



TIER 1 ENVIRONMENTAL ASSESSMENT APPENDICES

May 2016

Northern New England Intercity Rail Initiative

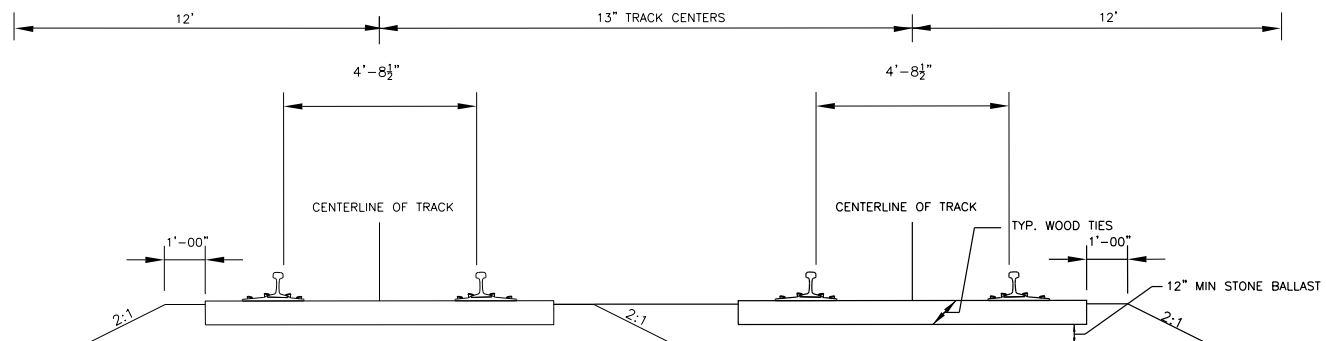
Tier 1 Environmental Assessment

APPENDICES – VOLUME 1

Appendix A	Conceptual Rail Sections
Appendix B	Noise and Vibration Technical Report
Appendix C	Flood Zone Maps
Appendix D	Impaired Water Bodies in the Rail Corridor
Appendix E	Massachusetts and Vermont Resource Area Maps

Appendix A

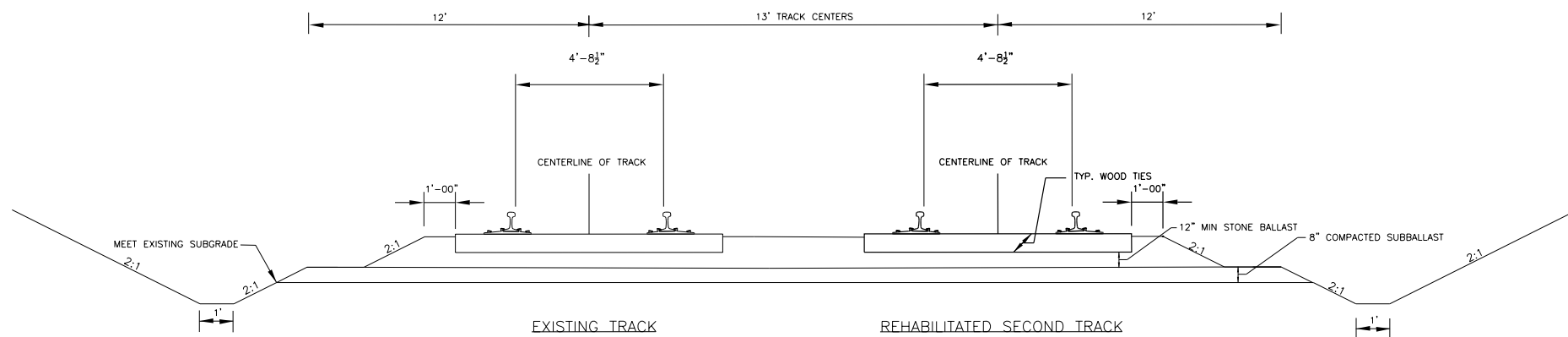
Conceptual Rail Sections



TYPICAL DOUBLE TRACK CROSS SECTION

NECR SWANTON SUBDIVISION MP 6

N.T.S.



EXISTING TRACK

REHABILITATED SECOND TRACK

TYPICAL EXISTING TRACK SECTION WITH REHABILITATED SECOND TRACK

NECR PALMER SUBDIVISION MP 122

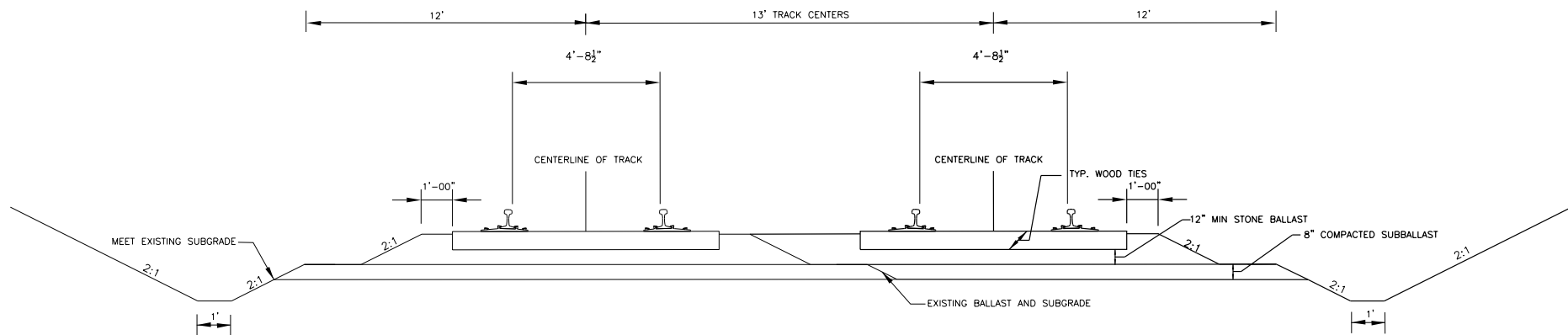
CSX BOSTON SUBDIVISION MP 72

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NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE

TYPICAL TRACK CROSS SECTIONS





EXISTING TRACK PROPOSED SECOND TRACK

TYPICAL EXISTING TRACK WITH PROPOSED SECOND TRACK WITH EXPANDED ROADBED

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 <small>HDR INC. 300 ATLANTIC AVENUE, SUITE 2100 BOSTON, MA 02110 (617) 267-7000</small>		 <small>MASSACHUSETTS DEPARTMENT OF TRANSPORTATION Rail & Transit Division</small>																																																																																			
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Appendix B

Noise and Vibration Technical Report



NOISE AND VIBRATION TECHNICAL MEMORANDUM

May 2016

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Noise and Vibration Technical Report

The Study Team performed noise and vibration analyses for the Boston to Springfield and East Northfield to Canadian border segments of the NNEIRI Corridor. Federal Railroad Administration (FRA) performed noise and vibration analyses for the New Haven to East Northfield segment as part of the EA for the NHHS project for the region between New Haven, Connecticut and Springfield, Massachusetts, and the Knowledge Corridor – Restore Vermonter EA for the region between Springfield and East Northfield, Massachusetts. FRA based the Knowledge Corridor noise and vibration analyses on a proposed service with fewer trains and lower speeds than the NNEIRI, so this segment of the NNEIRI Corridor will need to be evaluated further during Tier 2 analysis. The NNEIRI Study Area for noise and vibration covers 309 miles of existing rail line traversing urban, suburban, and rural areas of Massachusetts and Vermont. The Study Team evaluated potential noise and vibration impacts based on relevant methodologies and criteria as summarized below.

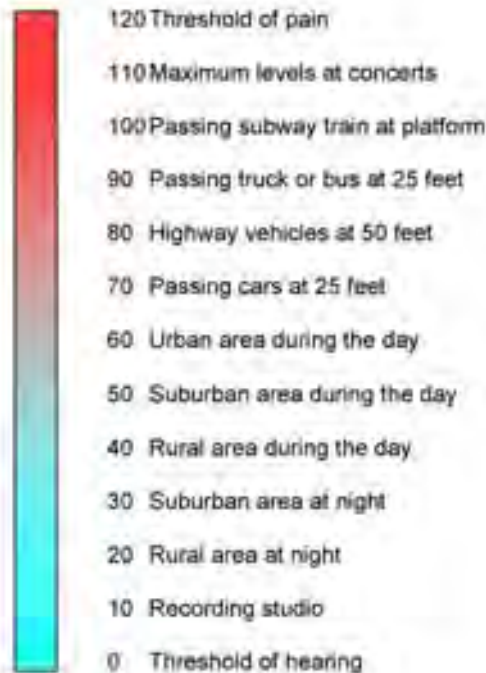
1. Environmental Noise Parameters

Sound is caused by pressure fluctuations that generate energy waves in the surrounding air. Sound levels are typically measured using a logarithmic decibel (dB) scale. Sound that causes disturbance or annoyance, or unwanted sound, is often called noise. The terms sound and noise are used interchangeably in this analysis.

Human hearing varies in sensitivity for different sound frequencies. Frequency is the rate of variation of the pressure wave and is typically described in units of cycles per second or Hertz (Hz). Although we can hear sounds between roughly 20 and 20,000 Hz, the human ear is most sensitive to sound frequencies between 500 and 4,000 Hz and is less sensitive to sound frequencies below 250 Hz or above 10,000 Hz. Consequently, several different frequency weighting schemes have been developed to model the way the human ear responds to noise levels. The “A-weighted” decibel scale (dBA) is the most widely used for this purpose. A list of typical sound levels for example sound sources is presented in Figure 1. Each increase of 10 dBA is typically perceived as a doubling of loudness and each decrease of 10 dBA is typically perceived as cutting the loudness in half. Sound pressure levels in dBA are used in most environmental assessments to rate the potential for human annoyance.

Varying sound levels are often described in terms of an equivalent decibel level. Equivalent sound levels (L_{eq}) are not simple averages of decibel values but are based on the total acoustical energy associated with the varying sound levels. L_{eq} values sometimes are referred to as energy-averaged sound levels. They are the constant sound levels that have the same acoustic energy as the time-varying signal over a specified period. As a consequence of the calculation procedure, high dB events contribute more to the L_{eq} value than do low dB events. L_{eq} values are used to develop single-value descriptions of average sound exposure over various periods of time. Such average sound exposure ratings often include additional weighting factors for potential annoyance due to time of day or other considerations. The L_{eq} data used for average sound exposure descriptors are generally based on A-weighted sound level measurements.

Figure 1. Common environments with associated sound pressure levels in dBA



Sound exposure over a 24-hour period is often presented as a day-night average level (L_{dn}). L_{dn} values are calculated from hourly L_{eq} values, with the L_{eq} values for the nighttime period (10 pm to 7 am) increased by 10 dBA to reflect the greater disturbance potential from nighttime sounds. If a sound source emits a constant level of sound over a full 24 hour period, the L_{dn} is approximately 6 dBA higher than the instantaneous sound pressure level because of the mathematics associated with the calculated 10 dBA increase in nighttime levels.

A common descriptor used for discrete noise events is the sound exposure level (SEL), which is the sound pressure level associated with the sound energy generated by an event (such as a train pass-by) compressed into a 1-second period. For any event that occurs over time periods longer than 1 second, the SEL is higher in level than any other descriptor (including the maximum instantaneous level) because of the assumption that the energy associated with the entire event is compressed into the single second. SEL is useful for combining the sound levels associated with different sources into a single L_{eq} value.

Sound intensity reduces with distance as it propagates over a larger area, generally in a spherical spreading pattern, away from a point source where the sound waves were generated. Generally speaking, the sound pressure level emitted from a point source (a sound source small in size compared to the distance of interest) decreases by approximately 6 dBA for each doubling of distance from the source. If a sound source can be characterized as a line rather than a point, as is the case for long trains, the sound pressure level drop-off rate generally reduces from 6 dBA to a rate of 3 dBA for each doubling of distance from the source. In addition to this decrease in sound intensity by divergence of sound energy with distance, sound propagation (and thus sound pressure levels at specific locations) is affected by atmospheric and ground conditions. An

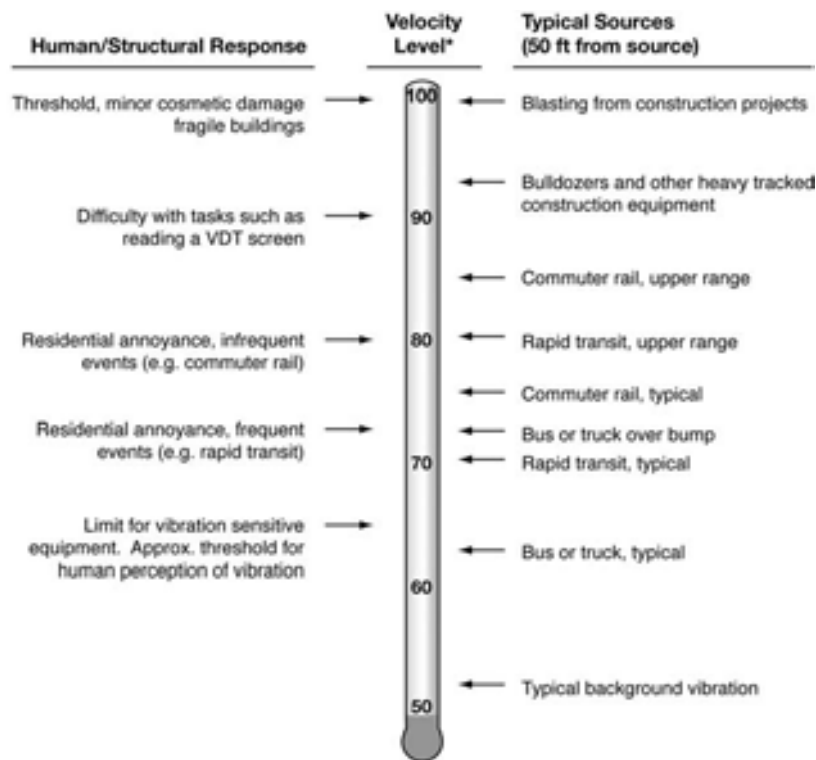
acoustically absorptive ground condition, as would be the case for loose soil or fresh snow, can add another 1.5 dBA per doubling of distance to the drop-off rate of sound pressure level from a point or line source.

With respect to combining sources, a difference in sound pressure level of 10 dB or more between two sources (measured independently at the same location) results in a combined sound pressure level of the same magnitude as the higher of the two values. In other words, the overall sound pressure level at a specific location will be unaffected if a second sound source is introduced that is measured independently as generating 10 dB less than the original signal (for example, 70 dB + 60 dB = 70 dB).

2. Environmental Vibration Parameters

Vibrational energy is typically rated in terms of vibration velocity level, in decibel units of VdB. These values are put into perspective in Figure 2, showing that the threshold of human perception is in the 65 VdB range and the potential for annoyance begins at 72 VdB. Vibration propagation is highly dependent upon the composition of the ground and building structures between the source and receivers, so detailed analyses must be performed to determine the full potential for vibration impacts on sensitive locations.

Figure 2. Ground-borne vibration levels



* RMS Vibration Velocity Level in VdB relative to 10^{-6} inches/second

Source: FTA 2006

3. Regulatory Requirements and Methodology

3.1 Regulatory Requirements

Local regulations typically defer to federal regulations and criteria for interstate rail projects. Criteria relevant to this project are those published by FRA and Federal Transit Administration (FTA). FRA published its latest noise and vibration guidelines in 2012 (entitled *High-Speed Ground Transportation Noise and Vibration Impact Assessment*, Report Number DOT/FRA/ORD-12/15) and FTA published its latest noise and vibration guidelines in 2006 (entitled *Transit Noise and Vibration Impact Assessment*, Report Number FTA-VA-90-1003-06). The FRA guidelines are intended only for high-speed rail lines, where trains are traveling at speeds greater than 90 miles per hour. The introduction of the FRA document begins by stating that “this manual is intended for projects with train speeds of 90–250 mph” and that “the FTA manual provides guidance for projects with conventional train speeds below 90 mph.” Because the maximum speeds associated with NNEIRI Build Alternative operations would be 79 miles per hour, the Study Team followed the FTA guidelines for this analysis.

3.2 Methodology

The noise and vibration impact criteria are the same in the FRA and FTA guidelines. Each guideline addresses the same three categories of noise- and vibration-sensitive uses and the same three categories of impacts.

Operations Noise Criteria

The descriptors and criteria for assessing noise impacts vary according to land use categories adjacent to the tracks. For land uses where people live and sleep (e.g., residential neighborhoods, hospitals, and hotels), L_{dn} is the assessment parameter. For other land use types where there are noise-sensitive uses (e.g., outdoor concert areas, schools, and libraries), the equivalent noise level for an hour of noise sensitivity ($L_{eq(h)}$) that coincides with train activity is the assessment parameter. Table 1 summarizes the three land use categories with their associated noise metrics.

The noise impact criteria used by the FTA are ambient-based, in which the increase in future noise (future noise levels with the project added to existing noise levels) is assessed rather than the noise caused by each passing train. The criteria vary with existing levels and the permitted cumulative increase due to the project decreases with increasing existing levels. Figure 3 shows the FTA noise impact criteria for human annoyance. Depending on the magnitude of the cumulative noise increases, FTA categorizes impacts as (1) no impact; (2) moderate impact; or (3) severe impact. Severe impact is where a significant percentage of people would be highly annoyed by the project’s noise. Moderate impact is where the change in cumulative noise levels would be noticeable to most people, but may not be sufficient to generate strong, adverse reactions. Mitigation measures are typically addressed for severe impacts.

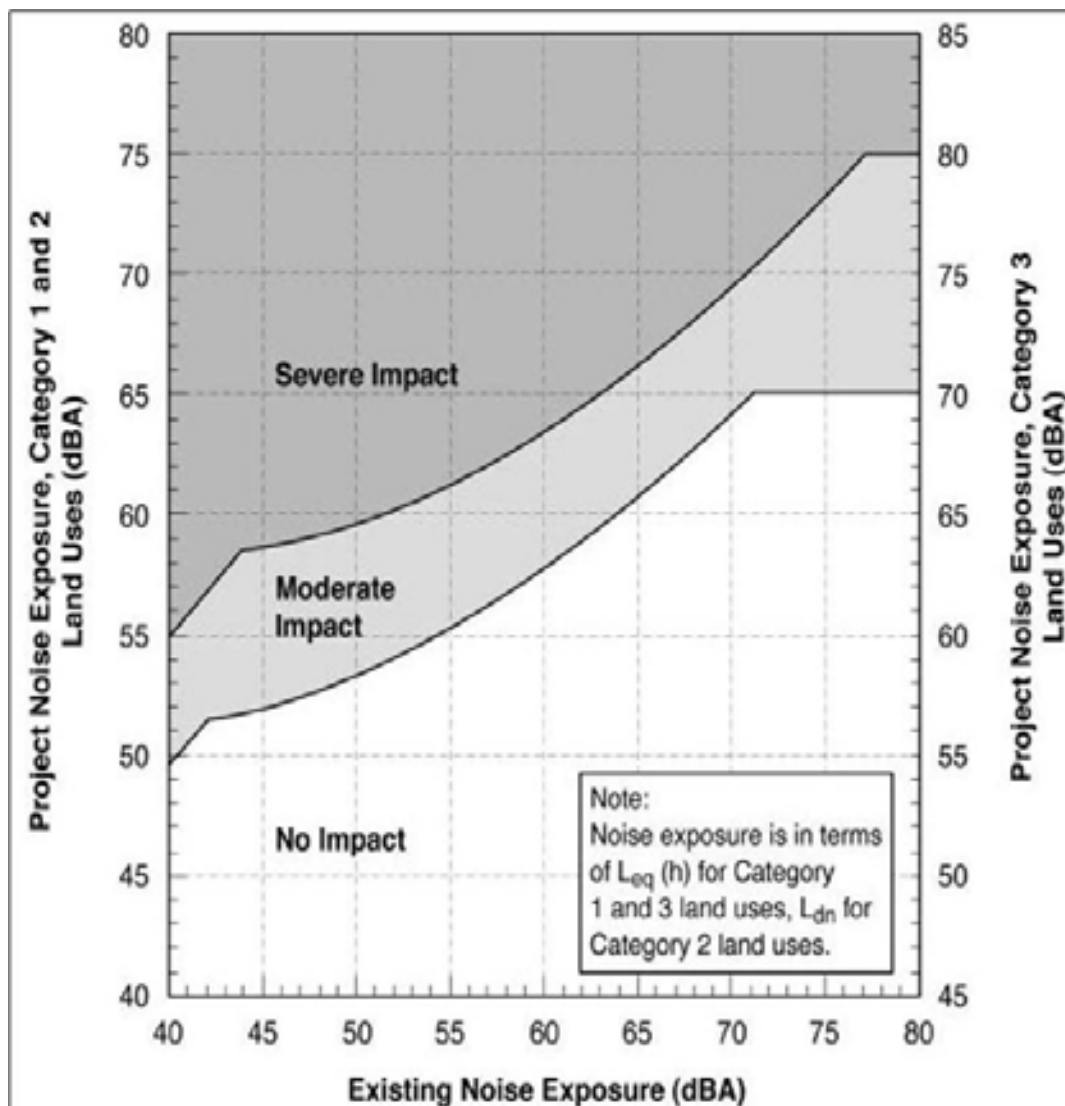
Table 1. FTA noise-sensitive land uses

Land Use Category	Noise Metric (dBA)	Land Use Category Description
1	Outdoor $L_{eq(h)}$ *	Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet, such as outdoor amphitheaters, concert pavilions, and National Historic Landmarks with significant outdoor use.
2	Outdoor L_{dn}	Residences and buildings where people normally sleep. This category includes homes and hospitals, where nighttime sensitivity to noise is of utmost importance.
3	Outdoor $L_{eq(h)}$ *	Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, and churches, where it is important to avoid interference with such activities as speech, meditation, and concentration. Buildings with interior spaces where quiet is important, such as medical offices, conference rooms, recording studios, and concert halls fall into this category, as well as places for meditation or study associated with cemeteries, monuments, and museums. Certain historical sites, parks, and recreational facilities are also included.

* - L_{eq} for the noisiest hour of transit-related activity during hours of noise sensitivity

Source: FTA 2006

Figure 3. FTA Noise Impact Criteria



Source: FTA 2006

Operations Vibration Criteria

Ground-borne vibration impacts from new rail operations inside vibration-sensitive buildings are defined by the vibration velocity level, expressed in terms of VdB, and the number of vibration events per day of the same kind of source. Table 2 summarizes vibration sensitivity in terms of the three land use categories and the criteria for acceptable ground-borne vibrations and acceptable ground-borne noise. Ground-borne noise is a low-frequency rumbling sound inside buildings, caused by vibrations of floors, walls, and ceilings. Ground-borne noise is generally not a problem for buildings near railroad tracks at- or above-grade, because the airborne noise from trains typically overshadows the effects of ground-borne noise. Ground-borne noise becomes an issue in cases where airborne noise cannot be heard, such as for buildings near tunnels.

The FTA provides guidelines to assess the human response to different levels of ground-borne vibration, as shown in Table 2. These levels represent the maximum vibration level of an individual train pass-by. A vibration event occurs each time a train passes a building or property and causes discernible vibration. “Frequent Events” are more than 70 vibration events per day, and “Infrequent Events” are fewer than 30 vibration events per day.

Table 2 includes separate FTA criteria for ground-borne noise (the rumble that radiates from the motion of room surfaces in buildings from ground-borne vibration). Although the criteria are expressed in dBA, which emphasizes the more audible middle and high frequencies, the criteria are significantly lower than airborne noise criteria to account for the annoying low-frequency character of ground-borne noise.

Because airborne noise often masks ground-borne noise for above-ground (i.e., at-grade or viaduct) trains, ground-borne noise criteria apply primarily to operations in a tunnel, where airborne noise is not a factor. Since the NEIRI project is planned to be at-grade only, ground-borne noise criteria are not expected to be issues for the project and only ground-borne vibration is being analyzed in this Study.

Table 2. FTA vibration impact criteria

Land Use Category	Ground-borne vibration impact levels (VdB re 1 micro-inch/sec)			Ground-borne noise impact levels (dB re 20 micro-Pascals)		
	Frequent events ¹	Occasional events ²	Infrequent events ³	Frequent events ¹	Occasional events ²	Infrequent events ³
Category 1: Buildings where vibration would interfere with interior operations.	65 VdB⁴	65 VdB⁴	65 VdB⁴	N/A⁵	N/A⁵	N/A⁵
Category 2: Residences and buildings where people normally sleep.	72 VdB	75 VdB	80 VdB	35 dBA	38 dBA	43 dBA
Category 3: Institutional land uses with primarily daytime use.	75 VdB	78 VdB	83 VdB	40 dBA	43 dBA	48 dBA

Notes:

1. “Frequent events” is defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.
2. “Occasional events” is defined as between 30 and 70 vibration events of the same source per day. Most commuter trunk lines have this many operations.
3. “Infrequent events” is defined as fewer than 30 vibration events of the same kind per day. This category includes most commuter rail branch lines.
4. This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration-sensitive manufacturing or research will require detailed evaluation to define the acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the HVAC systems and stiffened floors.
5. Not applicable – vibration-sensitive equipment is generally not sensitive to ground-borne noise.

Source: FTA 2006

Overall Methodologies

There are three levels of noise and vibration analyses discussed in the guidelines – screening analysis, general assessment, and detailed analysis – based on three categories of sensitive receptors mentioned above.

The Study Team assessed the noise and vibration impacts of the Build Alternative using a mix of screening and general assessment analyses to determine whether a more detailed assessment of noise and vibration impacts would be required. Category 1 receptors were not analyzed because these receptor sites would be addressed in a Tier 2 project level study, for which the level of detail necessary to identify Category 1 receptors would be more appropriate. Since this is a Tier 1 service-level EA, a detailed analysis is not required for this Tier 1 noise and vibration assessment. The more detailed analyses would be part of a Tier 2 project level review.

Screening Analysis

The noise and vibration screening analyses are based on determining whether a significant number of noise- and vibration-sensitive locations are located within specified distances of the rail centerline.

For noise, these screening distances are 750 feet for passenger rail operations and 1,600 feet for horns, each assuming an unobstructed view between the rail line and the sensitive locations. These values are shorter for locations having their views obstructed by intervening buildings however, since there are thousands of potential sensitive receptors along hundreds of miles in this study area, the Study Team assumed unobstructed views throughout the Corridor – the most conservative assumption to determine the potential impacts.

For vibration, the screening distances are 600 feet for highly vibration-sensitive buildings, 200 feet for residential buildings, and 120 feet for institutional buildings.

The FTA guidelines assume that if any noise- or vibration-sensitive locations are within the screening distances, impacts are likely to occur and a minimum of a general assessment is required. This is the case for both noise and vibration for the Build Alternative and the Study Team used the relevant screening distances to define the NNEIRI Study Area for noise and vibration.

General Assessment

For a general noise assessment, the Study Team estimated Build Alternative noise levels and existing noise conditions to determine the location of a noise impact contour which defines the outer limit of an impact area. These estimates are based on calculations prescribed in the FTA guidelines. An inventory of noise impacts within the area then identifies locations where mitigation of noise impacts is likely to be needed.

The purpose of a general assessment for vibration is to develop estimates of the existing overall levels of ground-borne vibration that can be compared to the acceptability criteria in the FTA guidelines. The general vibration assessment defines a curve that is used to predict the overall ground-surface vibration as a function of distance from the source. Adjustments to this curve are used to account for factors such as vehicle speed, building type, and receiver locations. Given the size and complexity of the NNEIRI Study area, along with the lesser level of analysis typically performed for a Tier 1 study, the Study Team did not include building types in this assessment.

Vibration impacts are generally considered in terms of annoyance potential only. Typical rail operations are not capable of generating vibration levels that could cause structural damage; those kinds of levels are usually limited to heavy construction activities such as pile driving and blasting. With the possible exception of activities related to new station/platform construction in Worcester and Palmer, Massachusetts, the Study Team does not anticipate pile driving and blasting to occur in the implementation of the Build Alternative.

For this Tier 1 analysis, a mixture of screening and general assessment analyses was performed by the Study Team to determine the potential extent of severe impacts related to new train operations throughout the Corridor. Category 1 receptors were not analyzed, because these receptor sites would be addressed in a Tier 2 project level study, for which the level of detail necessary to identify Category 1 receptors would be more appropriate. Construction noise and vibration and automobile traffic noise associated with new stations were not analyzed in this Study, and would be addressed in a Tier 2 project level study as well.

4. Existing Conditions

The 99-mile Boston to Springfield NNEIRI segment traverses the urban areas of Boston, Worcester, and Springfield, Massachusetts, and suburban and rural areas in between. The 210-mile NNEIRI segment from Northfield, Massachusetts to the Canadian border travels through Brattleboro, Bellows Falls, White River Junction, St. Albans, and Burlington, Vermont and rural areas in between. The rail line serves freight operations from CSX, Pan Am Southern (PAS), and NECR, along with Amtrak passenger service between Boston and Springfield and between Springfield, Massachusetts and St. Albans, VT, and MBTA passenger service between Boston and Worcester, Massachusetts.

The Study Team determined the existing noise levels throughout the Corridor by a combination of regional population density calculations and regional freight operations noise calculations, as prescribed in the FTA guidelines. The Study Team derived population densities and noise- and vibration-sensitive locations throughout the Corridor from existing GIS information and aerial photography. For Vermont, the Study Team selected residences from the E911 Site Location data. For Massachusetts, the Study Team used the latest town parcel data and parcels tagged with a residential land use were selected. For New Hampshire, GIS data were not available and residential buildings were identified from recent (2011 or newer) aerial photographs.

Maximum speeds were assumed by the Study Team to be 59 miles per hour for all freight trains and 79 miles per hour for all passenger trains. The existing noise levels for each region of similar rail operations were considered by the Study Team to be the higher of these two calculated values, and these were used as the basis for the noise criteria established for the Build Alternative, since the noise criteria are based on the existing levels.

Current freight train operations vary by location throughout the study area. The following assumptions, from HDR, were used in the calculations of current freight train operations:

- Train noise – based on the FTA Guidance Manual for train operations including warning horns and the assumptions in Table 3, with the conditions based on current year (2015) operations. Daytime is 7 am to 10 pm and nighttime is 10 pm to 7 am.
 - Speeds – 59 mph for freight trains and 79 mph for passenger trains

- An average of 2.4 locomotives for freight trains and 1 locomotive for passenger trains
- For freight trains, an average of 63.4 cars during the daytime and 56.6 cars during the nighttime between Boston and Springfield, and 48.7 cars during the daytime and 40 cars during the nighttime between East Northfield and Canada
- For passenger trains, 8 cars between Boston and Springfield and 6 cars for passenger trains between East Northfield and Canada
- Horns – ¼-mile from each crossing and station
- Crossing signal noise – The crossing signal noise would be more than 10 dBA less than the warning horn noise at the same receiver. According to the FTA guidelines, horns generate sound exposure levels of 110 dBA at 50 feet while a 2-minute crossing signal generates a sound exposure level of 94 dBA at 50 feet. Therefore, the crossing signal noise was considered negligible and it was not included in the existing noise calculations.

Table 3. Existing train operations

Corridor segment		Number of freight operations (day/night)	Number of passenger operations (day/night)
Boston to Springfield, MA	Boston to Worcester	3/8	47/10
	Worcester to Springfield	5/10	2/0
East Northfield, MA to Canadian Border	East Northfield, MA to Bellows Falls, VT	5/3	2/0
	Bellows Falls to White River Junction	1/3	2/0
	White River Junction to Essex Junction (Burlington)	1/2	2/0
	Essex Junction to Canada	3/2	2/0

5. No-Build Alternative Consequences

No increase in passenger operations is anticipated by the Study Team along the Corridor in the No Build scenario except along the New Haven, Connecticut to Springfield, Massachusetts segment, which would experience increase in passenger operations due to the NHHS service. Other anticipated increase would be in terms of the number of cars in each freight train, assumed at a growth rate of 2.2% per year through 2035. An exception to this would be in the CSX section between Worcester and Springfield, where four additional trains (3 daytime/1 nighttime) would be added due to the anticipated service growth. Therefore, no significant increase in noise or vibration exposures would result from the No Build Alternative anywhere in the Corridor except for a slight increase between Worcester and Springfield.

Foreseeable improvements in the Corridor under the No-Build Alternative include the completion of construction activities to support the Knowledge Corridor – Restore Vermonter, the NHHS and the SSX projects.

The Knowledge Corridor – Restore Vermonter EA identified moderate train-horn noise impacts to 203 receptors (mainly residential) and severe horn noise impacts to two residential receptors. Based on the linear extent of the project and the number of the dense urban areas it passes through, the number of severe noise impacts is not significant. According to the EA, the project would have potential vibration impacts on residential and institutional land uses. However, the vibration impacts are not considered significant because of the limited number of train passing under the proposed alternative. As stated in the EA, the project would have two potential noise and vibration benefits through the use mitigation measures: the designation of Quiet Zones and installation of resilient track fasteners or ballast mats.

The NHHS EA identified severe noise impacts at 1,847 noise-sensitive receptors and moderate noise impacts at 2767 noise-sensitive receptors caused by train-horn noise at grade crossings and existing and new rail stations. Wallingford, Meriden, and Windsor are anticipated to have the most train-horn noise impacts. The project would also have severe wayside noise impacts to seven residential receptors and moderate wayside noise impacts to 214 residential receptors. The EA proposes designation of Quiet Zones to mitigate severe horn noise and provide increased noise insulation and home-specific improvements to mitigate wayside noise impacts. According to the EA, the project would have low to moderate noise impact to Springfield layover and maintenance facility, given the existing urban nature of the proposed site's vicinity, and therefore, no mitigation would be required. The EA notes that nearby receptors would be reviewed during the future Tier 2 to confirm that there are no impacts. The EA identified no adverse impacts due to project-related vibration as there are no vibration-sensitive receptors located within 60 feet of the tracks. Subsequent to the EA, some segments of the NHHS corridor were in final permitting and construction phase.

The SSX DEIR identified noise impacts at South Station site in Alternative 1 and at Readville Yard 2 layover facility. According to the DEIR, because of the slow speeds at which trains operate when entering and leaving South Station, typical vibration levels are below the FTA impact criterion.

6. Build Alternative Consequences

In addition to the FTA screening analysis, which consisted of determining the number of noise- and vibration-sensitive receptors within the specified screening distances, the Study Team determined refined screening distances based on FTA general assessment noise and vibration calculations in regions where common operational conditions are anticipated to occur. The project would generate new passenger train operations only. The following assumptions, from HDR, were used in the calculations of project-generated (2035) passenger train operations:

- Train noise – 18 daytime operations and 5 nighttime operations between Boston and Springfield, 4 daytime operations and no nighttime operations between East Northfield, Massachusetts and the Canadian border.
 - Speeds – 79 mph

- 1 locomotive per train
- 6 cars per train
- Horns – ¼-mile from each crossing and station
- Crossing signal noise – The crossing signal noise would be more than 10 dBA less than the warning horn noise at the same receiver. According to the FTA guidelines, horns generate sound exposure levels of 110 dBA at 50 feet while a 2-minute crossing signal generates a sound exposure level of 94 dBA at 50 feet. Therefore, the crossing signal noise was considered negligible and it was not included in the project-related noise calculations.

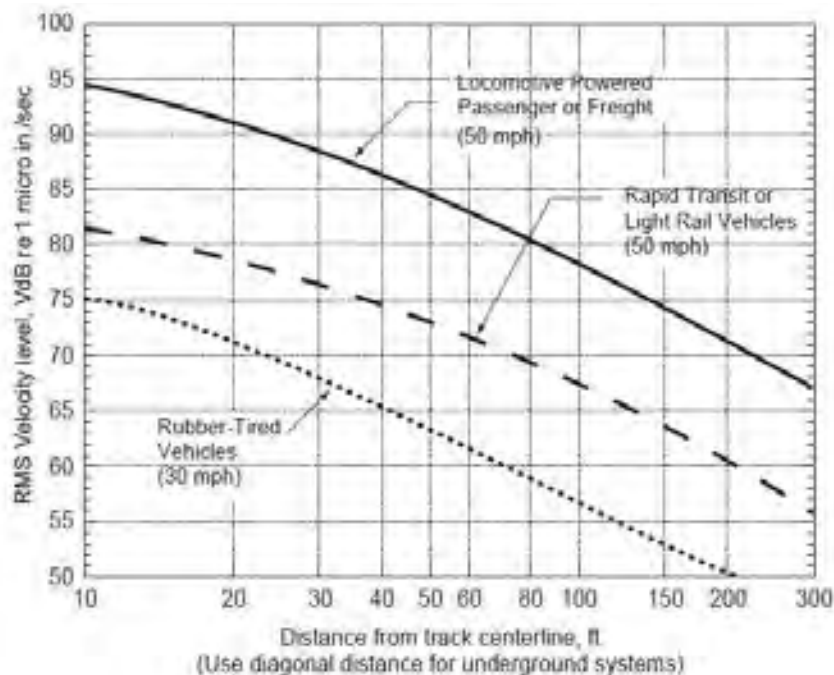
Vibration impacts were determined by using the top curve in Figure 4, adjusted for speed by a factor of +4.0 VdB to account for the maximum passenger train speed of 79 miles per hour (using the relationship of $20 \times \log(\text{speed}/50)$, per FTA guidelines), and using the distances associated with the impact levels in Table 2.

The results of these calculations are summarized in Tables 4 and 5 for noise, and in Table 6 for vibration. The results are divided by residential (Category 2) and institutional (Category 3) properties.

This analysis performed by the Study Team indicates that there is the potential for a total of 435 severe noise impacts, 11,827 moderate noise impacts, and 2,234 vibration annoyance impacts due to the project. Most of the impacts are in the highly populated and heavily traveled Boston to Springfield segment. This is due to the nature of the FTA criteria, which become more stringent as existing noise levels increase (since background noise levels are higher in the Boston to Springfield segment than in other areas along the project Corridor). All potential noise impacts would be caused by horn soundings within the FRA-mandated ¼-mile distance of grade crossings. Vibration impacts would not result from horn soundings.

As is mentioned above, these calculations are based on the worst-case scenario of all trains travelling at maximum speeds throughout the Corridor and no natural or man-made noise barriers between the trains and sensitive locations. As these worst-case conditions would not be present everywhere along the Corridor, these estimates would decrease when a more detailed analysis (taking these factors into account) is performed in Tier 2.

Figure 4. FTA Generalized Ground Surface Vibration Curves



Source: FTA 2006

Table 4. Potential severe noise impacts

	Corridor segment	Number of residential (Category 2) receptors	Number of institutional (Category 3) receptors
Boston to Springfield	Boston to Route 128	68	0
	Route 128 to Framingham	130	0
	Framingham to Worcester	46	0
	Worcester area	79	0
	Worcester to Springfield	85	0
	Springfield area	26	0
East Northfield to Canadian Border	East Northfield to Brattleboro	0	0
	Brattleboro to Bellows Falls	0	0
	Bellows Falls to White River Junction	0	0
	White River Junction to Essex Junction (Burlington)	1	0
	Essex Junction to St. Albans	0	0
	St. Albans to Canadian border	0	0
Totals		435	0

Table 5. Potential moderate noise impacts

Corridor segment		Number of residential (Category 2) receptors	Number of institutional (Category 3) receptors
Boston to Springfield	Boston to Route 128	3,558	0
	Route 128 to Framingham	2,194	0
	Framingham to Worcester	1,185	1
	Worcester area	2,018	3
	Worcester to Springfield	1,850	1
	Springfield area	981	0
East Northfield to Canadian Border	East Northfield to Brattleboro	1	0
	Brattleboro to Bellows Falls	4	0
	Bellows Falls to White River Junction	6	0
	White River Junction to Essex Junction (Burlington)	22	0
	Essex Junction to St. Albans	0	0
	St. Albans to Canadian border	3	0
Totals		11,822	5

Table 6. Potential Vibration Annoyance Impacts

Corridor segment		Number of residential (Category 2) receptors	Number of institutional (Category 3) receptors
Boston to Springfield	Boston to Route 128	415	0
	Route 128 to Framingham	395	4
	Framingham to Worcester	199	5
	Worcester area	195	4
	Worcester to Springfield	208	1
	Springfield area	61	0
Northfield to Canada	Northfield to Brattleboro	26	0
	Brattleboro to Bellows Falls	51	0
	Bellows Falls to White River Junction	134	0
	White River Junction to Essex Junction (Burlington)	399	0
	Essex Junction to St. Albans	78	0
	St. Albans to Canadian border	59	0
Totals		2,220	14

7. Potential Mitigation Measures

A detailed Tier 2 project level analysis would more precisely determine the number of potential noise and vibration impacts that may require mitigation. Potential mitigation measures may include noise barriers, operational changes, stationary wayside horns at grade crossings, horn shrouds on locomotives, and resilient rail fasteners and ties. Quiet zones, in which train horn soundings are prohibited, are typically not listed as mitigation measures in environmental assessments because they require municipal involvement outside the scope of the project, although they would eliminate the noise impacts since those impacts are caused exclusively by horns.

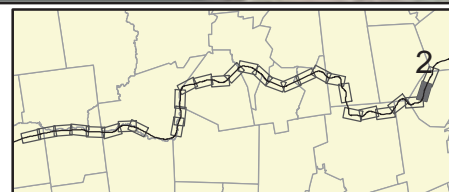
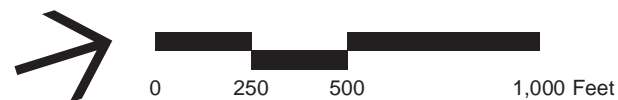
Appendix C

Flood Zone Maps



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Data provided by MassGIS. Date of photos: 2013/2014
Flood Data provided by FEMA, February 2015



- Existing Track
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- 100-Year
- 500-Year
- Floodway

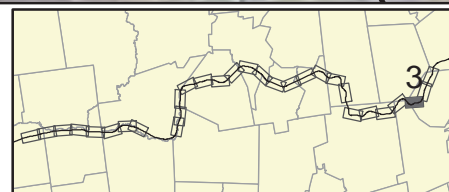
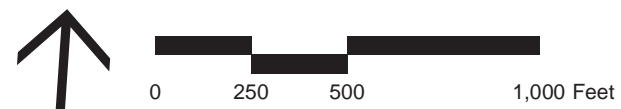
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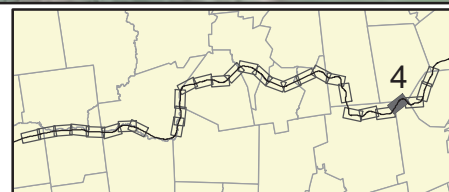
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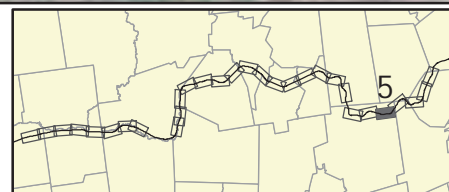
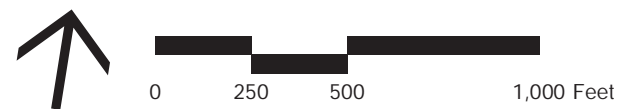
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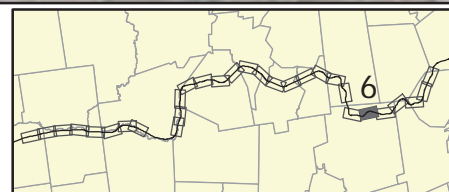


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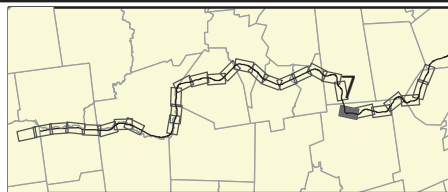
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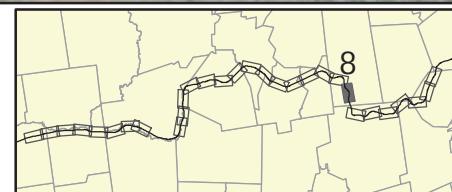
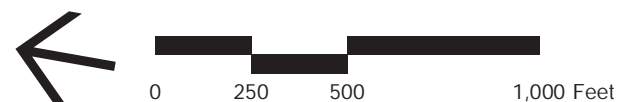
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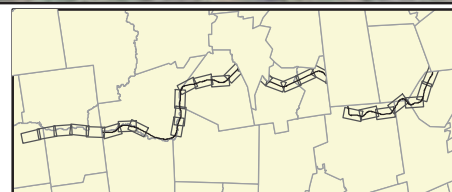
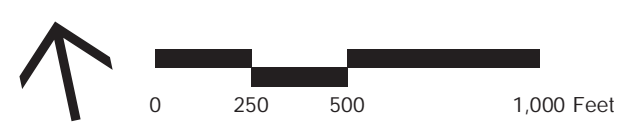
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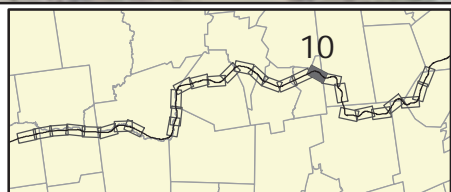
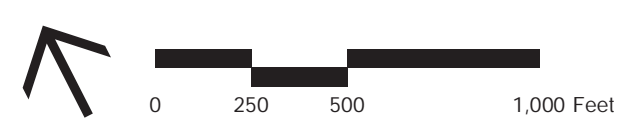
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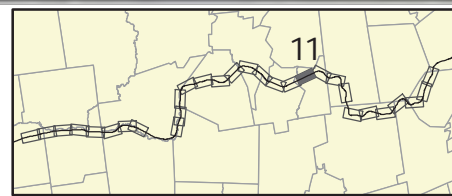
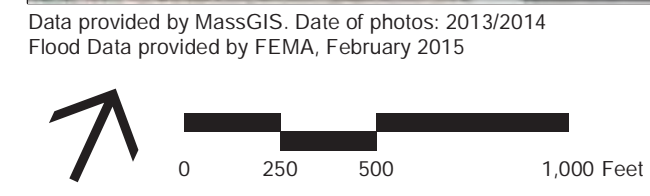
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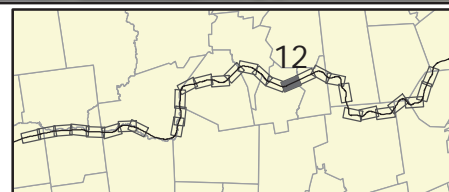
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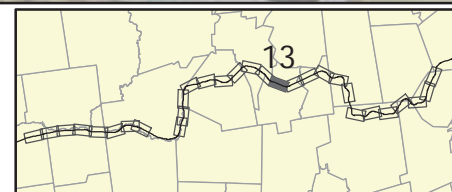
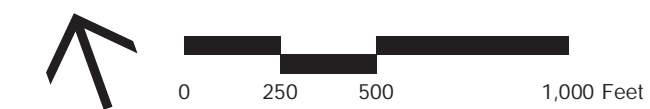
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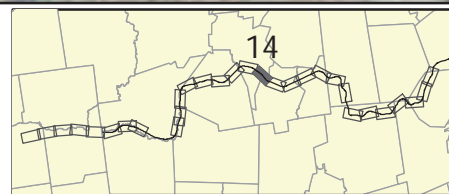
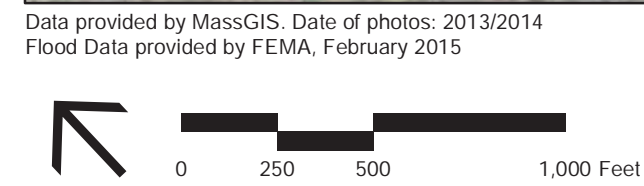
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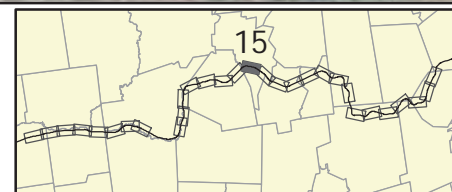
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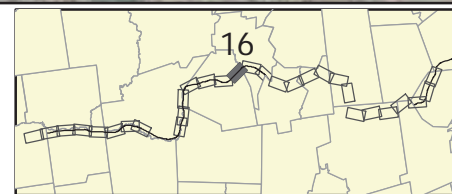
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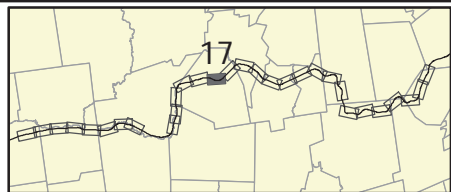
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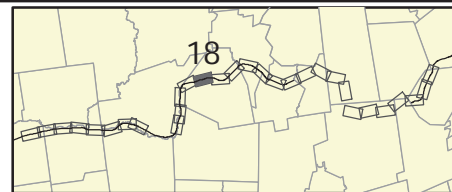
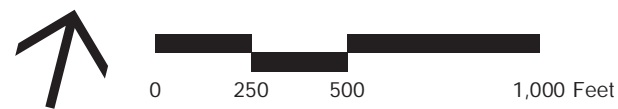
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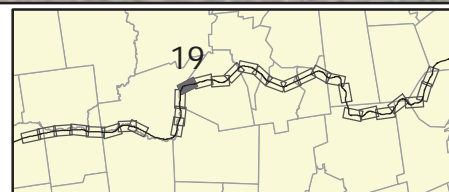
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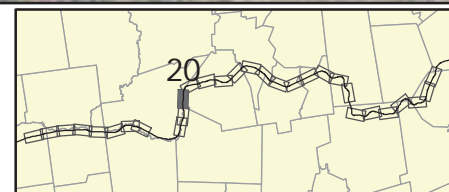
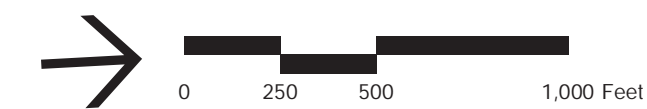
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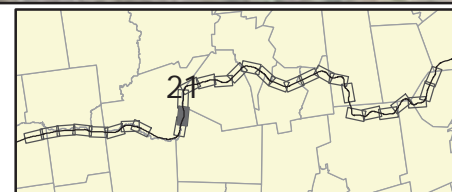
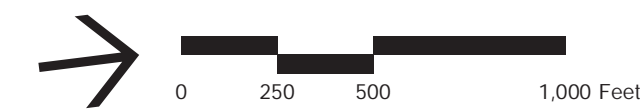
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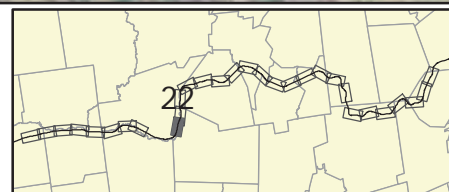
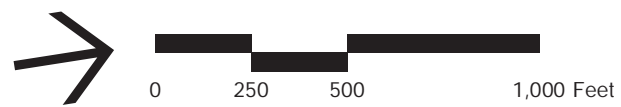
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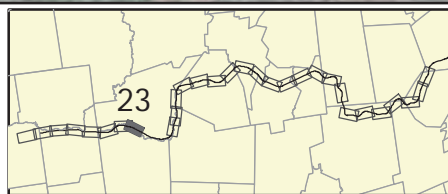
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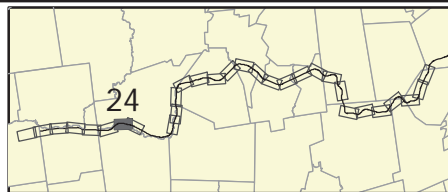


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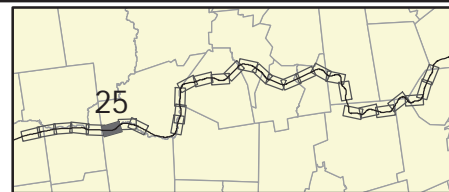


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Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL
Flood Hazards Worcester to Springfield

Page 25 of 30



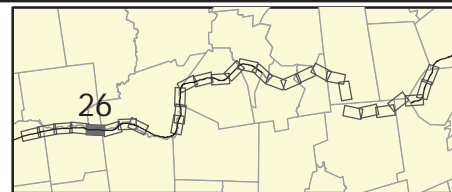


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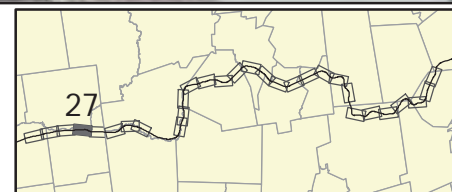
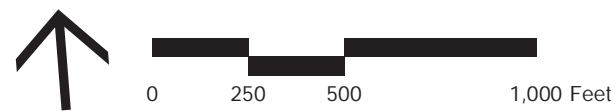
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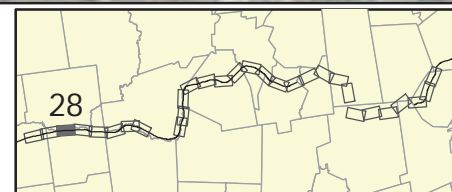


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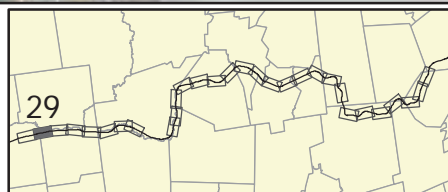
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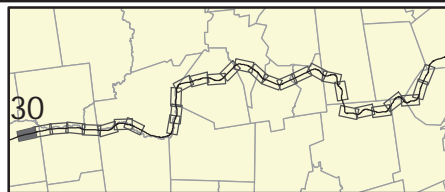


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- Additional Track with Minor Realignment

- 100-Year
- 500-Year
- Floodway

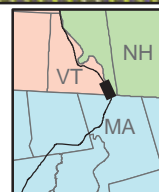
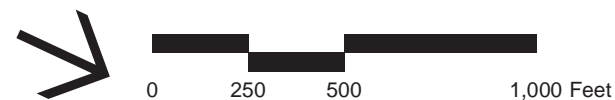
Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL
Flood Hazards Worcester to Springfield





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Data provided by MassGIS. Date of photos: 2013/2014
Flood Data provided by FEMA, February 2015



- Existing Single Tack
- Proposed Additional Track
- Additional Track with Minor Realignment

- 100-Year
- 500-Year
- Floodway
- Area Not Mapped

Northern New England Intercity Rail Initiative

BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Flood Hazards East Northfield

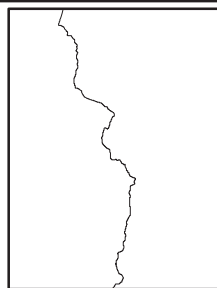
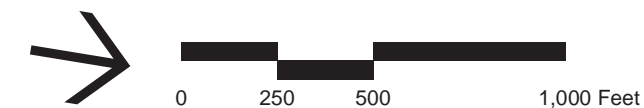
MP 110.5 - 111.8



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Data provided by VT GIS. Date of photos: 2014



- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- 100-Year Flood Zone
- 500-Year Flood Zone
- Floodway

Note: Digital flood zone data unavailable for St. Albans to Swanton area.

Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Flood Zones
Brattleboro to Bellows Falls

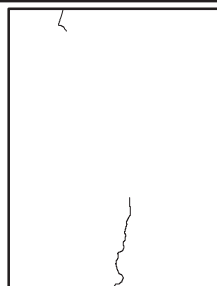
Page 1 of 17





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Data provided by VT GIS. Date of photos: 2014



- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- 100 -Year Flood Zone
- 500-Year Flood Zone
- Floodway

Note: Digital flood zone data unavailable for St. Albans to Swanton area.

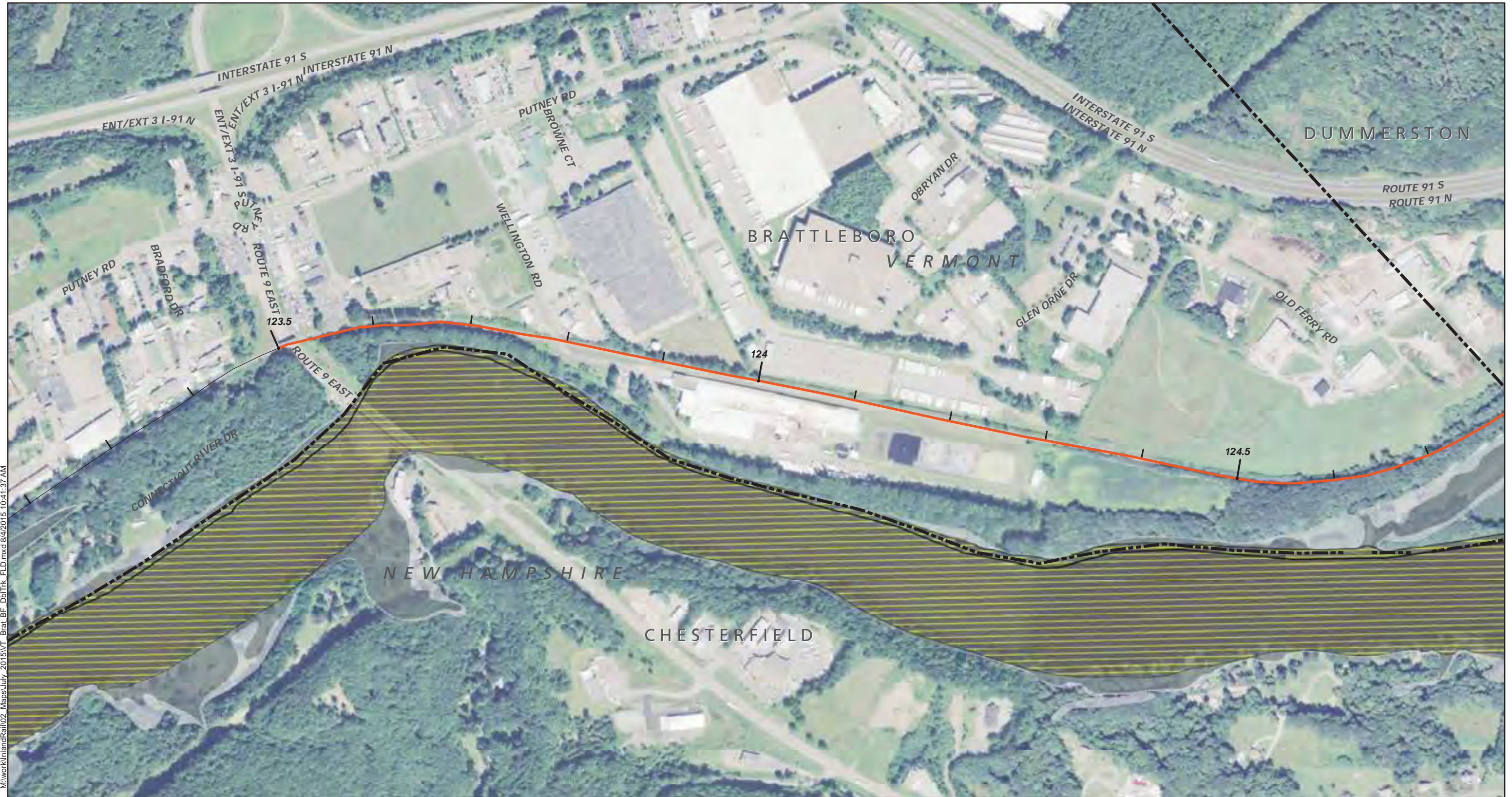
Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Flood Zones
Brattleboro to Bellows Falls

Page 2 of 17



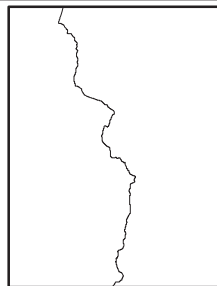
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Data provided by VT GIS. Date of photos: 2014



0 250 500 1,000 Feet



- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- 100 -Year Flood Zone
- 500-Year Flood Zone
- Floodway

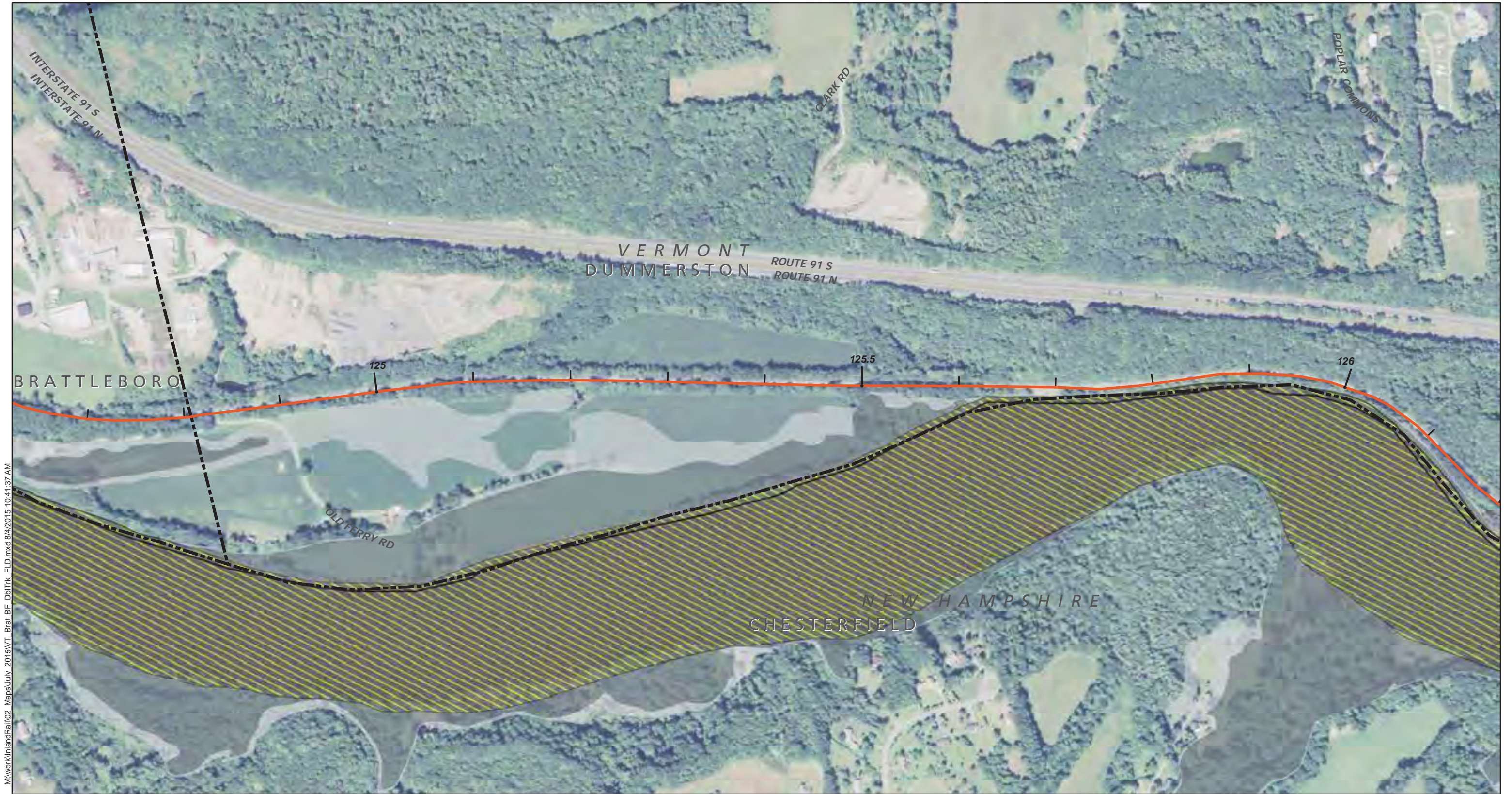
Note: Digital flood zone data unavailable for St. Albans to Swanton area.

Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Flood Zones
Brattleboro to Bellows Falls

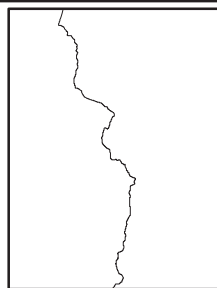
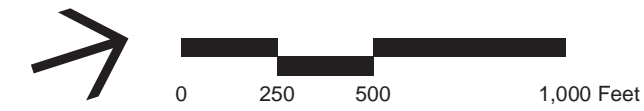
Page 3 of 17





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Data provided by VT GIS. Date of photos: 2014



- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- 100 -Year Flood Zone
- 500-Year Flood Zone
- Floodway

Note: Digital flood zone data unavailable for St. Albans to Swanton area.

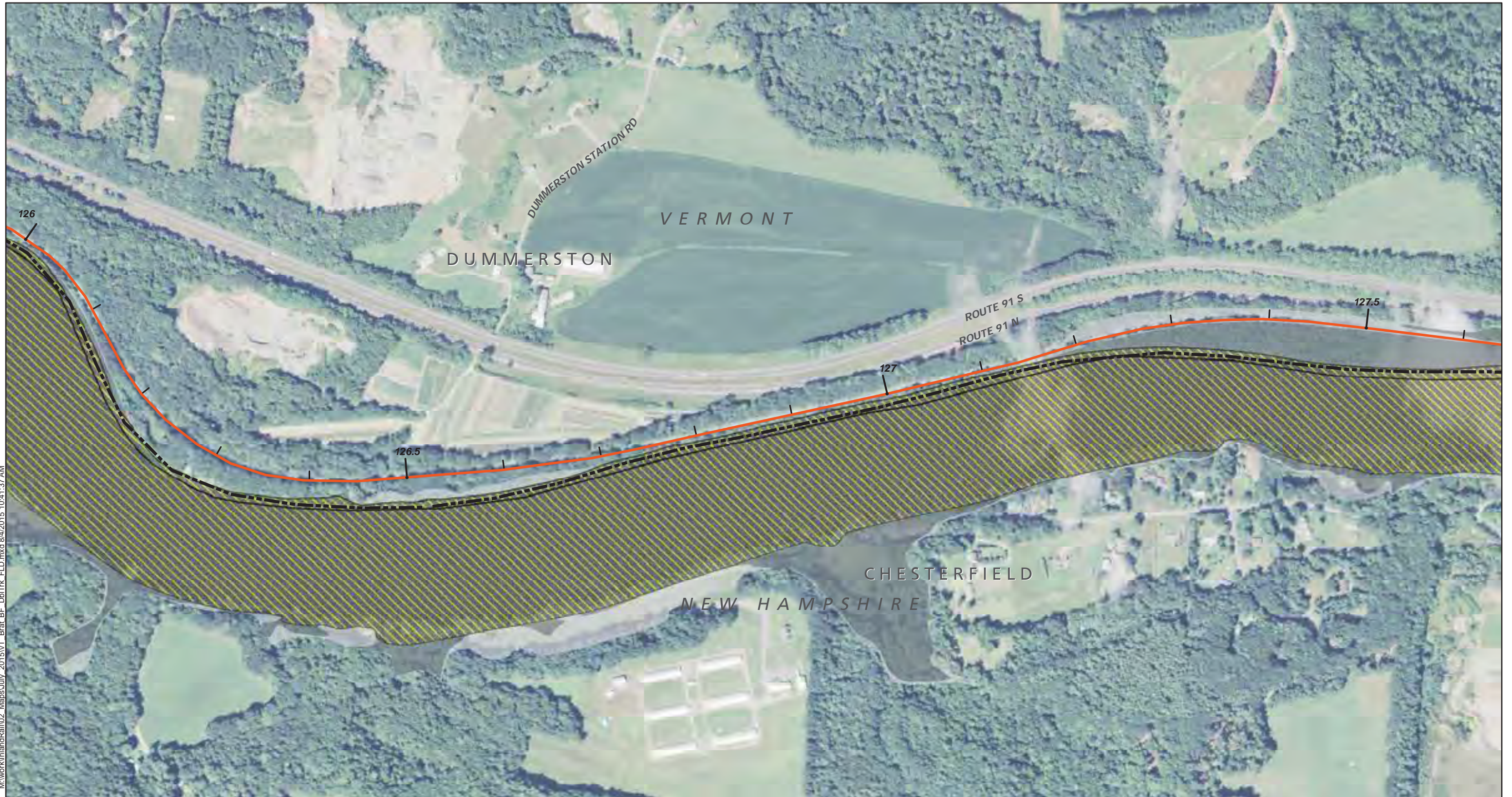
Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Flood Zones
Brattleboro to Bellows Falls

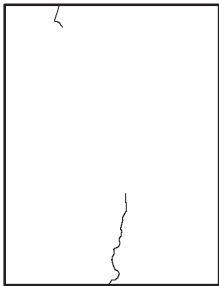
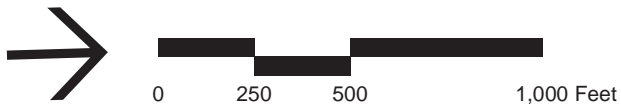
Page 4 of 17



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Data provided by VT GIS. Date of photos: 2014



- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- 100 -Year Flood Zone
- 500-Year Flood Zone
- Floodway

Note: Digital flood zone data unavailable for St. Albans to Swanton area.

Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

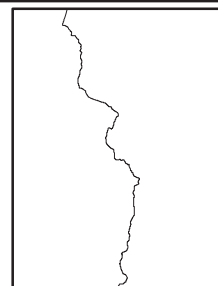
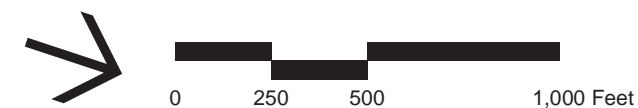
Flood Zones
Brattleboro to Bellows Falls



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Data provided by VT GIS. Date of photos: 2014



- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- 100 -Year Flood Zone
- 500-Year Flood Zone
- Floodway

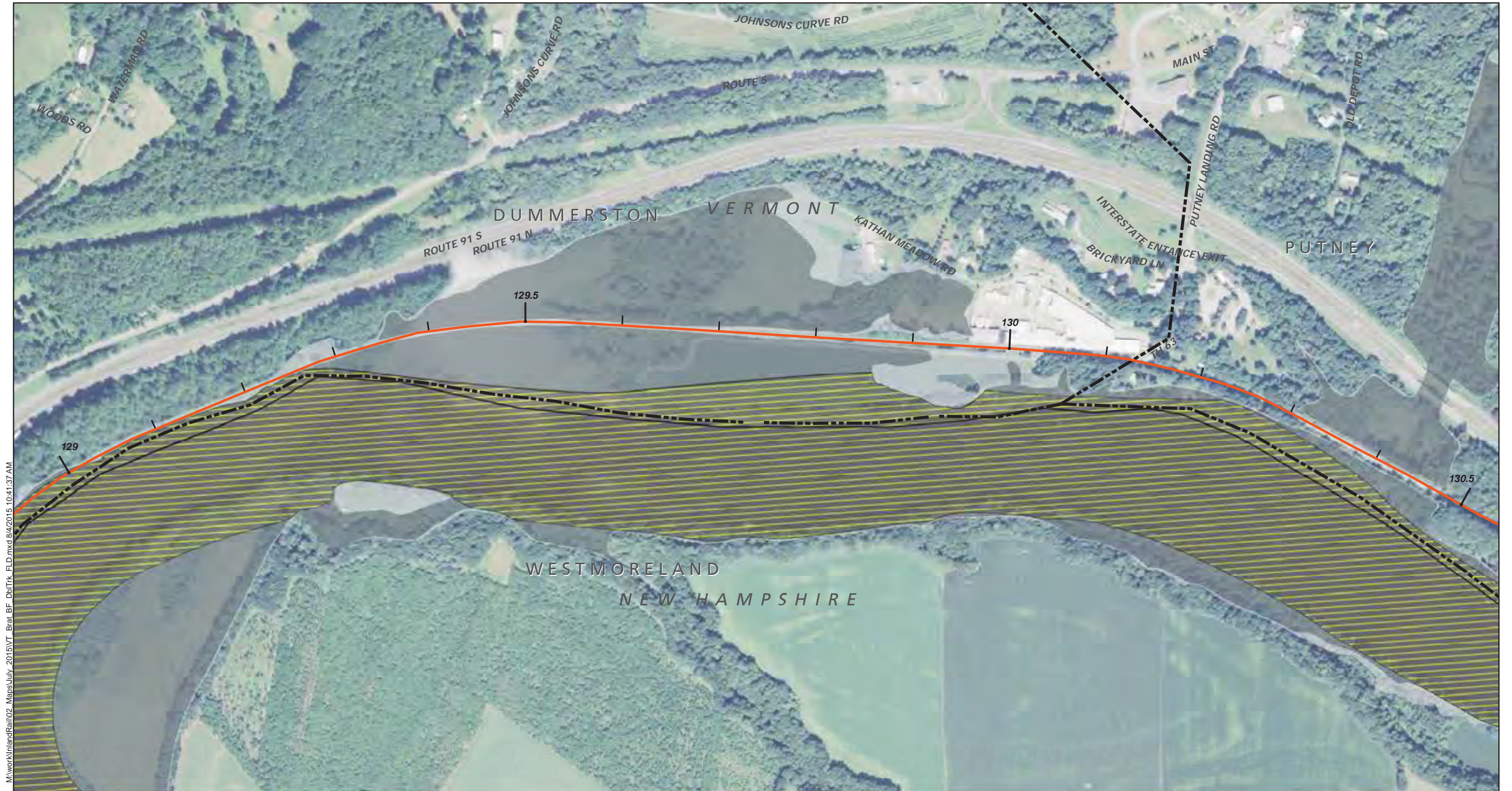
Note: Digital flood zone data unavailable for St. Albans to Swanton area.

Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Flood Zones
Brattleboro to Bellows Falls

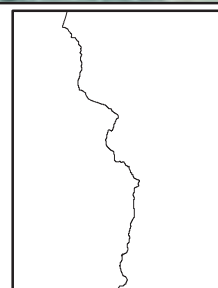
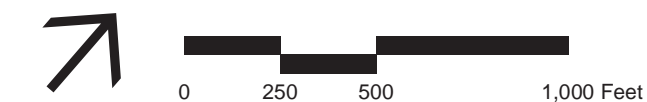
Page 6 of 17





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Data provided by VT GIS. Date of photos: 2014



- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- 100 -Year Flood Zone
- 500-Year Flood Zone
- Floodway

Note: Digital flood zone data unavailable for St. Albans to Swanton area.

Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Flood Zones
Brattleboro to Bellows Falls

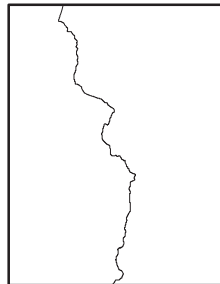
Page 7 of 17



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Data provided by VT GIS. Date of photos: 2014



- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- 100 -Year Flood Zone
- 500-Year Flood Zone
- Floodway

Note: Digital flood zone data unavailable for St. Albans to Swanton area.

Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Flood Zones
Brattleboro to Bellows Falls

Page 8 of 17



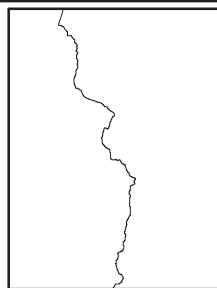


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Data provided by VT GIS. Date of photos: 2014



0 250 500 1,000 Feet



- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- 100 -Year Flood Zone
- 500-Year Flood Zone
- Floodway

Note: Digital flood zone data unavailable for St. Albans to Swanton area.

Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Flood Zones
Brattleboro to Bellows Falls

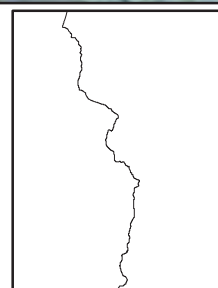
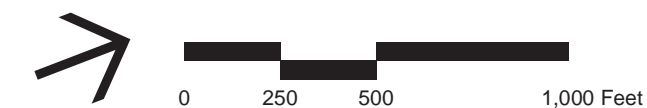
Page 9 of 17





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- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- 100 -Year Flood Zone
- 500-Year Flood Zone
- Floodway

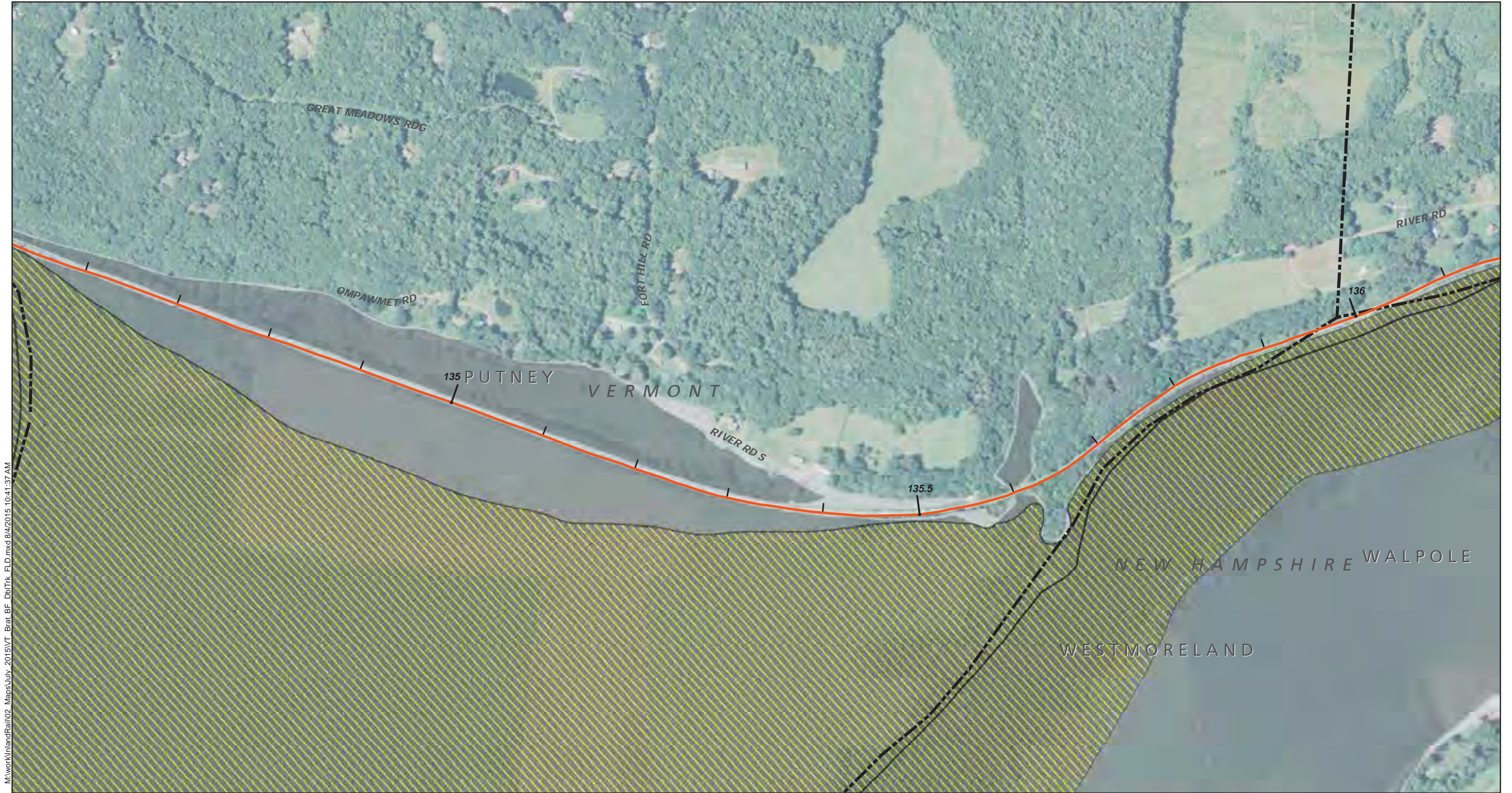
Note: Digital flood zone data unavailable for St. Albans to Swanton area.

Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Flood Zones
Brattleboro to Bellows Falls

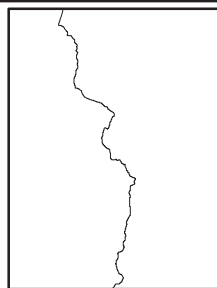
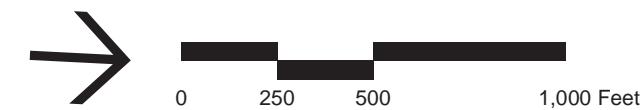
Page 10 of 17





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Data provided by VT GIS. Date of photos: 2014



- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- 100 -Year Flood Zone
- 500-Year Flood Zone
- Floodway

Note: Digital flood zone data unavailable for St. Albans to Swanton area.

Northern New England Intercity Rail Initiative
 BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Flood Zones
 Brattleboro to Bellows Falls

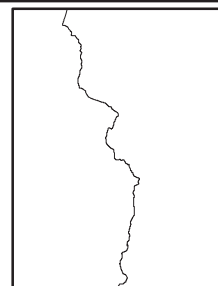
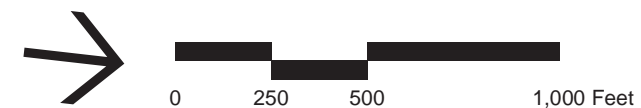
Page 11 of 17





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Data provided by VT GIS. Date of photos: 2014



- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- 100 -Year Flood Zone
- 500-Year Flood Zone
- Floodway

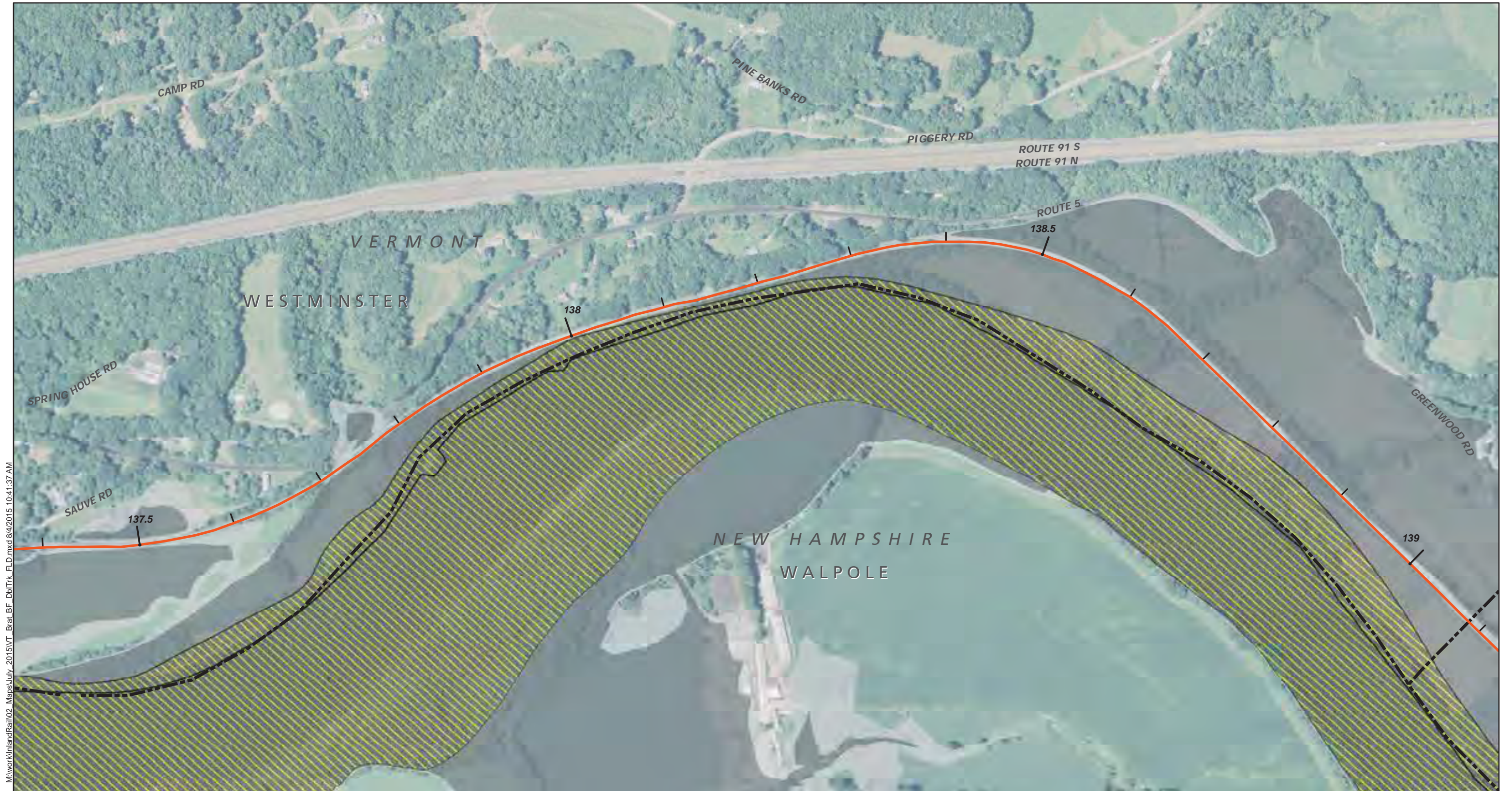
Note: Digital flood zone data unavailable for St. Albans to Swanton area.

Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Flood Zones
Brattleboro to Bellows Falls

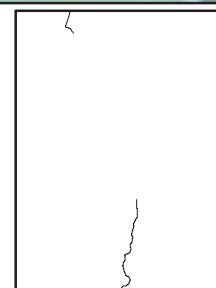
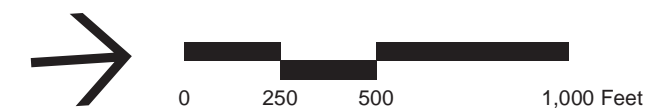
Page 12 of 17





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Data provided by VT GIS. Date of photos: 2014



- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- 100 -Year Flood Zone
- 500-Year Flood Zone
- Floodway

Note: Digital flood zone data unavailable for St. Albans to Swanton area.

Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Flood Zones
Brattleboro to Bellows Falls

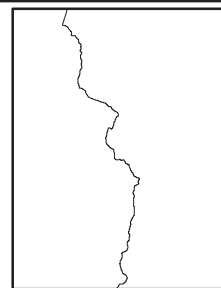
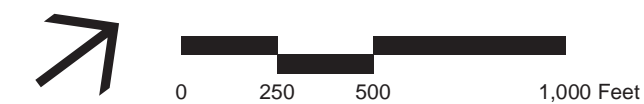
Page 13 of 17





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Data provided by VT GIS. Date of photos: 2014



- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- 100 -Year Flood Zone
- 500-Year Flood Zone
- Floodway

Note: Digital flood zone data unavailable for St. Albans to Swanton area.

Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Flood Zones
Brattleboro to Bellows Falls

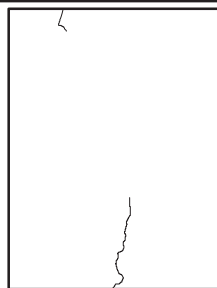
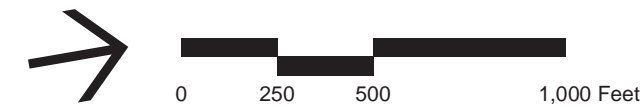
Page 14 of 17





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Data provided by VT GIS. Date of photos: 2014



- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- 100 -Year Flood Zone
- 500-Year Flood Zone
- Floodway

Note: Digital flood zone data unavailable for St. Albans to Swanton area.

Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Flood Zones
Brattleboro to Bellows Falls

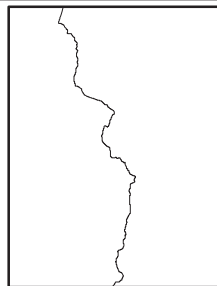
Page 15 of 17



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Data provided by VT GIS. Date of photos: 2014



- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- 100 -Year Flood Zone
- 500-Year Flood Zone
- Floodway

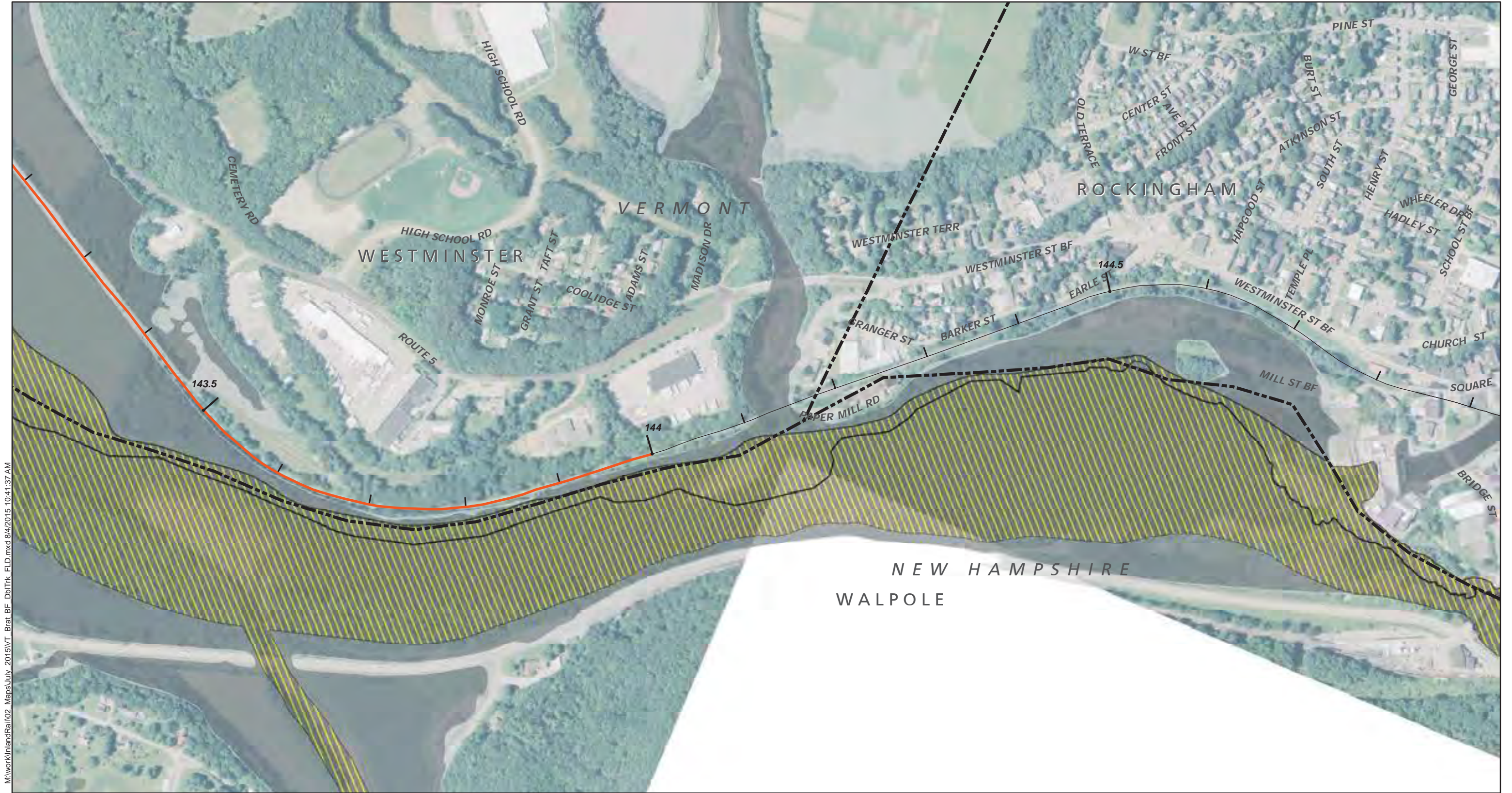
Note: Digital flood zone data unavailable for St. Albans to Swanton area.

Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Flood Zones
Brattleboro to Bellows Falls

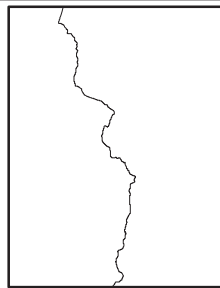
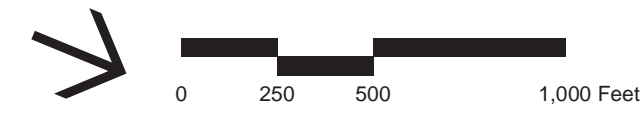
Page 16 of 17





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Data provided by VT GIS. Date of photos: 2014



- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- 100 -Year Flood Zone
- 500-Year Flood Zone
- Floodway

Note: Digital flood zone data unavailable for St. Albans to Swanton area.

Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Flood Zones
Brattleboro to Bellows Falls

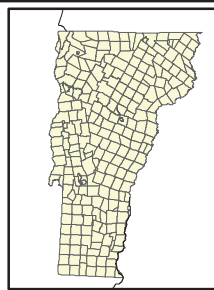
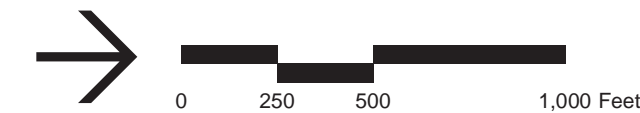
Page 17 of 17





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Data provided by VT GIS, FEMA. Date of photos: 2014



- Existing Single Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- 100-Year
- 500-Year
- Floodway
- Area Not Mapped

Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

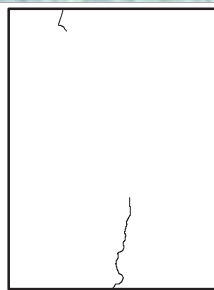
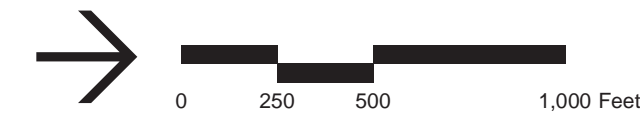
Flood Hazards
Randolph Double Track





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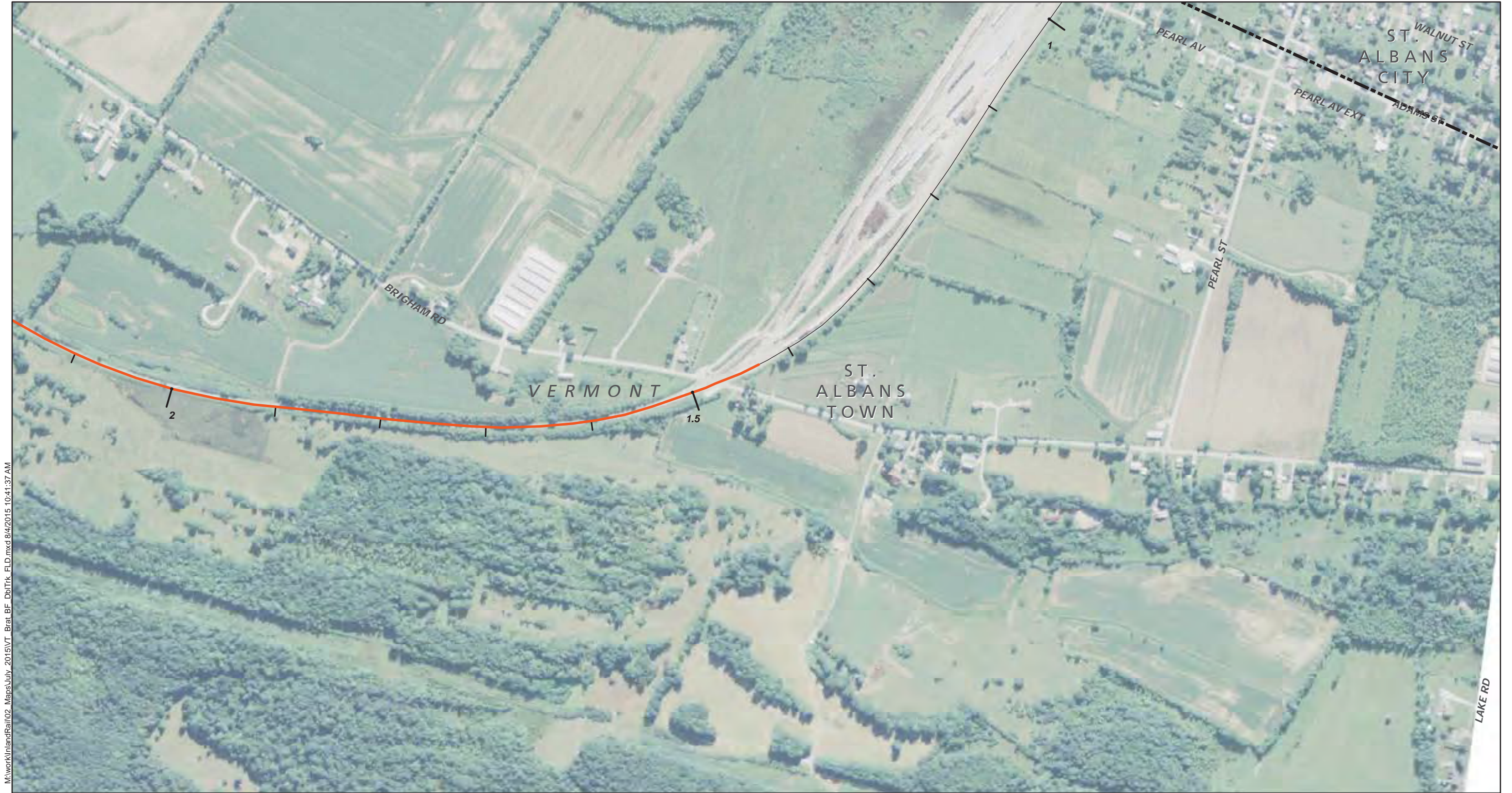


- Existing Single Track
- Proposed Additional Track
- Additional Track with Minor Realignment
- 100-Year
- 500-Year
- Floodway

Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

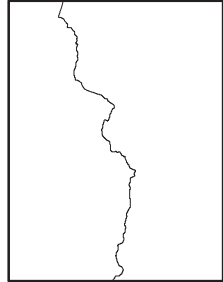
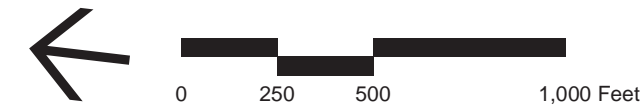
Flood Hazards
Roxbury Double Track





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Data provided by VT GIS. Date of photos: 2014



- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- 100 -Year Flood Zone
- 500-Year Flood Zone
- Floodway

Note: Digital flood zone data unavailable for St. Albans to Swanton area.

Northern New England Intercity Rail Initiative
 BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Flood Zones St Albans to Swanton

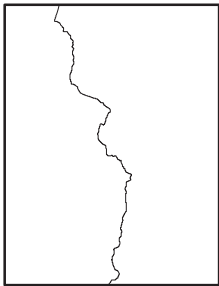
Page 1 of 6



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Data provided by VT GIS. Date of photos: 2014



- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- 100 -Year Flood Zone
- 500-Year Flood Zone
- Floodway

Note: Digital flood zone data unavailable for St. Albans to Swanton area.

Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Flood Zones
St Albans to Swanton

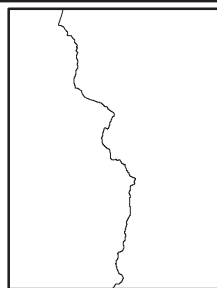
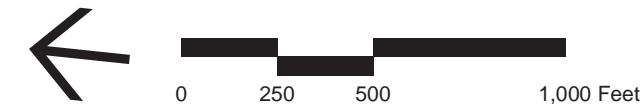
Page 2 of 6



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Data provided by VT GIS. Date of photos: 2014



- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- 100 -Year Flood Zone
- 500-Year Flood Zone
- Floodway

Note: Digital flood zone data unavailable for St. Albans to Swanton area.

Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Flood Zones
St Albans to Swanton

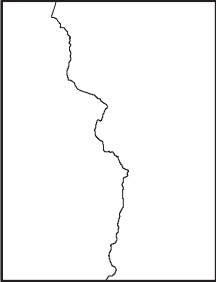
Page 3 of 6



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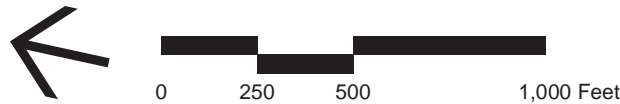
- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- 100 -Year Flood Zone
- 500-Year Flood Zone
- Floodway

Note: Digital flood zone data unavailable for St. Albans to Swanton area.

Northern New England Intercity Rail Initiative
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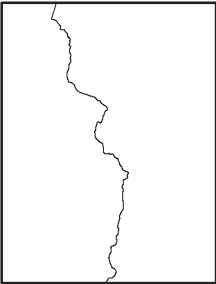
Flood Zones
St Albans to Swanton



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Data provided by VT GIS. Date of photos: 2014



- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- 100 -Year Flood Zone
- 500-Year Flood Zone
- Floodway

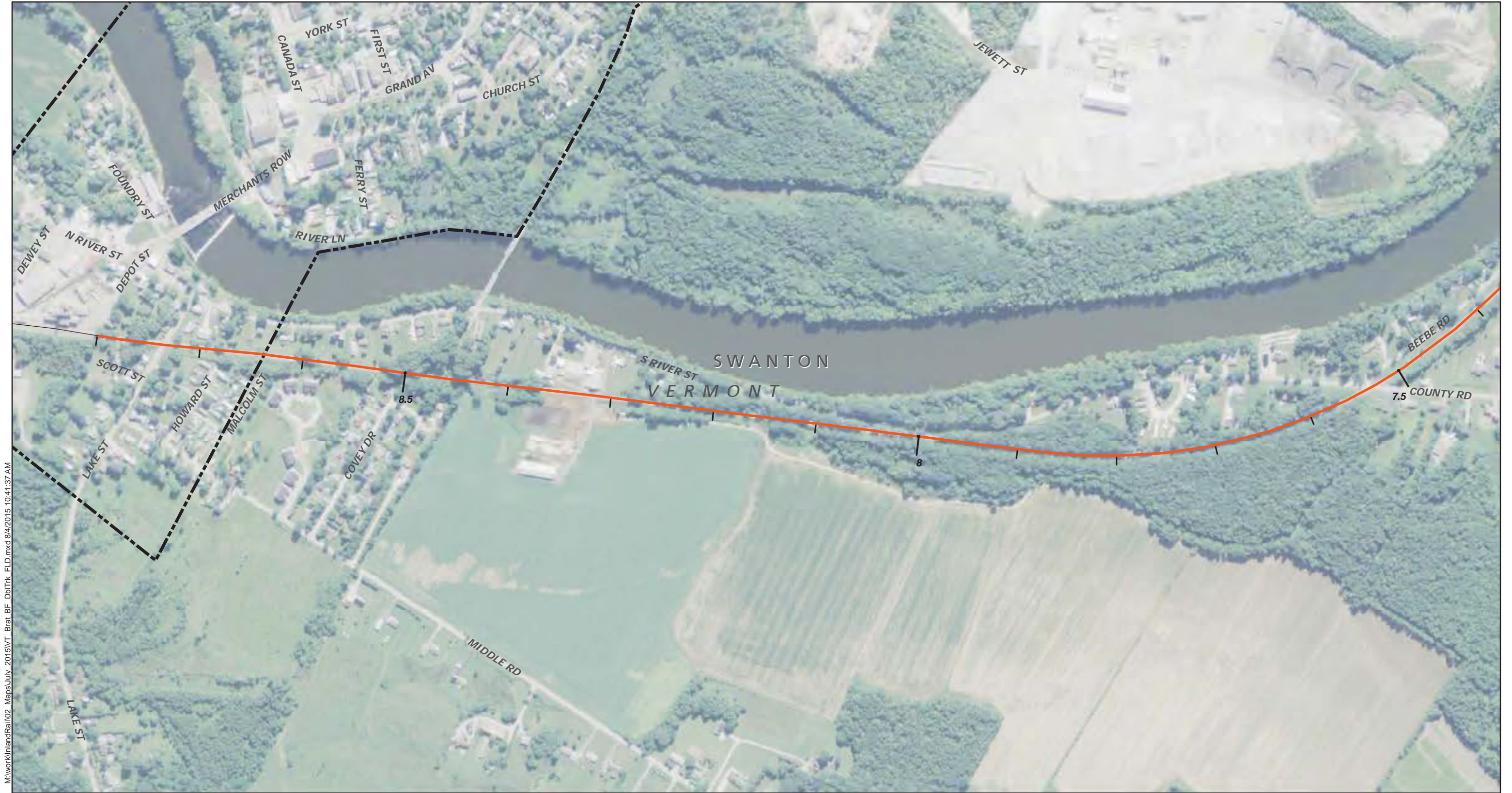
Note: Digital flood zone data unavailable for St. Albans to Swanton area.

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Flood Zones
St Albans to Swanton

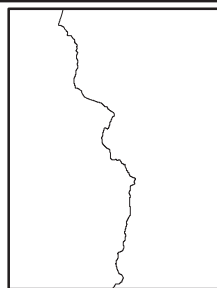
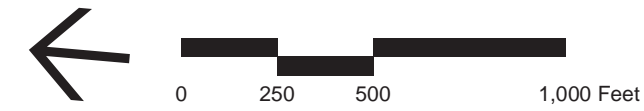
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- 500-Year Flood Zone
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Note: Digital flood zone data unavailable for St. Albans to Swanton area.

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Flood Zones
St Albans to Swanton

Page 6 of 6



Appendix D

Impaired Water Bodies in the Rail Corridor

Table 1. Impaired Water Bodies in the Boston-to-Springfield Segment of the Rail Corridor

Segment	Water Body	Impaired Use	Reason for Impairment	Orientation to Corridor
Boston–Springfield	Quaboag River	Recreation	Fecal Coliform	Crossed
Boston–Springfield	Chicopee River	Recreation	Fecal Coliform	Adjacent
Boston–Springfield	French River	Habitat for fish, other aquatic life and wildlife	Phosphorous, Total	Crossed
Boston–Springfield	Kettle Brook	Habitat for fish, other aquatic life and wildlife	Aquatic macroinvertebrate bioassessments	Crossed
Boston–Springfield	Middle River	Habitat for fish, other aquatic life and wildlife	Other cause	Crossed
Boston–Springfield	Beaver Brook	Recreation	Fecal Coliform	Crossed
Boston–Springfield	Boston Inner Harbor	Fish/shellfish Consumption	PCB(s) in fish tissue	Adjacent
Boston–Springfield	Charles River	Habitat for fish, other aquatic life and wildlife	Phosphorous, Total	Crossed/Adjacent
Boston–Springfield	Fuller Brook	Habitat for fish, other aquatic life and wildlife	Nutrient/eutrophication biological indicators	Adjacent
Boston–Springfield	Assabet River	Habitat for fish, other aquatic life and wildlife	Aquatic macroinvertebrate bioassessments	Crossed
Boston–Springfield	Glen Echo Lake	Habitat for fish, other aquatic life and wildlife	Dissolved oxygen	Adjacent
Boston–Springfield	Muddy River	Public Water Consumption	Taste and odor	Crossed
Boston–Springfield	Assabet River Reservoir	Habitat for fish, other aquatic life and wildlife	Excess algal growth	Adjacent
Boston–Springfield	Farm Pond	Habitat for fish, other aquatic life and wildlife	Turbidity	Adjacent
Boston–Springfield	Framingham Reservoir #2	Habitat for fish, other aquatic life and wildlife	Turbidity	Crossed/Adjacent
Boston–Springfield	Hocomonco Pond	Habitat for fish, other aquatic life and wildlife	Polycyclic aromatic hydrocarbons (PAHs) (aquatic ecosystems)	Adjacent
Boston–Springfield	Lake Cochituate	Habitat for fish, other aquatic life and wildlife	Dissolved oxygen	Adjacent

Source:

Massachusetts Department of Environmental Protection, 2010 303(d) list

U.S. EPA. National Summary of Impaired Waters and TMDL Information, retrieved on October 10, 2013. [U.S. EPA National Summary of State Information](#) and [U.S. EPA Reach Address Database](#).

Table 2. Impaired Water Bodies in the Springfield to US/Canadian Border Segment of the Rail Corridor

Segment	Water Body	Impaired Use	Reason for Impairment	Orientation to Corridor
Springfield–US/Canadian Border	Green River	Recreation	Fecal coliform	Crossed
Springfield–US/Canadian Border	Connecticut River	Fish/shellfish Consumption	PCB(s) in fish tissue; E coli; pH; Copper	Crossed/Adjacent
Springfield–US/Canadian Border	Chicopee River	Recreation	E. coli	Crossed
Springfield–US/Canadian Border	Connecticut River – Bellows Falls	Habitat for fish, other aquatic life and wildlife; fish/shellfish consumption	pH; mercury	Adjacent
Springfield–US/Canadian Border	Mascoma River	Habitat for fish, other aquatic life and wildlife; fish/shellfish consumption	Aluminum; mercury	Adjacent

Segment	Water Body	Impaired Use	Reason for Impairment	Orientation to Corridor
Springfield–US/Canadian Border	Blow-Me-Down Brook	Habitat for fish, other aquatic life and wildlife; fish/shellfish consumption	Aluminum; mercury	Crossed
Springfield–US/Canadian Border	Sugar River, WTF	Recreation; fish/shellfish consumption	E. coli; mercury	Crossed
Springfield–US/Canadian Border	Clay Brook	Habitat for fish, other aquatic life and wildlife; fish/shellfish consumption	Fish bioassessments, mercury	Crossed
Springfield–US/Canadian Border	Cold River	Habitat for fish, other aquatic life and wildlife; fish/shellfish consumption	PH; mercury	Adjacent
Springfield–US/Canadian Border	Connecticut River, PWS	Habitat for fish, other aquatic life and wildlife; fish/shellfish consumption; public water consumption	PH; mercury	Crossed
Springfield–US/Canadian Border	Partridge Brook, PWS	Recreation; fish/shellfish consumption; public water consumption	E. coli; mercury	Crossed
Springfield–US/Canadian Border	Ash Swamp Brook	Habitat for fish, other aquatic life and wildlife; fish/shellfish consumption	Benthic macroinvertebrates bioassessments; mercury	Adjacent
Springfield–US/Canadian Border	Rugg Brook from Mouth Upstream about 3.1 Miles	Recreation	E. coli	Crossed
Springfield–US/Canadian Border	Stevens Brook Lowest Segment	Recreation	E. coli	Crossed
Springfield–US/Canadian Border	Stevens Brook Middle Segment	Habitat for fish, other aquatic life and wildlife	Toxics	Crossed
Springfield–US/Canadian Border	Deer Brook	Habitat for fish, other aquatic life and wildlife	Sedimentation/siltation	Adjacent
Springfield–US/Canadian Border	Upper Mid-Winooski River	Recreation	E. coli	Crossed
Springfield–US/Canadian Border	Mad River	Recreation	E. coli	Adjacent
Springfield–US/Canadian Border	Smith Brook	Habitat for fish, other aquatic life and wildlife	Iron	Adjacent
Springfield–US/Canadian Border	Crosby Brook	Habitat for fish, other aquatic life and wildlife	Sedimentation/siltation	Adjacent
Springfield–US/Canadian Border	Whetstone Brook	Recreation	E. coli	Adjacent
Springfield–US/Canadian Border	Newton Brook	Habitat for fish, other aquatic life and wildlife	Sedimentation/siltation	Adjacent
Springfield–US/Canadian Border	Oxbow	Habitat for fish, other aquatic life and wildlife	Turbidity	Adjacent
Springfield–US/Canadian Border	Log Pond Cove	Fish/shellfish consumption	PCB(s) in fish tissue	Adjacent
Springfield–US/Canadian Border	Champ-Northeast Arm	Fish/shellfish consumption	PCB(s) in fish tissue	Crossed/Adjacent

Source:

Massachusetts Department of Environmental Protection, 2010 303(d) list

Vermont Department of Environmental Conservation, 2010 303(d) list

New Hampshire Department of Environmental Services, 2010 303(d) list

U.S. EPA. National Summary of Impaired Waters and TMDL Information, retrieved on October 10, 2013. U.S. EPA National Summary of State Information and U.S. EPA Reach Address Database

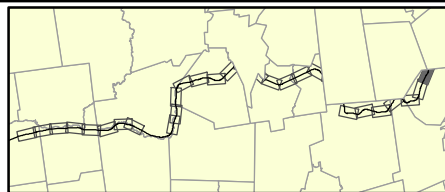
Appendix E

Massachusetts and Vermont Resource Area Maps



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| Proposed Additional Track | NHESP Estimated Habitats for Rare Wildlife | Open Space |
| Additional Track with Minor Realignment | NHESP Priority Habitats for Rare Species | |

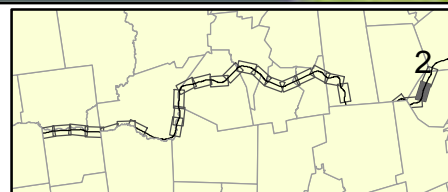
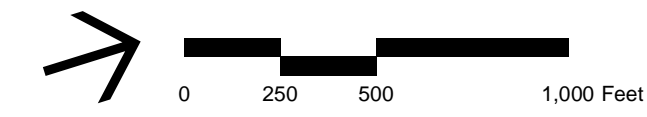
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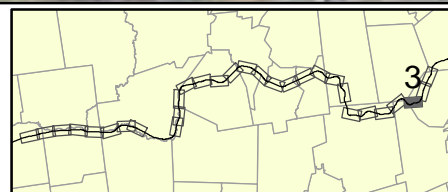
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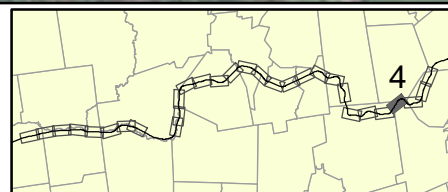
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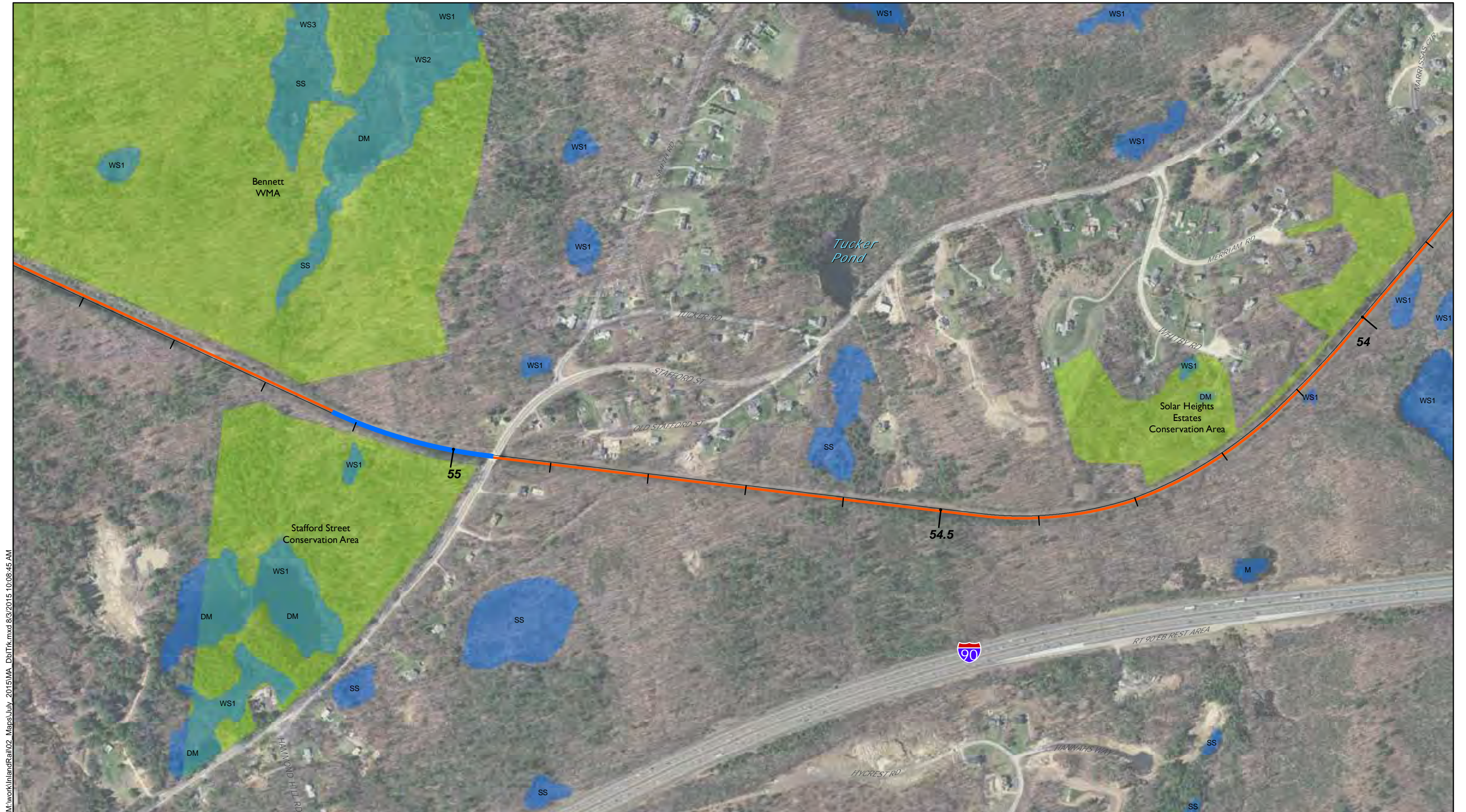
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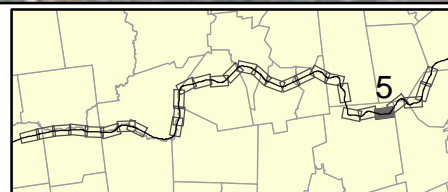
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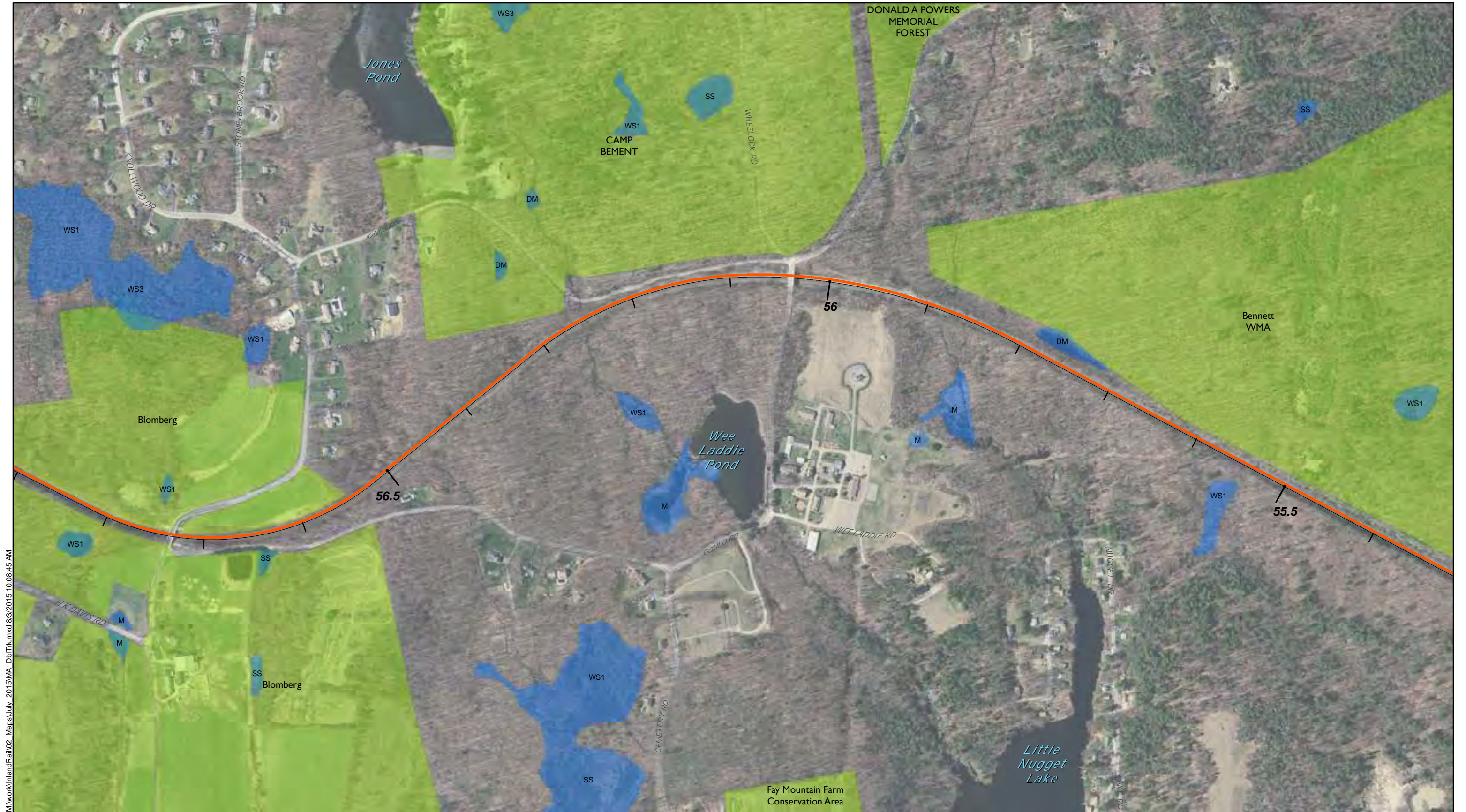
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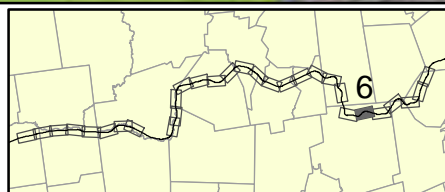
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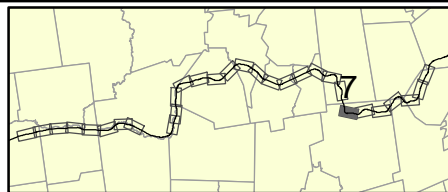
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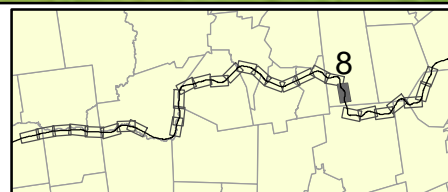


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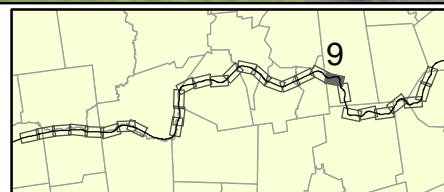
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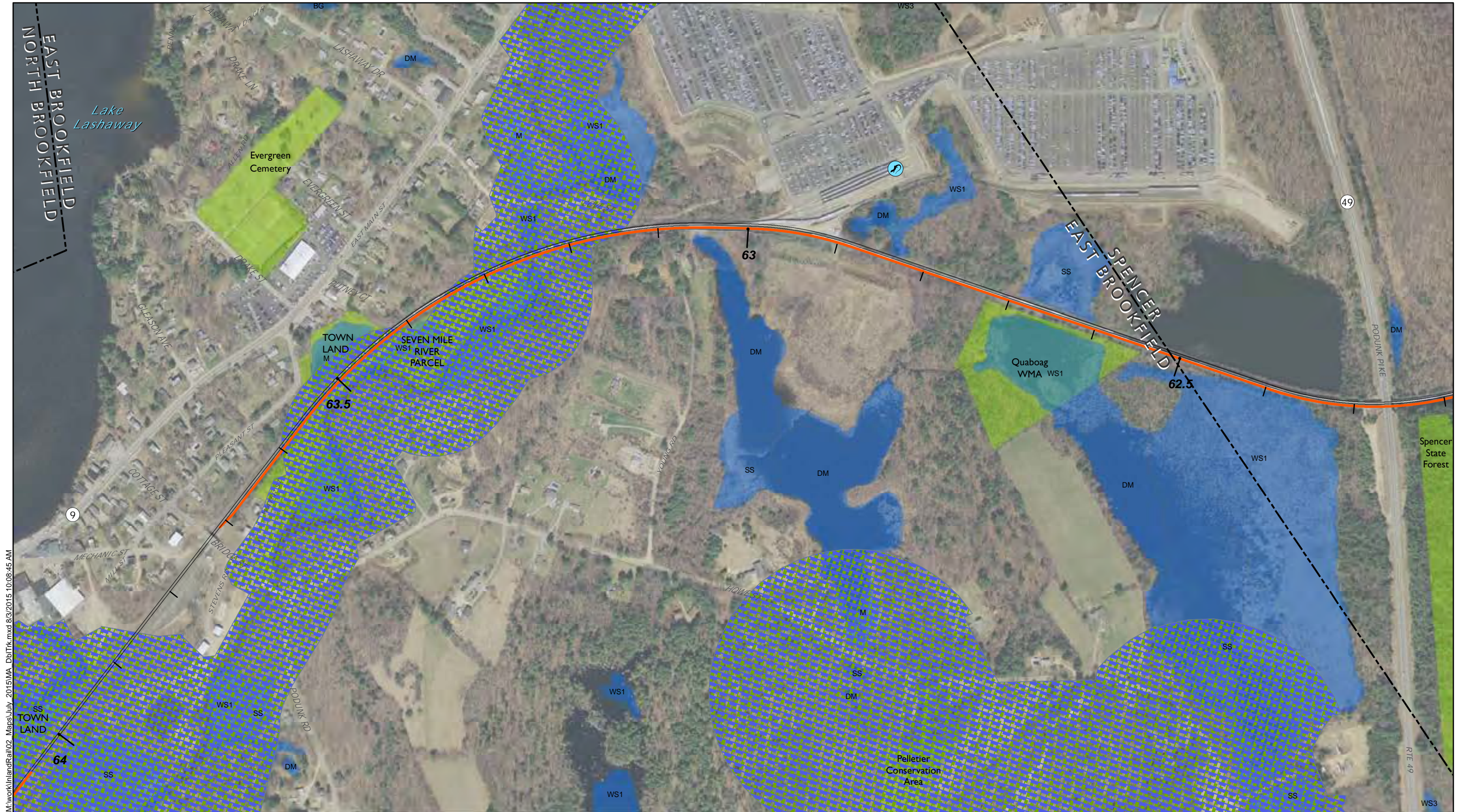
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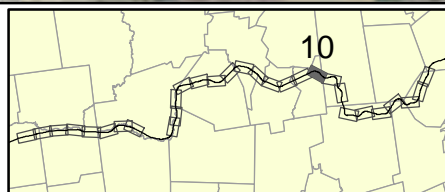
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NHESP Certified Vernal Pools



NHESP Estimated Habitats for Rare Wildlife



NHESP Priority Habitats for Rare Species



DEP Wetland



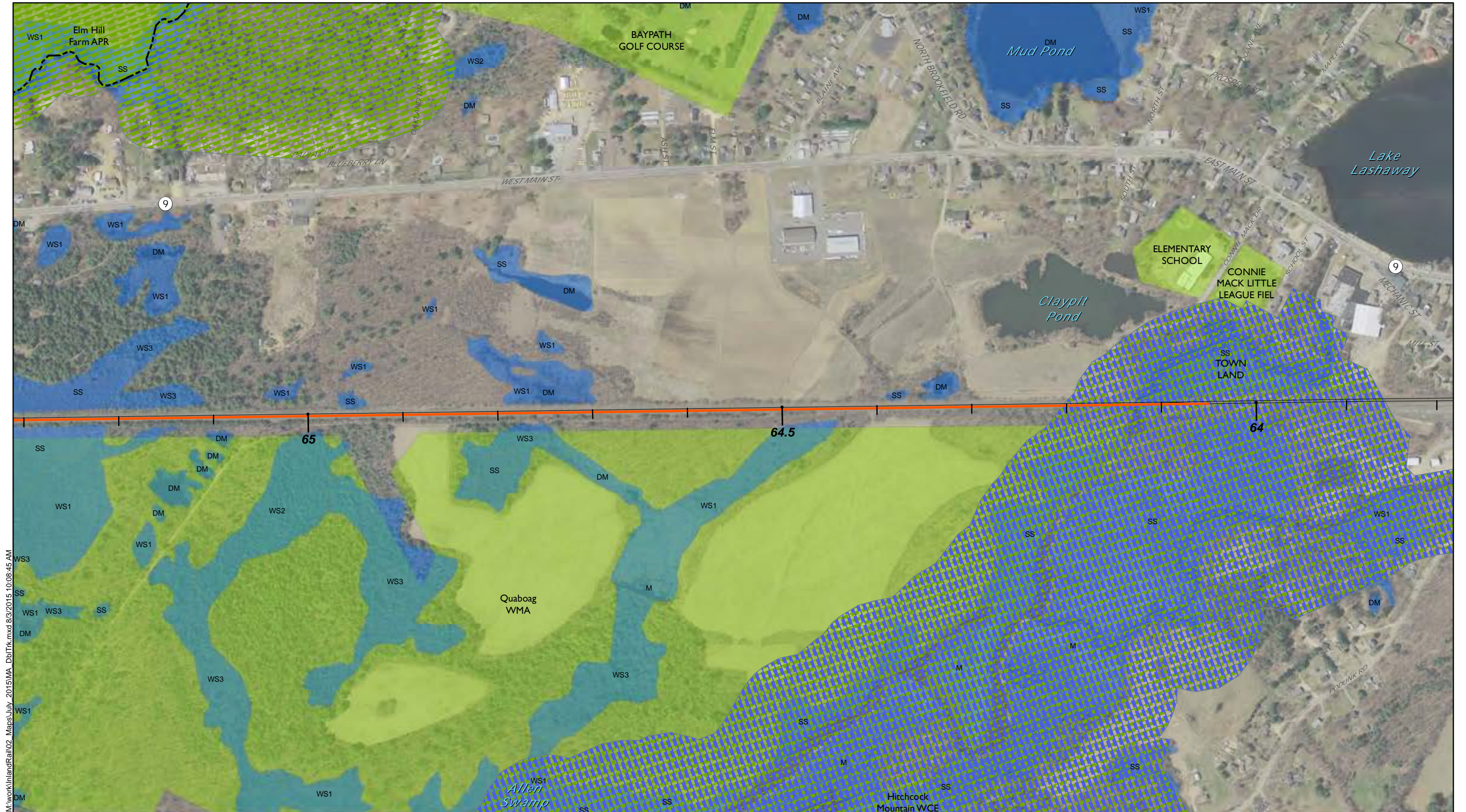
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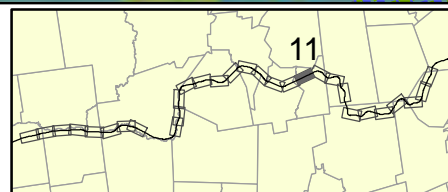


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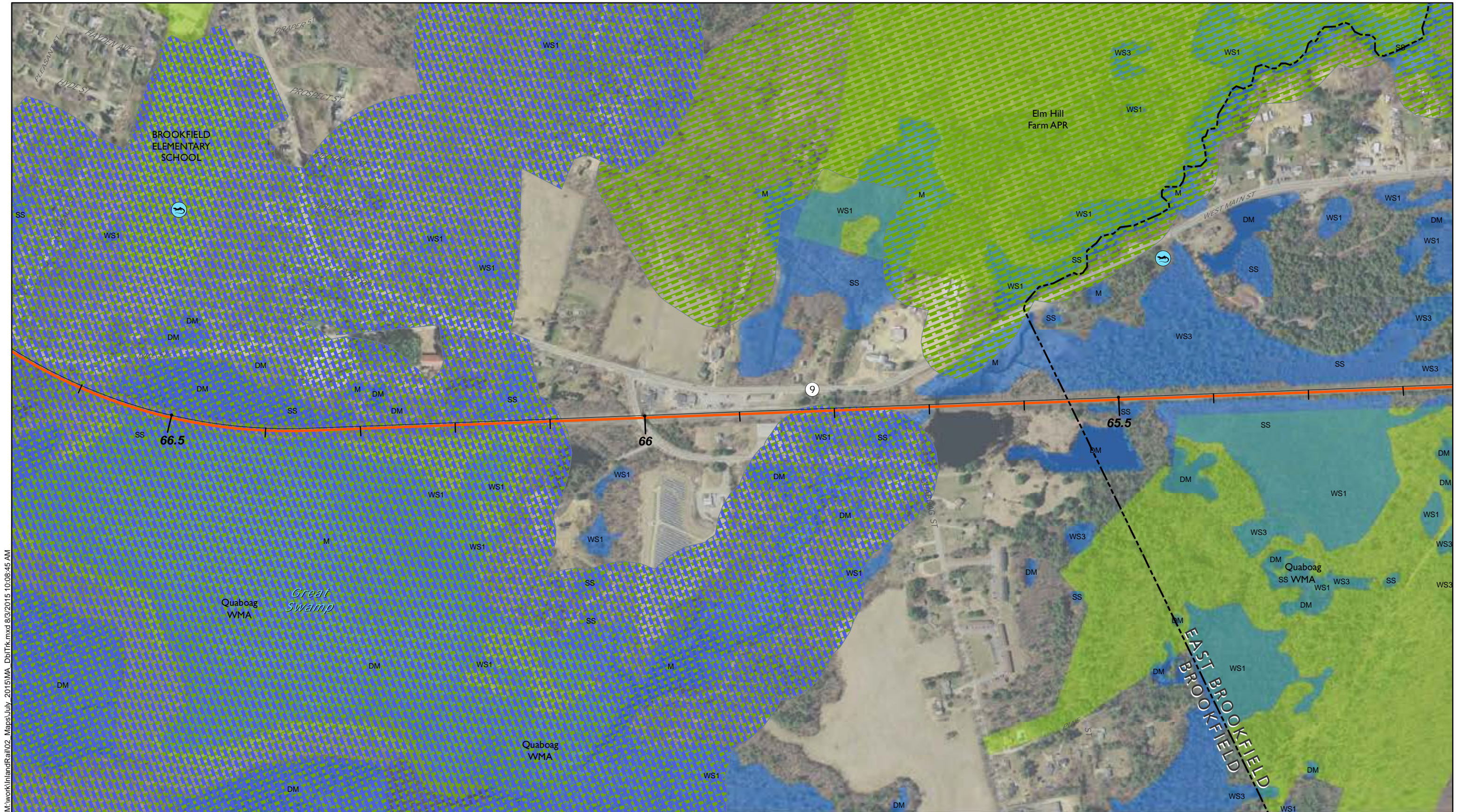
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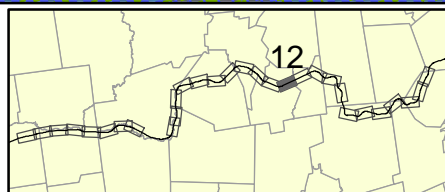
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

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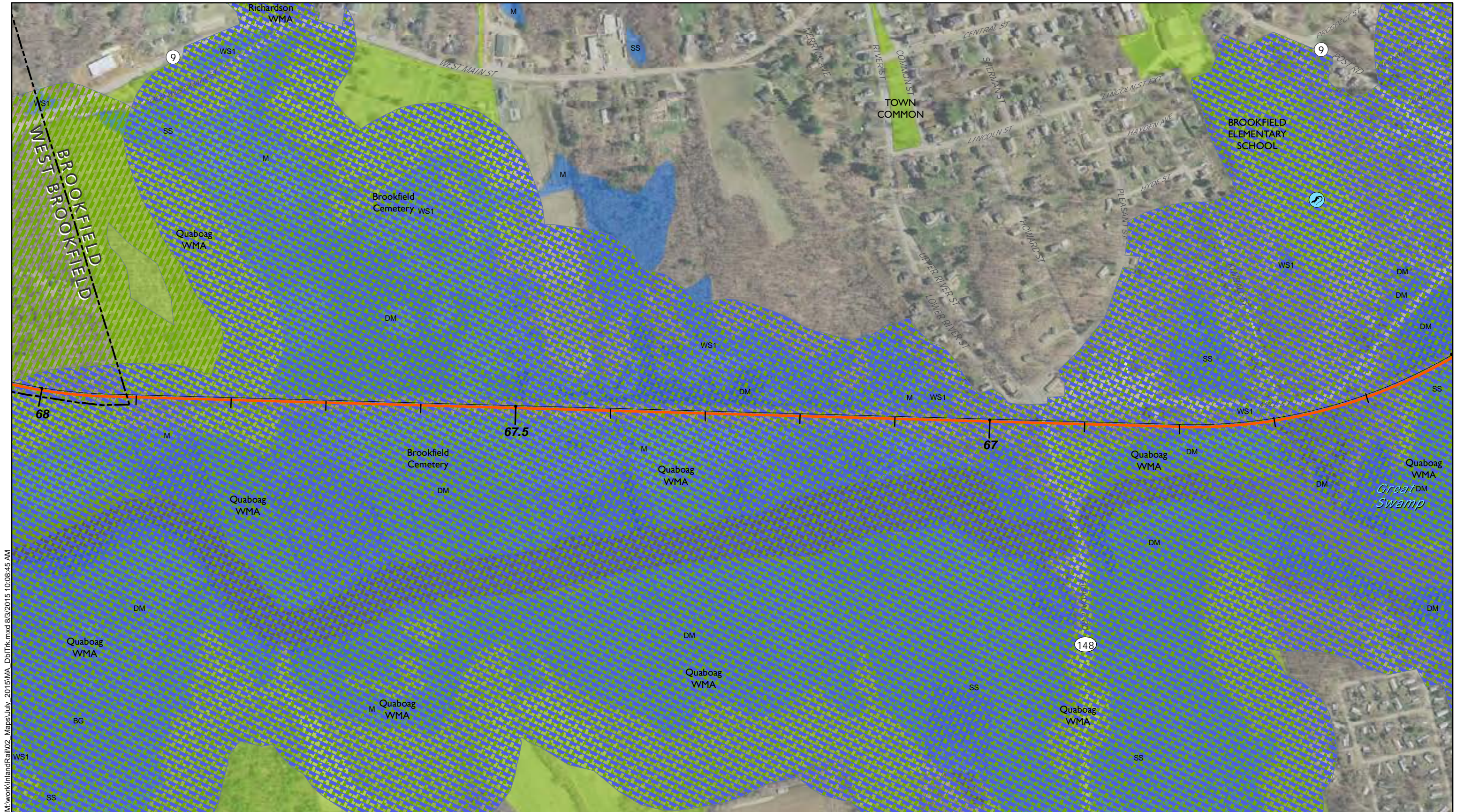
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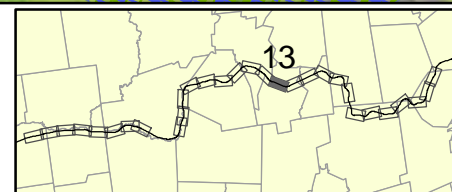
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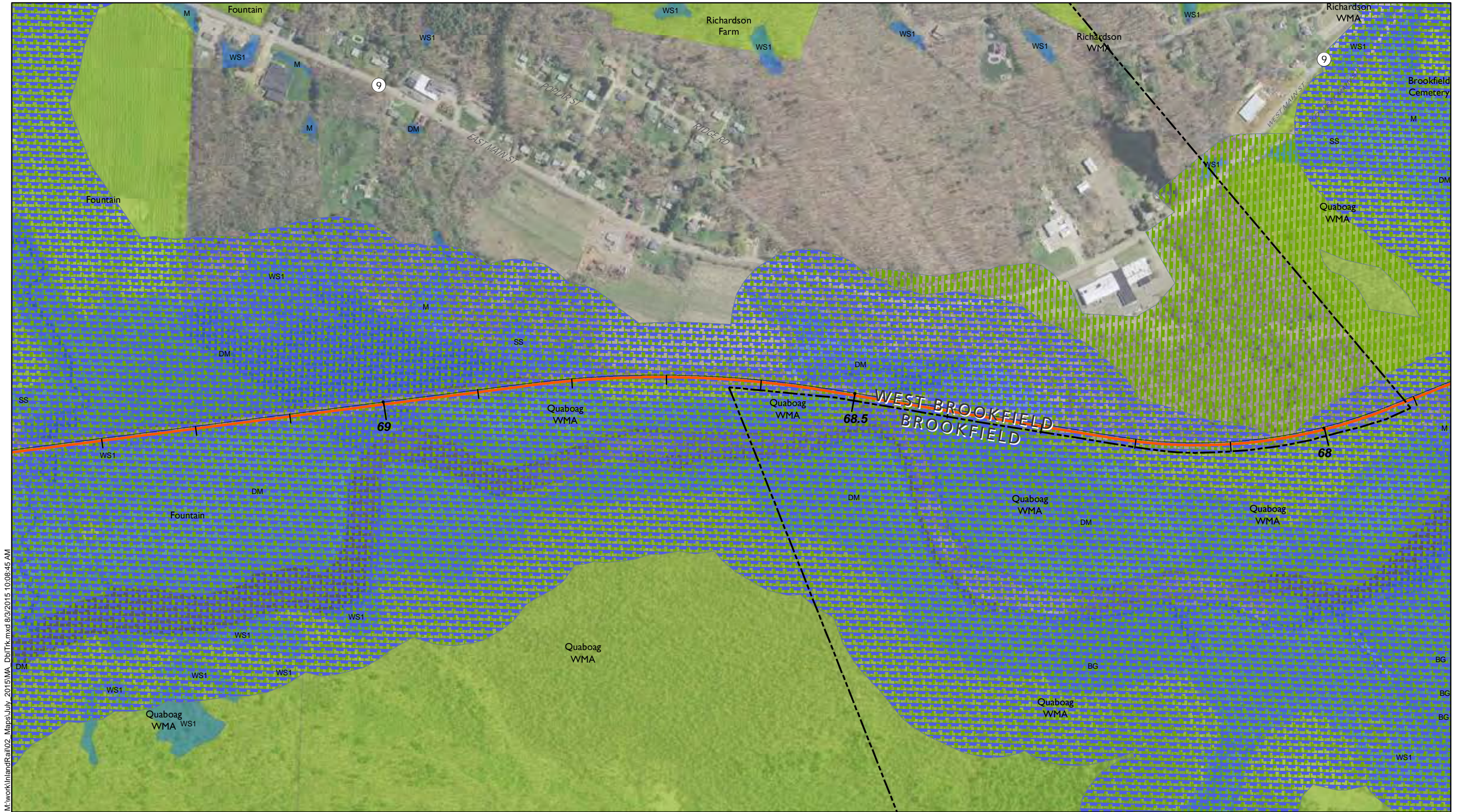
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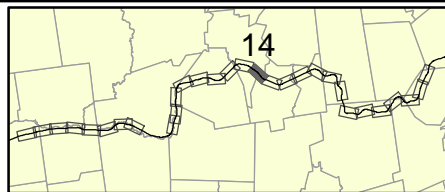
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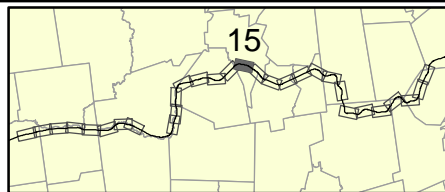
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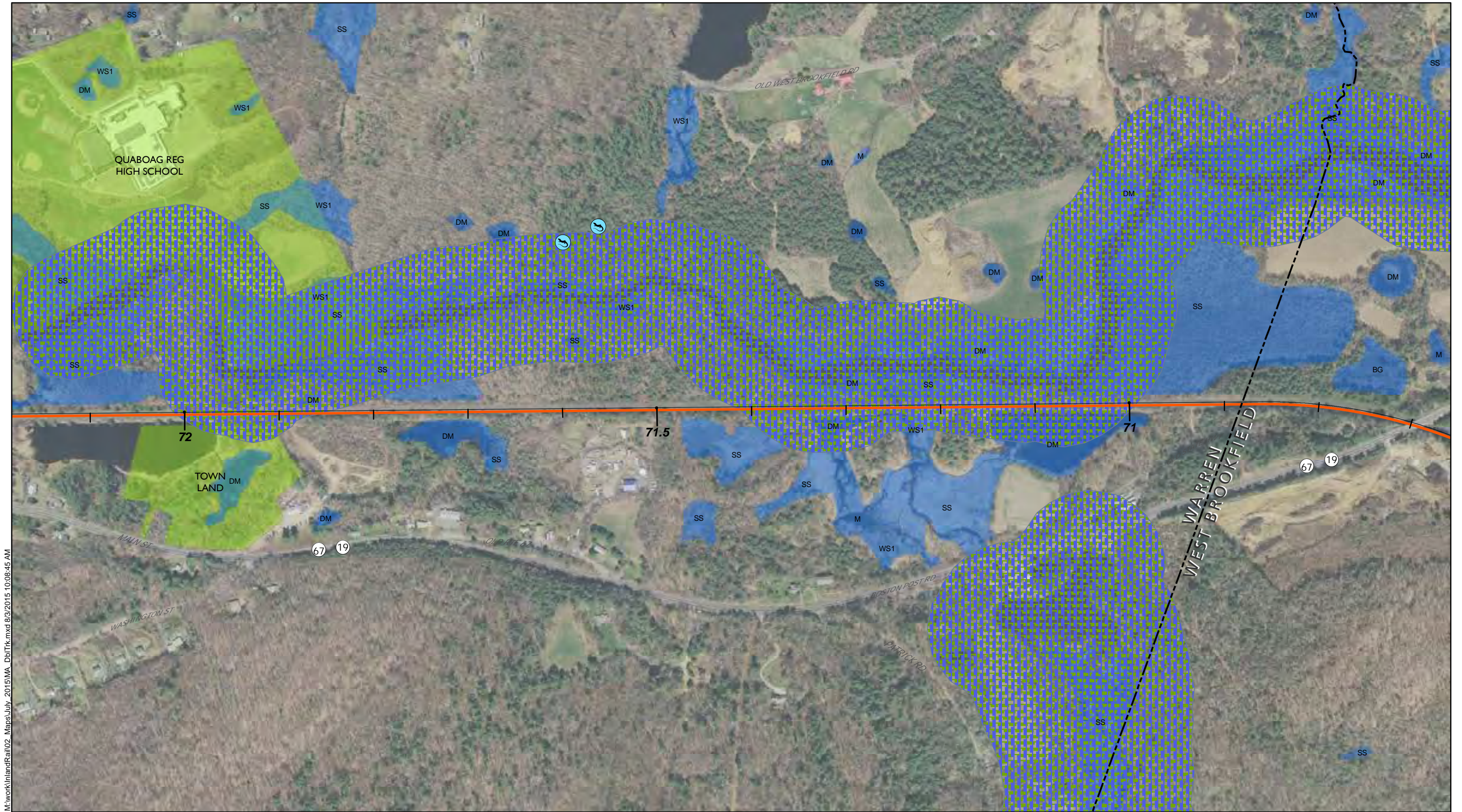
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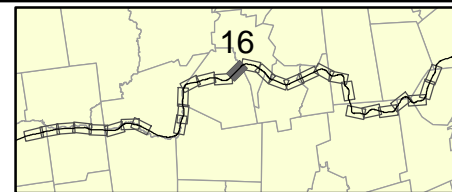
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
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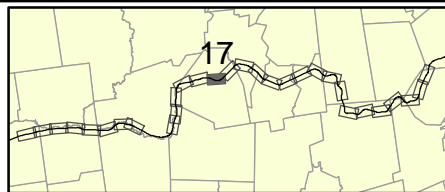
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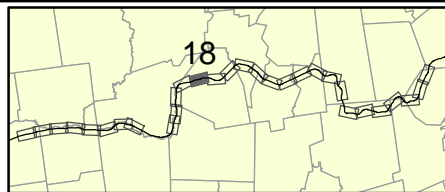
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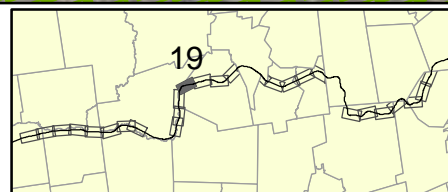
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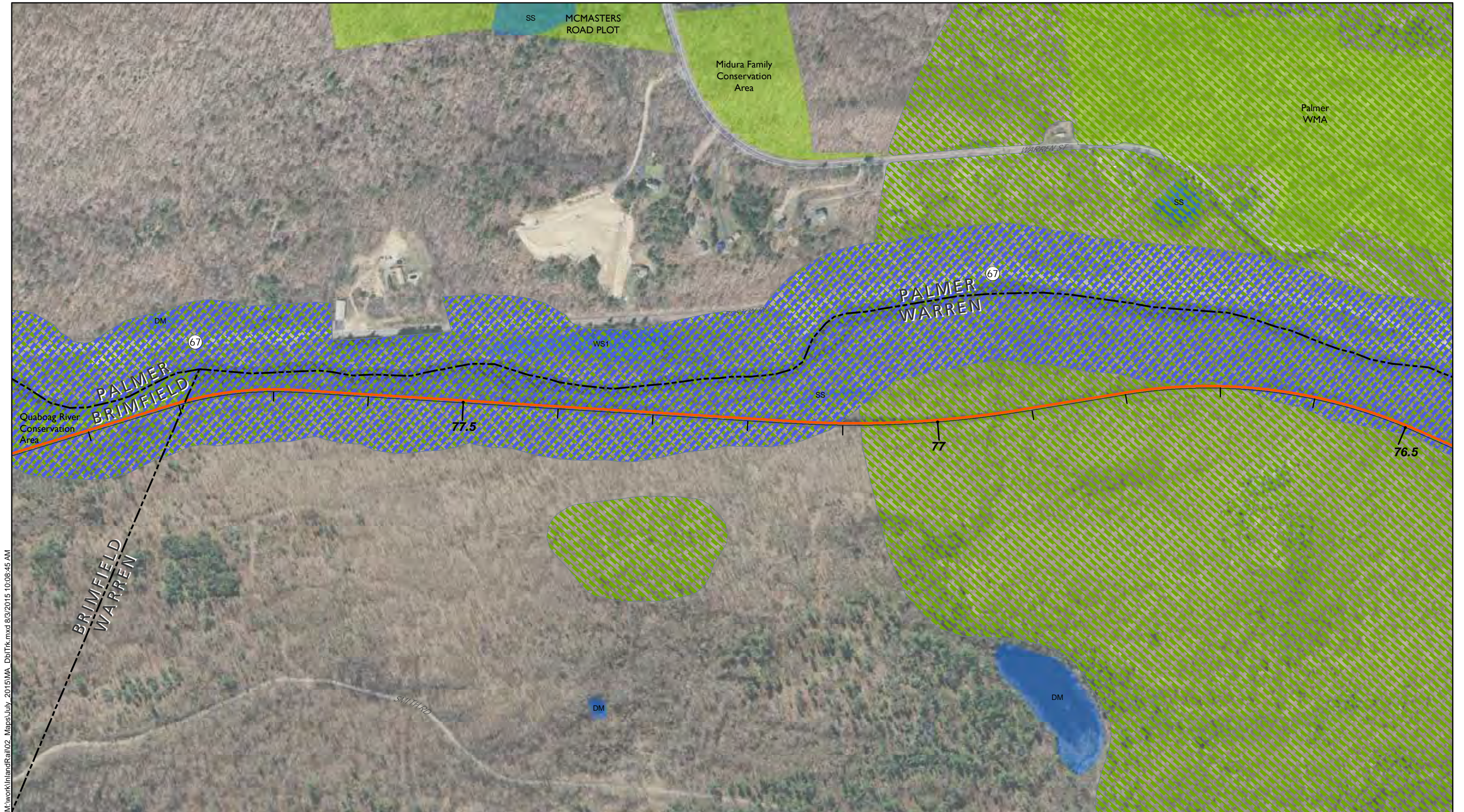
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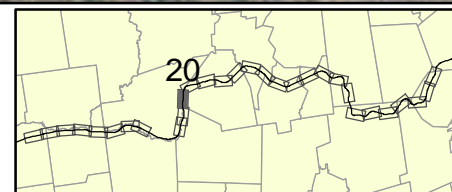
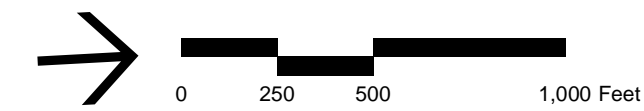
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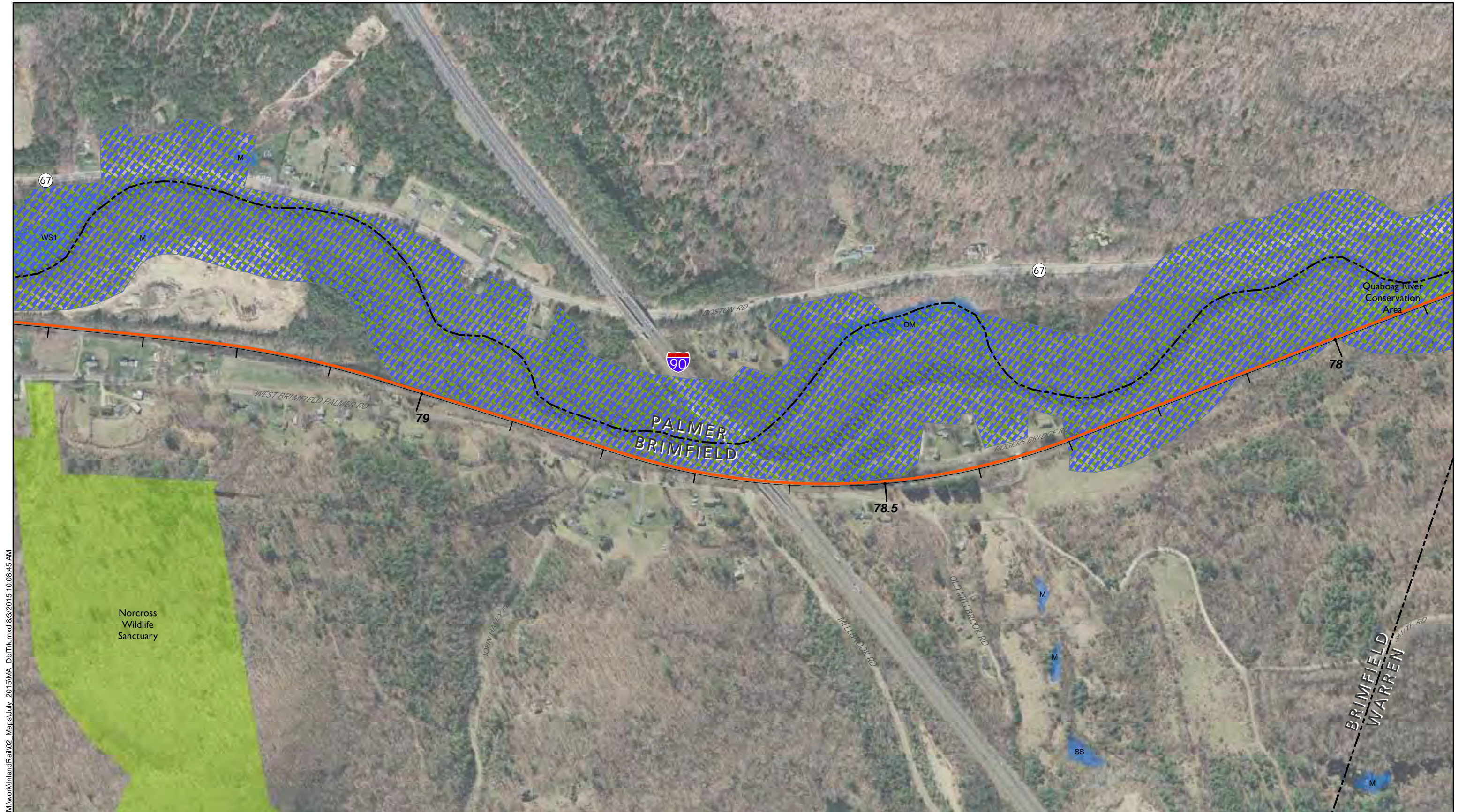
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| | Existing Track | | NHESP Certified Vernal Pools | | DEP Wetland |
| | Proposed Additional Track | | NHESP Estimated Habitats for Rare Wildlife | | Open Space |
| | Additional Track with Minor Realignment | | NHESP Priority Habitats for Rare Species | | |

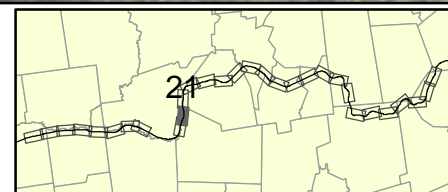
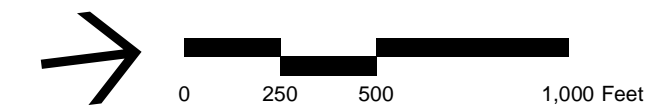
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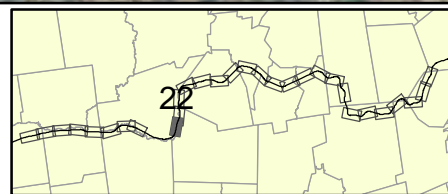
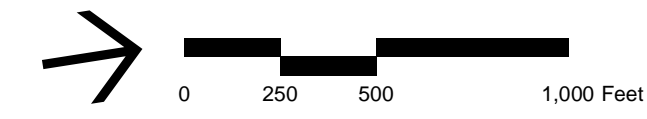
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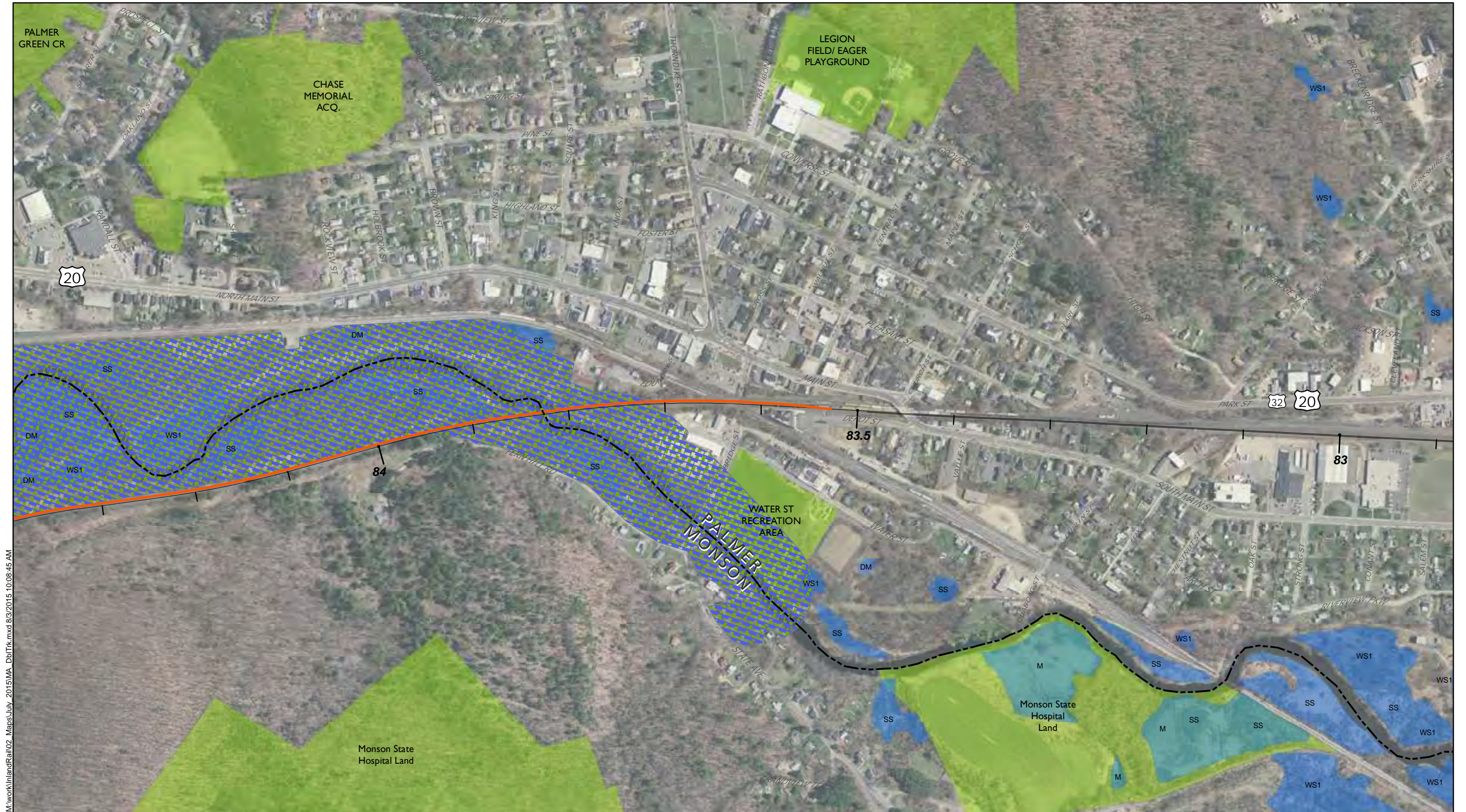
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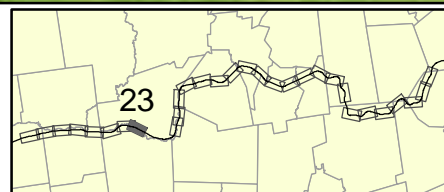
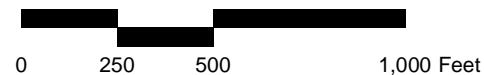
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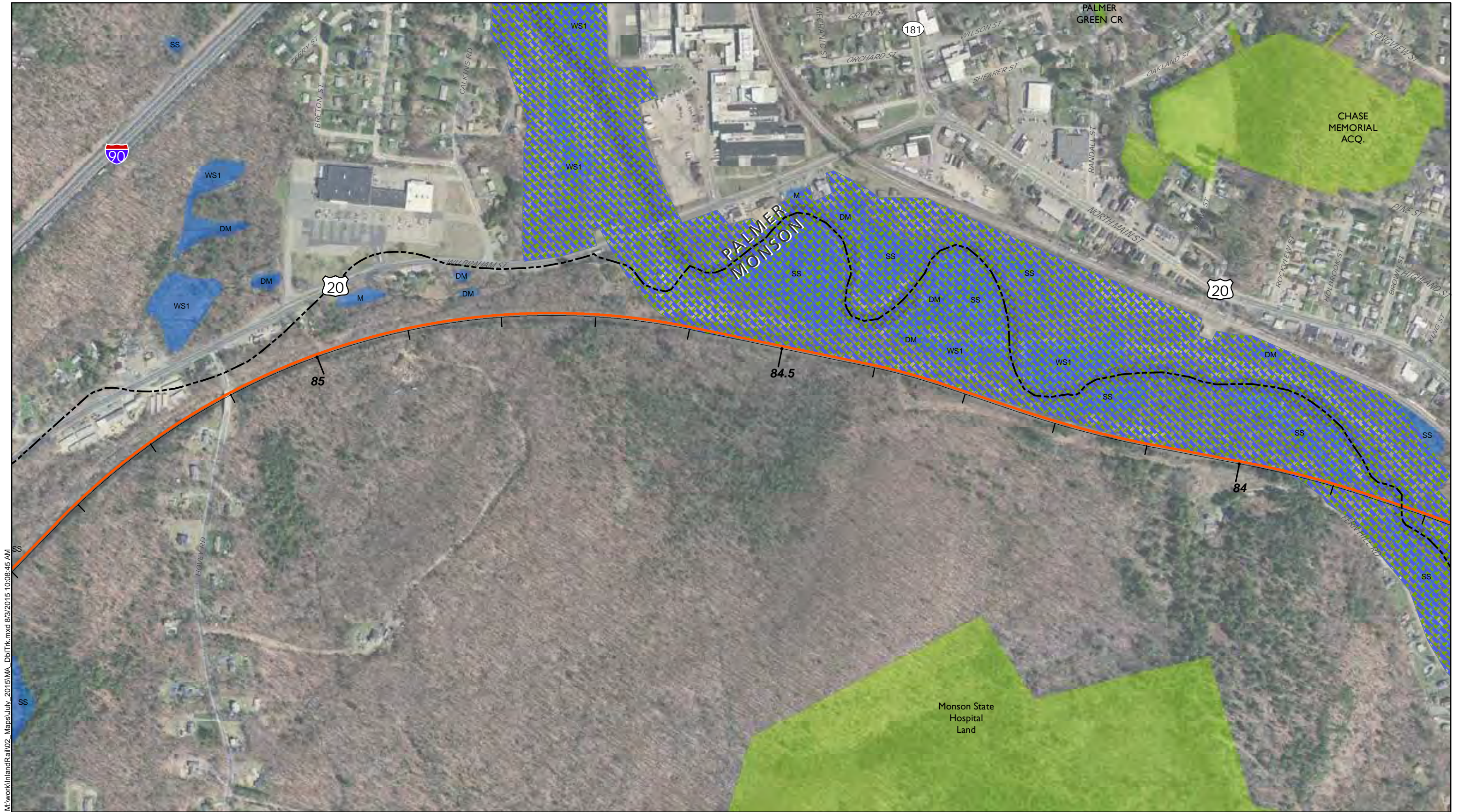
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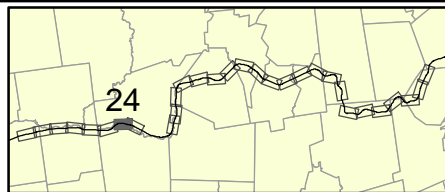
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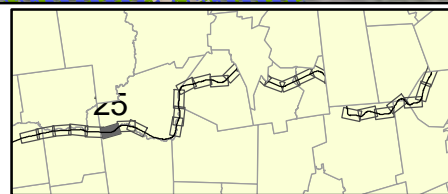
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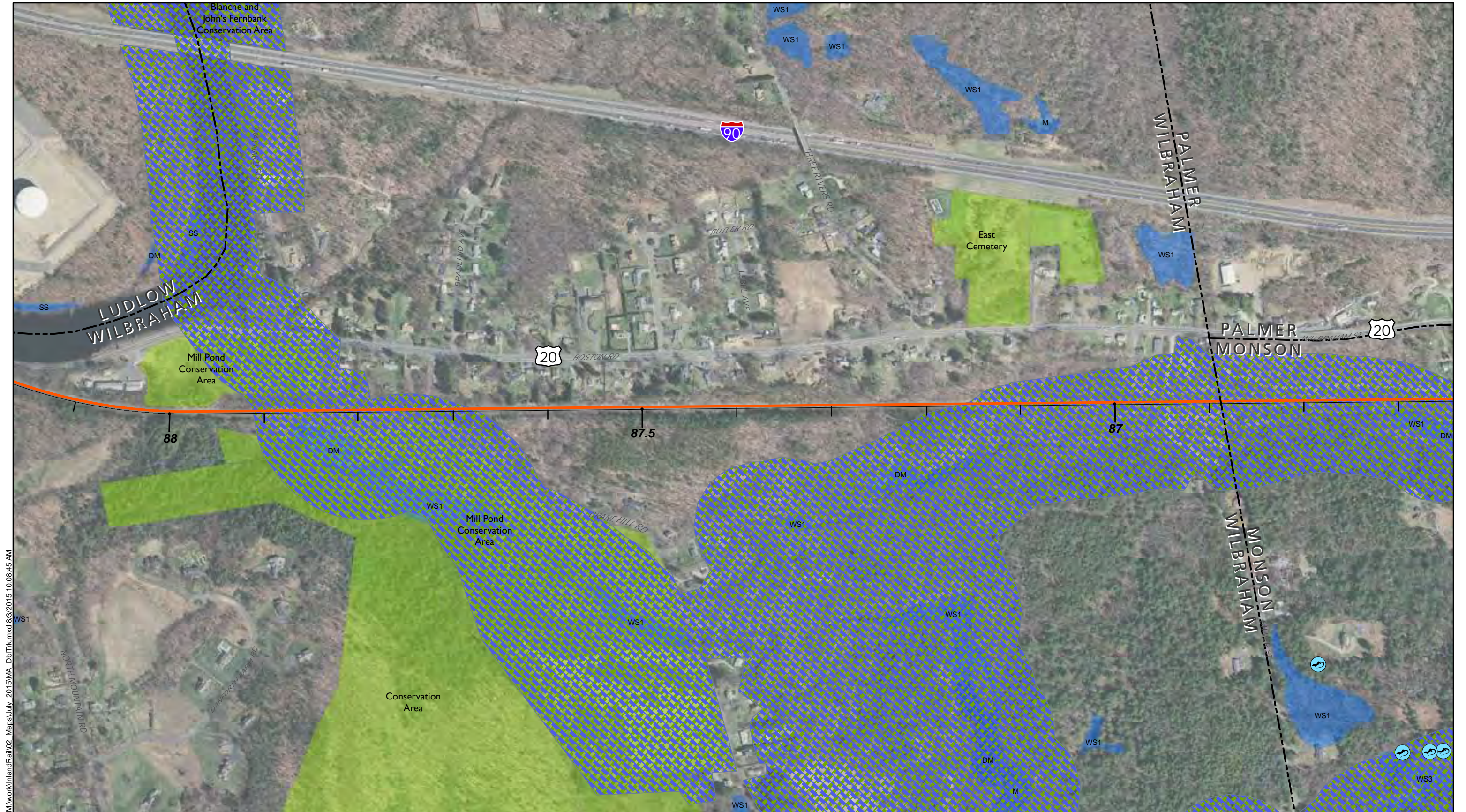
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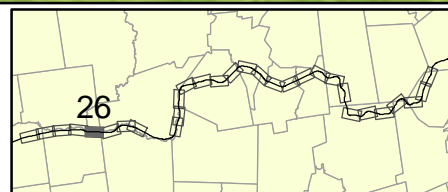
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Resource Areas Worcester to Springfield





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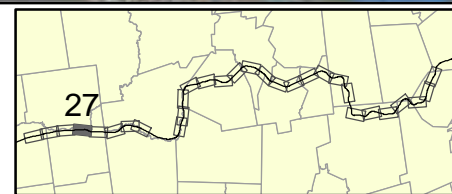
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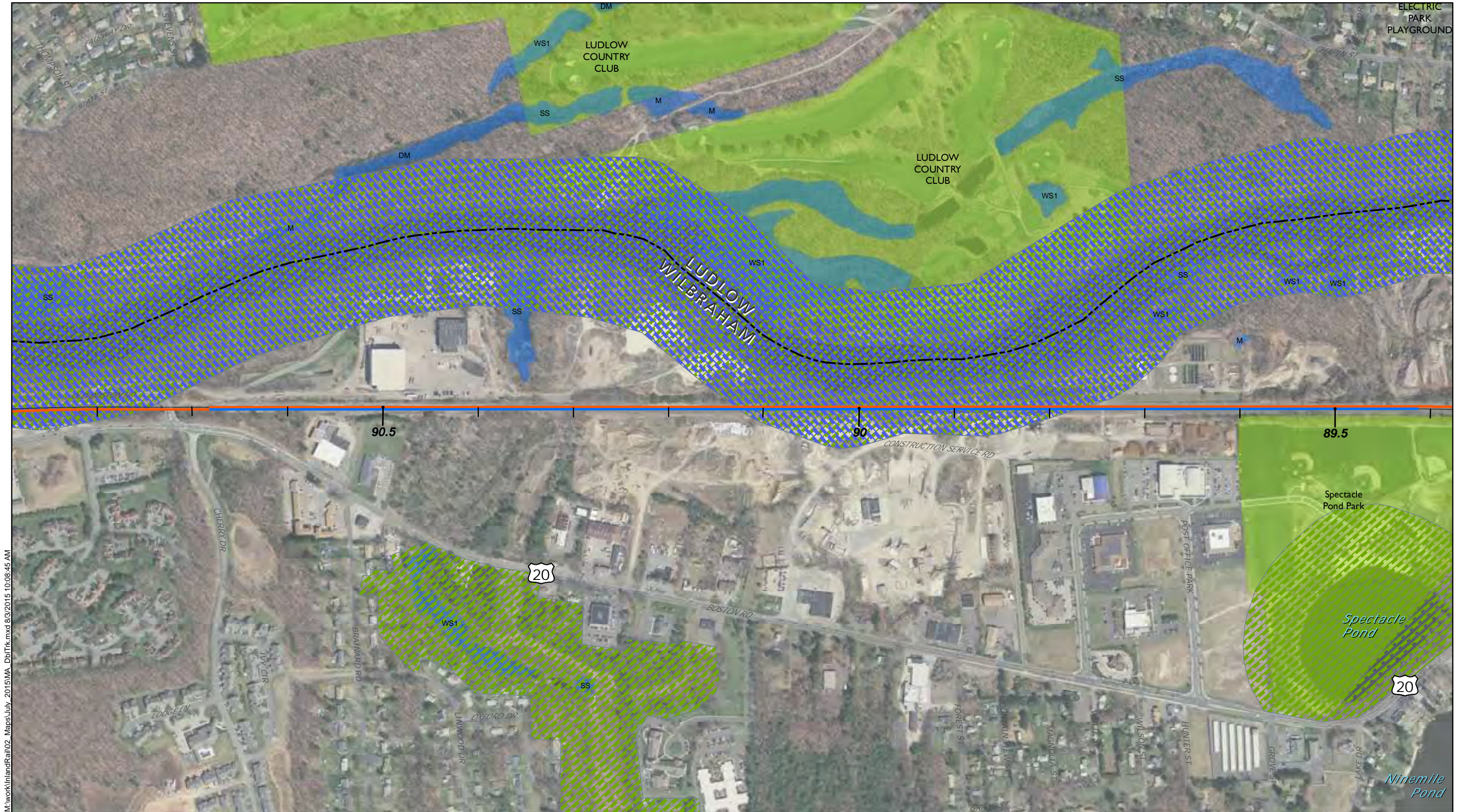
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 Resource Areas Worcester to Springfield



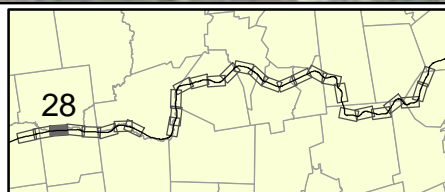


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0 250 500 1,000 Feet



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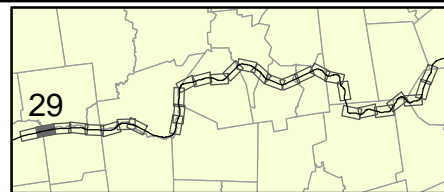


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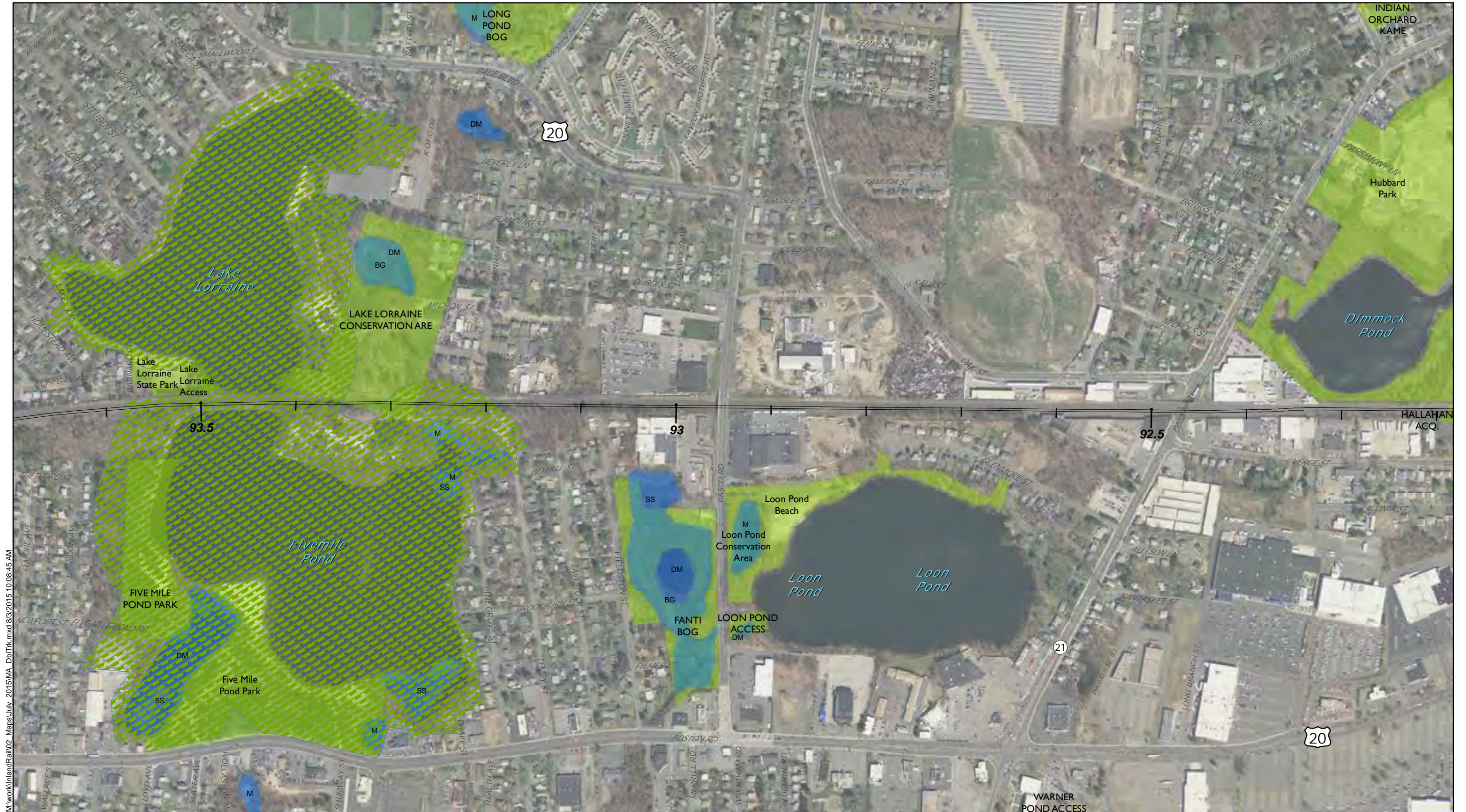
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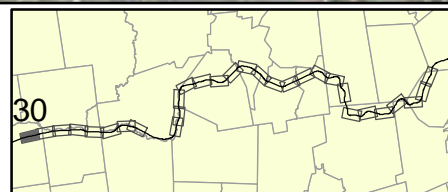


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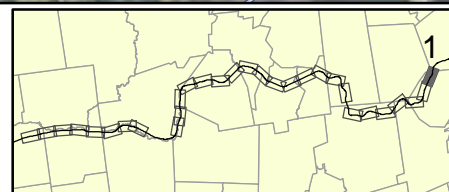
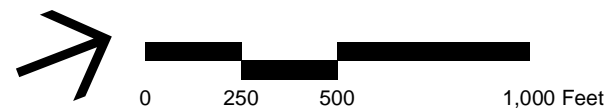
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- Existing Track
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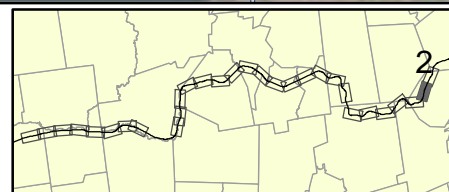
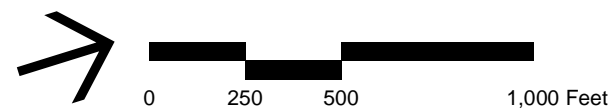
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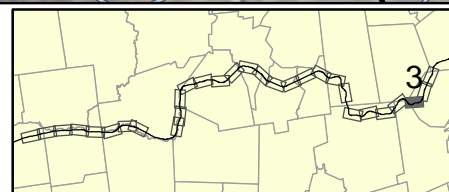


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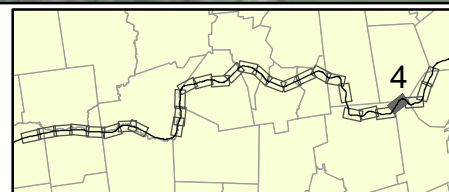
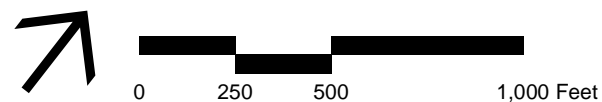
Page 3 of 30





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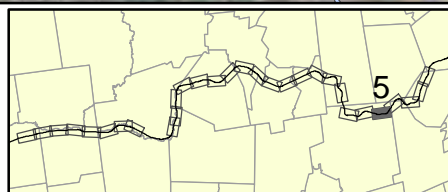
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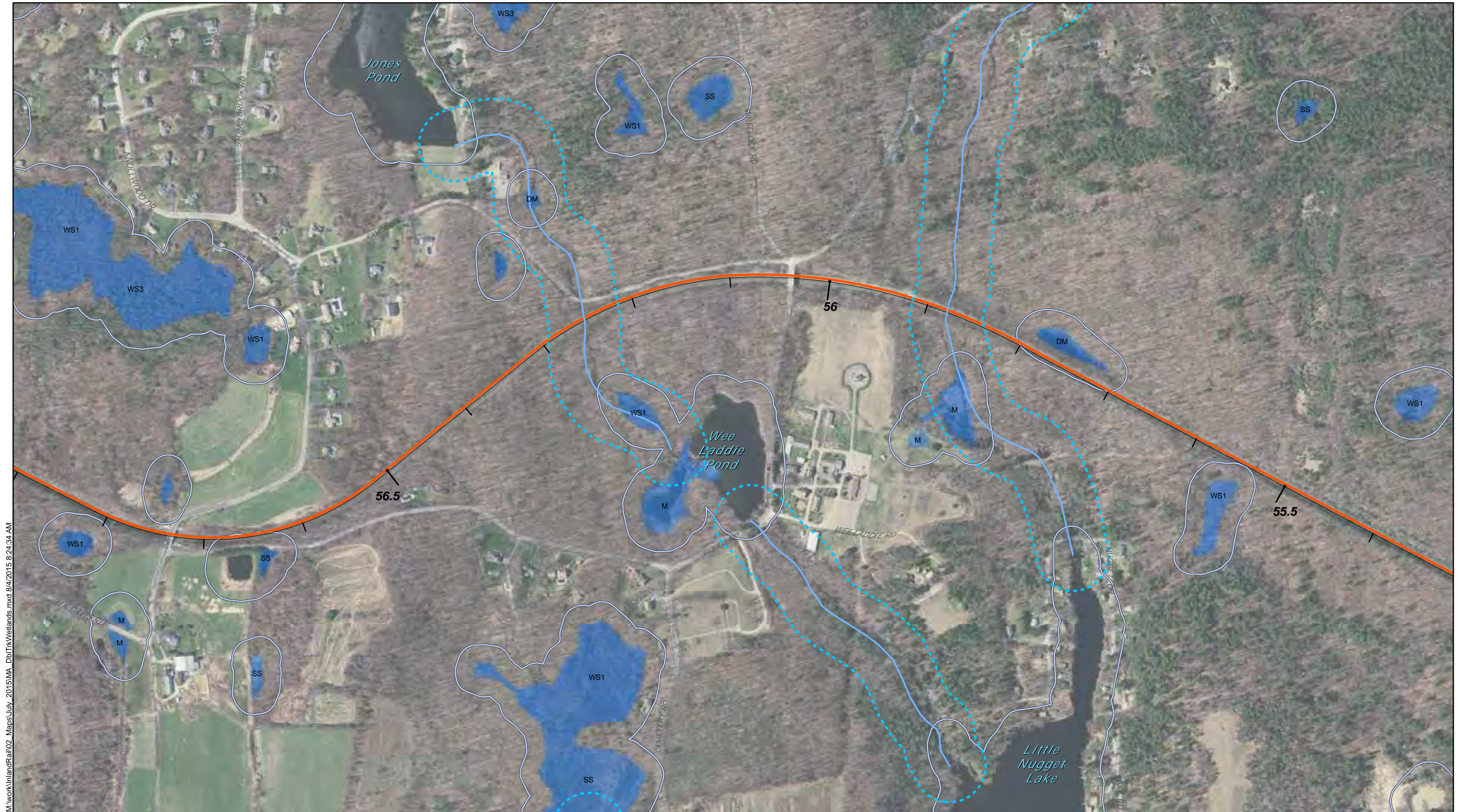


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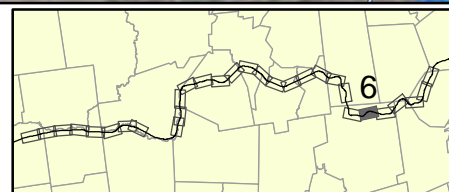
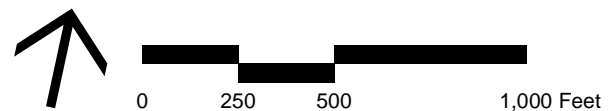
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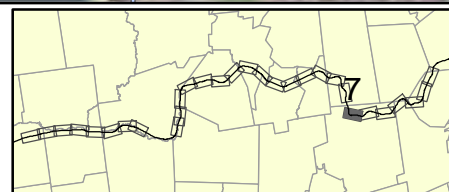
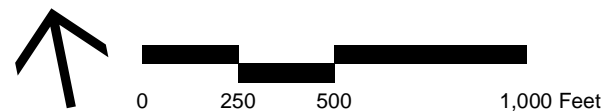
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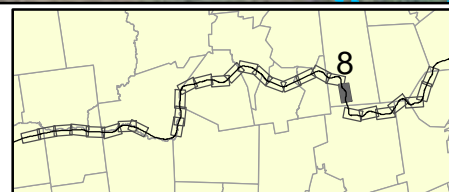
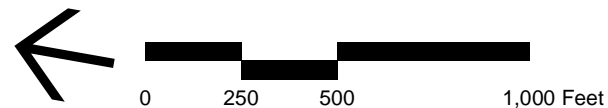
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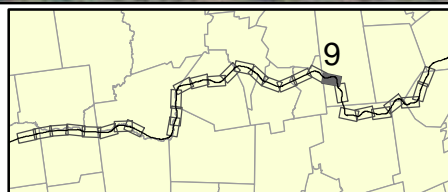
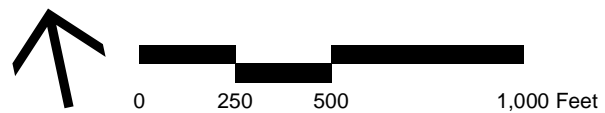
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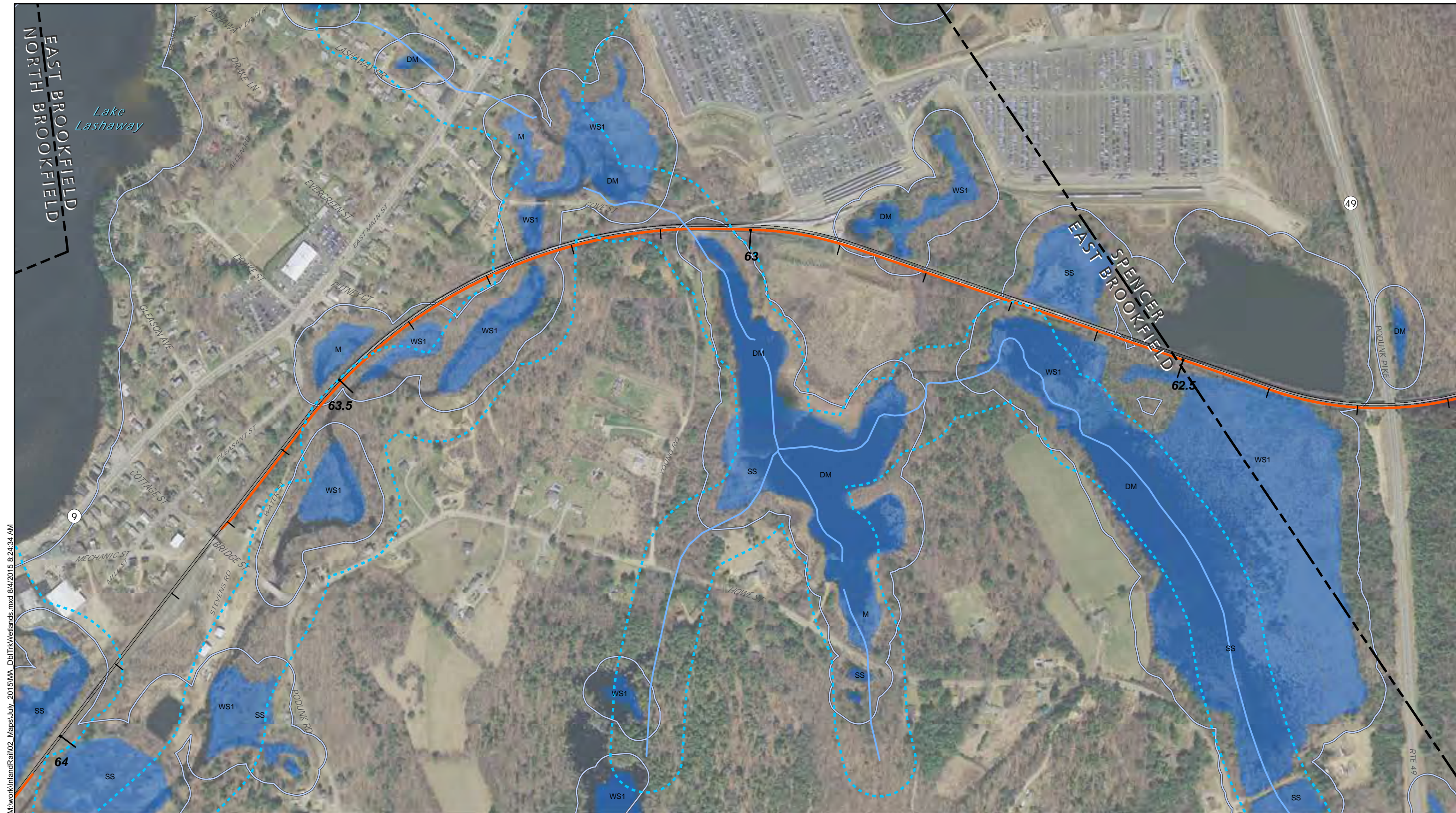
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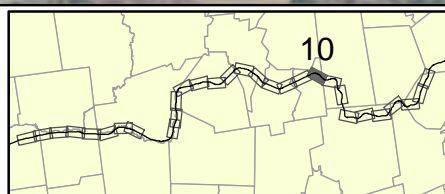


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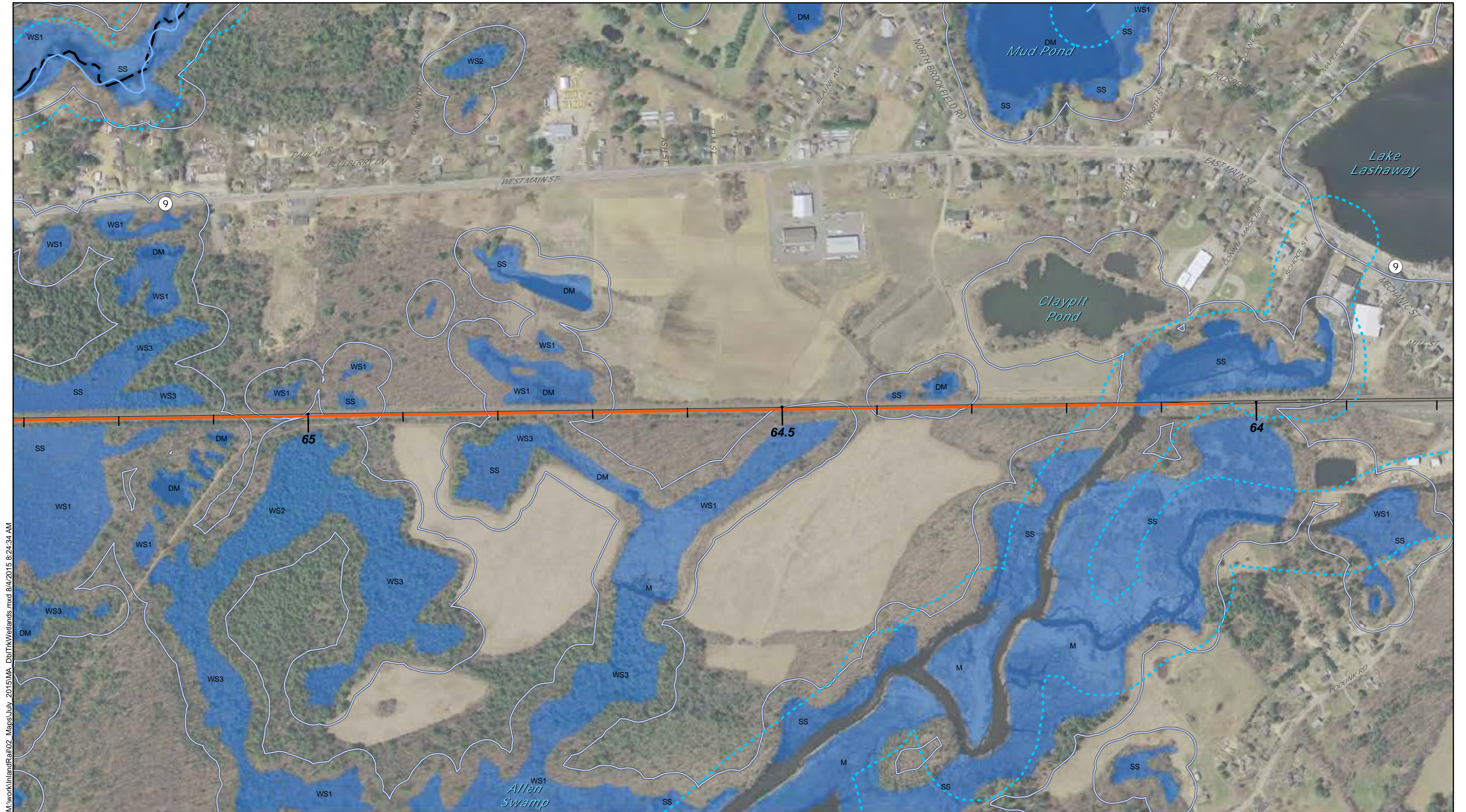


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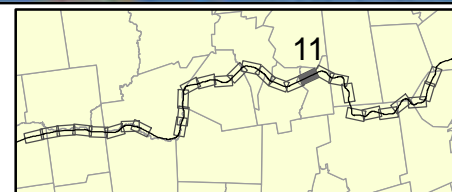
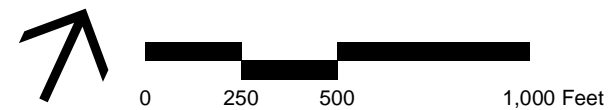
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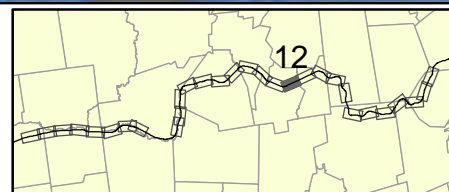
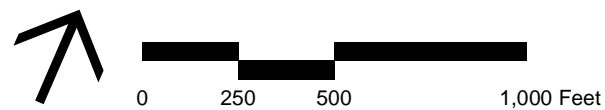
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Water Resources Worcester to Springfield





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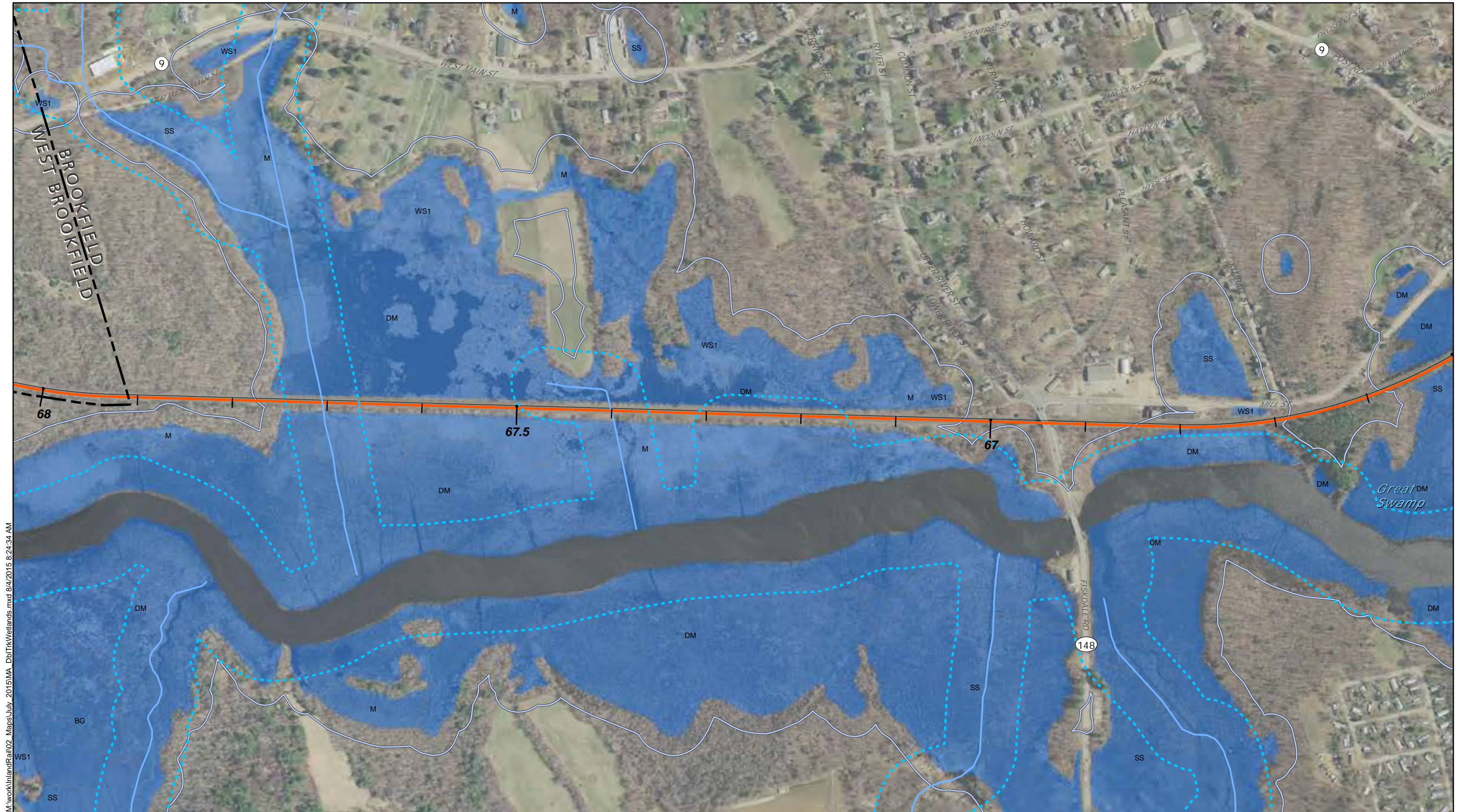


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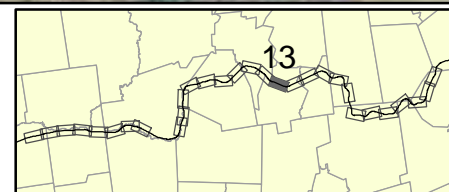
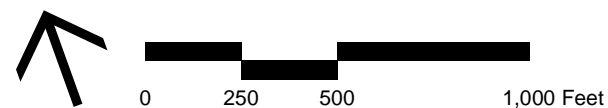
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Water Resources Worcester to Springfield





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BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL
Water Resources Worchester to Springfield



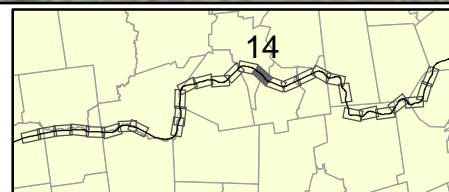


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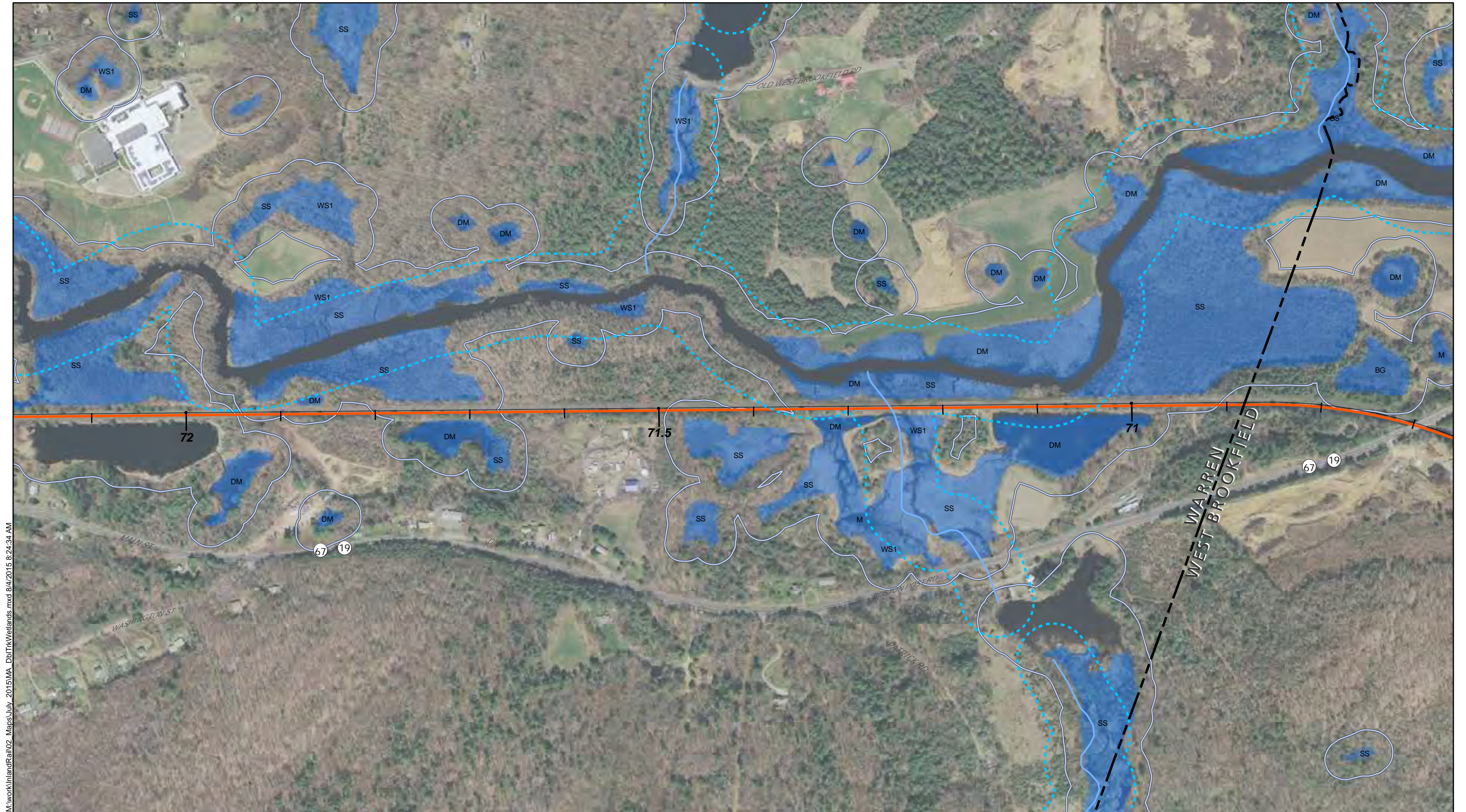
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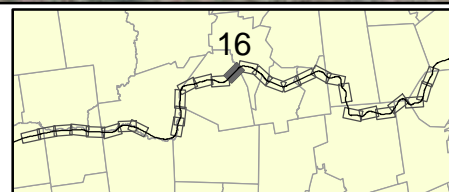
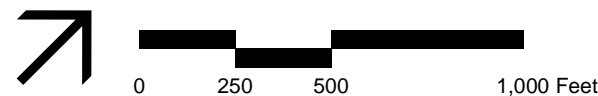
Page 14 of 30





M:\work\InlandRail\02 Maps\July 2015\MA DbTrk\Wetlands.mxd 8/4/2015 8:24:34 AM

Data provided by MassGIS. Date of photos: 2013/2014
National Hydrologic Dataset



- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- DEP Wetland
- Wetland Buffer Zone
- Perennial Stream
- Riverfront Area

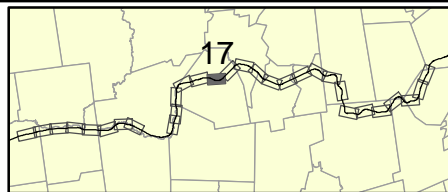
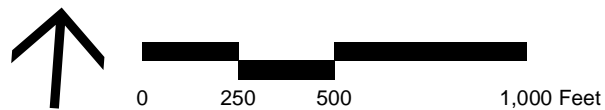
Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL
Water Resources Worchester to Springfield





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National Hydrologic Dataset



- Existing Track
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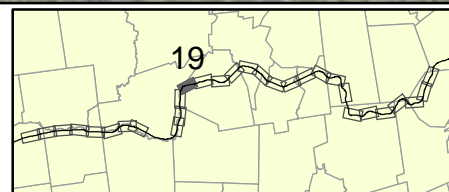
Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL
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National Hydrologic Dataset



- Existing Track
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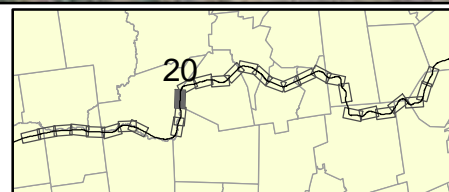
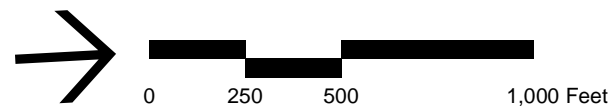
- DEP Wetland
- Wetland Buffer Zone
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National Hydrologic Dataset



- Existing Track
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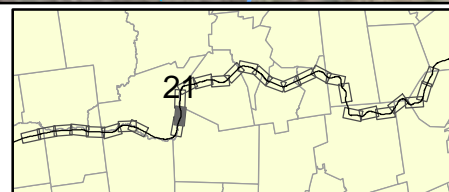
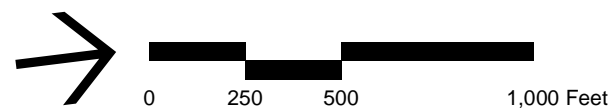
Northern New England Intercity Rail Initiative
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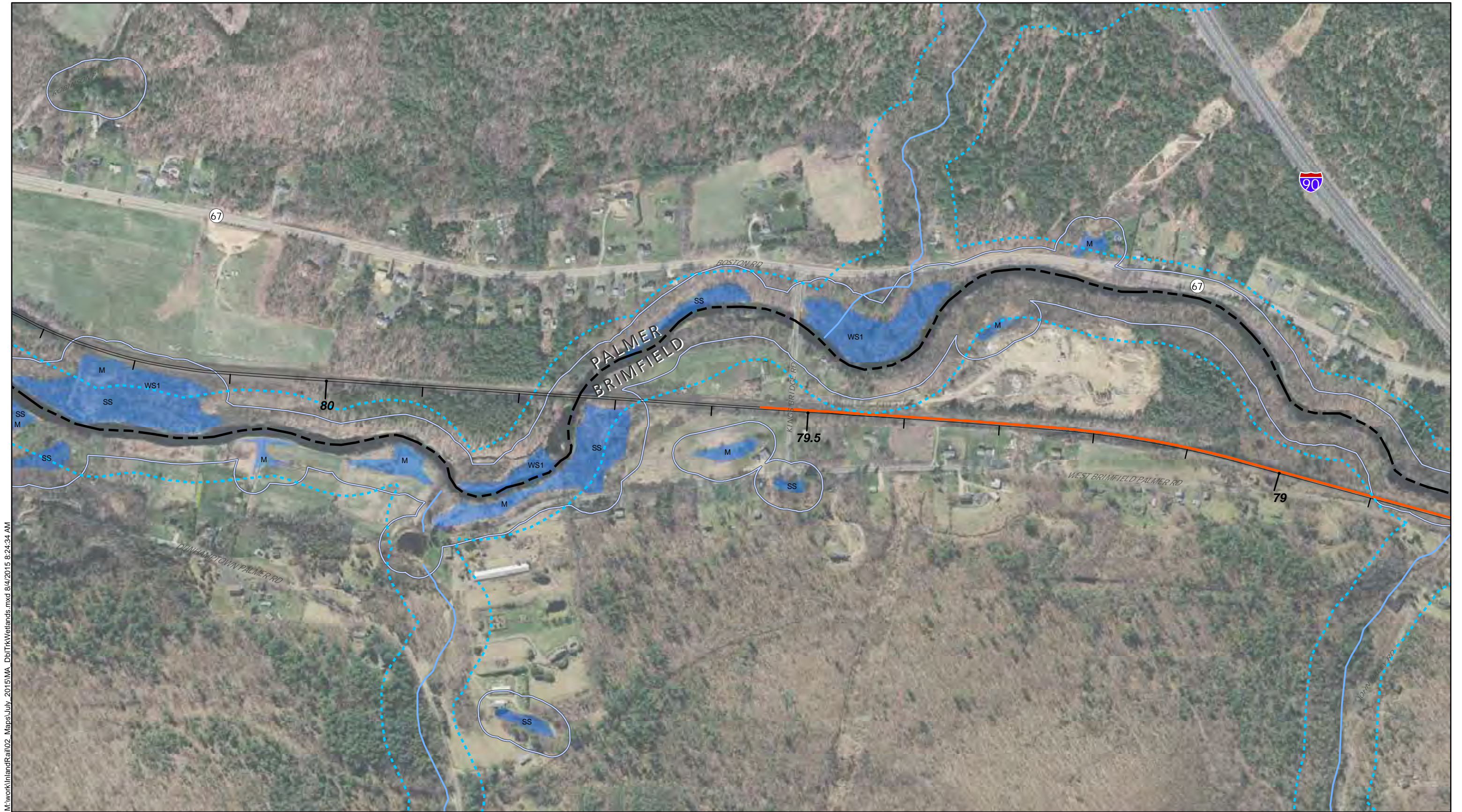


- Existing Track
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- Additional Track with Minor Realignment

- DEP Wetland
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- Perennial Stream
- Riverfront Area

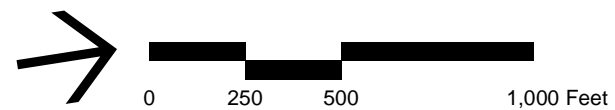
Northern New England Intercity Rail Initiative
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Water Resources Worcester to Springfield





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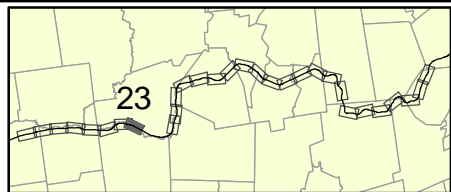
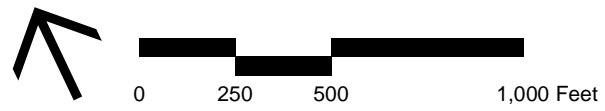
Northern New England Intercity Rail Initiative
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Water Resources Worcester to Springfield





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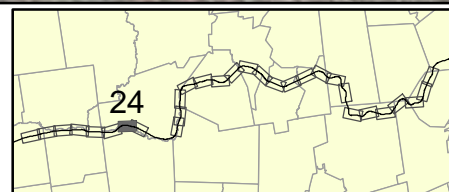
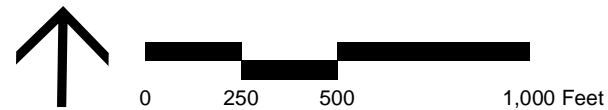
Northern New England Intercity Rail Initiative
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Water Resources Worcester to Springfield





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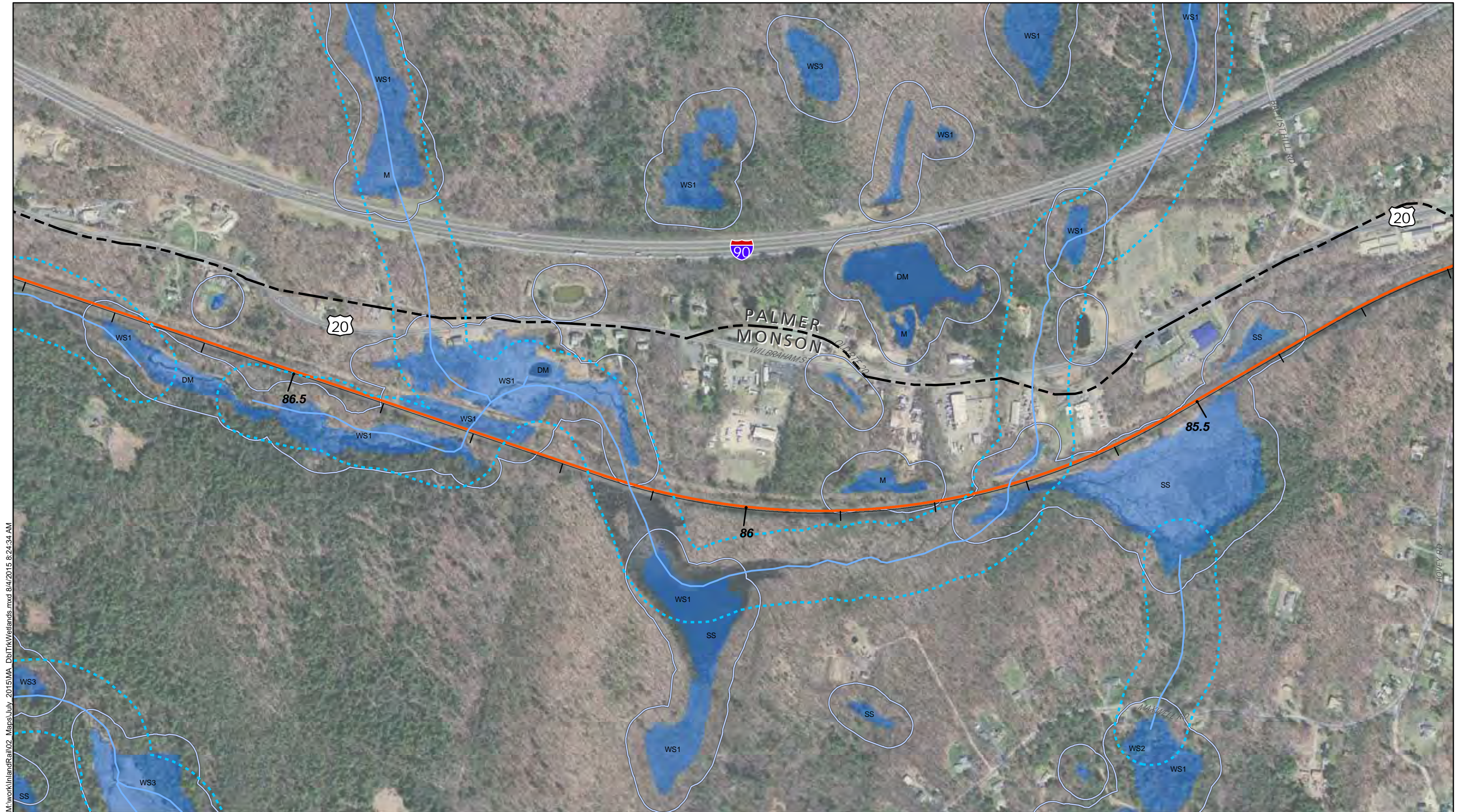


- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- DEP Wetland
- Wetland Buffer Zone
- Perennial Stream
- Riverfront Area

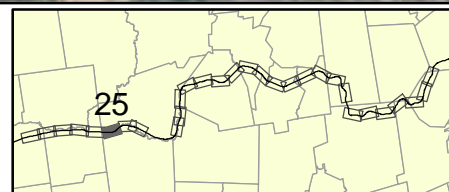
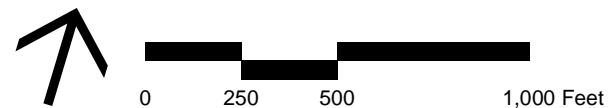
Northern New England Intercity Rail Initiative
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Water Resources Worchester to Springfield





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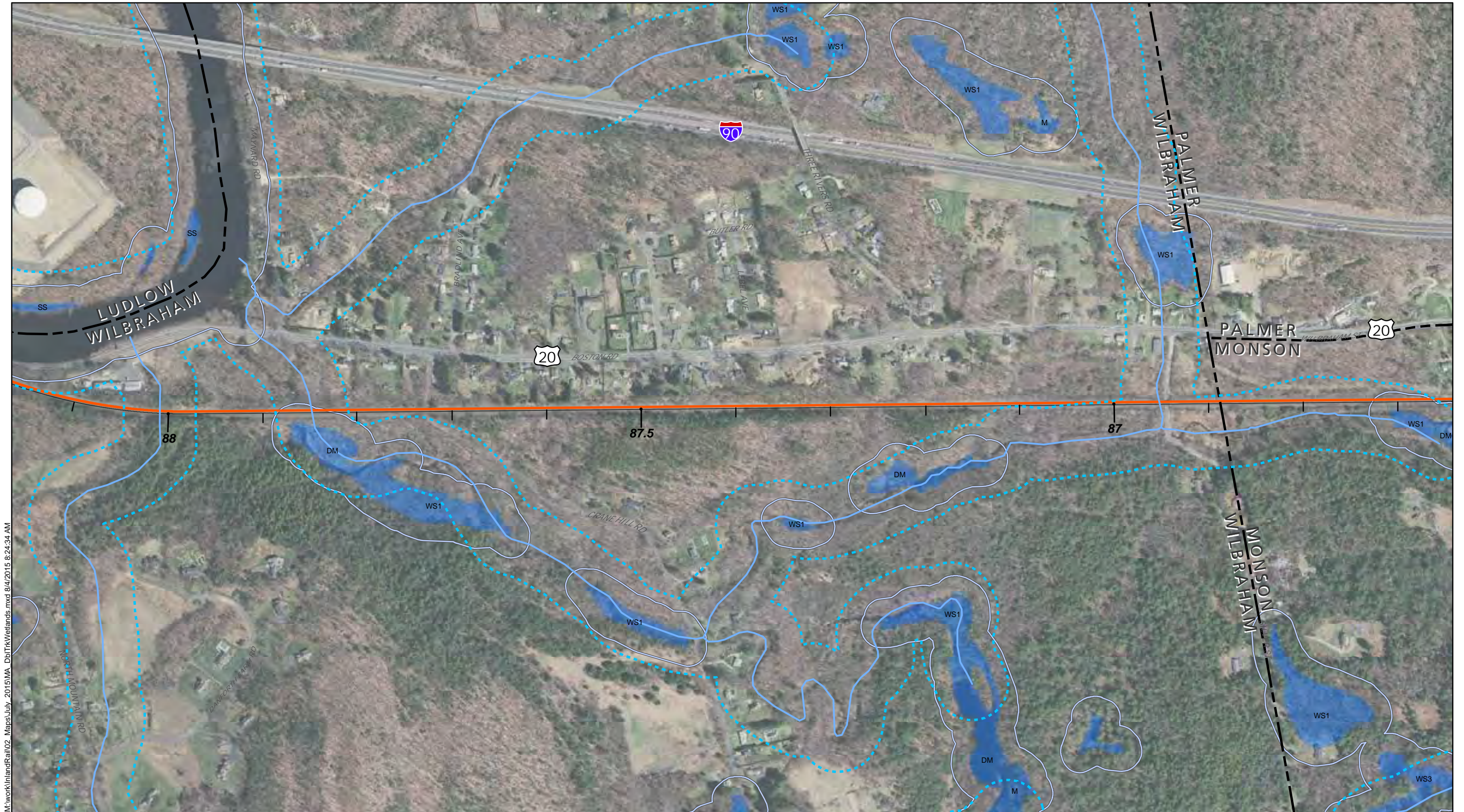


- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- DEP Wetland
- Wetland Buffer Zone
- Perennial Stream
- Riverfront Area

Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL
Water Resources Worcester to Springfield



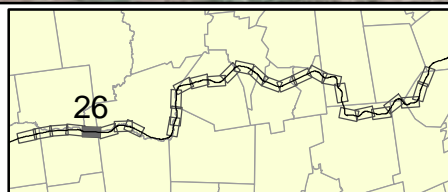


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National Hydrologic Dataset



0 250 500 1,000 Feet



- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- DEP Wetland
- Wetland Buffer Zone
- Perennial Stream
- Riverfront Area

Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL
Water Resources Worchester to Springfield

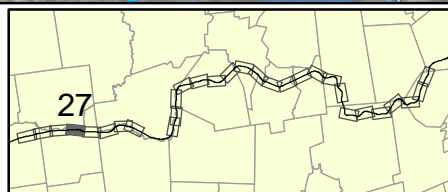
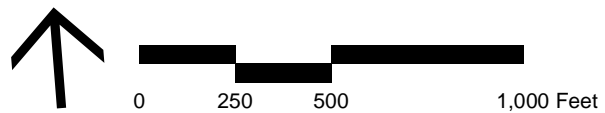
Page 26 of 30





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National Hydrologic Dataset



- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- DEP Wetland
- Wetland Buffer Zone
- Perennial Stream
- Riverfront Area

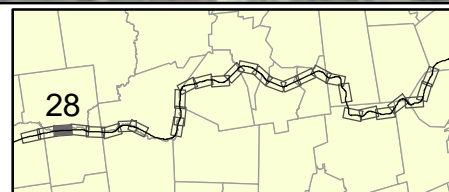
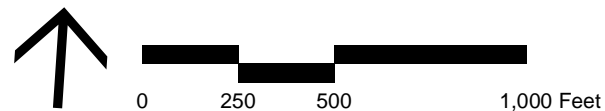
Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL
Water Resources Worchester to Springfield





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National Hydrologic Dataset



- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- DEP Wetland
- Wetland Buffer Zone
- Perennial Stream
- Riverfront Area

Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL
Water Resources Worcester to Springfield

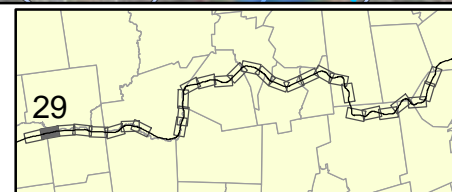
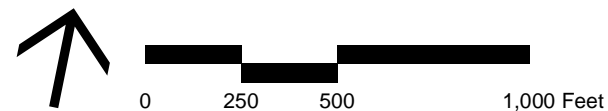
Page 28 of 30





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National Hydrologic Dataset

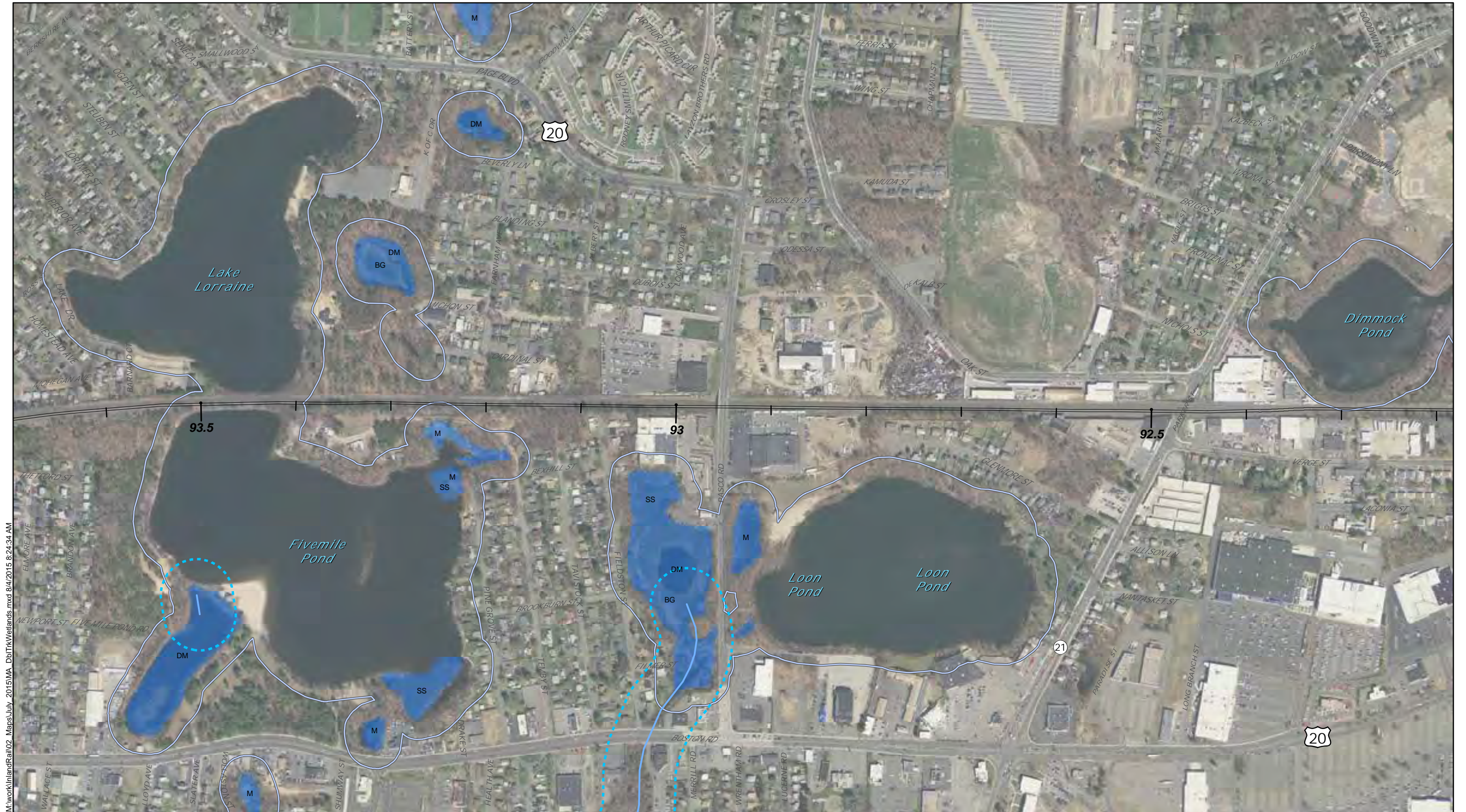


- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment

- DEP Wetland
- Wetland Buffer Zone
- Perennial Stream
- Riverfront Area

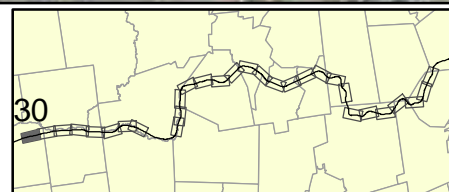
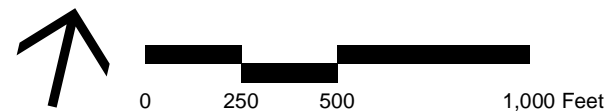
Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL
Water Resources Worcester to Springfield





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National Hydrologic Dataset



- Existing Track
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- DEP Wetland
- Wetland Buffer Zone
- Perennial Stream
- Riverfront Area

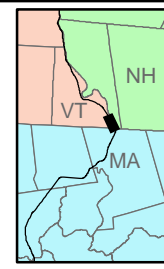
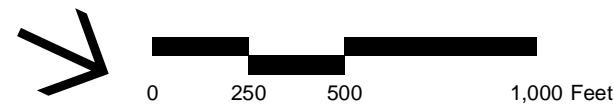
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Data provided by MassGIS. Date of photos: 2013/2014



- Existing Single Track
- Proposed Additional Track
- Additional Track with Minor Realignment
- MA DEP/NWI Wetland

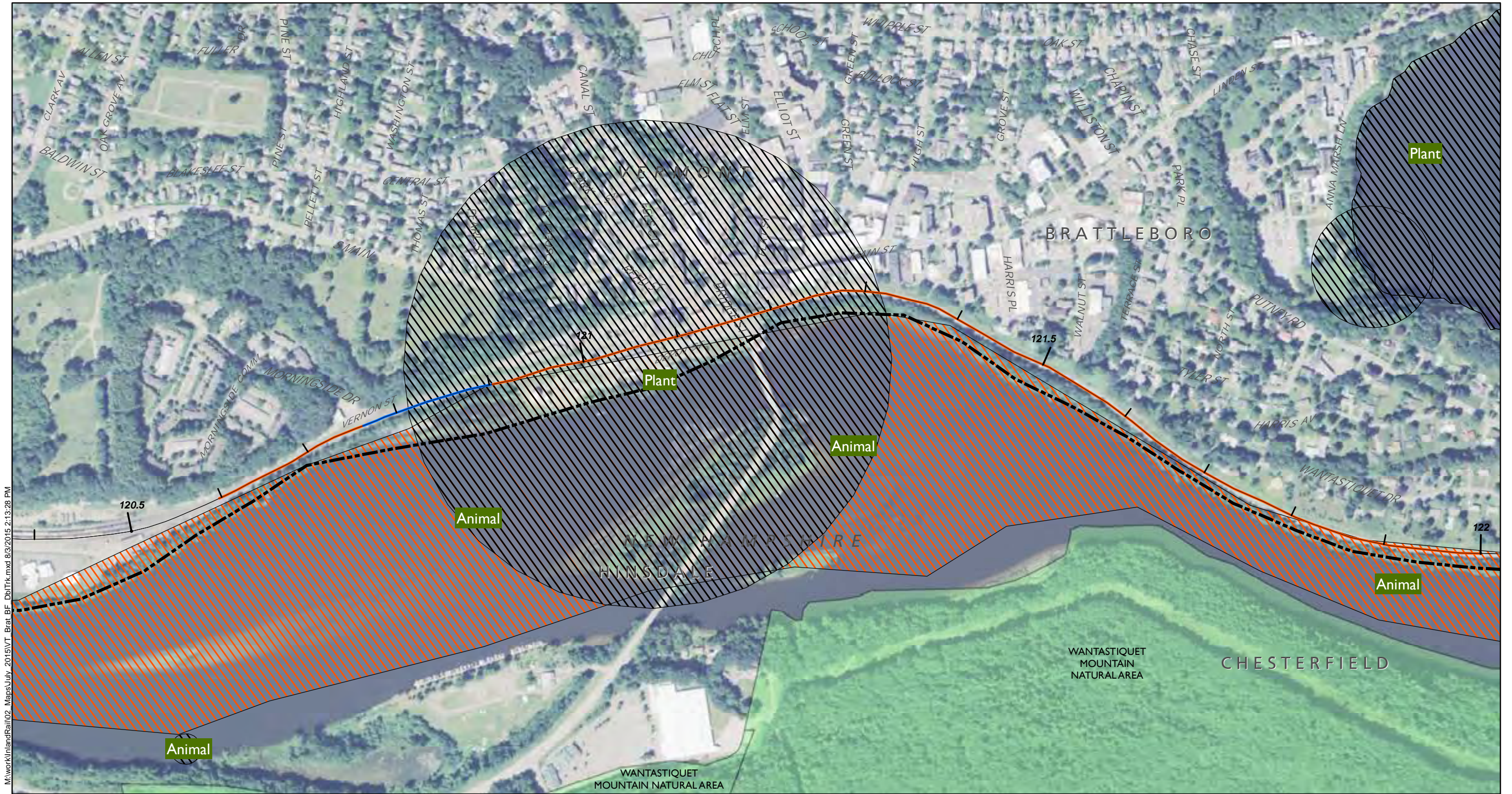
- Open Space
- Federal
 - State
 - Municipal/County
 - Other Public/Quasi-Public
 - Private

- Massachusetts Critical Habitat
- NHESP Certified Vernal Pools
 - NHESP Estimated Habitats for Rare Wildlife
 - NHESP Priority Habitats for Rare Species

- Vermont Critical Habitat
- State-Endangered
 - Special Concern
 - Other

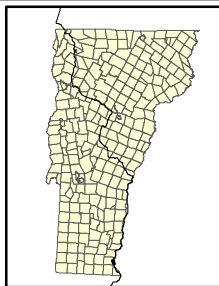
Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL
Resource Areas East Northfield
MP 110.5 - 111.8





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Data provided by VT GIS. Date of photos: 2014



- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment
- NWI Wetland
- Wetland Buffer (50 Feet)

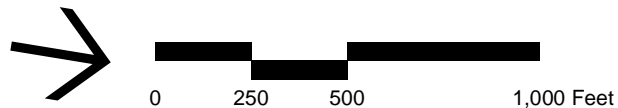
- Open Space
 - Federal
 - State
 - Municipal/County
 - Other Public/Quasi-Public
 - Private

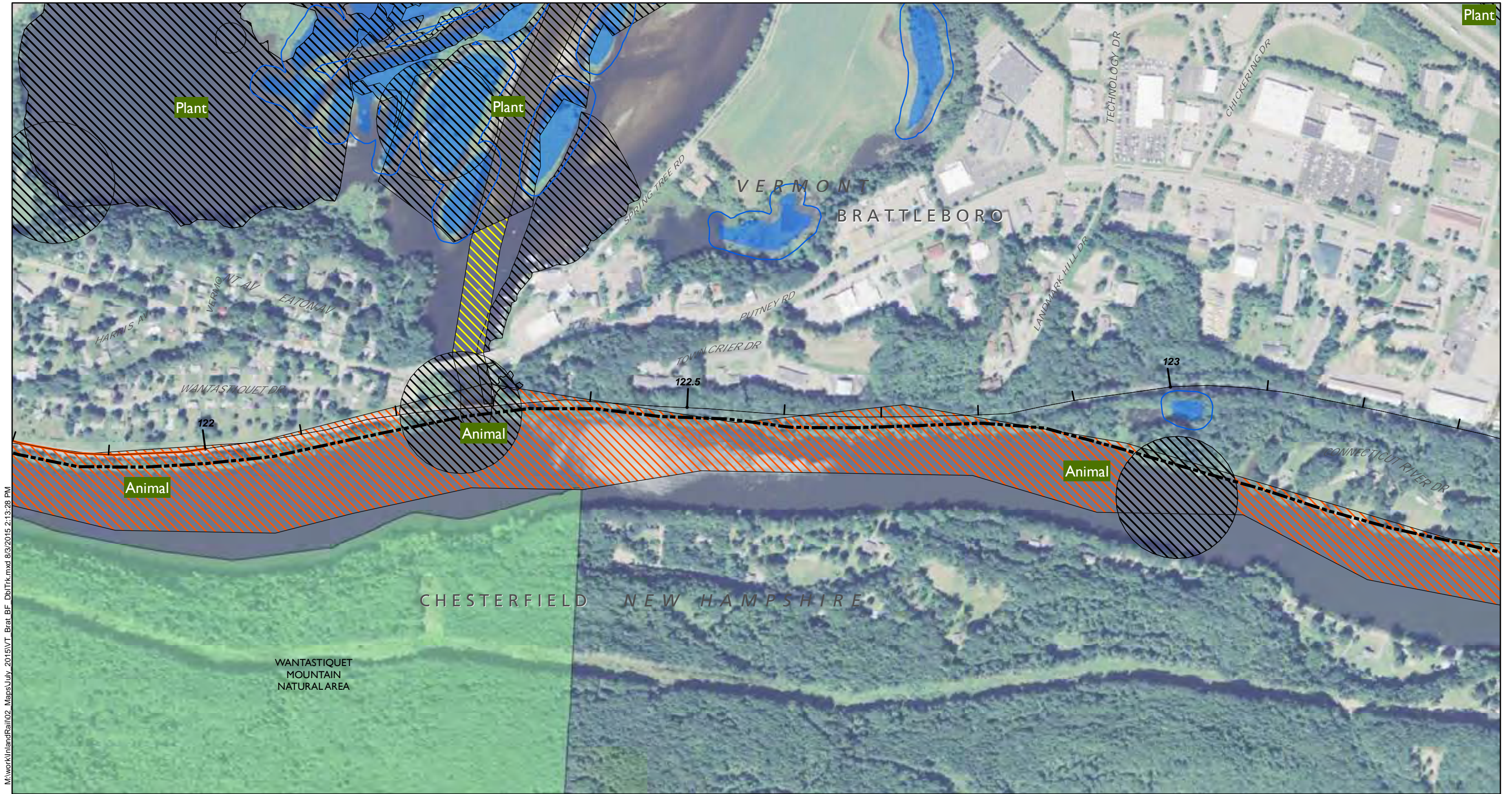
- Vermont Critical Habitat
 - State-Endangered
 - State-Threatened
 - Special Concern
 - Other

Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Resource Areas
Brattleboro to Bellows Falls

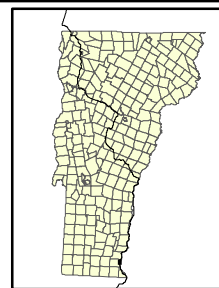
Page 1 of 17





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- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment
- NWI Wetland
- Wetland Buffer (50 Feet)

- Open Space
 - Federal
 - State
 - Municipal/County
 - Other Public/Quasi-Public
 - Private

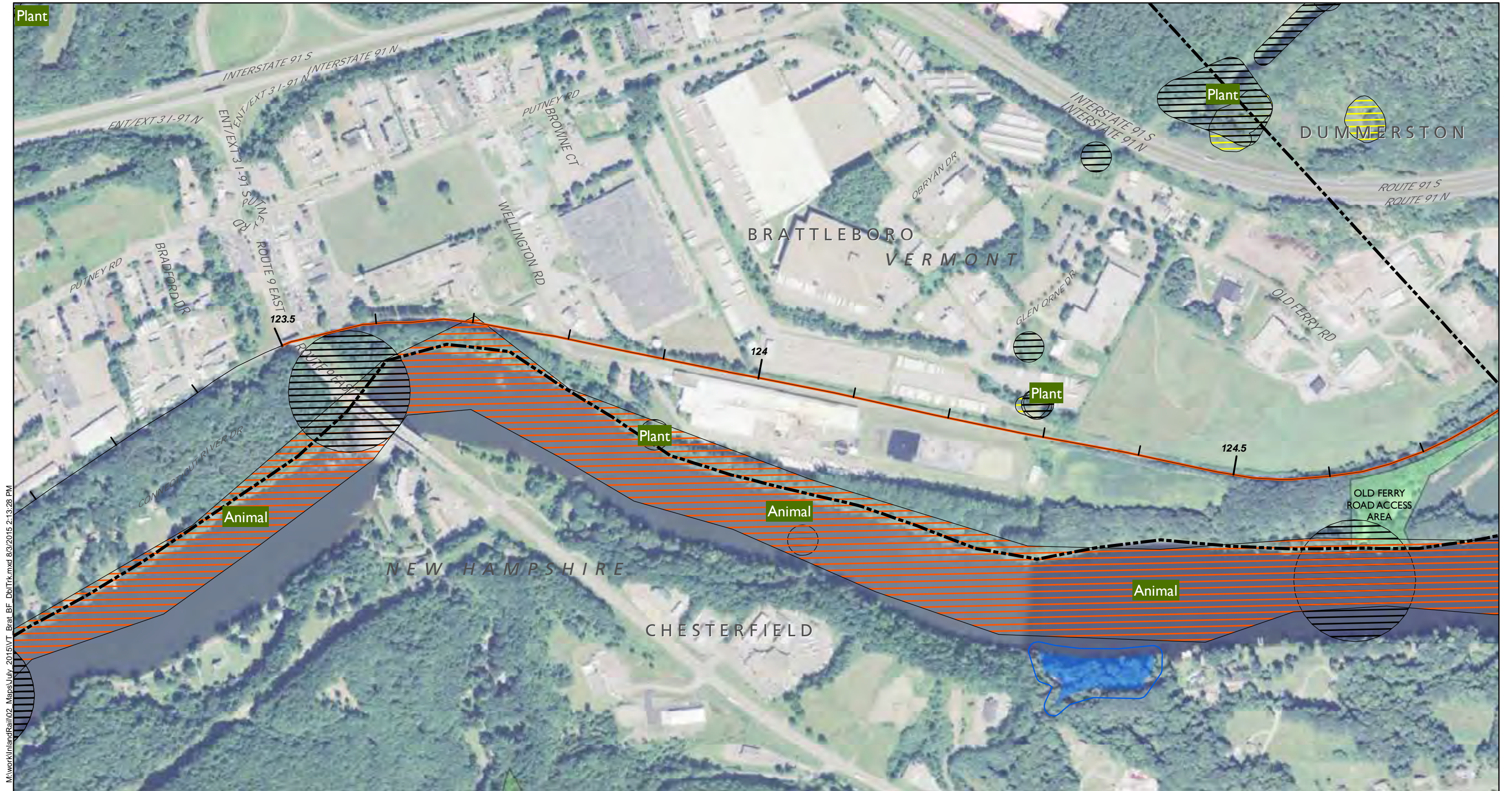
- Vermont Critical Habitat
 - State-Endangered
 - State-Threatened
 - Special Concern
 - Other

Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Resource Areas
Brattleboro to Bellows Falls

Page 2 of 17



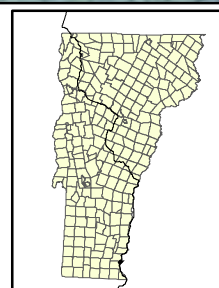


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Data provided by VT GIS. Date of photos: 2014



0 250 500 1,000 Feet



- Existing Track
- Proposed Additional Track
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- Open Space
 - Federal
 - State
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 - Private

- Vermont Critical Habitat
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Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Resource Areas
Brattleboro to Bellows Falls

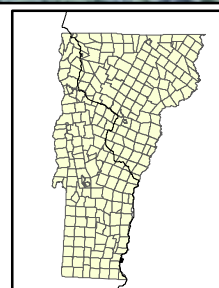
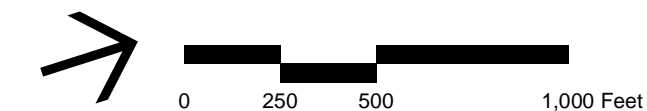
Page 3 of 17





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- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment
- NWI Wetland
- Wetland Buffer (50 Feet)

- Open Space
 - Federal
 - State
 - Municipal/County
 - Other Public/Quasi-Public
 - Private

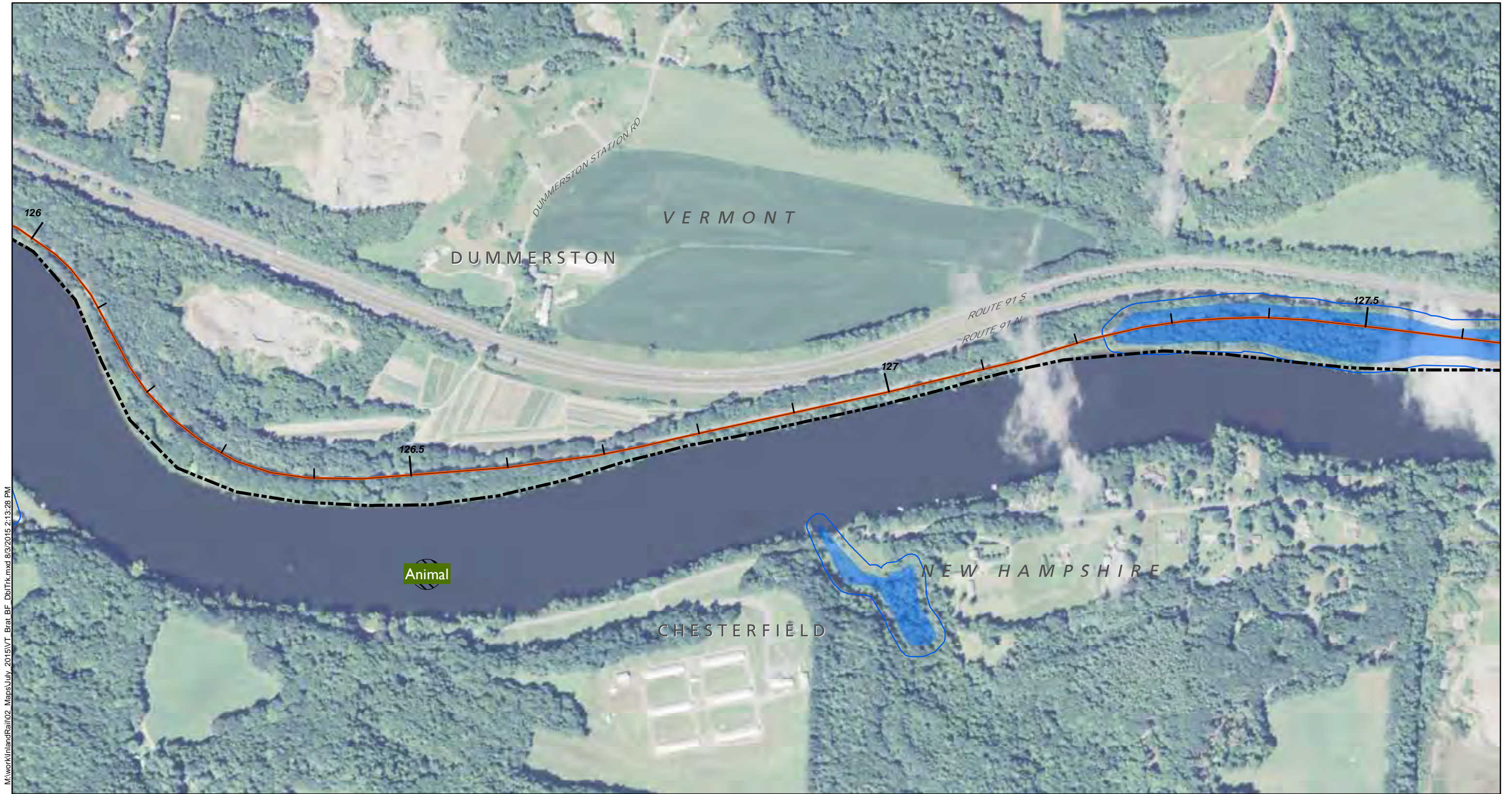
- Vermont Critical Habitat
 - State-Endangered
 - State-Threatened
 - Special Concern
 - Other

Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Resource Areas
Brattleboro to Bellows Falls

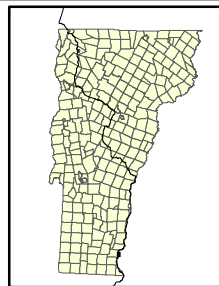
Page 4 of 17





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- Existing Track
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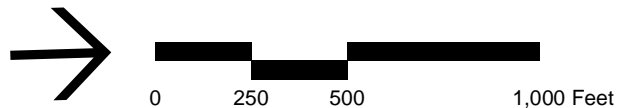
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 - Federal
 - State
 - Municipal/County
 - Other Public/Quasi-Public
 - Private

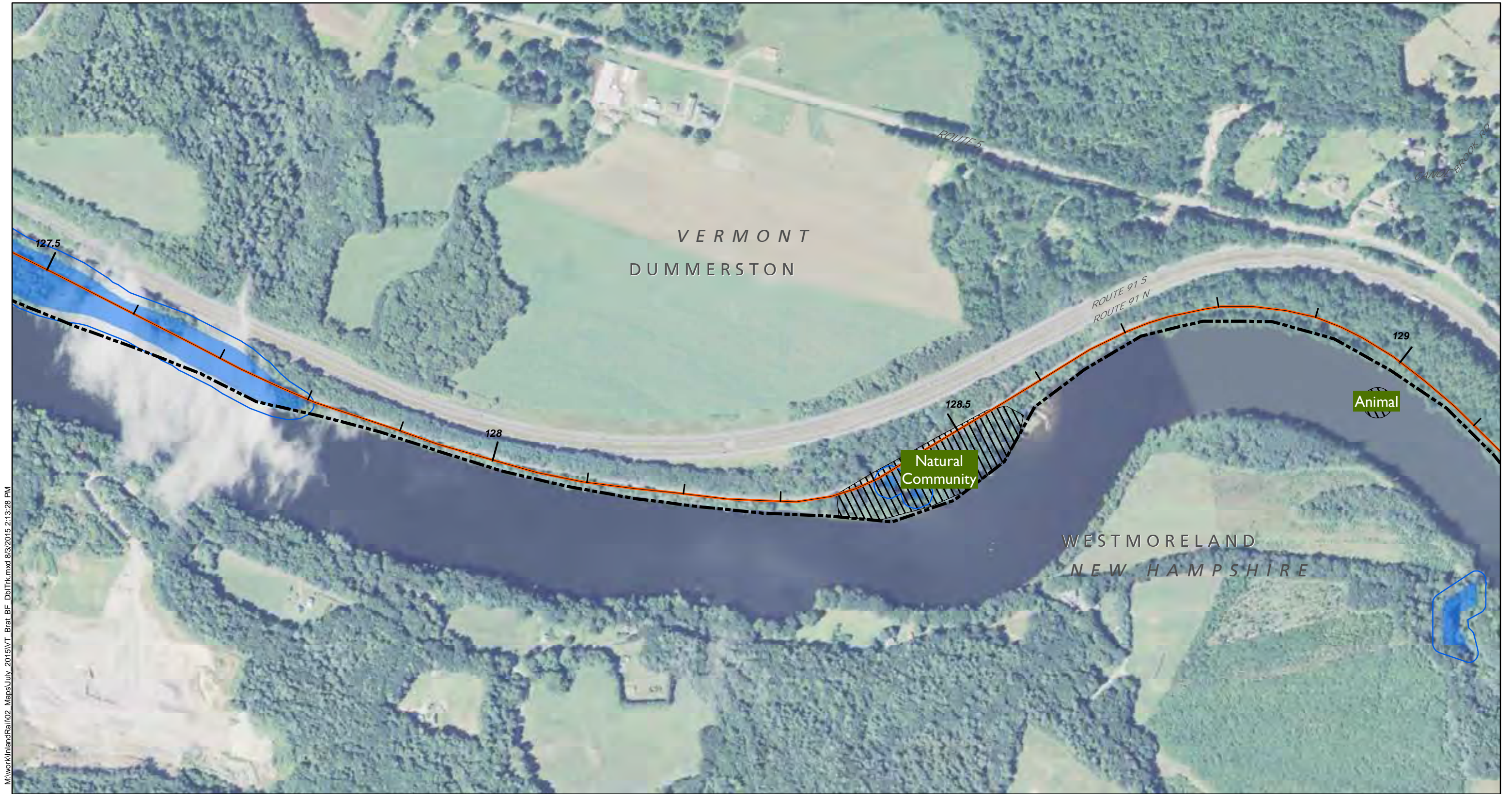
- Vermont Critical Habitat
 - State-Endangered
 - State-Threatened
 - Special Concern
 - Other

Northern New England Intercity Rail Initiative
 BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Resource Areas
Brattleboro to Bellows Falls

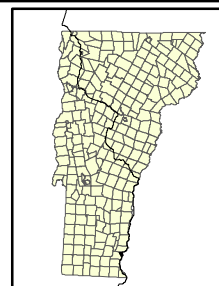
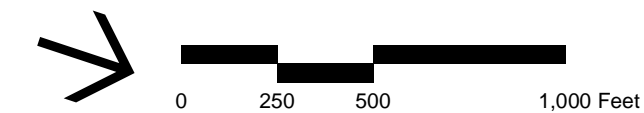
Page 5 of 17





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Data provided by VT GIS. Date of photos: 2014



- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment
- NWI Wetland
- Wetland Buffer (50 Feet)

- Open Space
 - Federal
 - State
 - Municipal/County
 - Other Public/Quasi-Public
 - Private

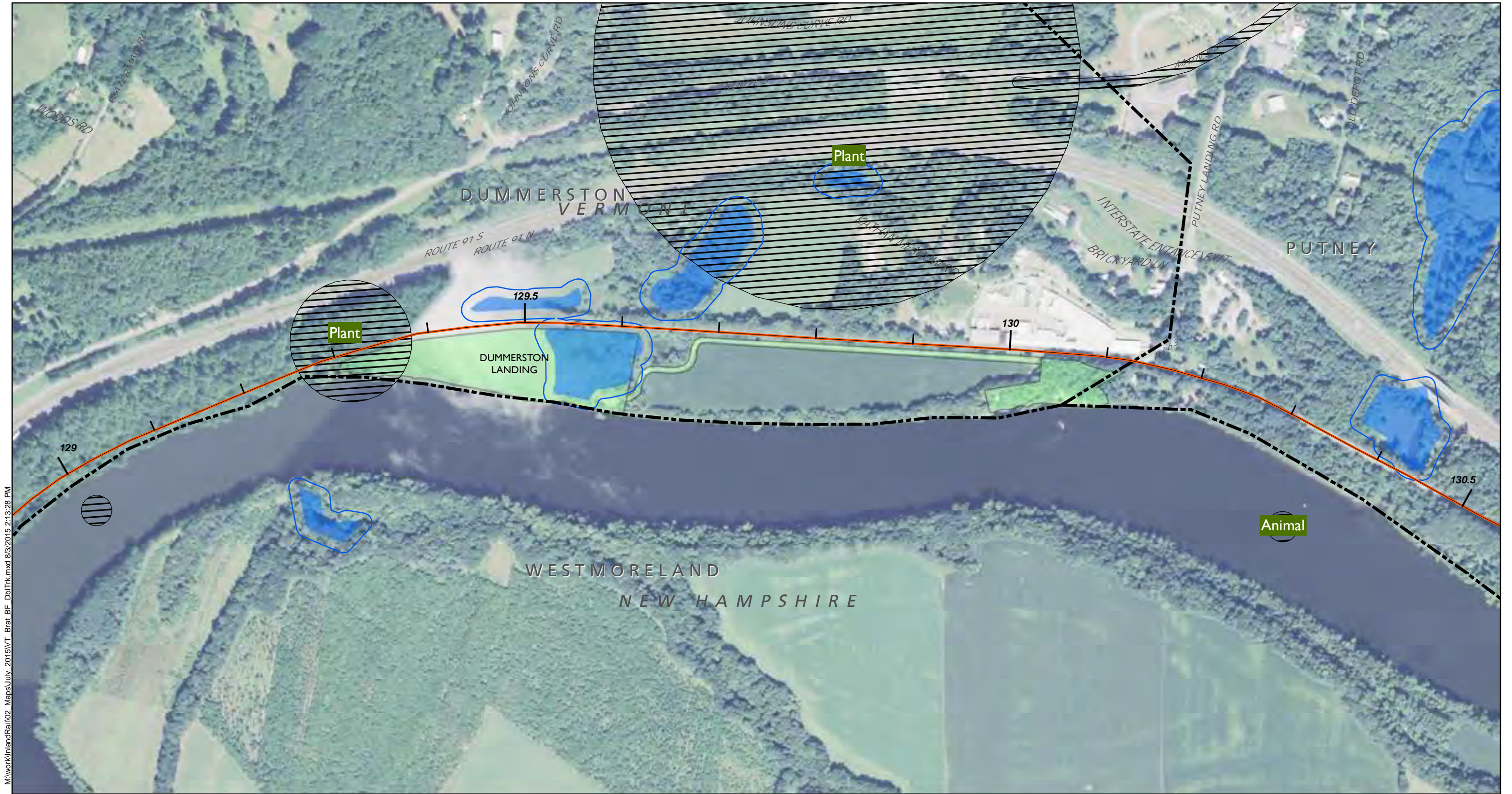
- Vermont Critical Habitat
 - State-Endangered
 - State-Threatened
 - Special Concern
 - Other

Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Resource Areas
Brattleboro to Bellows Falls

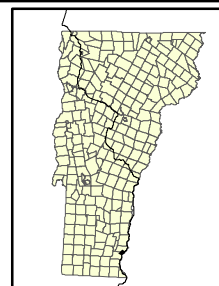
Page 6 of 17





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Data provided by VT GIS. Date of photos: 2014



- Existing Track
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- Additional Track with Minor Realignment
- NWI Wetland
- Wetland Buffer (50 Feet)

- Open Space
 - Federal
 - State
 - Municipal/County
 - Other Public/Quasi-Public
 - Private

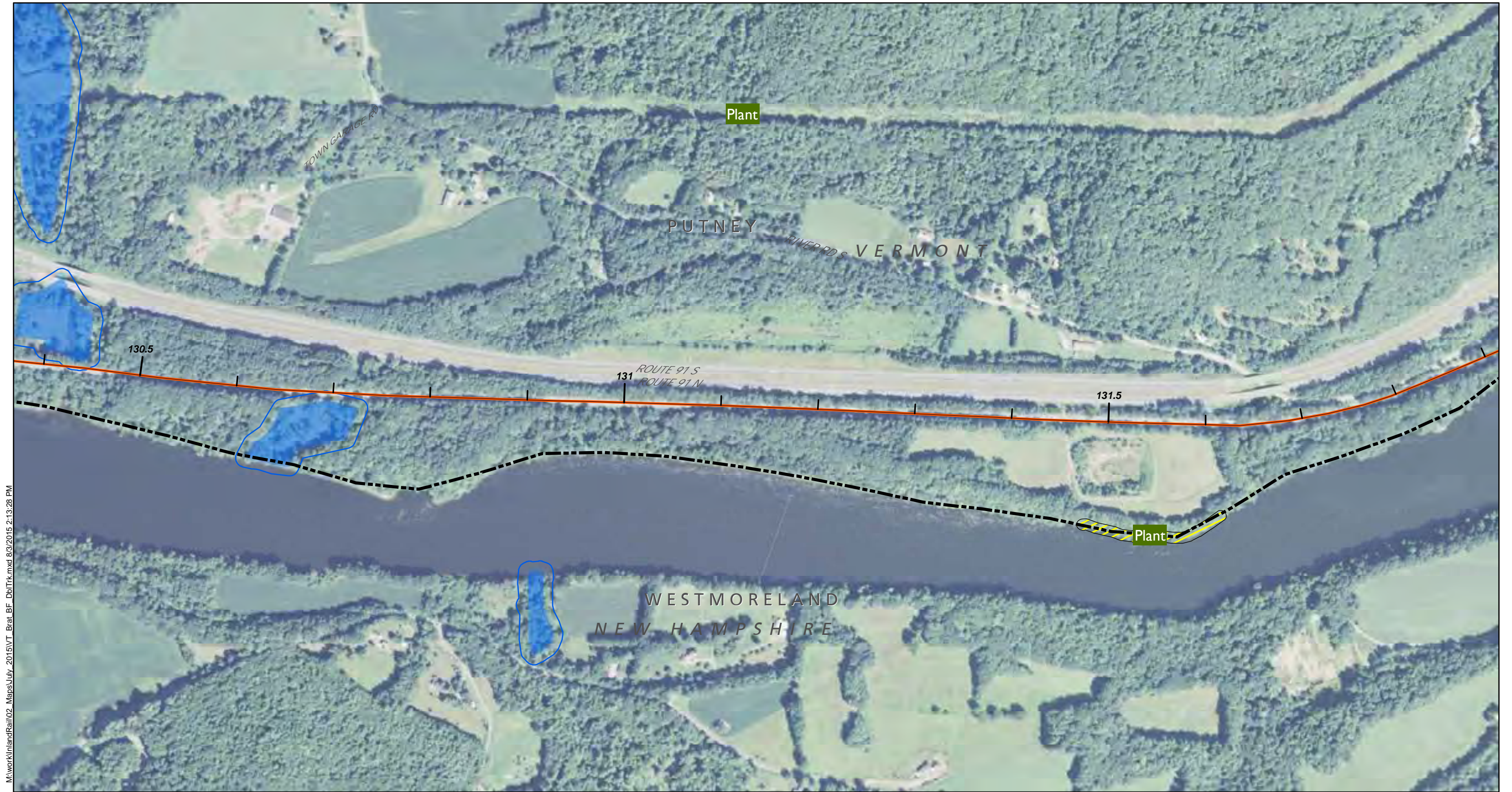
- Vermont Critical Habitat
 - State-Endangered
 - State-Threatened
 - Special Concern
 - Other

Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Resource Areas
Brattleboro to Bellows Falls

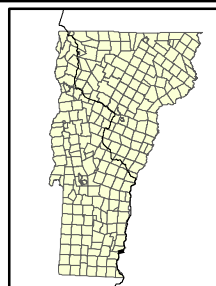
Page 7 of 17





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- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment
- NWI Wetland
- Wetland Buffer (50 Feet)

- Open Space
- Federal
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 - Municipal/County
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 - Private

- Vermont Critical Habitat
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 - State-Threatened
 - Special Concern
 - Other

Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Resource Areas
Brattleboro to Bellows Falls

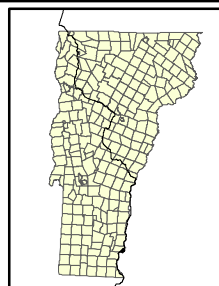
Page 8 of 17





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- Existing Track
- Proposed Additional Track
- Additional Track with Minor Realignment
- NW1 Wetland
- Wetland Buffer (50 Feet)

- Open Space
- Federal
 - State
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Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Resource Areas
Brattleboro to Bellows Falls

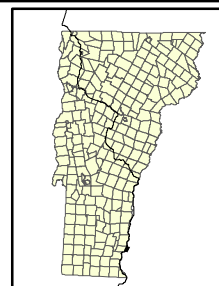
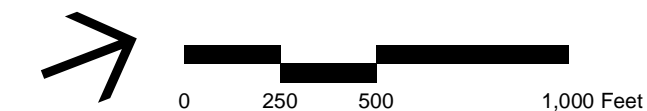
Page 9 of 17





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- Existing Track
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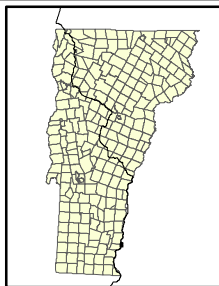
Page 10 of 17





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0 250 500 1,000 Feet

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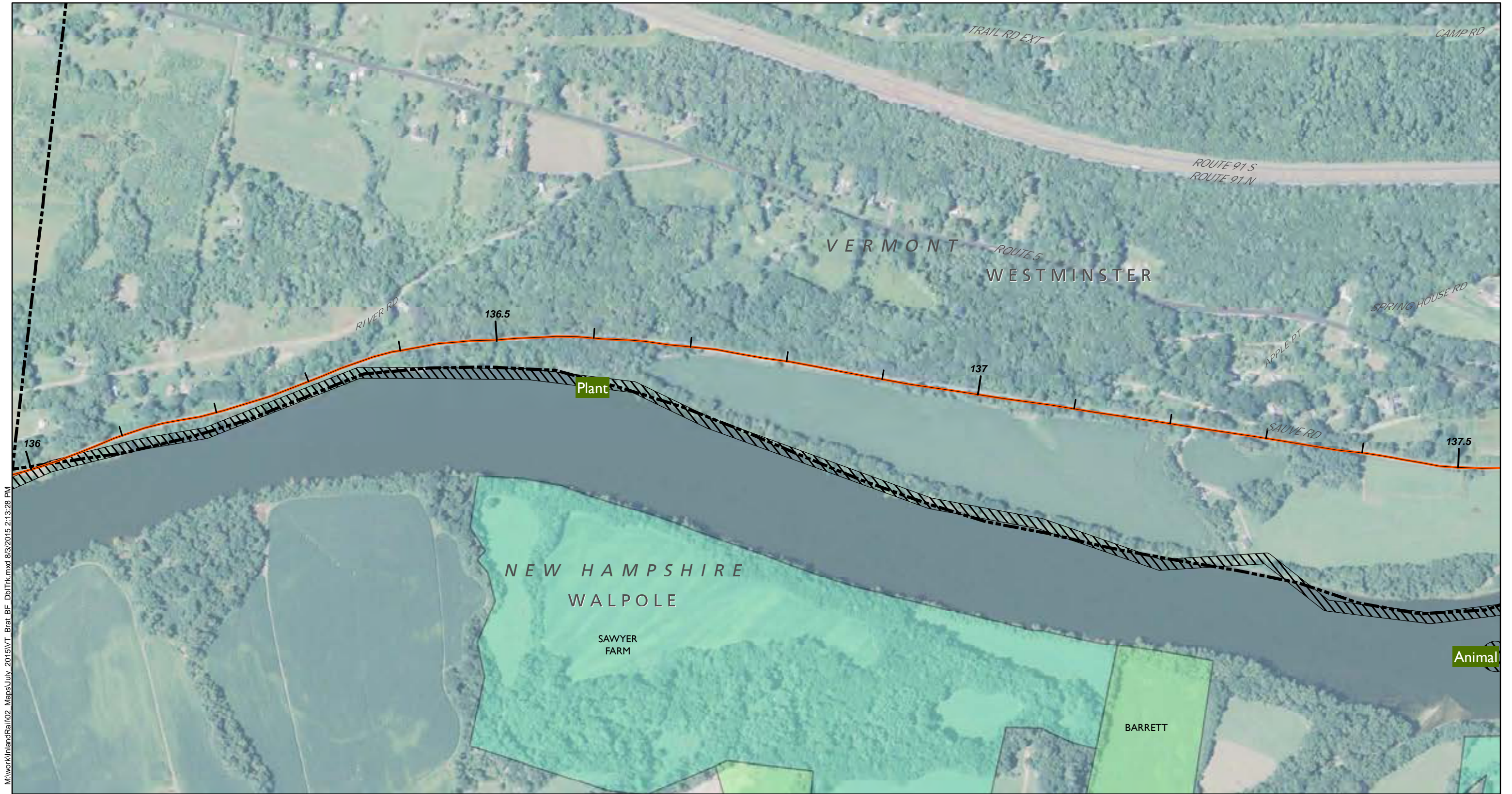
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Resource Areas
Brattleboro to Bellows Falls

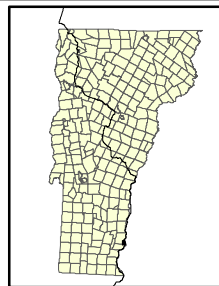
Page 11 of 17





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Brattleboro to Bellows Falls

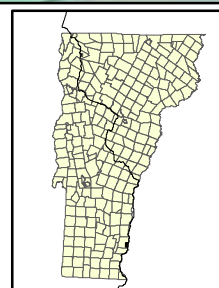
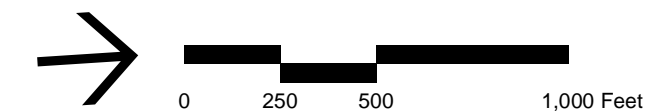
Page 12 of 17





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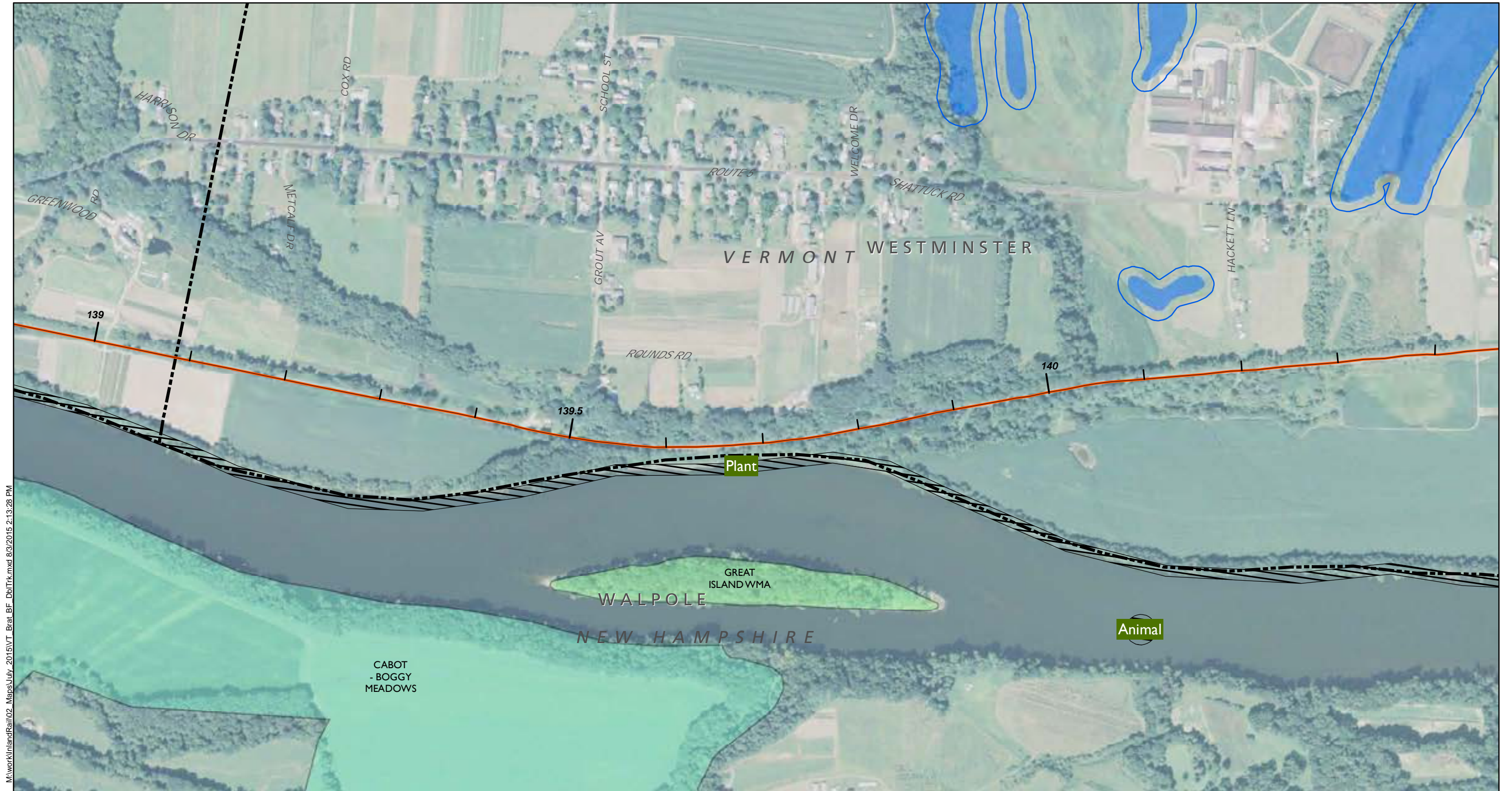
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Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Resource Areas
Brattleboro to Bellows Falls

Page 13 of 17



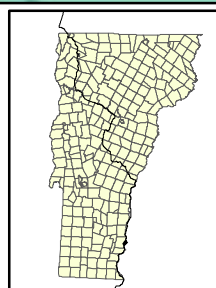


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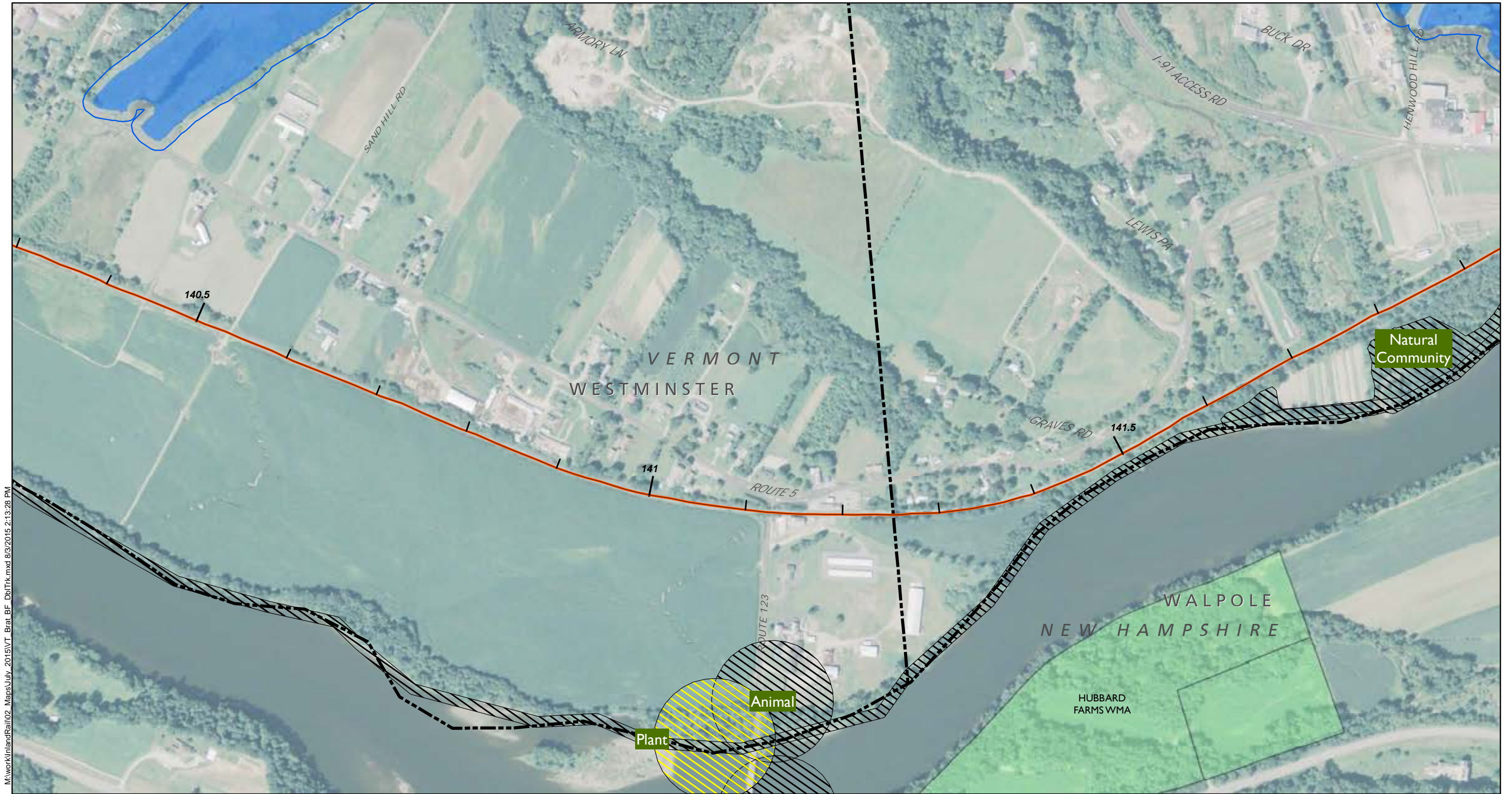
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Brattleboro to Bellows Falls

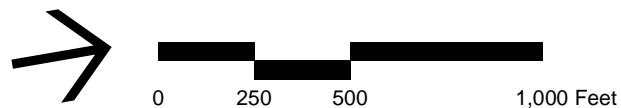
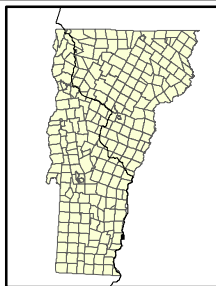
Page 14 of 17





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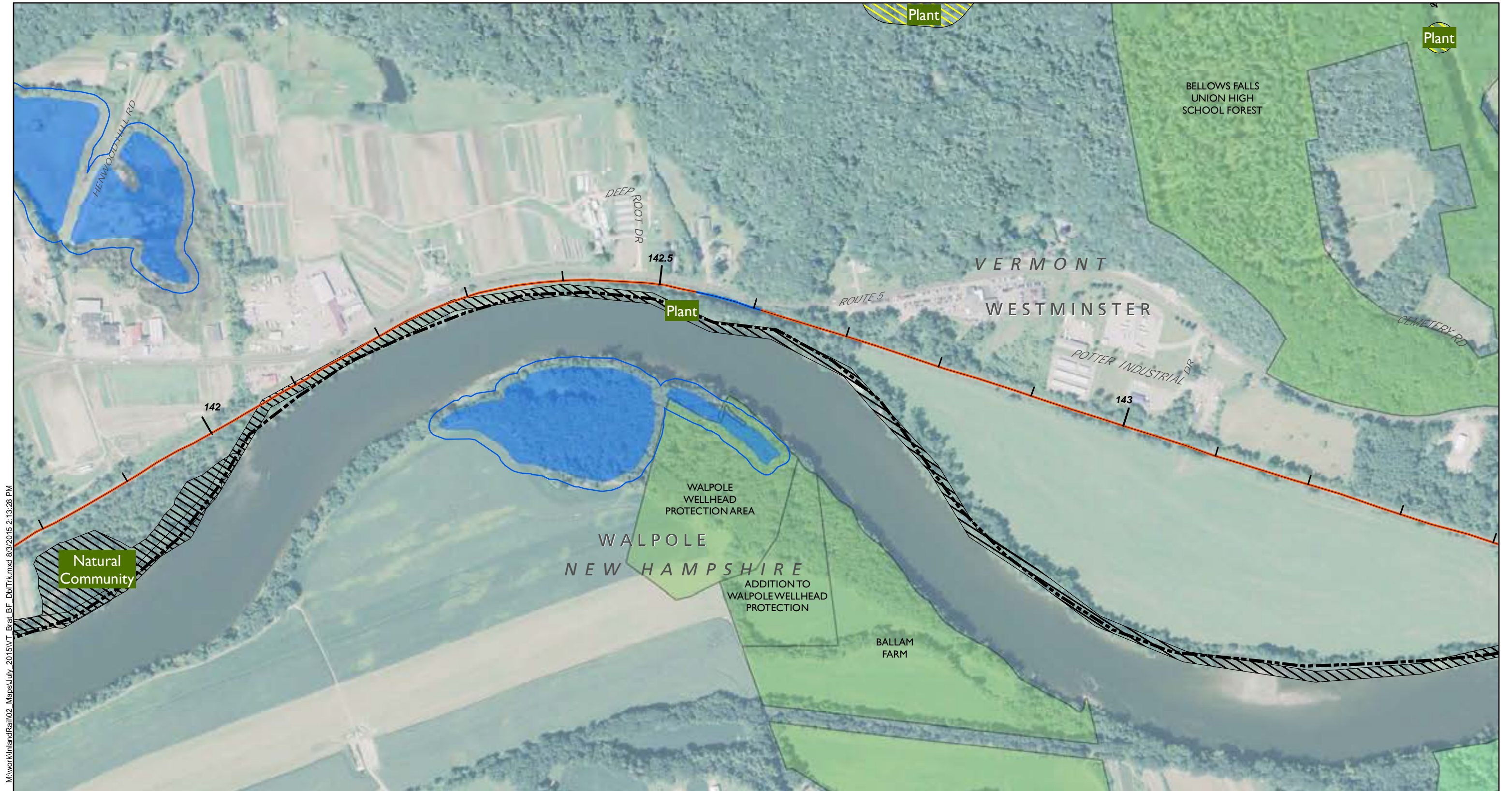
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BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Resource Areas
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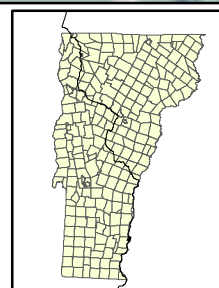
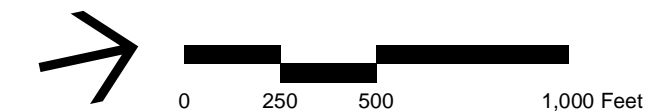
Page 15 of 17





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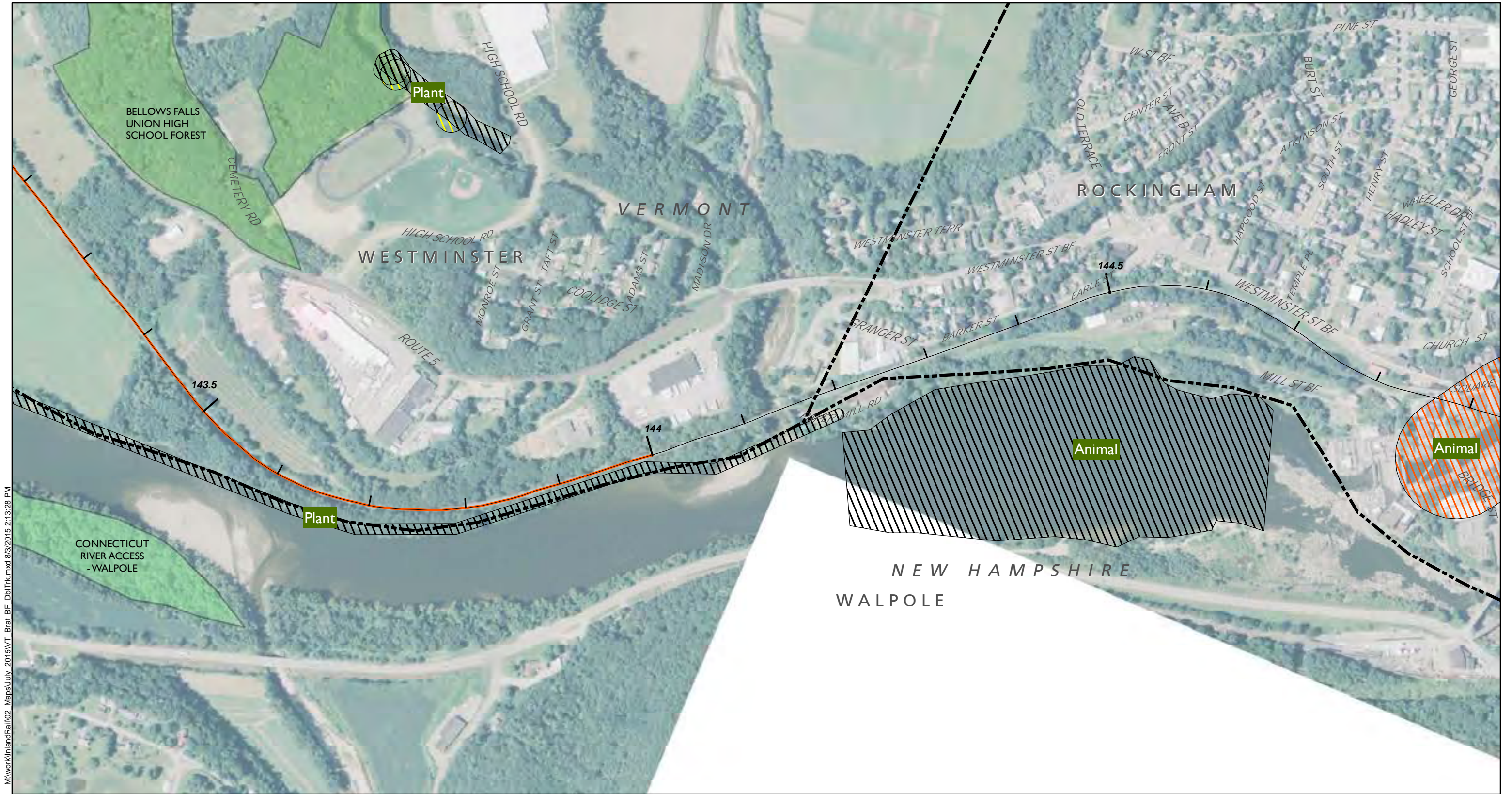
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Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Resource Areas
Brattleboro to Bellows Falls

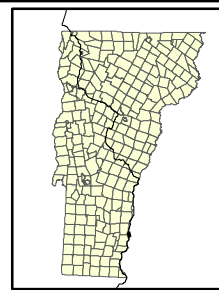
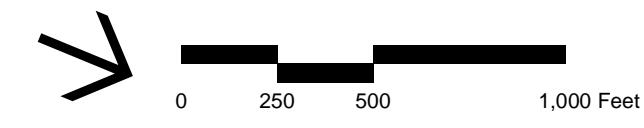
Page 16 of 17





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BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Resource Areas
Brattleboro to Bellows Falls

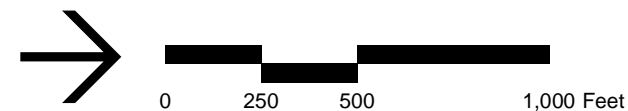
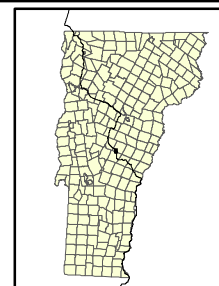
Page 17 of 17





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BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

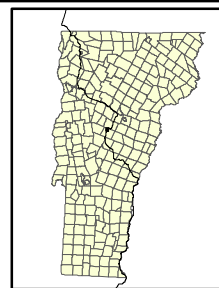
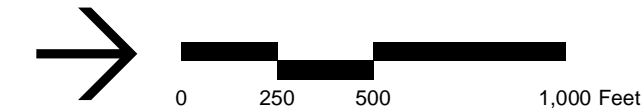
Resource Areas
Randolph Double Track





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BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

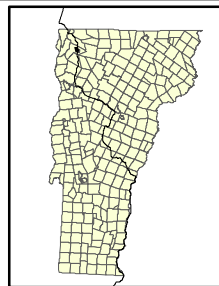
Resource Areas
Roxbury Double Track





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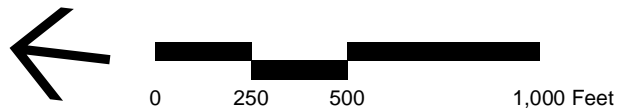
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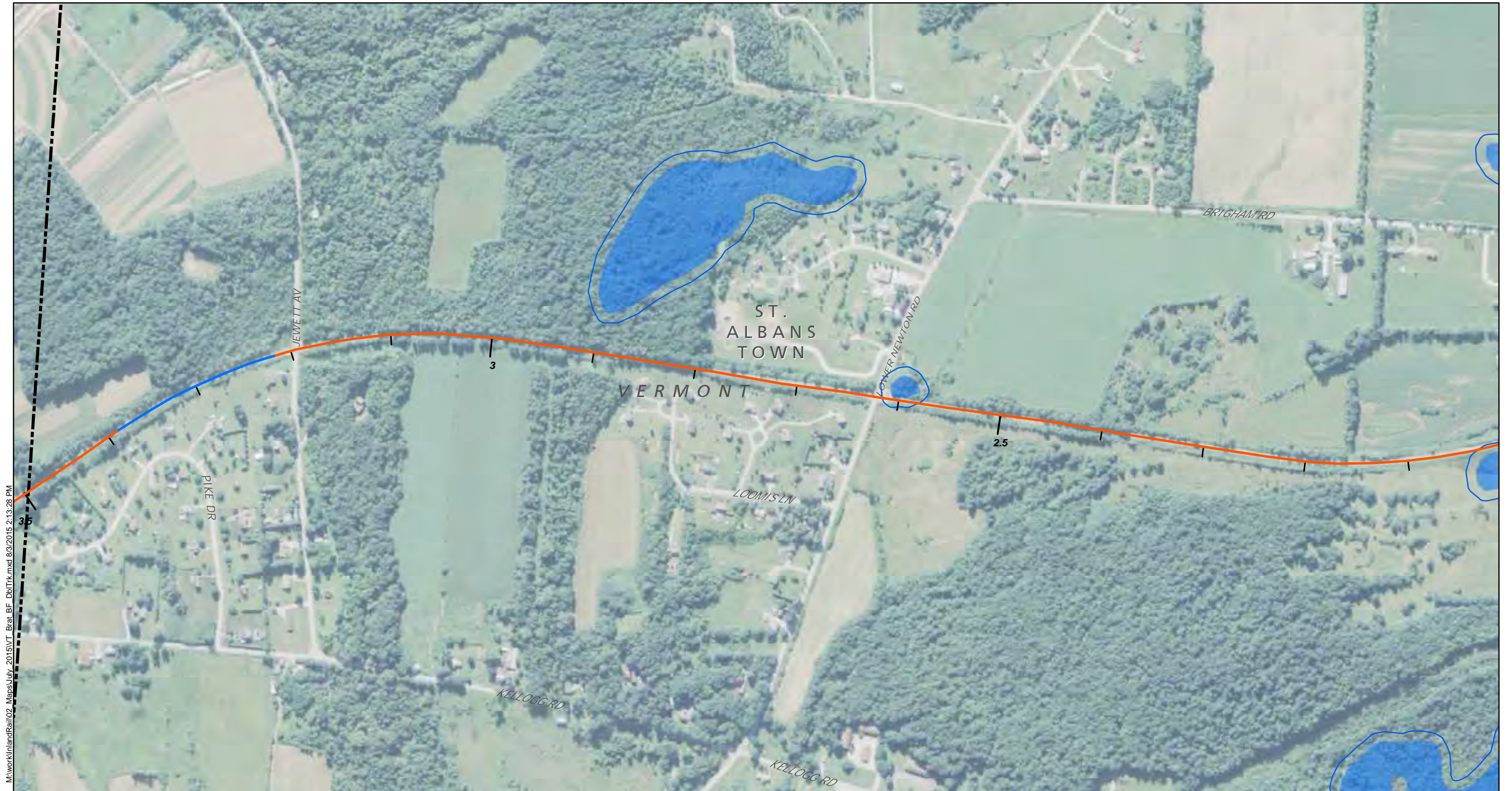
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Northern New England Intercity Rail Initiative
BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Resource Areas
St Albans to Swanton

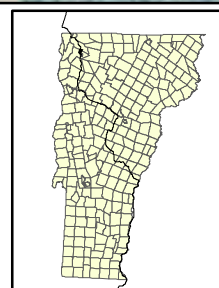
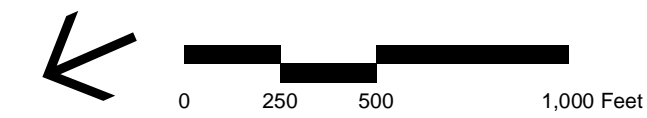
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BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Resource Areas
St Albans to Swanton

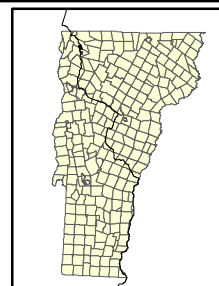
Page 2 of 6





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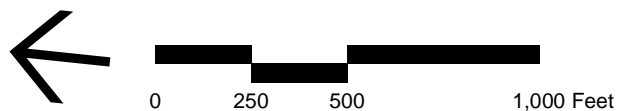
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BOSTON | SPRINGFIELD | NEW HAVEN | MONTREAL

Resource Areas
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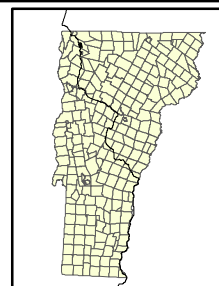
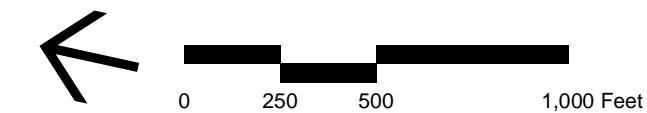
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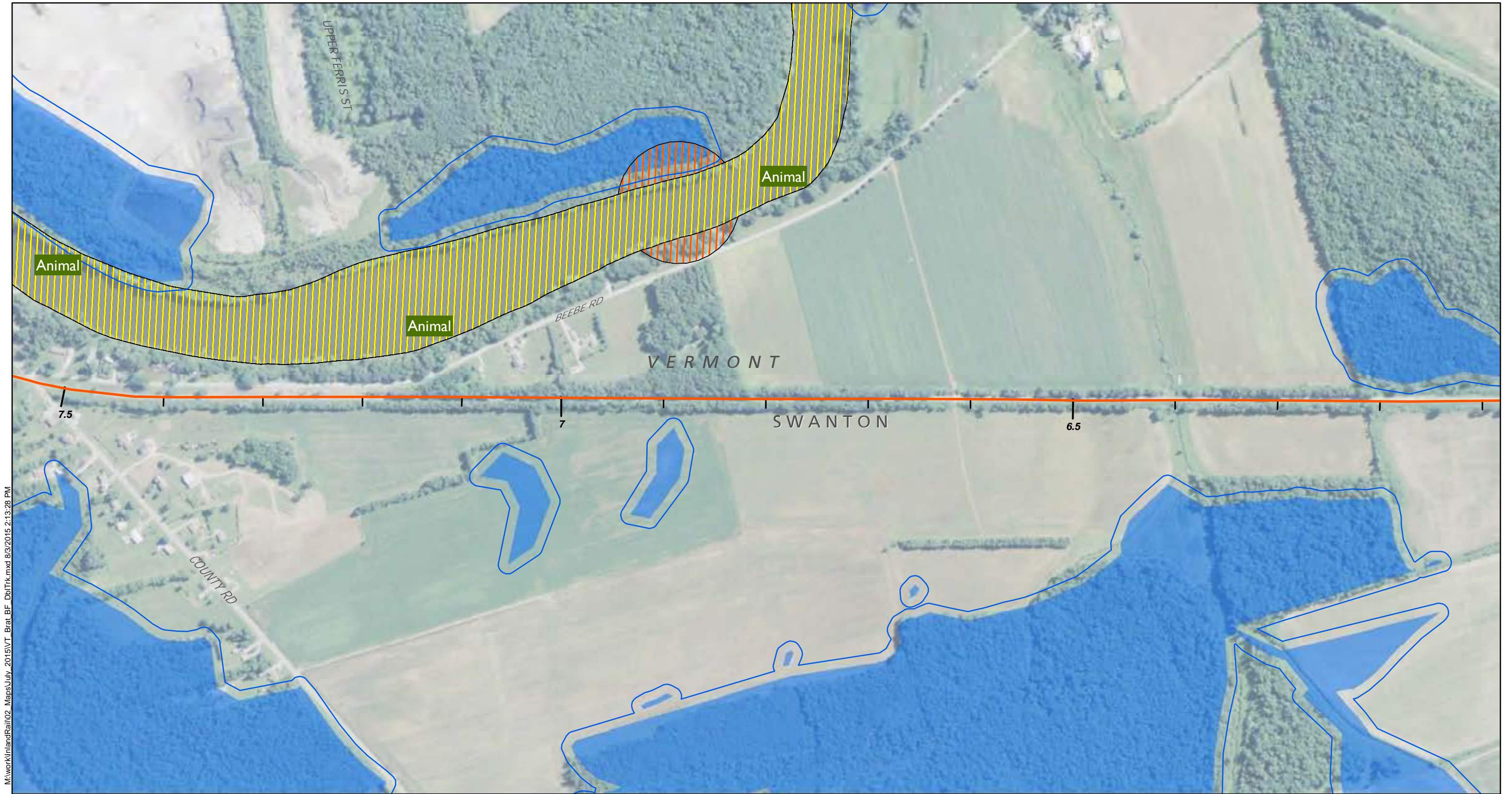
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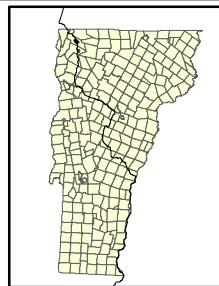
Page 4 of 6





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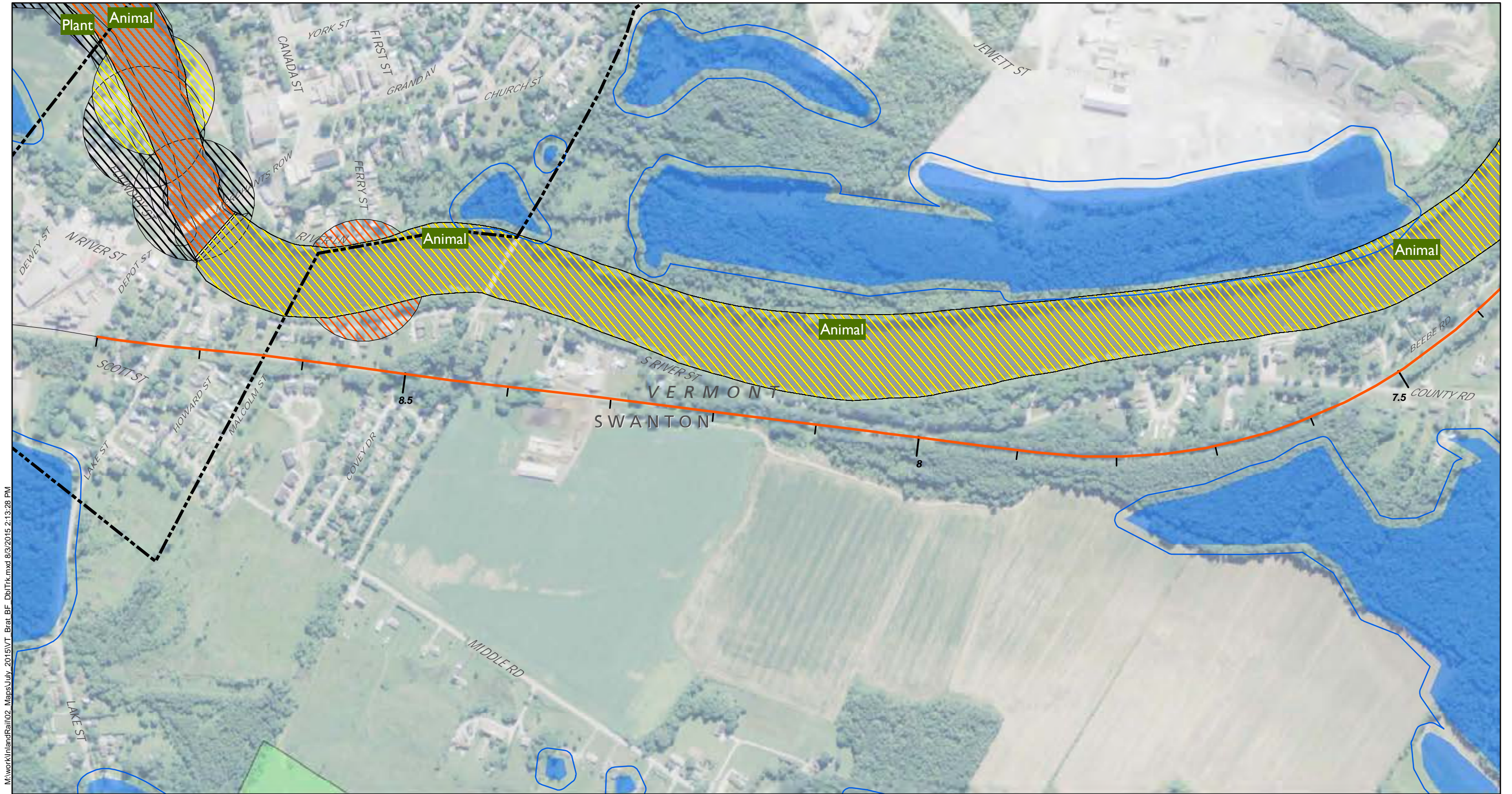
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Resource Areas
St Albans to Swanton

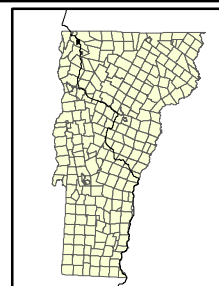
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Page 6 of 6

