Cooper Ln
Shelburne Center Rd
Shelburne Rd
Plain Rd
Leyden Rd
Colrain Rd
Allen Brook
Mill Brook
Fall Brook
Bernardston Rd
Adams Rd
Mohawk Trl
French King Hwy
Charlemont Rd
Hog Hollow Rd
Clark Brook
Avery Brook Rd
Miller Brook
Millers River Rd
Chickley River Rd
Ashfield Rd
Doubleday Rd
Pudding Hill Rd
Mohawk Trail
Old Stage Rd
Old Colrain Rd
Old Shelburne Rd
Old Greenfield Rd
Old Main St
Old Bernardston Rd
Old Adams Rd
Old Mill Rd
Old Wilson Rd
Old Sheafer Hill Rd
Old Barton Rd
Old Lampblack Rd
Old Mohawk Trl
Old Fall Brook Rd
Old Meadow Brook Rd
Old Houghton Brook Rd
Old Prolovich Rd
Old Greenfield Rd
Old Shelburne Line Rd
Old Van Nuys Rd
Old Nelson Rd
Old Eden Trl
Old W Mountain Rd
Old Glen Brook Rd
Old Glen Rd
Old Brandy Brook Rd
Old Frizzell Hill Rd
Old Avery Hill Rd
Old Everett Hill Rd
Old Katley Hill Rd
Old Green River Rd
Old W Leyden Rd
Old S County Rd
Old S Green River Rd
Old Nelson Rd
Old Eden Trl
Old W Mountain Rd
Old Barton Rd
Old Lampblack Rd
Old Fall Brook Rd
Old Mohawk Trl
Old French King Hwy
Old Bernardston Rd
Old Adams Rd
Old Mill Rd
Old Wilson Rd
Old Sheafer Hill Rd
Old Shelburne Rd
Old Plain Rd
Old Leyden Rd
Old Colrain Rd
Old Allen Brook Rd
Old Greenfield Rd
Old Shelburne Line Rd
Old Van Nuys Rd
Old Prolovich Rd
Old Meadow Brook Rd
Old Houghton Brook Rd
Old Sluice Brook Rd
Old Patten Rd
Old Reynolds Rd
Old Colrain Shelburne Rd
Old Peckville Rd
Old Skinner Rd
Old Cooper Ln
Old Shelburne Center Rd
Old Dragon Hill Rd
Old Greenfield Mountain Rd
Old Ball Park Rd
Old Murphy Park Rd
Old Greenfield Meadows Rd
Old Country Club of Greenfield Rd
Old Turners Falls Rd
Old Temple Rd
Old Walnut Hill Rd
Old Johnson Hill Rd
Old Snow Mountain Rd
Old Putnam Hill Rd
Old Clark Brook Rd
Old Hog Hollow Rd
Old Charlemont Rd
Old Ashfield Rd
Old Doubleday Rd
Old Pudding Hill Rd
Old Mohawk Trail
Old Stage Rd
Old Colrain Rd
Old Shelburne Rd
Old Greenfield Rd
Old Main St
Old Bernardston Rd
Old Adams Rd
Old Mill Rd
Old Wilson Rd
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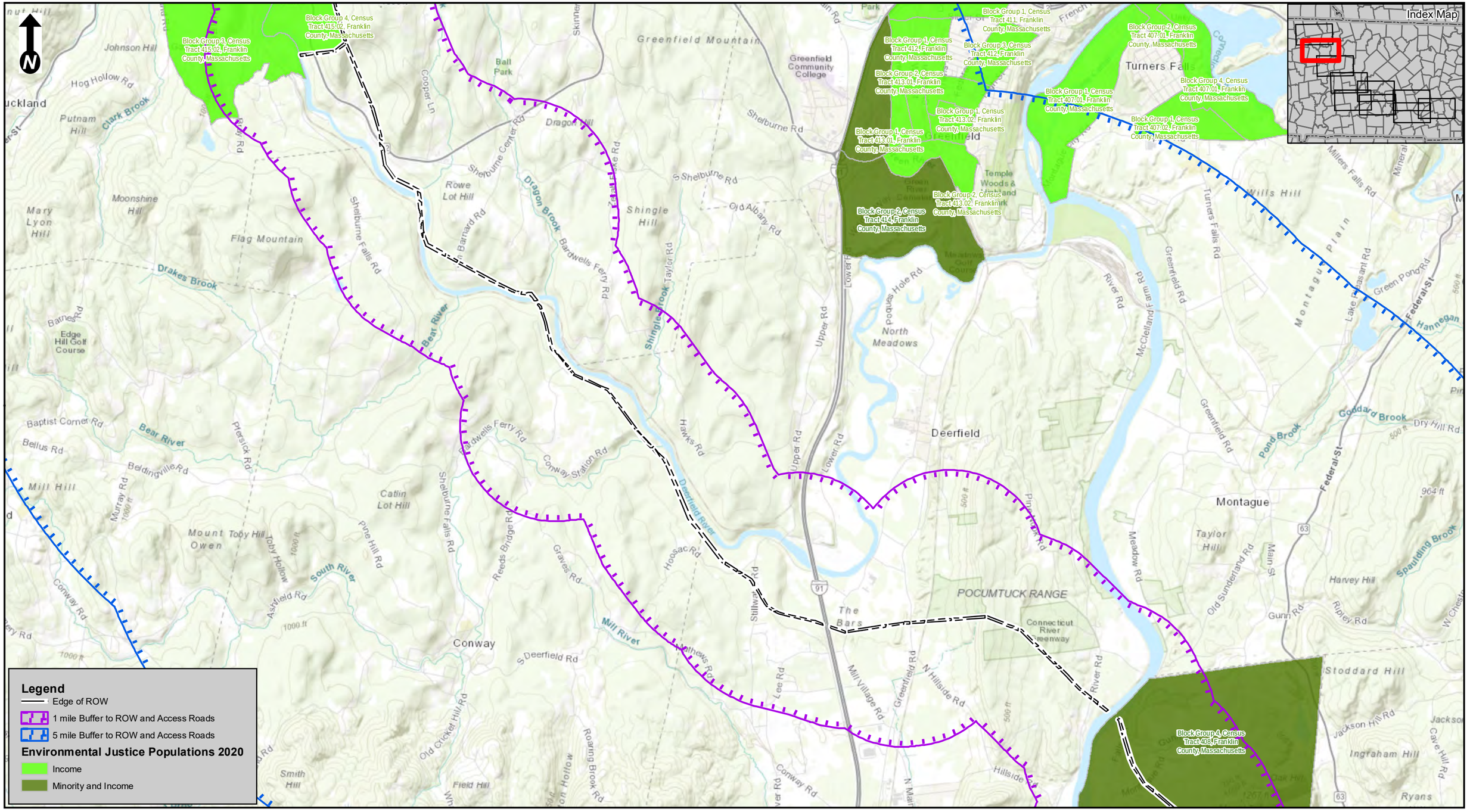
Old Barton Rd
Old Lampblack Rd
Old Fall Brook Rd
Old Mohawk Trl
Old French King Hwy



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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT
Environmental Justice Populations Site Location Map
Shelburne, Conway, Deerfield & Sunderland, MA
Page 2 of 10

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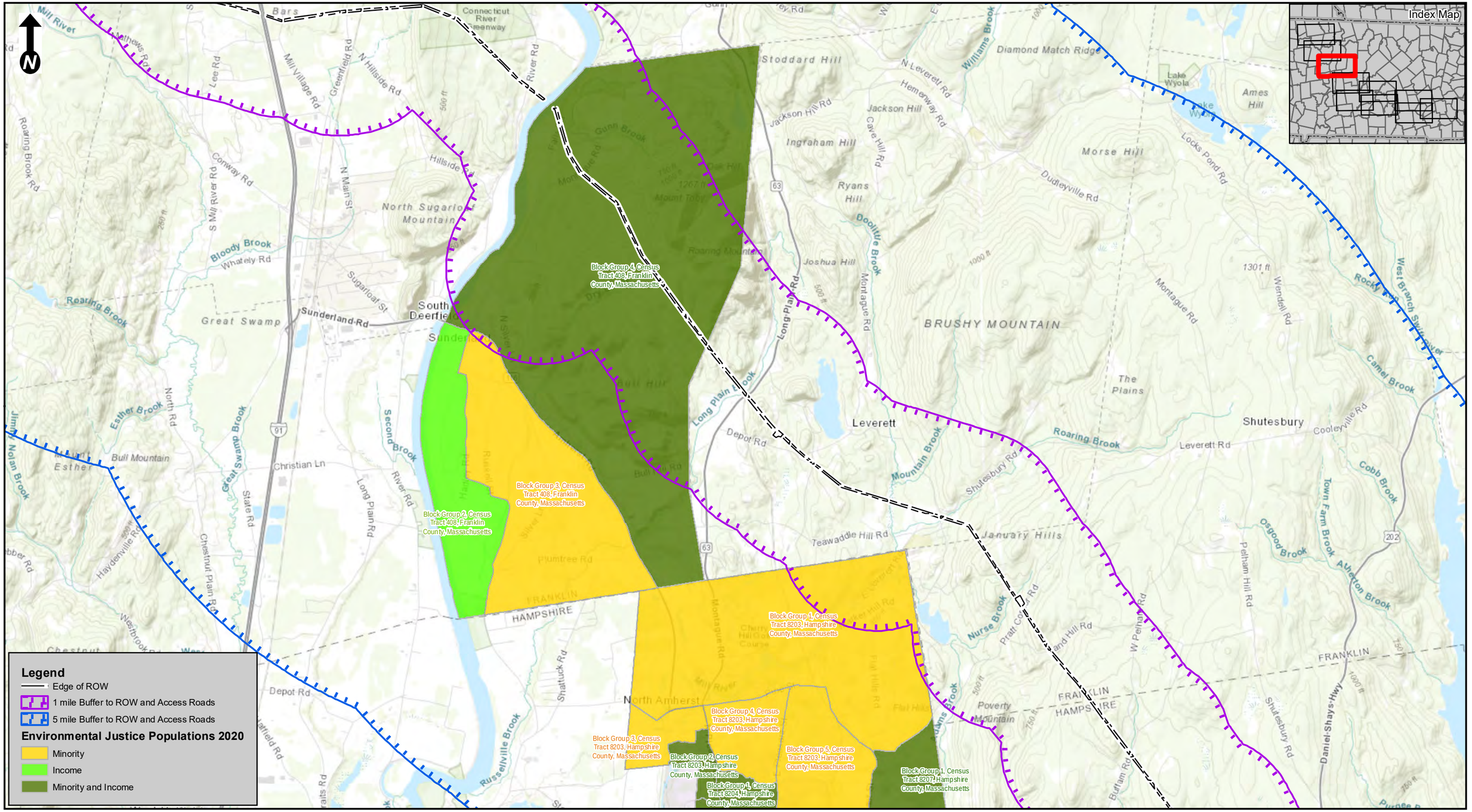

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT
Environmental Justice Populations Site Location Map
Deerfield, Sunderland, Leverett, Shutesbury & Pelham, MA
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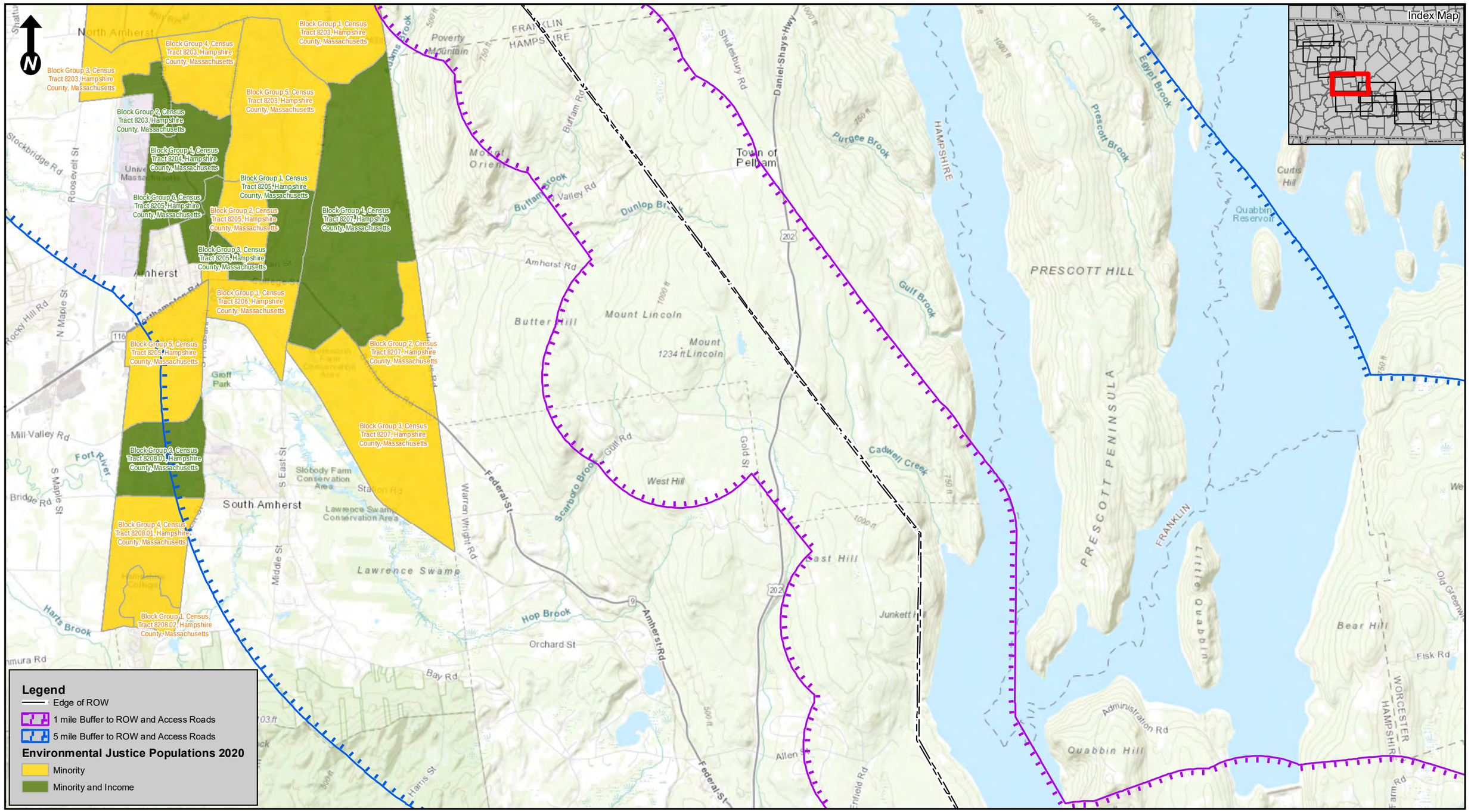

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT
Environmental Justice Populations Site Location Map
Shutesbury, Pelham & Belchertown, MA
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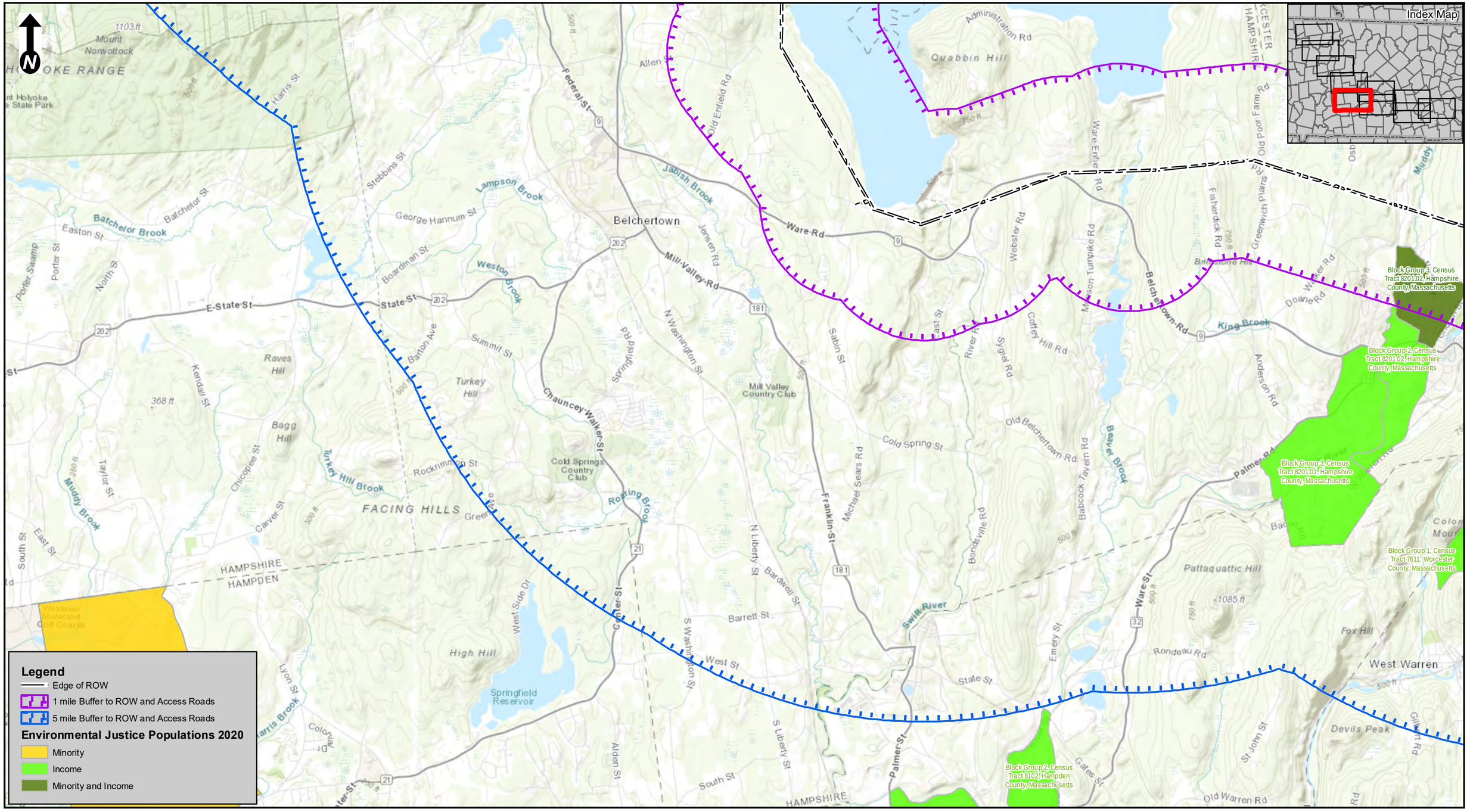

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT
Environmental Justice Populations Site Location Map
Belchertown & Ware, MA
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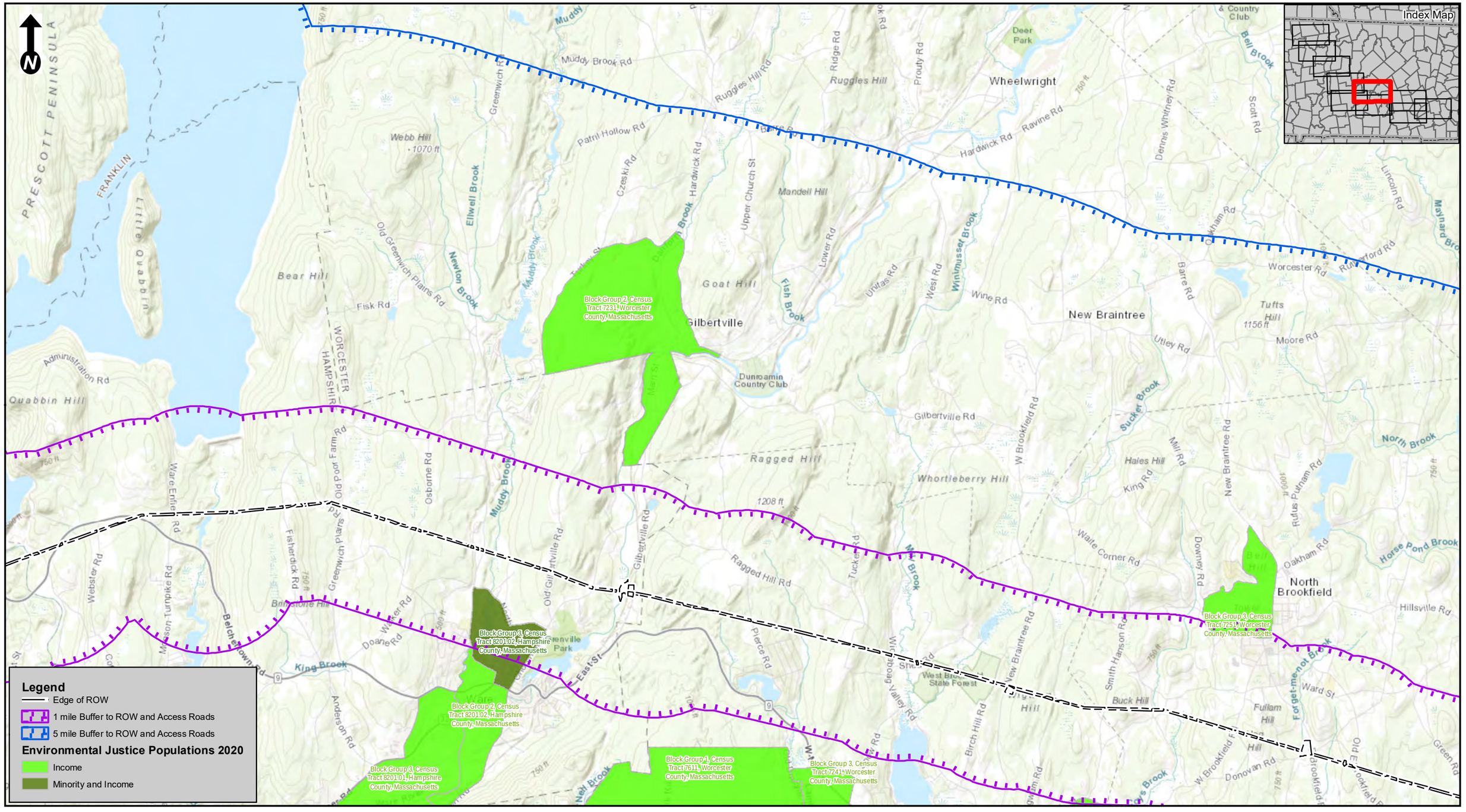
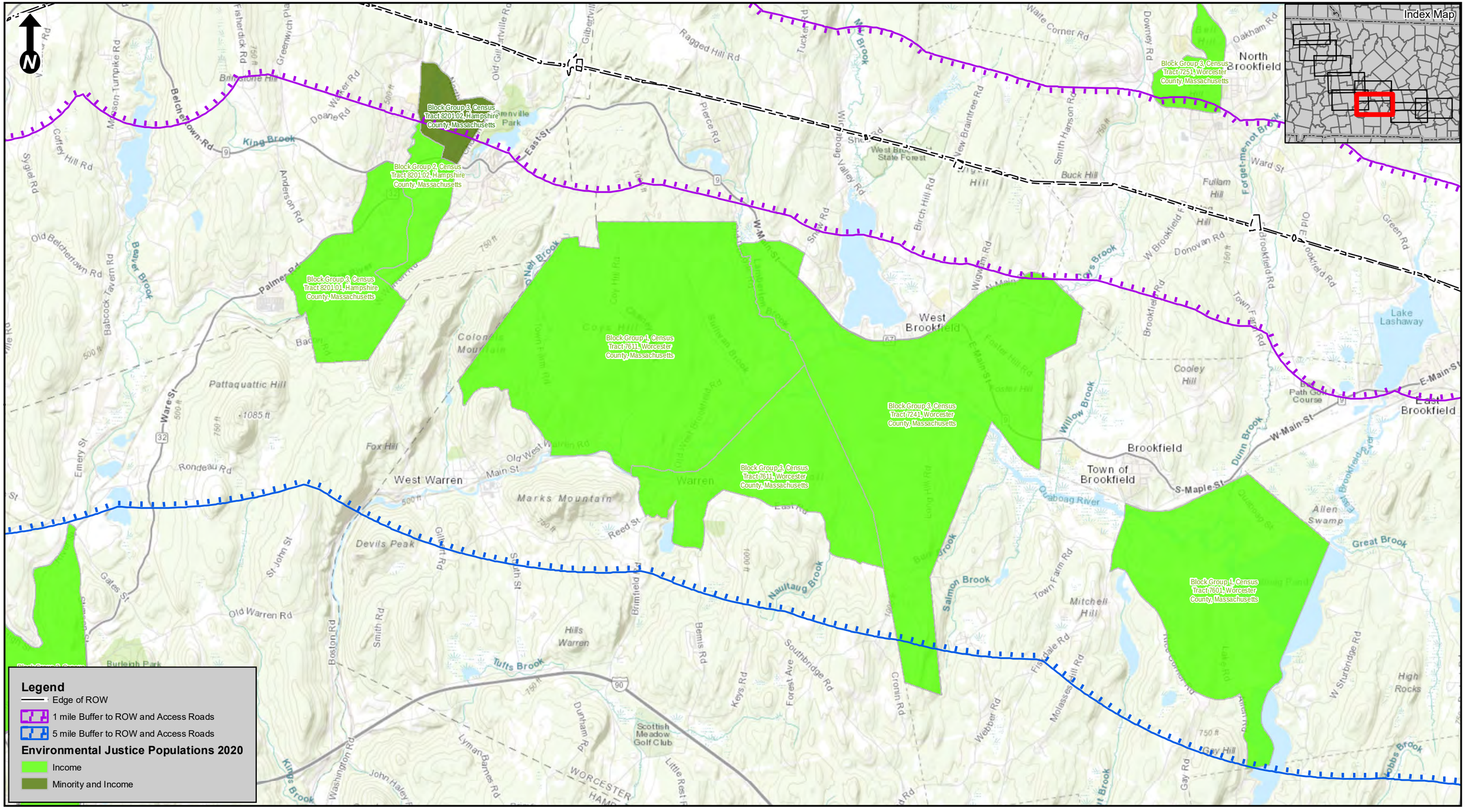

Index Map
Block Group 2, Census Tract 7231, Worcester County, Massachusetts
Block Group 3, Census Tract 8201.02, Hampshire County, Massachusetts
Block Group 2, Census Tract 8201.02, Hampshire County, Massachusetts
Block Group 3, Census Tract 8201.01, Hampshire County, Massachusetts
Block Group 1, Census Tract 7611, Worcester County, Massachusetts
Block Group 3, Census Tract 7241, Worcester County, Massachusetts
Block Group 3, Census Tract 7251, Worcester County, Massachusetts
Legend
Edge of ROW
1 mile Buffer to ROW and Access Roads
5 mile Buffer to ROW and Access Roads
Environmental Justice Populations 2020
Income
Minority and Income
Gilbertville
New Braintree
North Brookfield
Wheelwright
Dunroamin Country Club
Quabbin Hill
Bear Hill
Webb Hill
Goat Hill
Mandell Hill
Ragged Hill
Whortleberry Hill
Tufts Hill
Fullam Hill
Buck Hill
Hales Hill
Deer Park
Muddy Brook Rd
Ruggles Hill Rd
Patrl Hollow Rd
Hardwick Rd
Ravine Rd
Fisk Rd
Wine Rd
Utley Rd
Moore Rd
Worcester Rd
Gilbertville Rd
Ragged Hill Rd
Oakham Rd
Hillsville Rd
Ward St
Donovan Rd
Webster Rd
Maison Turnpike Rd
Belchertown Rd
King Brook
Ellwell Brook
Newton Brook
Fish Brook
Winimusset Brook
Sucker Brook
North Brook
Horse Pond Brook
Forget-me-not Brook
Scott Rd
Bell Brook
Lincoln Rd
Barre Rd
Rufus Putnam Rd
Dennis Whitney Rd
Downey Rd
Smith Hanson Rd
Birch Hill Rd
Pierce Rd
Tucker Rd
Old Gilbertville Rd
Old Greenwich Plains Rd
Osborne Rd
Ware Enfield Rd
Fisherdick Rd
Doane Rd
Anderson Rd
Administration Rd
Prouty Rd
Ridge Rd
Lower Rd
Upper Church St
Hardwick Rd
Czeski Rd
Greenwich Rd
Old Post Farm Rd
Brookfield Rd
Green Rd
Maynard Brook
Muddy Brook
Dunn Brook
Mill Brook
Valley Rd
West Rd
Unitas Rd
Main St
East St
Tucker St
Mill Rd
King Rd
New Braintree Rd
W Brookfield Rd
Gilbertville Rd
Oakham Rd
Rutland Rd
Country Club
Bell Brook
Scott Rd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Block Group 2, Census Tract 8201.02, Hampshire County, Massachusetts
Block Group 3, Census Tract 8201.01, Hampshire County, Massachusetts
Block Group 1, Census Tract 7611, Worcester County, Massachusetts
Block Group 3, Census Tract 7241, Worcester County, Massachusetts
Block Group 3, Census Tract 7611, Worcester County, Massachusetts
Block Group 3, Census Tract 7251, Worcester County, Massachusetts
Block Group 1, Census Tract 7601, Worcester County, Massachusetts
Legend
Edge of ROW
1 mile Buffer to ROW and Access Roads
5 mile Buffer to ROW and Access Roads
Environmental Justice Populations 2020
Income
Minority and Income
West Brookfield
North Brookfield
East Brookfield
Brookfield
Town of Brookfield
West Warren
Warren
Pattaquattic Hill
Colonels Mountain
Fox Hill
Marks Mountain
Devils Peak
Hills Warren
Cole Hill
Buck Hill
Fullam Hill
Cooley Hill
Mitchell Hill
Gay Hill
Lake Lashaway
Allen Swamp
High Rocks
Scottish Meadow Golf Club
Quaboag River
King Brook
Beaver Brook
Naultaug Brook
Tufts Brook
Great Brook
Dunn Brook
Willow Brook
Salmon Brook
Sullivan Brook
Cole Hill Rd
Belchertown Rd
East St
W Main St
E Main St
W Brookfield Rd
Ware St
Rondeau Rd
Old West Warren Rd
Old Belchertown Rd
Palmer Rd
Ragged Hill Rd
Pierce Rd
Donovan Rd
Ward St
Green Rd
Old E Brookfield Rd
Brookfield Rd
Town Farm Rd
Waite Corner Rd
Oakham Rd
Downey Rd
Smith Hanson Rd
Buck Hill Rd
Birch Hill Rd
Wigwam Rd
Fiske Hill Rd
Molasses Hill Rd
Webber Rd
Gay Rd
Keys Rd
Forest Ave
Southbridge Rd
Cronin Rd
Bemis Rd
Brimfield Rd
Boston Rd
Smith Rd
St John St
Gilbert Rd
Reed St
Durham Rd
Lyman Barnes Rd
Washington Rd
Old Warren Rd
Gates St
Emery St
Babcock Tavern Rd
Coffey Hill Rd
Sigiel Rd
Anderson Rd
Doane Rd
Webster Rd
Fisherdick Rd
Greenwich Plain Rd
Mattawan Turnpike Rd
Old Gilbertville Rd
Tucker Rd
Mill Brook
Lovell Hill Rd
Fiske Rd
Brookfield Rd
Path Golf Course
Burleigh Park
Greenville Park
West Brookfield State Forest
Lovell Hill
Fisher Hill Rd
Lake Rd
W Sturbridge Rd
Hobbs Brook
Little Rest Brook
Mill Brook
Old Brookfield Rd
Fiske Hill Rd
Town Farm Rd
Mitchell Hill
Gay Hill
Allen Swamp
Great Brook
Quaboag River
Dunn Brook
Willow Brook
Salmon Brook
Naultaug Brook
Tufts Brook
King Brook
Beaver

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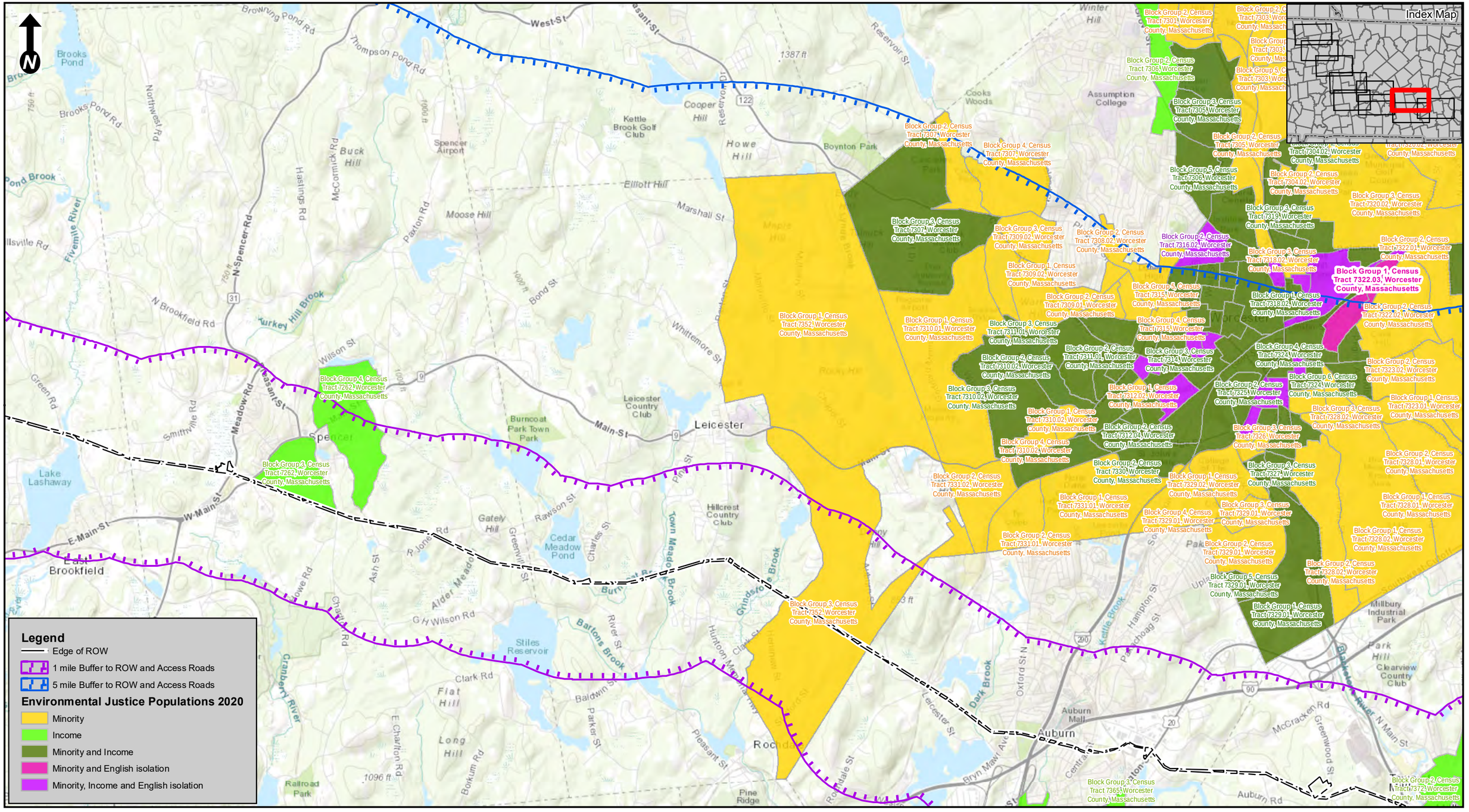

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT
Environmental Justice Populations Site Location Map
North Brookfield, East Brookfield, Spencer, Leicester, Auburn & Millbury, MA

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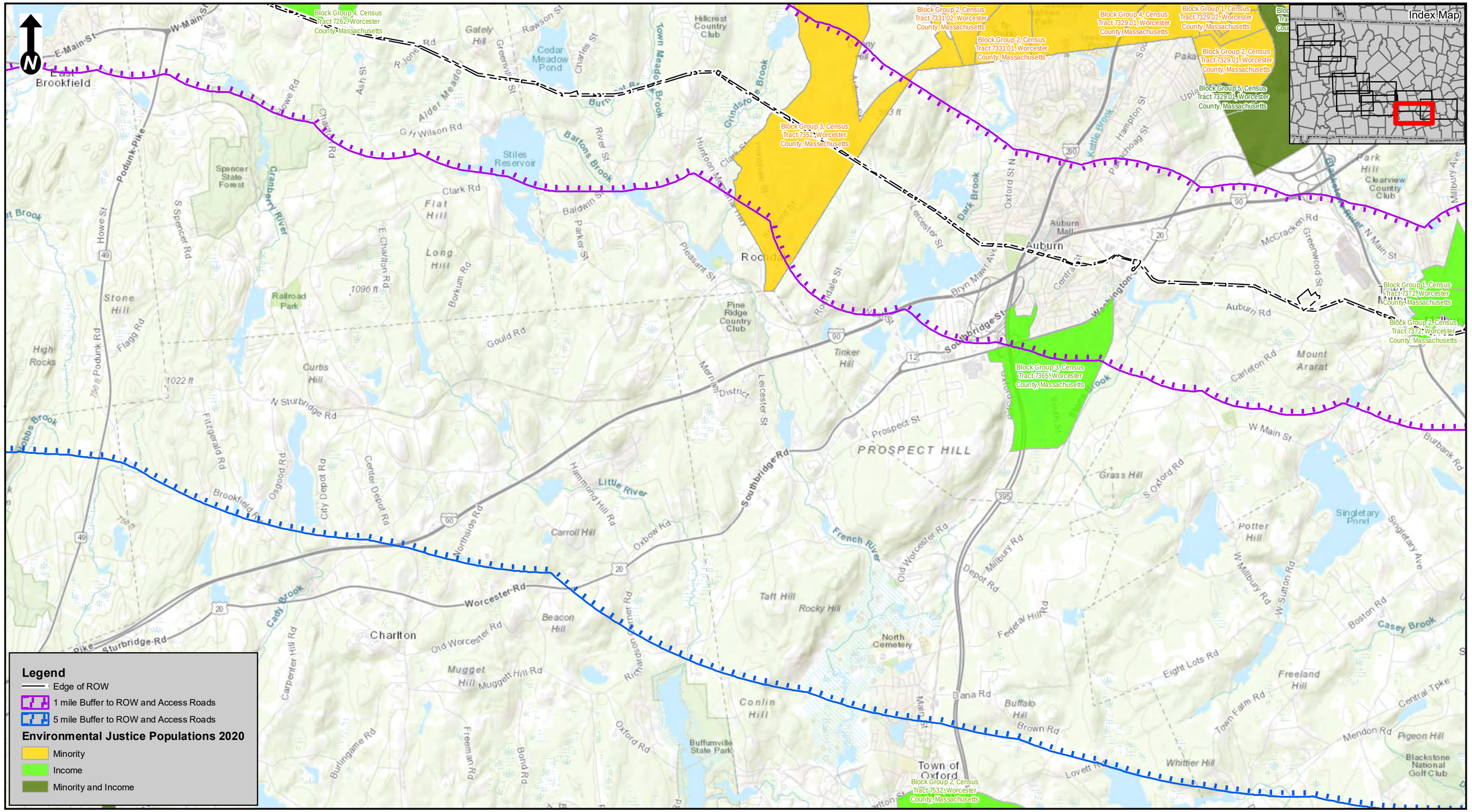

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT
Environmental Justice Populations Site Location Map
Spencer, Leicester, Auburn & Millbury, MA
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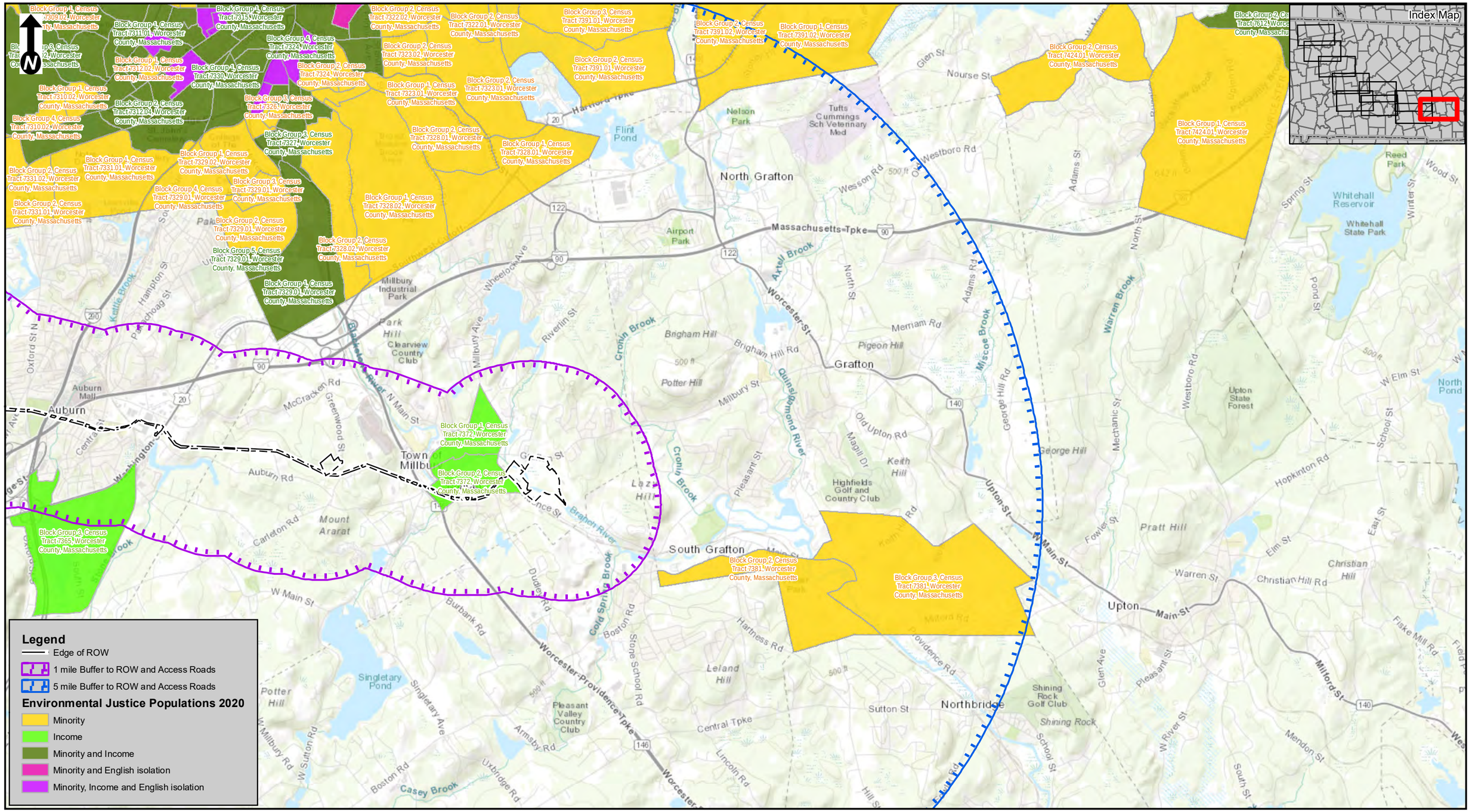

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CENTRAL TO WESTERN MASSACHUSETTS ENERGY IMPROVEMENT PROJECT
Environmental Justice Populations Site Location Map
Auburn & Millbury, MA
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Appendix D – Environmental Justice Screening Form

Environmental Justice Screening Form

Project Name	Central to Western MA Energy Improvement Project
Anticipated Date of MEPA Filing	January 15, 2025
Proponent Name	New England Power Company
Contact Information (e.g., consultant)	Priyanka Shrestha, BSC Group Inc. 1 Mercantile Street Suite 610 Worcester, MA 01608 (617) 896-4570 Project email: CWMA-EIP@bscgroup.com
Public website for project or other physical location where project materials can be obtained (if available)	https://cmatowmaenergy.com/
Municipality and Zip Code for Project (if known)	Shelburne (01370), Conway (01341), Deerfield (01342), Sunderland (01375), Leverett (01054), Shutesbury (01072), Pelham (01002), Belchertown (01007), Ware (01082), West Brookfield (01585), North Brookfield (01535), East Brookfield (01515), Spencer (01562), Leicester (01524), Auburn (01501), Millbury (01527)
Project Type* (list all that apply)	Rebuild New England Power Company's Existing E5/F6 Overhead Electric Transmission Line
Is the project site within a mapped 100-year FEMA flood plain? Y/N/ unknown	Yes, in short segments of the right-of-way scattered along the project length.
Estimated GHG emissions of conditioned spaces (click here for GHG Estimation tool)	Not applicable – No buildings are proposed as part of this Project.

Project Description

1. Provide a brief project description, including overall size of the project site and square footage of proposed buildings and structures if known.

   New England Power Company owns and operates the E5 and F6 electric transmission lines and associated tap lines located within existing maintained right-of-ways. The mainline right-of-way begins at New England Power Company's Millbury #305 Substation in Millbury, MA and ends at the Shelburne #4 Switchyard located in Shelburne, MA. The E5 and F6 transmission lines are operated at 69 kilovolts. These E5 and F6 Lines were put into service in the early 1900s, and portions of the E5/F6 Lines were refurbished in 2001.

   The wires are supported primarily by the original steel lattice structures installed in the early 1900s. The E5 and F6 "mainline" Lines cross approximately 67 miles within the following municipalities: Shelburne, Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn, and Millbury.

In addition to the mainline, there are also seven (7) tap lines[1] that are part of the Project. Five (5) of the tap lines, Shutesbury Tap (E5D/F6D), Lashaway Substation Tap (E5E/F6E), Harrington Switch Yard Tap (E5/F6), Leicester Substation Tap (E5E/F6E), and Pondville Substation Tap (E5E/F6E) are short tap lines with the tap structures and lines not extending outside of the mainline corridor. The Quabbin Switching Tap (E5W/F6W) and the Deerfield #3 Tap extend away from the mainline. The Quabbin Switching Tap is approximately 0.08 miles in length and the Deerfield #3 Tap is approximately 0.54 miles in length. Please refer to **Figure 1-1**.

Recent analyses and studies demonstrate that these century-old transmission lines are increasingly unreliable. As a result, New England Power Company is proposing to rebuild the E5 and F6 Lines and tap lines on new structures. The purpose is to ensure that New England Power Company provides reliable and continuous electricity to its customers serviced by these lines within Worcester, Hampden, Hampshire, and Franklin Counties. Although the new lines will continue to transmit electricity at 69 kilovolts, New England Power Company has planned and designed the Project to support transmission of a higher voltage since it is anticipated that New England Power Company will eventually need to be able to operate the lines at 115 kilovolts to support higher volumes of electricity usage and future renewable energy resources in this region. New England Power Company will also be installing Optical Primary Ground Wire, which serves a dual purpose by providing the necessary electrical grounding in the event of lightning strikes with the additional feature of enabling telecommunication along the lines and between substations. This telecommunication is critical to identifying problems, such as damage to the infrastructure from storm events or storm related outages, enabling New England Power Company to respond quickly to any problems with the transmission of electricity along these lines. In addition, due to poor access along most of the right-of-way, access improvements or re-establishment of existing and construction of new access will be undertaken to conduct the proposed work and support future maintenance of the lines.

2. List anticipated MEPA review thresholds (301 CMR 11.03) (if known)

ENF Review:

- 301 CMR 11.03(3)(b)(1)(b)-Wetlands, Waterways and Tidelands: alteration of 500 or more linear feet of bank along a fish run or inland bank.
- 301 CMR 11.03(3)(b)(1)(f)- Wetlands, Waterways and Tidelands: alteration of ½ or more acres of any other wetlands.
- 301 CMR 11.03(2)(b)(2)- State-listed species: taking of an endangered or threatened species or species of special concern, provided that the Project site is two or more acres and includes an area mapped as designated priority habitat. (Potential).

ENF and Mandatory EIR:

- 301 CMR 11.03(1)(a) - Land: Direct alteration of 50 or more acres of land, unless the Project is consistent with an approved conservation farm plan or forest cutting plan or other similar.
- 301 CMR 11.03(3)(a)(1)(a) - Wetlands, Waterways and Tidelands: alteration of one or more acres of bordering vegetated wetlands (BVW).
- 301 CMR 11.03(3)(a)(1)(b) - Wetlands, Waterways and Tidelands: alteration of ten or more acres of any other wetlands.
- 301 CMR 11.06(7)(b) - Environmental Justice (EJ): The Secretary shall require an EIR for any Project that is located within a Designated Geographic Area around an EJ Population.

[1] Tap Lines, in terms of utility infrastructure, refer to transmission lines that serve as a connection between a primary utility transmission line (i.e., the mainline) and a substation facility.

3. List all anticipated state, local and federal permits needed for the project (if known)

Agency	Permit, Review, or Approval
Federal	
U.S. Army Corps of Engineers ("USACE")	Section 404 General Permit (Pre-Construction Notice) and consultations under Section 106 of National Historic Preservation Act and Section 7 of the Endangered Species Act
United States Environmental Protection Agency ("EPA")	National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges and Construction Dewatering Activities/Stormwater Pollution Prevention Plan (SWPPP)
State	
Executive Office of Energy and Environmental Affairs ("EEA")	MEPA Review/Certificate of the Secretary
Massachusetts Department of Environmental Protection ("MassDEP")	Section 401 Individual Water Quality Certificate; WQC Variance
Massachusetts Natural Heritage and Endangered Species Program ("NHESP")	Massachusetts Endangered Species Act – Determination of Take or No Take; Conservation Permit (if needed)
Massachusetts Historical Commission ("MHC")	Consultation under M.G.L. c. 9 in accordance with 950 CMR 70-71
Energy Facilities Siting Board ("EFSB")	G.L. c. 164, §69J Petition for Approval to Construct Transmission Lines
Department of Conservation and Recreation ("DCR")	Construction Access Permit
DCR, Division of Water Supply Protection	Watershed Protection Act Determination of Applicability
Massachusetts Department of Transportation ("MassDOT")	Permit to Access State Highway/Non-Municipal Utility Permits for crossing over of state roads with utility lines
Local	
Conservation Commissions in Shelburne, Conway, Deerfield, Sunderland, Leverett, Shutesbury, Pelham, Belchertown, Ware, West Brookfield, North Brookfield, East Brookfield, Spencer, Leicester, Auburn, and Millbury.	Order of Conditions per the Massachusetts Wetlands Protection Act (MA WPA)

4. Identify EJ populations and characteristics (Minority, Income, English Isolation) within 5 miles of project site (can attach map identifying 5-mile radius from EJ Maps Viewer in lieu of narrative)

See Attachment A.

5. Identify any municipality or census tract meeting the definition of "vulnerable health EJ criteria" in the DPH EJ Tool located in whole or in part within a 1 mile radius of the project site

The Towns of Millbury (heart attack), Shelburne (heart attack and elevated blood lead), Sunderland (elevated blood lead and low birth weight), and West Brookfield (heart attack) met Vulnerable Health EJ Criteria definitions. Six and five census tracts met the elevated blood lead and low birth weight Vulnerable Health EJ Criteria definitions, respectively. **See Attachment B.**

6. Identify potential short-term and long-term environmental and public health impacts that may affect EJ Populations and any anticipated mitigation.

Out of 19 EJ Populations within the 1-mile radius of the right-of-ways, only four (4) of the EJ Populations overlap with the right-of-ways or are within proximity to the right-of-ways. These EJ Populations are in the municipalities of Shelburne, Sunderland, Leicester, and Millbury. The right-of-ways pass through or are adjacent to one (1) population in Shelburne, one (1) population in Sunderland, one (1) in Leicester, and one (1) in Millbury. Out of the 67 miles of right-of-way, 4.6 right-of-way miles are within an EJ Census Tract.

Municipality	Census Tract
Shelburne	Block Group 4, Census Tract 415.02
Sunderland	Block Group 4, Census Tract 408
Leicester	Block Group 3, Census Tract 7352
Millbury	Block Group 2, Census Tract 7372

Potential environmental and public health impacts of the Project and anticipated mitigation include the following:

Air Quality
Construction-period activities, such as grading, road building, vehicle travel, and other earth-disturbing work may result in a temporary increase in airborne dust. Impacts to air quality will be minimized by adopting practices to control dust such as spreading wood mulch or straw and using water trucks to spray dried soil to prevent dust. The potential for dust generation is only anticipated during the construction period and is not anticipated to cause impacts to public health. Post construction, soil will be stabilized and re-vegetated.

In addition, diesel-powered equipment is required to use ultra-low sulfur diesel fuel. Any diesel-powered non-road construction equipment rated 50-horsepower or more that will be used on the Project for 30 days or more will be required to install emission control devices. The impacts from these emissions will be minimal and are not anticipated to cause impacts to public health.

Water Quality
The project will incorporate protective and preventative measures to minimize and avoid impacts to water quality. The right-of-ways cross wetland areas, streams, and rivers. To protect water quality and these sensitive areas, temporary access will be constructed using protective construction mats. Construction mats are comprised of wooden beams, bolted together, and are typically 4 feet wide by 16 feet long. They are laid temporarily on top of the ground and vegetation. Use of these mats is a "Best Management Practice" because they reduce environmental impacts by allowing heavy machines and vehicles to cross sensitive areas without damaging the soil or roots of vegetation and are also placed in a manner that does not affect the flow of water in streams. These mats will be removed when construction is completed, and the wetlands will be restored. Additional Best Management Practices, such as the use of straw wattles, silt fencing, stormwater management features, and other control measures will be used to prevent soil and other material from being transported into wetlands and streams. Using these Best Management Practices, any impacts to water quality will be negligible and temporary and are not anticipated to cause impacts to public health.

Land Protection and Open Space
There are three EJ Populations within Municipal Open Space within the Project right-of-ways. These

populations include - Block Group 4, Census Tract 415.02 in Shelburne, Block Group 4, Census Tract 408 in Sunderland, and Block Group 3, Census Tract 7262 in Spencer across the Franklin and Worcester County, Massachusetts. Block Group 4, Census Tract 408 is located within four (4) separate parcels named Mt. Toby Wildlife Management Area owned by Department of Fish and Game, and one parcel named Patterson Donald F Jr APR owned by Patterson Donald F Jr and Susan T. Additionally, Block Group 3, Census Tract 7262 in Spencer, Worcester County, Massachusetts is located within two Article 97 Lands: John O'Gara Park and Bixby Road CR, owned by Town of Spencer and South Middlesex Non-Profit Housing Corporation. Project activities within EJ Census Tracts Open Space parcels will be limited to the existing right-of-ways and historically used access.

The Project has been designed to utilize existing access within New England Power Company easements wherever feasible. However, improvements to existing access and construction of new access ways within existing easements will be required within some of these parcels (for instance, Mt. Toby Wildlife Management Area). The public's access to Protected Land and Open Space within EJ Populations will be temporarily impacted during construction.

New England Power Company will provide notification of the intended construction plan and schedule to any affected abutters so that the effect of any temporary disruptions may be minimized. To mitigate temporary construction-phase disturbances to public open spaces, specifically existing trail systems, New England Power Company will coordinate with the affected stakeholders and will develop an outreach plan to include safety signage and temporary detours around active construction zones. Normal operation at all facilities will continue and existing land uses will be allowed to continue following construction. None of these activities are anticipated to cause impacts to public health.

Noise

The EJ communities that are most likely to have temporary noise impacts are the communities that are directly within or are located near the right-of-ways. The EJ Populations that have relatively greater development are Block Group 2, Census Tract 7372 in Millbury; and Block Group 3, Census Track 7352, in Leicester, primarily along Stafford Street and Henshaw Street. Noise impacts associated with construction-period activities are temporary in nature and expected to be minimal. Where construction will occur adjacent to residences, New England Power Company will notify landowners prior to the commencement of work. Noise-generating activities will be conducted in accordance with any local and state requirements and are not anticipated to cause impacts to public health.

Traffic

Impacts to traffic during the construction of the project will be minor and intermittent. The work areas will be accessed primarily from New England Power Company-owned access routes or minor town roadways. Within Block Group 4, Census Tract 408 in Sunderland, temporary access off Route 47 (Montague Rd) will be required. Block Group 4, Census Tract 415.02, in Shelburne, temporary access off Route 2 (Mohawk Trail) will be required. New England Power Company will obtain the necessary permits from MassDOT for access. Once on-site, vehicle traffic will be limited to within or in proximity to the right-of-way. Since the right-of-way is an un-manned facility, there will be no permanent impacts to traffic patterns or use of existing roadways and no impacts to public health are anticipated from traffic.

7. Identify project benefits, including "Environmental Benefits" as defined in 301 CMR 11.02, that may improve environmental conditions or public health of the EJ population.

Potential "Environmental Benefits" include the following:

- Increased resiliency of the overall transmission line. By installing improved foundations and more robust structures, this infrastructure will be better suited to

withstand strong winds and storm events.

- The new overhead lines will have higher voltage capacity which will allow more electricity to flow during times of high usage, such as extreme heat events, which are anticipated to increase in frequency due to climate change.
- The installation of Optical Primary Ground Wire will allow better communication between substations, resulting in improved response time during storm-related emergencies and outages, which will increase public safety.

Other benefits of this project that are not expressly included under the definition of "Environmental Benefits" consist of the following:

- Reduce overall disturbance to adjacent landowners, wetland resource areas, and rare species habitat over time by planning for the future and reducing the likelihood of multiple repeat projects, thereby reducing environmental impacts, and reducing costs to New England Power Company's customers.
- The replacement of the lines will have the added benefit of allowing future renewable energy resources to connect into the system. Addressing the climate change crisis requires a major expansion of renewable energy and the infrastructure necessary to support and deliver that energy. New England Power Company is actively taking steps to ensure that its system is ready to meet this critical challenge. Replacing infrastructure like the E5 and F6 Lines helps to accomplish this goal. The replacement lines will have higher kilovolt ratings that will support higher volumes of electricity usage and interconnection of future renewable energy resources in this region. This longer-term view is supported by the initial results of the ISO-NE 2050 study, where an upgrade to 115 kilovolts is necessary based on the current study assumptions and long-term forecasts for the Commonwealth.

8. Describe how the community can request a meeting to discuss the project, and how the community can request oral language interpretation services at the meeting. Specify how to request other accommodations, including meetings after business hours and at locations near public transportation.

Communities and members of the public can access information related to the project in the following ways:

- A public website, hosted at the following web address: https://cmatowmaenergy.com/
- A virtual community meeting hosted by New England Power Company on December 19, 2024.
    - Recipients of this screening form will receive information related to this meeting via email.
    - Notification of this virtual meeting will be published in newspapers prior to the meeting.
- Hard copies of project materials will be made available to anyone on request.
- If you have additional questions, please contact 888-431-3536 or email us at info@cmatowmaenergy.com.

There are no EJ communities that meet the "English Isolation" criteria within 1-mile DGA of the Project ROW. However, should individuals request interpretation services in advance of meeting dates, including translation of project materials, please email info@cmatowmaenergy.com. NEP will

endeavor to translate the documents provided to EJ populations and provide requested interpretation.

Recipients of this form include organizations on the EJ Reference List provided by Massachusetts Executive Office of Energy and Environmental Affairs per the Public Involvement Protocol. In addition, notice of the virtual public meeting details will be sent to Town Administrators.

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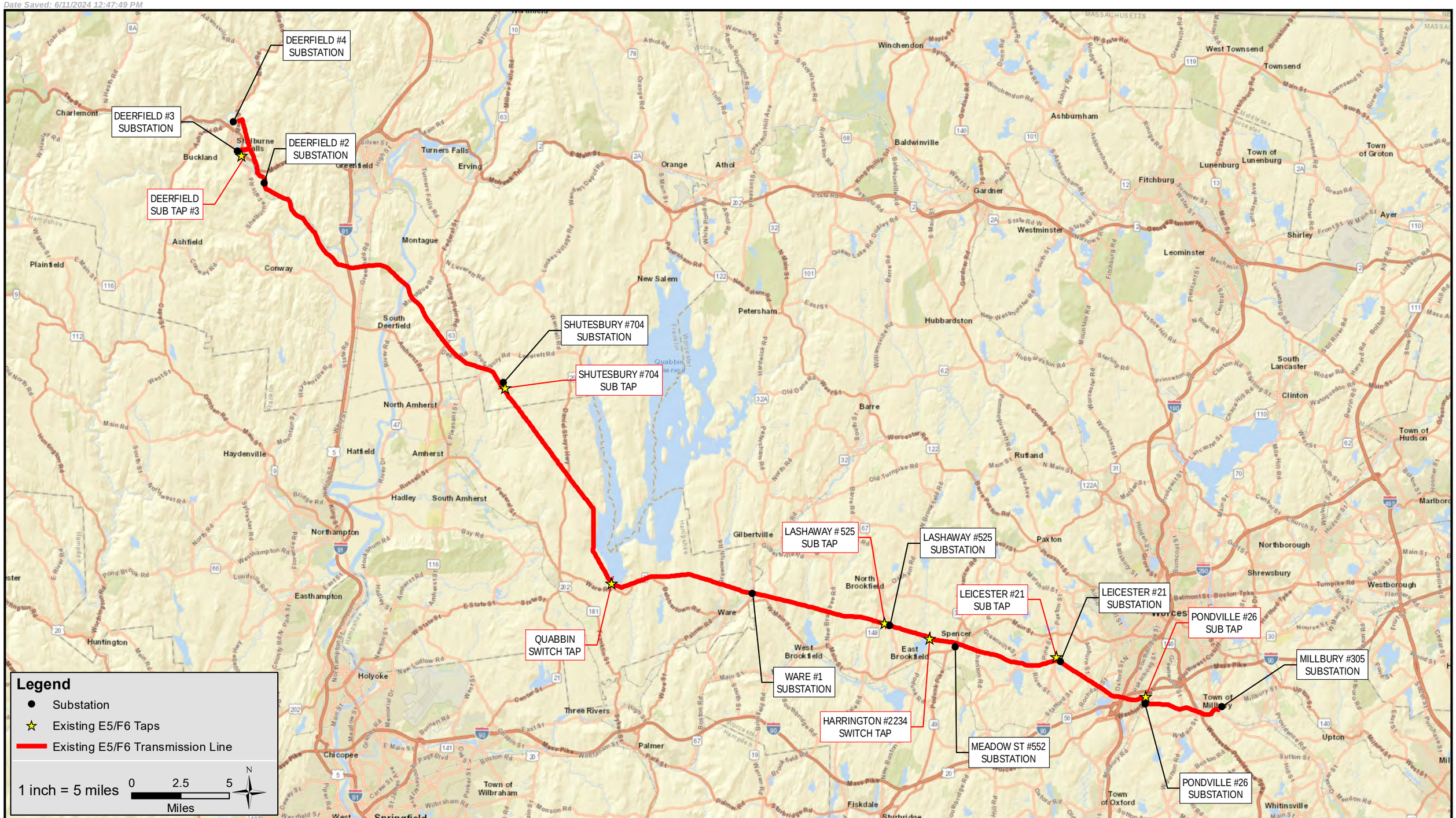

Central to Western MA Energy Improvement Project

nationalgrid
BSC GROUP

Figure 1-1
Overview of the Project Route

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Attachment A: Central to Western MA Energy Improvement Project
Environmental Justice (EJ) Communities within 5 Miles

Block Group	Census Tract	Municipality	EJ Criteria Met	Minority Population (%)	Median Income ($; % of MA Median Income)	English Isolation (%)
4	401	Charlemont	Income	9.65%	$53,229; 63.08%	0.00%
1	407.01	Montague	Income	18.44%	$40,491; 47.98%	0.00%
2	407.01	Montague	Income	23.09%	$25,339; 30.03%	1.46%
4	407.01	Montague	Income	15.73%	$54,696; 64.82%	0.00%
1	407.02	Montague	Income	6.89%	$40,000; 47.40%	1.85%
2	408	Sunderland	Income	23.12%	$47,614; 56.42%	5.73%
3	408	Sunderland	Minority	29.21%	$95,230; 112.85%	6.57%
4	408	Sunderland	Minority and income	24.84%	$41,845; 49.59%	2.31%
1	411	Greenfield	Income	8.70%	$52,315; 61.99%	2.39%
1	412	Greenfield	Income	12.99%	$54,432; 64.50%	0.00%
3	412	Greenfield	Income	12.10%	$51,435; 60.95%	5.34%
1	413.01	Greenfield	Income	21.40%	$40,204; 47.64%	3.85%
2	413.01	Greenfield	Income	20.44%	$44,091; 52.25%	4.15%
3	413.01	Greenfield	Income	17.50%	$43,472; 51.52%	0.00%
1	413.02	Greenfield	Income	14.54%	$21,792; 25.82%	0.00%
2	413.02	Greenfield	Income	15.76%	$41,146; 48.76%	2.49%
1	414	Greenfield	Minority and income	39.85%	$24,688; 29.26%	2.92%
2	414	Greenfield	Minority and income	24.84%	$47,404; 56.18%	9.00%
3	415.02	Buckland	Income	8.97%	$44,063; 52.22%	0.00%
4	415.02	Shelburne	Income	9.42%	$49,063; 58.14%	4.78%
2	7231	Hardwick	Income	12.27%	$39,205; 46.46%	0.00%
3	7241	West Brookfield	Income	10.81%	$36,913; 43.74%	0.00%
3	7251	North Brookfield	Income	11.85%	$51,053; 60.50%	0.00%
3	7262	Spencer	Income	20.78%	$37,448; 44.38%	0.00%
4	7262	Spencer	Income	17.34%	$28,977; 34.34%	0.00%
2	7307	Worcester	Minority	32.33%	$98,269; 116.45%	0.00%
3	7307	Worcester	Minority and income	34.15%	$44,099; 52.26%	0.00%
4	7307	Worcester	Minority	36.82%	$81,708; 96.83%	5.48%

Attachment A: Central to Western MA Energy Improvement Project
Environmental Justice (EJ) Communities within 5 Miles

Block Group	Census Tract	Municipality	EJ Criteria Met	Minority Population (%)	Median Income ($; % of MA Median Income)	English Isolation (%)
2	7308.02	Worcester	Minority	29.27%	$80,300; 95.16%	7.88%
2	7309.01	Worcester	Minority	28.93%	$69,306; 82.13%	15.55%
1	7309.02	Worcester	Minority	26.41%	$98,073; 116.22%	0.00%
2	7309.02	Worcester	Minority	35.89%	$0; 0%	11.92%
3	7309.02	Worcester	Minority	24.64%	$101,750; 120.58%	0.00%
1	7310.01	Worcester	Minority	48.87%	$75,882; 89.92%	8.72%
1	7310.02	Worcester	Minority	47.89%	$36,168; 42.86%	5.51%
2	7310.02	Worcester	Minority and income	57.88%	$41,745; 49.47%	10.13%
3	7310.02	Worcester	Minority and income	50.88%	$61,429; 72.80%	9.75%
4	7310.02	Worcester	Minority	60.54%	$62,321; 73.85%	7.56%
1	7311.01	Worcester	Minority and income	67.94%	$2,500; 2.96%	18.82%
2	7311.01	Worcester	Minority and income	62.12%	$54,609; 64.71%	4.60%
3	7311.01	Worcester	Minority and income	33.77%	$50,568; 59.93%	1.54%
4	7311.01	Worcester	Minority and income	66.34%	$40,847; 48.41%	11.22%
1	7311.02	Worcester	Minority	26.38%	$118,594; 140.54%	0.00%
2	7311.02	Worcester	Minority and income	50.68%	$46,964; 55.65%	9.61%
3	7311.02	Worcester	Minority	36.22%	$118,750; 140.72%	0.00%
1	7312.02	Worcester	Minority	27.56%	$0; 0%	0.00%
1	7312.03	Worcester	Minority and income	73.68%	$14,852; 17.60%	16.78%
2	7312.03	Worcester	Minority and income	59.47%	$32,567; 38.59%	5.56%
3	7312.03	Worcester	Minority, income and English isolation	67.40%	$39,276; 46.54%	29.44%
4	7312.03	Worcester	Minority and income	66.90%	$41,058; 48.66%	0.00%
1	7312.04	Worcester	Minority and income	73.27%	$44,784; 53.07%	10.56%
2	7312.04	Worcester	Minority and income	73.89%	$31,406; 37.22%	10.10%
1	7313	Worcester	Minority and income	80.81%	$16,719; 19.81%	12.10%

Attachment A: Central to Western MA Energy Improvement Project
Environmental Justice (EJ) Communities within 5 Miles

Block Group	Census Tract	Municipality	EJ Criteria Met	Minority Population (%)	Median Income ($; % of MA Median Income)	English Isolation (%)
2	7313	Worcester	Minority, income and English isolation	88.57%	$37,548; 44.50%	42.62%
3	7313	Worcester	Minority and income	78.02%	$38,333; 45.43%	19.32%
1	7314	Worcester	Minority, income and English isolation	84.86%	$14,744; 17.47%	25.50%
2	7314	Worcester	Minority, income and English isolation	79.14%	$22,778; 26.99%	30.74%
3	7314	Worcester	Minority and income	74.83%	$67,778; 80.32%	17.23%
4	7314	Worcester	Minority and income	85.42%	$46,908; 55.59%	0.00%
5	7314	Worcester	Minority and income	77.71%	$27,981; 33.16%	0.00%
1	7315	Worcester	Minority and income	84.27%	$16,319; 19.34%	19.41%
2	7315	Worcester	Minority and income	68.93%	$14,179; 16.80%	18.15%
3	7315	Worcester	Minority and income	79.90%	$39,240; 46.50%	4.15%
4	7315	Worcester	Minority	84.90%	$0; 0%	9.87%
5	7315	Worcester	Minority	62.56%	$0; 0%	14.94%
1	7316.01	Worcester	Minority and income	48.36%	$17,012; 20.16%	9.90%
2	7316.01	Worcester	Minority and income	65.81%	$41,481; 48.32%	7.13%
3	7316.01	Worcester	Minority and income	48.08%	$40,984; 48.57%	23.25%
4	7316.01	Worcester	Minority and income	35.10%	$25,772; 30.02%	0.00%
2	7316.02	Worcester	Minority, income and English isolation	34.35%	$25,921; 30.72%	25.20%
1	7317	Worcester	Minority and income	49.39%	$32,813; 38.88%	20.81%
2	7317	Worcester	Minority and income	46.12%	$34,856; 41.31%	11.59%
3	7317	Worcester	Minority and income	61.01%	$40,993; 48.58%	9.09%
2	7318.01	Worcester	Minority, income and English isolation	50.43%	$15,176; 17.98%	29.20%
1	7318.02	Worcester	Minority and income	60.91%	$43,583; 51.65%	23.23%
2	7318.02	Worcester	Minority, income and English isolation	91.93%	$11,543; 13.68%	33.93%

Attachment A: Central to Western MA Energy Improvement Project
Environmental Justice (EJ) Communities within 5 Miles

Block Group	Census Tract	Municipality	EJ Criteria Met	Minority Population (%)	Median Income ($; % of MA Median Income)	English Isolation (%)
4	7318.02	Worcester	Minority, income and English isolation	69.17%	$33,203; 39.35%	51.15%
2	7322.01	Worcester	Minority	47.57%	$76,250; 90.36%	12.18%
1	7322.02	Worcester	Minority and income	41.89%	$51,163; 60.63%	23.46%
2	7322.02	Worcester	Minority	38.89%	$92,344; 109.43%	9.14%
1	7322.03	Worcester	Minority and English isolation	56.73%	$75,401; 89.35%	25.93%
2	7322.03	Worcester	Minority and English isolation	51.76%	$68,902; 81.65%	33.42%
3	7322.03	Worcester	Minority and income	68.75%	$39,732; 47.08%	14.59%
1	7323.01	Worcester	Minority	42.72%	$61,607; 73.01%	4.59%
2	7323.01	Worcester	Minority	35.12%	$68,795; 81.53%	4.69%
1	7323.02	Worcester	Minority and income	56.12%	$39,207; 46.46%	14.81%
2	7323.02	Worcester	Minority	46.02%	$77,561; 91.91%	21.75%
1	7324	Worcester	Minority	64.55%	$60,851; 72.11%	4.26%
2	7324	Worcester	Minority	64.66%	$66,250; 78.51%	14.15%
3	7324	Worcester	Minority, income and English isolation	76.26%	$37,964; 44.99%	29.15%
4	7324	Worcester	Minority and income	75.66%	$52,621; 62.36%	14.81%
5	7324	Worcester	Minority, income and English isolation	82.52%	$31,406; 37.22%	34.55%
6	7324	Worcester	Minority and income	72.98%	$35,217; 41.73%	8.70%
1	7325	Worcester	Minority and income	60.39%	$29,886; 35.42%	8.70%
2	7325	Worcester	Minority and income	75.32%	$32,845; 38.92% of the MA median	10.95%
1	7326	Worcester	Minority, income and English isolation	72.92%	$22,578; 26.76%	33.49%
2	7326	Worcester	Minority and income	71.43%	$37,500; 44.44%	19.14%
3	7326	Worcester	Minority	60.70%	$74,018; 87.71%	0.00%
4	7326	Worcester	Minority	64.07%	$118,250; 140.13%	2.59%
5	7326	Worcester	Minority, income and English isolation	71.92%	$37,839; 44.84%	43.53%

Attachment A: Central to Western MA Energy Improvement Project
Environmental Justice (EJ) Communities within 5 Miles

Block Group	Census Tract	Municipality	EJ Criteria Met	Minority Population (%)	Median Income ($; % of MA Median Income)	English Isolation (%)
1	7327	Worcester	Minority and income	60.84%	$24,044; 28.49%	14.81%
2	7327	Worcester	Minority and income	68.38%	$53,750; 63.70%	2.99%
3	7327	Worcester	Minority and income	67.99%	$47,788; 56.63%	9.39%
4	7327	Worcester	Minority and income	67.45%	$28,997; 34.36%	0.00%
1	7328.01	Worcester	Minority	32.93%	$77,821; 92.22%	1.71%
2	7328.01	Worcester	Minority	42.81%	$70,766; 83.86%	5.39%
1	7328.02	Worcester	Minority	41.79%	$63,676; 75.46%	10.36%
2	7328.02	Worcester	Minority	57.39%	$73,250; 86.80%	8.68%
3	7328.02	Worcester	Minority	64.55%	$0; 0%	13.11%
1	7329.01	Worcester	Minority and income	51.36%	$32,768; 38.83%	8.83%
2	7329.01	Worcester	Minority	51.76%	$63,737; 75.53%	7.60%
3	7329.01	Worcester	Minority	54.48%	$71,458; 84.68%	14.74%
4	7329.01	Worcester	Minority	39.48%	$64,798; 76.79%	5.44%
5	7329.01	Worcester	Minority and income	59.02%	$12,080; 14.32%	17.66%
1	7329.02	Worcester	Minority	31.10%	$0; 0%	0.00%
1	7330	Worcester	Minority and income	77.87%	$41,667; 49.38%	0.00%
2	7330	Worcester	Minority and income	64.70%	$41,369; 49.02%	6.68%
3	7330	Worcester	Minority and income	81.18%	$33,799; 40.05%	14.54%
1	7331.01	Worcester	Minority	46.47%	$57,500; 68.14%	6.50%
2	7331.01	Worcester	Minority	37.34%	$66,369; 78.65%	0.00%
1	7331.02	Worcester	Minority and income	57.28%	$43,696; 51.78%	8.28%
2	7331.02	Worcester	Minority	41.94%	$74,712; 88.54%	7.60%
1	7352	Leicester	Minority	25.96%	$103,021; 122.08%	0.00%
3	7352	Leicester	Minority	26.48%	$97,821; 115.92%	0.00%
3	7365	Auburn	Income	10.13%	$44,773; 53.06%	0.00%
1	7372	Millbury	Income	16.65%	$53,875; 63.84%	0.00%
2	7372	Millbury	Income	13.73%	$53,375; 63.25%	0.00%
2	7381	Grafton	Minority	27.96%	$67,273; 79.72%	0.00%

Attachment A: Central to Western MA Energy Improvement Project
Environmental Justice (EJ) Communities within 5 Miles

Block Group	Census Tract	Municipality	EJ Criteria Met	Minority Population (%)	Median Income ($; % of MA Median Income)	English Isolation (%)
3	7381	Grafton	Minority	35.79%	$127,619; 151.23%	0.00%
2	7391.01	Shrewsbury	Minority	32.05%	$72,425; 85.83%	0.00%
3	7391.01	Shrewsbury	Minority	44.44%	$131,200; 155.48%	2.82%
1	7391.02	Shrewsbury	Minority	57.23%	$148,523; 176.01%	0.00%
2	7391.02	Shrewsbury	Minority	58.24%	$100,313; 118.88%	11.76%
1	7601	Brookfield	Income	7.40%	$34,779; 41.21%	0.00%
1	7611	Warren	Income	10.46%	$50,128; 59.40%	0.00%
3	7611	Warren	Income	12.83%	$48,711; 57.72%	0.00%
2	8102	Palmer	Income	10.22%	$47,163; 55.89%	2.29%
3	8201.01	Ware	Income	13.88%	$41,731; 49.45%	0.00%
2	8201.02	Ware	Income	19.14%	$29,250; 34.66%	0.00%
3	8201.02	Ware	Minority and income	24.51%	$33,889; 40.16%	2.56%
1	8203	Amherst	Minority	28.51%	$118,250; 140.13%	1.60%
2	8203	Amherst	Minority and income	51.39%	$37,500; 44.44%	5.65%
3	8203	Amherst	Minority	58.45%	$67,778; 80.32%	3.88%
4	8203	Amherst	Minority	33.43%	$75,882; 89.92%	3.83%
5	8203	Amherst	Minority	45.06%	$61,429; 72.80%	4.91%
1	8204	Amherst	Minority and income	39.52%	$2,500; 2.96%	0.00%
1	8205	Amherst	Minority and income	28.86%	$54,609; 64.71%	0.00%
2	8205	Amherst	Minority	24.75%	$106,190; 125.84%	4.96%
3	8205	Amherst	Minority and income	36.89%	$22,936; 27.18%	0.00%
4	8205	Amherst	Minority and income	25.91%	$16,226; 19.23%	0.00%
5	8205	Amherst	Minority	30.69%	$74,018; 87.71%	1.21%
6	8205	Amherst	Minority and income	41.89%	$40,956; 48.53%	2.29%
1	8206	Amherst	Minority	52.41%	$0; 0%	0.00%
1	8207	Amherst	Minority and income	44.46%	$36,168; 42.86%	2.75%
2	8207	Amherst	Minority	40.03%	$62,321; 73.85%	9.09%
3	8207	Amherst	Minority	27.74%	$140,000; 165.91%	3.64%

Attachment A: Central to Western MA Energy Improvement Project
Environmental Justice (EJ) Communities within 5 Miles

Block Group	**Census Tract**	**Municipality**	**EJ Criteria Met**	**Minority Population** (%)	**Median Income** ($; % of MA Median Income)	**English Isolation** (%)
3	8208.01	Amherst	Minority and income	60.34%	$47,435; 56.21%	5.64%
4	8208.01	Amherst	Minority	40.49%	$89,712; 106.31%	14.69%

Attachment B: Central to Western MA Energy Improvement Project
MA Department of Public Health (DPH) Environmental Justice (EJ) Tool Vulnerable Health EJ Criteria

Vulnerable Health Environmental Justice (EJ) by Community within the Designated Geographic Area (DGA) of 1 Mile

Municipality	Vulnerable Health Criteria Met (Yes/No)			
	Heart Attack	Elevated Blood Lead	Low Birth Weight	Childhood Asthma
Auburn	No	No	No	No
Belchertown	No	No	No	No
Conway	No	No	No	No
Deerfield	No	No	No	No
Leicester	No	No	No	No
Leverett	No	No	No	No
Millbury	**Yes**	No	No	No
North Brookfield	No	No	No	No
Pelham	No	No	No	No
Shelburne	**Yes**	**Yes**	No	No
Shutesbury	No	No	No	No
Spencer	No	No	No	No
Sunderland	No	**Yes**	**Yes**	No
Ware	No	No	No	No
West Brookfield	**Yes**	No	No	No
Auburn	No	No	No	No
Belchertown	No	No	No	No
Conway	No	No	No	No
Deerfield	No	No	No	No

Source: MA Department of Public Health (DPH) Environmental Justice (EJ) Tool, 2017 - 2021 data.

Attachment B: Central to Western MA Energy Improvement Project
MA Department of Public Health (DPH) Environmental Justice (EJ) Tool Vulnerable Health EJ Criteria

Vulnerable Health Environmental Justice (EJ) by Census Tract within the Designated Geographic Area (DGA) of 1 Mile

Census Tract	Environmental Justice (EJ) Population Present	Elevated Blood Lead		Low Birth Weight	
		Rate Prevalence	Criteria Met	Rate Prevalence	Criteria Met
406	No	24.1	**Yes**	NA	NA
407.02	No	22.1	**Yes**	NA	NA
408	Yes	NA	NA	368.1	**Yes**
415.01	No	70.4	**Yes**	NA	NA
415.02	Yes	NA	NA	0	No
7231	Yes	56.4	**Yes**	0	No
7251	Yes	35.2	**Yes**	452.3	**Yes**
7261	No	NA	NA	255.3	**Yes**
7262	Yes	14.1	No	NA	NA
7373	No	NA	NA	260.2	**Yes**
7511.01	No	0	No	NA	NA
7591	No	0	No	NA	NA
8201.01	No	14.6	No	NA	NA
8201.02	Yes	95.6	**Yes**	327.9	**Yes**
8202.04	No	NA	NA	217.4	No

Source: MA Department of Public Health (DPH) Environmental Justice (EJ) Tool, 2017 - 2021 data.

Notes: The criteria is met if the rate prevalence exceeds 110% of statewide value, which is 15 for elevated blood lead and 238.5 for low birth weight.

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Appendix D – Environmental Justice
EJ Reference List

Environmental Justice (EJ) Reference List

First Name	Last Name	Title	Phone	Email	Affiliation
Heather	Clish	Director of Conservation & Recreation Policy	(617) 523-0655	hclish@outdoors.org	Appalachian Mountain Club
Kerry	Bowie	Board President	Not Provided	kerry@msaadapartners.com	Browning the GreenSpace
Alma	Gordon	President	Not Provided	tribalcouncil@chappaquiddickwampanoag.org	Chappaquiddick Tribe of the Wampanoag Nation
Patricia	D. Rocker	Council Chair	Not Provided	rockerpatriciad@verizon.net	Chappaquiddick Tribe of the Wampanoag Nation, Whale Clan
Cindy	Luppi	New England Director	(617) 338-8131 x208	cluppi@cleanwater.org	Clean Water Action
Sylvia	Broude	Executive Director	(617) 292-4821	sylvia@communityactionworks.org	Community Action Works
Ryan	Odonnell	Water Quality Monitoring Coordinator	Not Provided	rodonnell@ctriver.org	Connecticut River Conservancy
Ryan	Odonnell	Water Quality Monitoring Coordinator	Not Provided	rodonnell@ctriver.org	Connecticut River Conservancy
Johannes	Epke	Staff Attorney	(617) 850-1761	jepke@clf.org	Conservation Law Foundation
Britteny	Jenkins	Vice President		Bjenkins@clf.org	Conservation Law Foundation
Ben	Hellerstein	MA State Director	(617) 747-4368	ben@environmentmassachusetts.org	Environment Massachusetts
Amy	Boyd Rabin	Vice President of Policy	(617) 221-8258	aboydrabin@environmentalleague.org	Environmental League of Massachusetts
Zahra	Saifee	Policy & Advocacy Coordinator	(435) 632-9482	zsaifee@environmentalleague.org	Environmental League of Massachusetts
Melissa	Ferretti	Chair	(508) 304-5023	melissa@herringpondtribe.org	Herring Pond Wampanoag Tribe

Mark	Wamsley	Conservation Director	Not Provided	mark@kestreltrust.org	Kestrel Land Trust
Brian	Weeden	Chair	(774) 413-0520	Brian.Weeden@mwtribe-nsn.gov	Mashpee Wampanoag Tribe
David	Weeden	THPO/Director	(774) 327.0068	David.Weeden@mwtribe-nsn.gov	Mashpee Wampanoag Tribe
Nakia	Hendricks Jr.	Office Manager	Not Provided	106Review@mwtribe-nsn.gov	Mashpee Wampanoag Tribe
Heidi	Ricci	Director of Policy	Not Provided	hricci@massaudubon.org	Mass Audubon
Robb	Johnson	Executive Director	(978) 443-2233	robb@massland.org	Mass Land Trust Coalition
Julia	Blatt	Executive Director	(617) 714-4272	juliablatt@massriversalliance.org	Mass Rivers Alliance
John	Peters, Jr.	Executive Director	(617) 573-1292	john.peters@mass.gov	Massachusetts Commission on Indian Affairs (MCIA)
Elizabeth	Solomon	Not Provided	Not Provided	Solomon.Elizabeth@gmail.com	Massachusetts Tribe at Ponkapoag
Lena Miles	Entin Gresham	Interim Co-Directors	Not Provided	Lena@N2NMa.org Miles@N2NMa.org	Neighbor to Neighbor Mass.
Cheryll	Toney Holley	Chair	(774) 317-9138	crwritings@aol.com	Nipmuc Nation (Hassanamisco Nipmucs)
Raquel	Halsey	Executive Director	(617) 232-0343	rhalsey@naicob.org	North American Indian Center of Boston
Rob	Moir	Executive Director	Not Provided	rob@oceanriver.org	Ocean River Institute
Cora	Pierce	Not Provided	Not Provided	Coradot@yahoo.com	Pocassett Wampanoag Tribe
Sarita	Hudson	Director Programs & Development	(413) 794-7739	shudson@publichealthwm.org	Public Health Institute of Western Mass
Sarita	Hudson	Director Programs & Development	(413) 794-7739	shudson@publichealthwm.org	Public Health Institute of Western Mass
Vickash	Mohanka	Director, MA Chapter	Not Provided	vick.mohanka@sierraclub.org	Sierra Club MA

Stockbridge-Munsee Tribe		Historic Preservation Manager	(413) 884-6048	THPO@Mohican-nsn.gov	Stockbridge-Munsee Tribe
Jodi	Valenta	Massachusetts State Director	(617) 367-6200	Jodi.Valenta@tpl.org	The Trust for Public Land
Claire	B.W. Muller	Movement Building Director	(508) 308-9261	claire@uumassaction.org	Unitarian Universalist Mass Action Network
Bettina	Washington	Tribal Historic Preservation Officer	(508) 560-9014	thpo@wampanoagtribe-nsn.gov	Wampanoag Tribe of Gay Head (Aquinnah)

Appendix D – Environmental Justice Advance Notification Submittal

From:	Central to Western Mass Energy Improvement Project
Sent:	Tuesday, November 26, 2024 9:57 AM
To:	mepa@mass.gov; MEPA-EJ@mass.gov; claire@uumassaction.org; juliablatt@massriversalliance.org; Jodi.Valenta@tpl.org; kerry@msaadapartners.com; sylvia@communityactionworks.org; hclish@outdoors.org; jepke@clf.org; Bjenkins@clf.org; aboydrabin@environmentalleague.org; zsaifee@environmentalleague.org; ben@environmentmassachusetts.org; robb@massland.org; cluppi@cleanwater.org; Lena@N2NMa.org; Miles@N2NMa.org; rob@oceanriver.org; deb.pasternak@sierraclub.org; Heidi Ricci; tribalcouncil@chappaquiddickwampanoag.org; crwritings@aol.com; john.peters@mass.gov; melissa@herringpondtribe.org; rockerpatriciad@verizon.net; rhalsey@naicob.org; Coradot@yahoo.com; Solomon.Elizabeth@gmail.com; THPO@Mohican-nsn.gov; thpo@wampanoagtribe-nsn.gov; Brian.Weeden@mwtribe-nsn.gov; David.Weeden@mwtribe-nsn.gov; 106Review@mwtribe-nsn.gov; rodonnell@ctriver.org; shudson@publichealthwm.org; mark@kestreltrust.org; rodonnell@ctriver.org; shudson@publichealthwm.org
Cc:	Tyrrell, Michael; Theresa Portante; Priyanka Shrestha
Subject:	MEPA Advanced Notification – Central to Western Mass Energy Improvement Project
Attachments:	EJ Screening Form_Central to Western Mass Energy Improvement Project.pdf

Good morning,

On behalf of the New England Power Company (NEP), please find attached the Environmental Justice (EJ) Screening Form for NEP's Central to Western Mass Energy Improvement Project, located within an existing Right-of-Way within the Towns of Auburn, Belchertown, Conway, Deerfield, East Brookfield, Leicester, Leverett, Millbury, North Brookfield, Pelham, Shelburne, Shutesbury, Spencer, Sunderland, Ware, and West Brookfield. Recipients of this Form include organizations on the EJ Reference List provided by the Massachusetts Executive Office of Energy and Environmental Affairs per the *MEPA Public Involvement Protocol for EJ Populations*.

Best regards,
Central to Western MA Energy Improvement Project Team

Phone: +1 (888) 431-3536 [toll free]

Appendix D – Environmental Justice Invite to Meeting Submittal

From: Central to Western Mass Energy Improvement Project
Sent: Tuesday, December 17, 2024 4:54 PM
To: mepa@mass.gov; MEPA-EJ@mass.gov; claire@uumassaction.org; juliablatt@massriversalliance.org; Jodi.Valenta@tpl.org; kerry@msaadapartners.com; sylvia@communityactionworks.org; hclish@outdoors.org; jepke@clf.org; Bjenkins@clf.org; aboydrabin@environmentalleague.org; zsaifee@environmentalleague.org; ben@environmentmassachusetts.org; robb@massland.org; cluppi@cleanwater.org; Lena@N2NMa.org; Miles@N2NMa.org; rob@oceanriver.org; Heidi Ricci; tribalcouncil@chappaquiddickwampanoag.org; crwritings@aol.com; john.peters@mass.gov; melissa@herringpondtribe.org; rockerpatriciad@verizon.net; rhalsey@naicob.org; mailto:vick.mohanka@sierraclub.org; Coradot@yahoo.com; Solomon.Elizabeth@gmail.com; THPO@Mohican-nsn.gov; thpo@wampanoagtribe-nsn.gov; Brian.Weeden@mwtribe-nsn.gov; David.Weeden@mwtribe-nsn.gov; 106Review@mwtribe-nsn.gov; mark@kestreltrust.org; rodonnell@ctriver.org; shudson@publichealthwm.org; dalbertson@belchertown.org; townadmin@conwayma.gov; townadmin@town.deerfield.ma.us; townclerk@eastbrookfieldma.us; townadministrator@leverett.ma.us; townclerk@pelhamma.gov; townadmin@townofshelburne.gov; townadmin@shutesbury.org; sbeckley@townofware.com; rsangelo@wbrookfield.com; Boubacar.Dieme@nationalgrid.com; Brandie.Long@nationalgrid.com; Aubrey.OKeefe@nationalgrid.com; Nayanny.Bello-Paniagua@nationalgrid.com; jackdavey72@yahoo.com
Cc: Tyrrell, Michael; Joseph Carroll; Theresa Portante; Priyanka Shrestha
Subject: RE: Reminder of Virtual Community Meeting – Central to Western MA Energy Improvement Project

Good evening,

This is a reminder of the upcoming **Central to Western Mass Energy Improvement Project** virtual community meeting to provide Project information and engage the public, including Environmental Justice communities.

Please join us on **Thursday, December 19th, 2024**, from **6pm to 8pm** for a virtual community meeting to learn more about the Project, including an overview, timeline, activities, and anticipated schedule. This meeting will give our neighbors an opportunity to raise questions regarding the Project and the MEPA review process.

Zoom Meeting Link:
https://bscgroup.zoom.us/j/91360329005?pwd=2huFU0wZ5Wh1f9jmAxQ1Sz4PeE1J5a.1
Zoom Dial-in Number and Meeting ID: +1 (305) 224-1968, 91360329005

We look forward to seeing you!

Best regards,

Central to Western MA Energy Improvement Project Team

Phone: +1 (888) 431-3536 [toll free]

From: Central to Western Mass Energy Improvement Project
Sent: Wednesday, November 27, 2024 4:15 PM
To: mepa@mass.gov; MEPA-EJ@mass.gov; claire@uumassaction.org; juliablatt@massriversalliance.org; Jodi.Valenta@tpl.org; kerry@msaadapartners.com; sylvia@communityactionworks.org; hclish@outdoors.org; jepke@clf.org; Bjenkins@clf.org; aboydrabin@environmentalleague.org; zsaifee@environmentalleague.org; ben@environmentmassachusetts.org; robb@massland.org; cluppi@cleanwater.org; Lena@N2NMa.org; Miles@N2NMa.org; rob@oceanriver.org; hricci@massaudubon.org; tribalcouncil@chappaquiddickwampanoag.org; crwritings@aol.com; john.peters@mass.gov; melissa@herringpondtribe.org; rockerpatriciad@verizon.net; rhalsey@naicob.org; Coradot@yahoo.com; Solomon.Elizabeth@gmail.com; THPO@Mohican-nsn.gov; thpo@wampanoagtribe-nsn.gov; Brian.Weeden@mwtribe-nsn.gov; David.Weeden@mwtribe-nsn.gov; 106Review@mwtribe-nsn.gov; mark@kestreltrust.org; rodonnell@ctriver.org; shudson@publichealthwm.org; dalbertson@belchertown.org; townadmin@conwayma.gov; townadmin@town.deerfield.ma.us; townclerk@eastbrookfieldma.us; townadministrator@leverett.ma.us; townclerk@pelhamma.gov; townadmin@townofshelburne.gov; townadmin@shutesbury.org; sbeckley@townofware.com; rsangelo@wbrookfield.com; Boubacar.Dieme@nationalgrid.com; Brandie.Long@nationalgrid.com; Aubrey.OKeefe@nationalgrid.com; Nayanny.Bello-Paniagua@nationalgrid.com
Cc: Tyrrell, Michael <Michael.Tyrrell@nationalgrid.com>; Joseph Carroll <Joseph.Carroll1@nationalgrid.com>; Theresa Portante <TPortante@bscgroup.com>; Priyanka Shrestha <pshrestha@bscgroup.com>
Subject: Virtual Community Meeting – Central to Western MA Energy Improvement Project

Dear Neighbor,

The Massachusetts Environmental Protection Act (MEPA) review process provides opportunities for public review of a project's potential environmental impacts. New England Power Company (NEP) will host a virtual community meeting for the **Central to Western Mass Energy Improvement Project** to provide Project information and engage the public, including Environmental Justice communities.

Please join us on **Thursday, December 19th, 2024**, from **6pm to 8pm** for a virtual community meeting to learn more about the Project, including an overview, timeline, activities, and anticipated schedule. This meeting will give our neighbors an opportunity to raise questions regarding the Project and the MEPA review process.

Zoom Meeting Link:
https://bscgroup.zoom.us/j/91360329005?pwd=2huFU0wZ5Wh1f9jmAxQ1Sz4PeE1J5a.1
Zoom Dial-in Number and Meeting ID: +1 (305) 224-1968, 91360329005

NEP is committed to providing ample access and opportunity to stay up-to-date on this Project. More information can be found on the Project website: https://www.cmatowmaenergy.com/ or by calling the Project hotline number: **+1 (888) 431-3536** [toll free].

To request translation of the project materials or live interpretation during the meeting, please email info@CMAtoWMAenergy.com by Wednesday, December 11th. After the request has been made, a member of our outreach team will contact you.

Recipients of this meeting invitation include organizations on the EJ Reference List, provided by the Massachusetts Executive Office of Energy and Environmental Affairs (EEA) per the *MEPA Public Involvement Protocol for EJ Populations*, and Municipality Administrators. We encourage organizations and municipalities to share this meeting invitation via websites, social media, or message boards. A public notice for the virtual community meeting will also be published in the following newspapers: the Worcester Telegram and Gazette (November 27th), the Greenfield Recorder (November 27th), and the Republican (November 29th).

We look forward to seeing you!

Best regards,
Central to Western MA Energy Improvement Project Team

Phone: +1 (888) 431-3536 [toll free]

Appendix D – Environmental Justice Legal Ad Submittal

Outlook

proof - PROJECT # 0100181.00-27.

From shunter@recorder.com <shunter@recorder.com>
Date Fri 11/22/2024 8:48 AM
To Julie Goldberg <JGoldberg@bscgroup.com>

3 attachments (104 KB)
4440935.pdf; relogo.jpg; shunter_4440935_1732283033353.png;

Hi Julie Attached is a proof of your notice to run in the Recorder on Wednesday November 27th. If that date works for you to publish, please approve by 11am on Monday. Suzanne

GREENFIELD RECORDER
Recorder.com
14 Hope Street
Greenfield, MA 01302
413-772-0261
Athol Daily News
Atholdailynews.com

Advertising Invoice

BSC GROUP
1 MERCANTILE ST # 610
WORCESTER, MA 01608

Cust#:17205
Ad#:4440935
Phone#:617-896-4500
Date:11/22/2024

Salesperson: Suzanne Hunter **Classification: Legals** **Ad Size: 2.0 x 4.000**

Advertisement Information:

Description	Start	Stop	Ins.	Cost/Day	Total
The Recorder	11/27/2024	11/27/2024	1	313.12	313.12

Payment Information:

Date:	Order#	Type
11/22/2024	4440935	BILLED ACCOUNT

Total Amount: 313.12

Tax: 0.00

Amount Due: 313.12

PROJECT # 0100181.00-27. - Thank you for your business!

Ad Copy

New England Power (NEP)
Central to Western Mass Energy Improvement Project
Virtual Community Meeting

NEP will host a virtual community meeting to provide Project information and engage the public on the Central to Western Mass Energy Improvement Project. Project information will include an overview, timeline, activities, and anticipated schedule. This meeting will give our neighbors an opportunity to raise questions regarding the Project and the Massachusetts Environmental Protection Act (MEPA) review process.

The Project will traverse through the Towns of Auburn, Belchertown, Conway, Deerfield, East Brookfield, Leicester, Leverett, Millbury, North Brookfield, Pelham, Shelburne, Shutesbury, Spencer, Sunderland, Ware, and West Brookfield.

Please join us on:
Thursday, December 19th, 2024 from 6pm to 8pm
Zoom Meeting Link: https://bscgroup.zoom.us/j/91360329005?pwd=2huFU0wZ5Whlf9jmAxQISz4PoEJJ5a.1
Zoom Dial-in Number and Meeting ID: +1 (305) 224-1968, 91360329005

NEP is committed to providing ample access and opportunity to stay up-to-date on this Project. More information can be found on the Project website: https://www.cmatowmaenergy.com/ or by calling the Project hotline number: **+1 (888) 431-3536** [toll free].

To request translation of the project materials or live interpretation during the meeting, please email info@CMAtoWMAenergy.com by Wednesday, December 11th. After the request has been made, a member of our outreach team will contact you.

November 27

4440935

Outlook

Thank you for placing your order with us.

From Worcester Legals <legalnotices@telegram.com>
Date Fri 11/22/2024 11:34 AM
To Deborah A. Horgan <dhorgan@bscgroup.com>; Julie Goldberg <JGoldberg@bscgroup.com>

1 attachment (15 KB)
LNEO01978440.pdf;

THANK YOU for your ad submission!

This is your confirmation that your order has been submitted. Below are the details of your transaction. Please save this confirmation for your records.

We appreciate you using our online self-service ads portal, available 24/7. Please continue to visit Worcester Telegram & Gazette's online Classifieds HERE to place your legal notices in the future.

Changes and/or cancellations may not be honored up to 2 business days prior to your first publication date.

Job Details

Order Number:	**LNEO0197844**
Classification:	Public Notices
Package:	General Package
Base amount:	$169.92
Service fee:	$6.78
Cash/Check/ACH	
Discount:	-$0.00
Total payment:	$176.70

As an incentive for customers, we provide a discount off the total order cost equal to the 3.99% service fee if you pay with Cash/Check/ACH. Pay by Cash/Check/ACH and save! In no event are service fees refundable.
Payment Type: visa

Account Details

Theresa Portante
207 Old Common Road
Lancaster, MA 01523
617-896-4346
jgoldberg@bscgroup.com
BSC Group
Credit Card - visa **********6673

Schedule for ad number LNEO01978440

Wed Nov 27, 2024
Worcester Telegram & Gazette *All Zones*

New England Power (NEP)
Central to Western Mass Energy Improvement Pro
Virtual Community Meeting

NEP will host a virtual community meeting to p
Project information and engage the public on the Cer
Western Mass Energy Improvement Project. Projec
mation will include an overview, timeline, activitie
anticipated schedule. This meeting will give our nei
an opportunity to raise questions regarding the Proje
the Massachusetts Environmental Protection Act (M
review process.

The Project will traverse the Towns of Auburn, Belche
Conway, Deerfield, East Brookfield, Leicester, Le
Millbury, North Brookfield, Pelham, Shelburne, Shute
Spencer, Sunderland, Ware, and West Brookfield.

Please join us on:
Thursday, December 19th, 2024 from 6pm to 8pm
Zoom Meeting Link: https://bscgroup.zoom.us/j/91360
pwd=2huFU0wZ5Wh1f9jmAxQ1Sz4PeE1J5a.1
Dial-in Number and Meeting ID: +1 (305) 224-19
91360329005

NEP is committed to providing ample access and opp
tunity to stay up-to-date on this Project. More inform
can be found on the Project website: https://www.cm
wmaenergy.com/ or by calling the Project hotline nur
+1 (888) 431-3536 [toll free].

To request translation of the project materials or live
interpretation during the meeting, please email info@
CMAtoWMAenergy.com by Wednesday, December 11
After the request has been made, a member of our ou
team will contact you.

Publication Dates
LNEO0197844

Outlook

Online Form Submittal: Contact Us - Town Manager Department

From noreply@civicplus.com <noreply@civicplus.com>
Date Wed 11/27/2024 4:29 PM
To Central to Western Mass Energy Improvement Project <CWMA-EIP@bscgroup.com>

Contact Us - Town Manager Department

Please complete the form below to submit your questions/comments. The Massachusetts Public Record Law states all electronic mail sent or received by the Town is considered a public record.

Your Name	Central to Western MA Energy Improvement Project Team
Your E-mail Address	CWMA-EIP@bscgroup.com
Subject	Virtual Community Meeting – Central to Western MA Energy Improvement Project
Message	Dear Neighbor, The Massachusetts Environmental Protection Act (MEPA) review process provides opportunities for public review of a project's potential environmental impacts. New England Power Company (NEP) will host a virtual community meeting for the Central to Western Mass Energy Improvement Project to provide Project information and engage the public, including Environmental Justice communities. Please join us on Thursday, December 19th, 2024, from 6pm to 8pm for a virtual community meeting to learn more about the Project, including an overview, timeline, activities, and anticipated schedule. This meeting will give our neighbors an opportunity to raise questions regarding the Project and the MEPA review process. Zoom Meeting Link: https://bscgroup.zoom.us/j/91360329005?pwd=2huFU0wZ5Wh1f9jmAxQ1Sz4PeE1J5a.1 Zoom Dial-in Number and Meeting ID: +1 (305) 224-1968, 91360329005 NEP is committed to providing ample access and opportunity to stay up-to-date on this Project. More information can be found

on the Project website: https://www.cmatowmaenergy.com/ or by calling the Project hotline number: +1 (888) 431-3536 [toll free].

To request translation of the project materials or live interpretation during the meeting, please email info@CMAtoWMAenergy.com by Wednesday, December 11th. After the request has been made, a member of our outreach team will contact you.

Recipients of this meeting invitation include organizations on the EJ Reference List, provided by the Massachusetts Executive Office of Energy and Environmental Affairs (EEA) per the MEPA Public Involvement Protocol for EJ Populations, and Municipality Administrators. We encourage organizations and municipalities to share this meeting invitation via websites, social media, or message boards. A public notice for the virtual community meeting will also be published in the following newspapers: the Worcester Telegram and Gazette (November 27th), the Greenfield Recorder (November 27th), and the Republican (November 29th).

We look forward to seeing you!

Best regards,
Central to Western MA Energy Improvement Project Team

Phone: +1 (888) 431-3536 [toll free]

Attachment 1	*Field not completed.*
Attachment 2	*Field not completed.*
Attachment 3	*Field not completed.*

Appendix E – Agency Permits and Status

Environmental Notification Form (ENF)

Central To Western Massachusetts Energy Improvement Project

Anticipated Federal, State, and Municipal Agency Permit, Approval, and Status

Anticipated Federal, State, and Municipal Agency Permit, Approval, and Status

Agency	Permit/Review/Approval	Status/Coordination
U.S. Army Corps of Engineers ("USACE")	Section 404 General Permits Pre-Construction Notification ("PCN") Authorization and consultations under Section 106 of National Historic Preservation Act ("NHPA") and Section 7 of the Endangered Species Act ("ESA")	Target filing for October 2026
United States Environmental Protection Agency ("EPA")	National Pollutant Discharge Elimination System ("NPDES") General Permit for Stormwater Discharges and Construction Dewatering Activities/Stormwater Pollution Prevention Plan ("SWPPP").	To be filed at least 14 days prior to the start of construction.
State		
Executive Office of Energy and Environmental Affairs ("EEA")	MEPA Review – Secretary's Certificate	Target filing January 2025. A joint MEPA-EJ pre-filling meeting with MEPA was held on December 12th.
Massachusetts Department of Environmental Protection ("MassDEP")	Section 401 Individual Water Quality Certificate ("WQC") and Variance	Target filing April 2026.
Massachusetts Natural Heritage and Endangered Species Program ("NHESP")	Massachusetts Endangered Species Act ("MESA") – Determination of "take" or No "take"; Conservation & Management Permit (if needed)	MESA checklist target filing May 2025. Consultation within NHESP is ongoing.
Massachusetts Historical Commission ("MHC")	Consultation under General Laws of Massachusetts ("M.G.L.") c. 9 in accordance with 950 70-71	Consultation with MHC is ongoing.
Energy Facilities Siting Board ("EFSB")[1]	G.L. c. 164, §69J Petition for Approval to Construct Transmission Lines	Target filing January 2025.
Massachusetts Department of Public Utilities ("DPU")	G.L. c. 164, §72 Petition for Determination of Public Necessity and Convenience	Target filing January 2025.

[1] Concurrently with its Petition to the Siting Board, NEP intends to file Petitions with the Department of Public Utilities (DPU) in accordance with G.L. c. 164, § 72 and requesting exemptions from the Zoning Ordinances of the communities pursuant to G.L. c. 40A, § 3, other than those noted above.

Department of Conservation and Recreation ("DCR")	Watershed Protection Act ("WsPA") Determination of Applicability or Variance (if required); Construction & Access Permit; and Short-term and Vehicle Access to Quabbin and Ware River Watershed System Permit	DCR WsPA Permit target filing May 26 2026; DCR Watershed Access Permit target filing July 2026; DCR Parks and Recreation Access Permit target filing June 2026.
Massachusetts Department of Transportation ("MassDOT")	Permit to Access State Highway/Non-Municipal Utility Permits for crossing over of state roads with utility lines.	Target filing October 2026.
Local/Municipal		
Conservation Commissions in Auburn, Belchertown, Conway, Deerfield, East Brookfield, Leicester, Leverett, Millbury, North Brookfield, Pelham, Shelburne, Shutesbury, Spencer, Sunderland, Ware, and West Brookfield	Order of Conditions ("OOC") per the Massachusetts Wetland Protection Act ("MA WPA")[2] and local bylaws.	Anticipated Summer/Fall 2026

[2] MA WPA Orders of Conditions are local permits unless and until a superseding Order of Conditions is issued by MassDEP.