Feasibility Study for the Bruce Freeman Rail Phase 3 Extension

Prepared for the Town of Sudbury

Massachusetts

June 2023

115 Broad Street 6th Floor
Boston, MA 02110

FUSS & O'NEILL

Table of Contents

Feasibility Study for the Bruce Freeman Rail Trail Phase 3 Extension

Sudbury, Massachusetts

Appendices

End of Report

Appendix A: Locus Map

Appendix B: Raw Survey

Appendix C: Alternative 2 Concept Roll Plan

Appendix D: Trail Profile

Appendix E: Alternative 2 Opinion of Probably Cost

Appendix F – Traffic Analysis Tables

1. Morning Peak Hour Table
2. Afternoon Peak Hour Table

Appendix G: Existing Structures Memo

Appendix H: Environmental Report

1. Project Overview

Fuss & O'Neill has completed a feasibility study which includes preliminary data collection, conceptual design, and cost analysis for the extension of the Bruce Freeman Rail Trail (BFRT) Phase 3 in Sudbury, MA.

The subject trail segment of this feasibility study, known as Phase 3 of the BFRT, will span approximately 1.4 miles from the Mass Central Rail Trail (MCRT)/BFRT Junction in Sudbury, MA to Eaton Road W in Framingham, MA. The BFRT currently provides approximately 15 miles of paved off-road trail, beginning in Lowell and ending in Concord. Currently in Construction, Phase 2D in Sudbury will add another 4.4 miles to the trail and will bring the trail from the existing terminus in Concord to the MCRT/BFRT Junction in Sudbury. Phase 3 of the trail will be constructed on an inactive railroad which was purchased by the Town of Sudbury from the CSX Corporation. Many considerations have been taken for this phase including the safety of trail users while crossing Boston Post Road (Route 20), the location of parking, environmental impacts, and other factors that will be explained in this feasibility study.

2. Existing Conditions

2.1 Condition of Rail Trail

The rail trail is proposed to follow the inactive Framingham and Lowell Railroad line which was abandoned in the 1980's. Because of this, the proposed build area is overgrown with trees and vegetation and remnants of the old railroad infrastructure are evident in the project area.

Image 1: Existing condition of the trail

2.2 Road Network

This phase is expected to cross one major road, Route 20 (Boston Post Road). Understanding the surrounding road network is important for ensuring pedestrian safety around high traffic areas as well as establishing potential design and construction costs for crossing such vehicular corridor.

Boston Post Road (Route 20):
Boston Post Road (Rt.20) is a State Highway Layout (SHLO) which is owned and maintained by the Massachusetts Department of Transportation (MassDOT) Highway Division. The roadway is classified as an urban principal arterial and has an Average Annual Daily Traffic (AADT) of approximately 21,700 vehicles per day. The speed limit in both directions is 30 mph and the average travel speed is approximately 27 mph. There are currently sidewalks along Route 20 within the project area as well as extending into surrounding areas, however, there is limited bike infrastructure including the lack of bike lanes and intersection accommodations. Pedestrian and cyclist safety around Route 20 is crucial to evaluate due to the anticipated increase in pedestrian and cyclist activity that the rail trail will cause. In the last 5 years, there has been one collision between a vehicle and pedestrian within the project limits which signifies that this intersection is an area where features for pedestrian and cyclist safety should be carefully considered and implemented.

Nobscot Road:
Nobscot Road is classified as an urban minor arterial and has an AADT of approximately 7,250 vehicles per day. Nobscot Road intersects with Route 20 near where the rail trail intersects with Route 20 making it a necessary road to analyze. A potential parking lot is also being considered at a location along Nobscot Road so understanding the functionality of this road is necessary when evaluating different options for parking. The posted speed limit is 35 mph, and the average travel speed was found to be approximately 39 mph. There is one sidewalk along Nobscot road that ties into the existing unpaved BFRT, however there is no existing bike infrastructure like designated bike lanes or intersection accommodations.

Union Avenue:
Union Avenue is classified as an urban minor arterial and has an AADT of approximately 9,200 vehicles per day. Union Avenue intersects with Route 20 approximately 730 feet east of Nobscot Road. Although Union Avenue is not within the project limits, the traffic operation at this intersection may be impacted by the addition of the rail trail crossing as well as by any signal timing or geometry changes to the Nobscot/Route 20 intersection.

Image 2: Google maps image looking west at the intersection of Route 20 and Nobscot Road

Image 3: Google maps image looking west at the intersection of Route 20 and Union Avenue

3. Proposed Crossing Alternatives

Five build alternatives were proposed for the BFRT crossing of Route 20. Three of the options are at grade crossing, meaning pedestrians and cyclists would cross the road at existing road level. The other two options are above grade (bridge overpass) and below grade (tunnel) crossings, respectively. Five main factors were considered when comparing and analyzing these options including pedestrian/cyclist safety, the anticipated construction cost, the effect on existing traffic conditions, anticipated environmental impacts, and anticipated right-of-way impacts. Pedestrian and cyclist safety is not necessarily a quantitative measure at this stage of the project but rather examines what safety features would be included in each alternative and how that compares to the safety features in the other alternatives. The project cost for each alternative is not exactly known at this time but are approximated based on completed rail trail projects of similar size and scope. The effect on existing traffic conditions has been analyzed by using traffic simulation based on projecting a growth factor on current traffic counts. Factors that are taken into consideration for the traffic analysis include delay per vehicle, 95% queue lengths, 50% queue lengths, and volume to capacity ratios. The anticipated environmental impacts are based on how the project would impact features including wetlands, rare species habitats, and other environmentally sensitive areas. The anticipated right-of-way impacts are based on how the project would affect surrounding properties and how much land would need to be acquired for easements and fee taking.

3.1 Alternative 1 – Un-signalized

The first alternative would consist of adding a mid-block at grade crossing that would allow trail users to cross Boston Post Road at the location where the trail would intersect the road at the existing railroad right-of-way alignment. For this alternative, new crosswalks, pedestrian curb ramps, rectangular rapid flashing beacons, and additional signage would be included at the intersection.

Cost Analysis:
This alternative would require minimal roadway geometry changes causing it to be less expensive when compared to other alternatives. Introducing features like the rectangular rapid flashing beacon would make this a more costly option when compared to alternative 2.

Pedestrian Safety and Accessibility:
This at grade crossing would be easily accessible to all users as users would not have to navigate up a pedestrian bridge or a sloped pedestrian tunnel. One concern is that a mid-block crossing could cause opportunity for conflict between pedestrians and vehicles due to the crossing not being at a signalized intersection with a designated pedestrian phase. The rectangular rapid flashing beacon would alert vehicles to the pedestrian crossing, but the safety of pedestrians relies heavily on drivers being alert and paying attention more so than if the crossing was at the signalized intersection. Due to the close proximity to an existing signalized intersection, a safer crossing method, a high-intensity activated crosswalk (HAWK signal), would not be feasible which raises concerns about how safe this option really is. Concern over pedestrian safety makes the implementation of this alternative less than optimal.

Effect on Traffic Conditions

The effect on traffic conditions can be seen in *Appendix F*. These results are based on optimizing the signal timings for both intersections (Route 20/Nobscot Road and Route 20/Union Avenue). When looking at the delay and level of service, this alternative operates under an acceptable condition that is very similar to how the intersection currently operates. The level of service is a C for both morning and afternoon peak hours at the Route 20/Nobscot Road intersection. One concern for this alternative is that having a midblock crossing that is not coordinated with the surrounding signalized intersections may cause queuing and could even queue into the intersection of Nobscot Road and Route 20. This may also limit the possibility of coordinating the surrounding intersection due to the unpredictable nature of pedestrian and cyclist volumes moving through the crossing.

Table 1: Benefits and Disadvantages of Alternative 1

Benefits	Disadvantages
• Low cost compared to other alternatives	• Safety concerns for pedestrians and other trial users
• Little to no effect on traffic operation at the Nobscot Road/Route 20 intersection	• Queuing on the Nobscot Road approach
	• Possible queuing into the Nobscot Road/Route 20 intersection due to the pedestrian crossing
	• Difficulty coordinating the intersection due to the inconsistent yield conditions

3.2 Alternative 2 - Signalized

The second alternative would align trail users with the existing signalized crosswalk location and allow them to cross the road under the protection of pedestrian signal phase (See Image 4 below). Supplemental signage and pavement markings for both trail users and drivers would be implemented to direct all intersection users on how to safely navigate this intersection. This alternative would maintain the existing roadway geometry, pavement markings, and signal infrastructure. Minor upgrades to signal phasing, push buttons, pedestrian count-down timers, curb ramps, and signage to meet ADA standards would be necessary, but generally the intersection configuration and assets would remain unchanged.

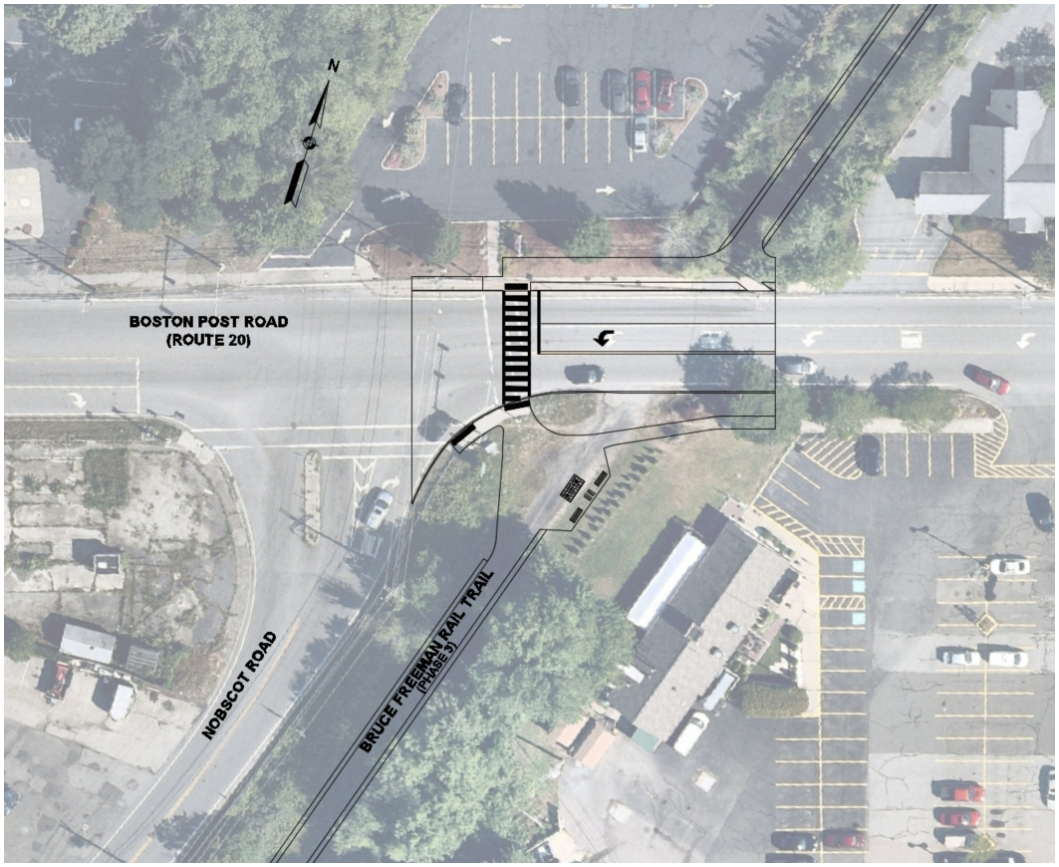


Image 4: Proposed Alternative 2

Cost Analysis:
This alternative would mostly utilize the existing infrastructure and would only require some changes to make the intersection easily accessible to all. By utilizing most of the existing infrastructures, the changes that would need to be made for this alternative would be much less expensive than if the roundabout, pedestrian bridge, or tunnel was implemented.

Pedestrian Safety and Accessibility:
One of the specific safety benefits to this alternative is the increased safety that crossing during an exclusive pedestrian phase offers when compared to a mid-block crossing. In this scenario, all intersection approaches would be stopped allowing trail users a dedicated phase to cross the street without any vehicle conflicts. Other measures that could be implemented to improve safety include limiting permissive vehicle movements like right turns on red or by adjusting the intersection geometry to give trail users a shorter distance to cross the street.

Effect on Traffic Conditions
The effect on traffic conditions can be seen in *Appendix F*. These results are based on optimizing the signal timings for both intersections (Route 20/Nobscot Road and Route 20/Union Avenue). The effects on traffic operation parameters like delay and level of service are minimal when compared to the 2042 No Build scenario. Overall, this alternative approximately maintains existing levels of traffic operations making it a viable option in that regard.

Table 2: Benefits and Disadvantages for Alternative 2

Benefits	Disadvantages
• Designed to have pedestrians cross at signalized cross walk which will improve pedestrian protection compared to other alternatives	• Locations of problematic queueing will remain due to the lack of geometry changes
• Low cost compared to other alternatives	• Minimal improvements (if any) to vehicle level-of-service/delay
• Minimal impact traffic operations at the Nobscot Road/Route 20 intersection	
• Coordination of intersections is possible without the mid-block crossing	

3.3 Alternative 3 - Roundabout

The third alternative would consist of the existing signalized intersection at Nobscot/Route 20 being rebuilt as a roundabout and trail users would cross Boston Post Road at grade along the eastern approach of the roundabout. Pedestrian safety features like rectangular rapid flashing beacons or a HAWK signal would be considered in this alternative to make this crossing safer. Other features that are proposed include shared use paths extending outwards from the roundabout to allow pedestrians and cyclists to access the trail safely from all directions.

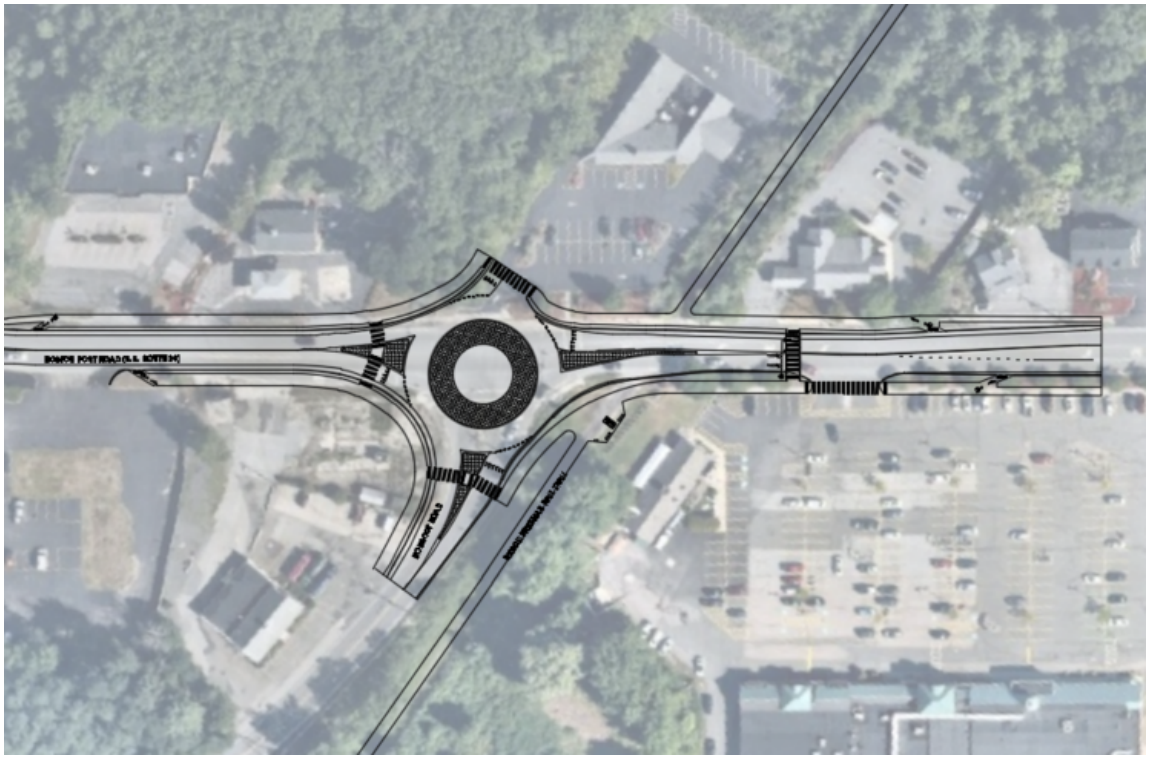


Image 5: Proposed Alternative 3

Cost Analysis:
This alternative would require major geometry changes to the intersection which would result in an anticipated cost that is much higher than alternatives 1 and 2.

Pedestrian Safety and Accessibility:
Trail users would cross the road at a mid-block crossing similar to alternative 1. The at grade crossing would allow for easy access for all users, however, there are some safety concerns about this type of crossing at this location. Because roundabouts are not signalized, the safety of pedestrians would rely solely on the attentiveness of both drivers and pedestrians which may cause conflicts between vehicles and trail users. In Image 5 above, the pedestrian crossing is moved east of the roundabout to a location where installing a HAWK signal would be appropriate and warranted meaning that the crossing can be manipulated in a way that makes it safer for trail users to cross the road despite the general unsafe nature of mid-block crossings.

Effect on Traffic Conditions
The effect on traffic conditions can be seen in *Appendix F*. The intersection delay improves for both morning and afternoon peak hours and the queueing improves or stays approximately the same for all approaches in the morning scenario and for most approaches in the afternoon scenario when compared to the 2042 No Build Scenario. One concern is that a roundabout is not able to be coordinated with surrounding intersections because it is not signalized which is less ideal for overall traffic operation when compared to alternative 2. Something else to note is that roundabouts are generally safer for vehicles compared to signalized intersection due to fewer possible collision points and the removal of opportunity for serious crashes like head on collisions and broadside collisions. Although the focus of this project is on the rail trail and not necessarily improving the intersection for vehicles, the roundabout would provide significant improvement to vehicular safety and traffic operation when compared to a traffic signal.

Table 3: Benefits and Disadvantages of Alternative 3

Benefits	Disadvantages
• Improves delay at the Nobscot/Boston Post Road intersection	• Potential for vehicle-pedestrian conflicts due to no signalized pedestrian phase
• Improves queue length in most approaches	• Requires a complete change to the existing geometry which would cause a high cost
• Would improve vehicular safety over existing conditions	• Not able to be coordinated with Union Avenue/Route 20 intersection
	• Would require costly right-of-way acquisition

3.4 Alternative 4 – Route 20 Over-Pass

The fourth alternative would consist of an above grade crossing that would allow pedestrians and cyclists to cross the street above Route 20 on a bridge over-pass.

Image 6: Example of a pedestrian over-pass located along the Clipper City Rail Trail in Newburyport, MA

Cost Analysis:
This alternative would require minimal geometry change to the intersection itself but the cost of constructing a pedestrian bridge would be very high when compared to the other alternatives.

Pedestrian Safety and Accessibility:
A grade separated crossing, a pedestrian bridge in this case, would be highly beneficial in terms of pedestrian safety as the likelihood of a pedestrian-vehicle conflict would be minimized due to pedestrians not crossing the street at street level.

Effect on Traffic Conditions:
This alternative would minimally affect traffic conditions because trail users would not require traffic to stop to allow them to cross the road. If this alternative was chosen, signal timings would most likely be altered to optimize the level of service and queue lengths so in that regard, the traffic conditions may slightly improve.

Table 4: Benefits and Disadvantages of Alternative 4

Benefits	Disadvantages
• Above grade crossing separates pedestrians from traffic for increased safety	• Extremely high cost that may not be necessary
• LOS and queues would remain the same or slightly improve when compared to existing conditions	• The crossing may be less accessible for some users
	• Addition esthetics and maintenance considerations are required

3.5 Alternative 5 – Route 20 Tunnel

The fifth alternative is a below grade crossing that would direct pedestrians and cyclists to a tunnel below Route 20. Proper signage and trail markers would direct users into the tunnel.

Image 7: Tunnel crossing example located along the Cape Cod Rail Trail

Cost Analysis:
This alternative would require minimal geometry change to the intersection itself but the cost of constructing a pedestrian tunnel would be extremely high compared to the other alternatives.

Pedestrian Safety and Accessibility:
A grade separated crossing, a pedestrian tunnel in this case, would be highly beneficial in terms of pedestrian safety as the likelihood of a pedestrian-vehicle conflict would be minimized due to pedestrians not crossing the street at street level. However, accessing the trail from Route 20 may be

difficult due to the grade separation so having the tunnel may not be as user friendly compared to other alternatives.

Effect on Traffic Conditions:
Like alternative 4, this alternative would minimally affect traffic conditions because trail users would not require traffic to stop to allow them to cross the road. If this alternative was chosen, signal timings would most likely be altered to optimize the level of service and queue lengths so in that regard, the traffic conditions may slightly improve.

Table 5: Benefits and Disadvantages of Alternative 5

Benefits	Disadvantages
• Below grade crossing separates pedestrians from traffic for increased safety	• Potential for extremely high cost that may not be necessary
• Would minimally effect or slightly improve traffic operations	• Depending on the grade of the tunnel, the crossing may be less accessible for some users
	• Public safety concerns related to lack of visibility of users in tunnel, particularly at night.

4. Crossing Alternative Analysis

The five alternatives previously discussed were analyzed for factors including safety impacts, cost, traffic impacts, environmental impacts, and right-of-way impacts which are summarized in the tables below. The rankings are based on how optimal each alternative is per category. The lowest score in each category is a 1 which represents the least favorable conditions and the highest score in each category is a 5 which represents the most favorable conditions.

4.1 Trail User Safety Impacts

Table 6: Comparing the alternatives based on the safety of trail users crossing Route 20.

Alternative	Comments	Score
1 - Unsignalized	Not at signalized intersection. Despite flashing beacons and other safety features, the safety of pedestrians relies solely on driver/pedestrian decision making	1
2 - Signalized	Crosses at existing signalized intersection	4
3 - Roundabout	Despite the HAWK signal and other safety features, the safety of pedestrians relies solely on driver/pedestrian decision making. The HAWK signal would still be safer than flashing beacons	3
4 – Over-pass	Avoids all vehicular traffic	5
5 - Tunnel	Avoids all vehicular traffic	5

1=Less Safe; 5=More Safe

4.2 Construction Cost Analysis

Table 7: Comparing the alternatives based on anticipated construction cost.

Alternative	Comments	Score
1 - Unsignalized	Would require rectangular rapid flashing beacons but cost is minimal, no major geometry changes would be required	4
2 - Signalized	Cost is minimal. No major geometry changes would be required, and signal equipment would be retained	5
3 - Roundabout	Would require complete geometry change and removal of existing signal equipment	3
4 – Over-pass	Would require extensive structural and geotechnical design/construction	1
5 - Tunnel	Would require extensive structural and geotechnical design/construction	1

1=High Cost; 5= Low Cost

4.3 Traffic Impacts

Table 8: Comparing the alternatives based upon projected level of service, delay, and queueing impacts.

Alternative	Comments	Score
1 - Unsignalized	Little affect to level of service, delay, and queueing compared to existing conditions	3
2 - Signalized	Little affect to level of service, delay, and queueing compared to existing conditions	3
3 - Roundabout	Improvements to delay and queue for most approaches compared to existing and other build conditions	5
4 – Over-pass	Little to no affect to level of service, delay, and queueing compared to existing conditions	3
5 - Tunnel	Little to no affect to level of service, delay, and queueing compared to existing conditions	3

1=Worsens Conditions; 5=Betters Conditions

4.4 Environmental Impacts

Table 9: Comparing the alternatives based on anticipated environmental impacts.

Alternative	Comments	Score
1 - Unsignalized	N/A	5
2 - Signalized	N/A	5
3 - Roundabout	N/A	5
4 – Over-pass	N/A	5
5 - Tunnel	N/A	5

1=Most Environmental Impacts; 5=Least Environmental Impacts

4.5 Right-of-Way Impacts

Table 10: Comparing the alternatives based on anticipated right-of-way impacts and the amount of properties affected by the design.

Alternative	Comments	Score
1 - Unsignalized	Minimal right-of-way impacts	5
2 - Signalized	Minimal right-of-way impacts	5
3 - Roundabout	Would cause some right-of-way impacts	3
4 – Over-pass	Would cause some right-of-way impacts	3
5 - Tunnel	Would cause some right-of-way impacts	3

1=More Properties Affected; 5=Less Properties Affected

4.6 Summarized Results

Table 11: Summarized results of the alternative comparisons

Alternative	Safety	Cost	Traffic	Environmental	Right-of- Way	Total Score
1 – Un-signalized	1	4	3	5	5	18
2 – Signalized	4	5	3	5	5	22
3 – Roundabout	3	3	5	5	3	19
4 – Over-pass	5	1	3	5	3	17
5 - Tunnel	5	1	3	5	3	17

4.7 Preferred Alternatives

The preferred alternative is alternative 2, which includes leaving the existing intersection signalized and only upgrading features like pedestrian curb ramps, sidewalks around the intersection, and the signal timings. No changes in roadway geometry are recommended because at the current stage, this is a rail trail project and a full intersection reconstruction is not deemed necessary to accommodate the trail.

If the project is decided to be expanded in size and scope to improve vehicular operations and accommodate cyclist safety on the approaches to the Nobscot Road/Route 20 intersection, alternative 3 is a viable option. Furthermore, a better option would be to fully reconstruct and upgrade the existing signal with new equipment and optimize travel lanes and shoulder widths.

Alternative 1 has been determined to not be feasible due to the lowest amount of safety for trail users crossing Route 20. This project is a rail trail project and the main goal of this section of trail is to allow trail users to safety cross Route 20 and implementing a midblock crossing would not provide an adequate level of safety given the expected trail user volumes and opposing vehicular volumes, therefore it is not feasible.

Alternatives 4 and 5 have been determined to not be feasible for this project primarily due to the high cost and lack of convenient universal access on Route 20. Although these two alternatives would most likely allow for the safest crossing, other alternatives also provide safe ways to cross the street without constructing a pedestrian bridge or tunnel.

5. Proposed Parking Areas

There are three potential parking areas that are being considered within the project limits of this phase. The first is on the property of Chiswick Park LLC (blue), located at the northern end of the project limit. The second is along Nobscot Road on a piece of property that is owned by the Town of Sudbury (red). The third location is in an existing parking lot that serves a small shopping plaza and is owned by 1776 Plaza Limited Partnership (orange).

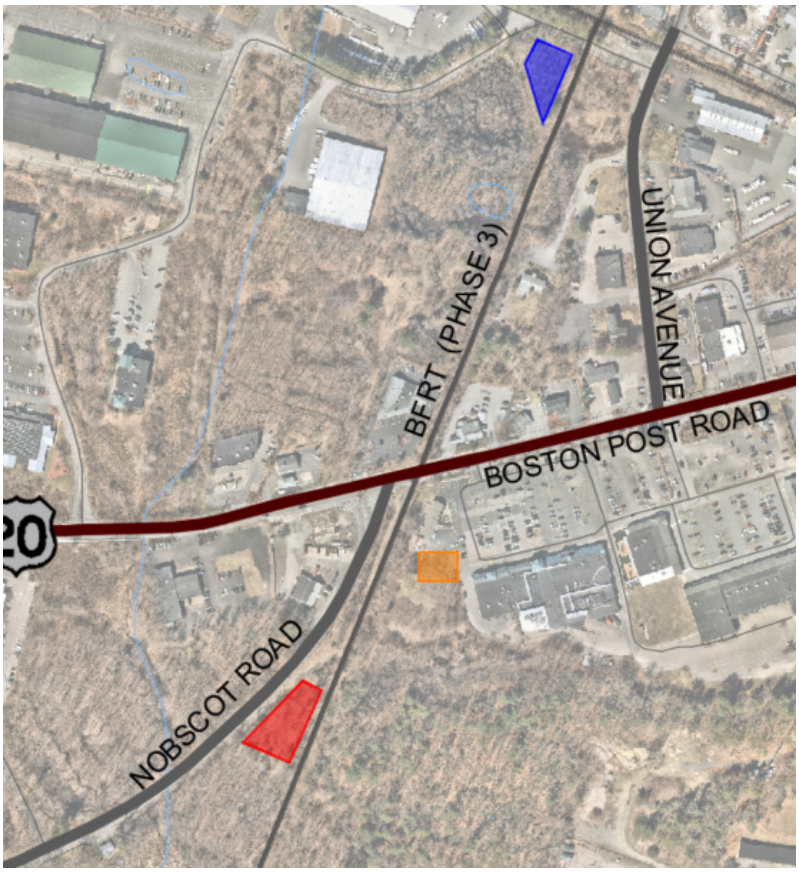


Image 8: Map of potential parking area locations

Currently, the second location (red) is most favorable because it is the only property that is owned by the town and would not require the fee taking of property. Two potential parking lot concepts are included below to show the general size and configuration of parking lots that can fit in the second location.

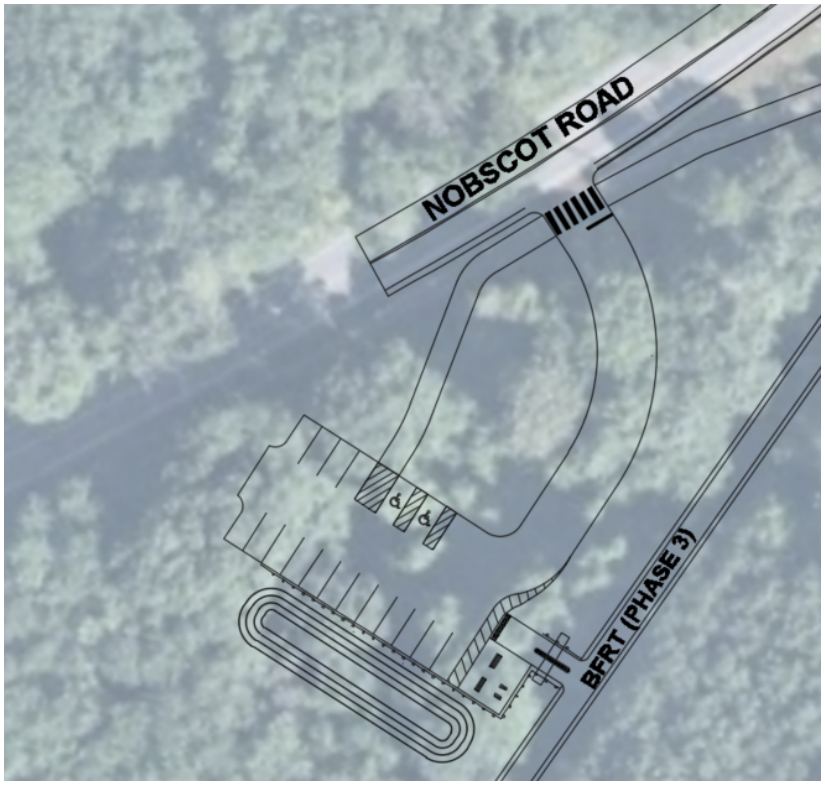


Image 9: Potential parking lot layout

Image 10: Potential parking lot layout

6. Trail Design Features

Phase 3 of the Bruce Freeman Rail Trail (BFRT) in Sudbury, MA spans approximately 1.4 miles from the MCRT/BFRT Junction to Eaton Road W. The road crossings and critical design locations are discussed further in the next section. A locus map of the project is included in *Appendix A*. The proposed rail trail will include the following features:

- 10-foot paved shared-use path with 2-foot dense graded crushed stone shoulders from Eaton Road W in Framingham to the Sudbury Diamond Railroad Crossing.
- Sections of 10-foot paved shared-use side path along Route 20.
- ADA accessible ramps at all at-grade crossings and proposed parking lot.
- Pedestrian wood rail safety fence located 2 feet from the shoulder at locations where the path sits on an embankment.
- Swales located where storm water drainage is of concern.
- Paved rest areas with benches, trail information, bicycle racks, and interpretive display signs with historical information consistent with trail elements found on Phase 2.
- Paved parking area with 15-20 spaces.
- Upgrading culvert crossings where required.

7. Trail Alignment, Profile, and Typical Sections

7.1 Trail Alignment

The alignment of the trail stays within the historic rail bed corridor of the Framingham and Lowell Railroad. This alignment will tie into the alignment of Phase 2D which is currently under construction to allow for a seamless transition from one phase to another once construction is completed. Phase 3 of BFRT has very few horizontal curves and will represent the longest straight tangent section of the BFRT within the Town of Sudbury. It also includes over 1 mile of uninterrupted trail without any grade crossings or impediments which would result in trail user delay. See *Appendix B* for the raw survey showing all existing features along the trail alignment.

7.2 Profile

The profile of the trail consists of multiple vertical curves throughout the length of the project to optimize the amount of cut and fill that is needed. There will be section of cut where soil is removed to widen the area where the path is going. Some areas will require fill to raise the elevation to avoid wetlands and to provide adequate cover for culverts and other structures. Although there will be many vertical curves proposed, the trail is still considered "flat" as compared to other built sections of the BFRT. No sections of the trail will exceed a running slope of 5%. See *Appendix D* for the current proposed profile along the trail.

7.3 Typical Sections

The images below show the anticipated typical cross-sections that will be used for a majority of the trail. A typical section will be a 10-foot shared-use path and 2-foot dense grade shoulders. Certain sections of

the trail will have fencing to protect trail users from either wetlands or steep side slopes which can be seen in Image 12 below.

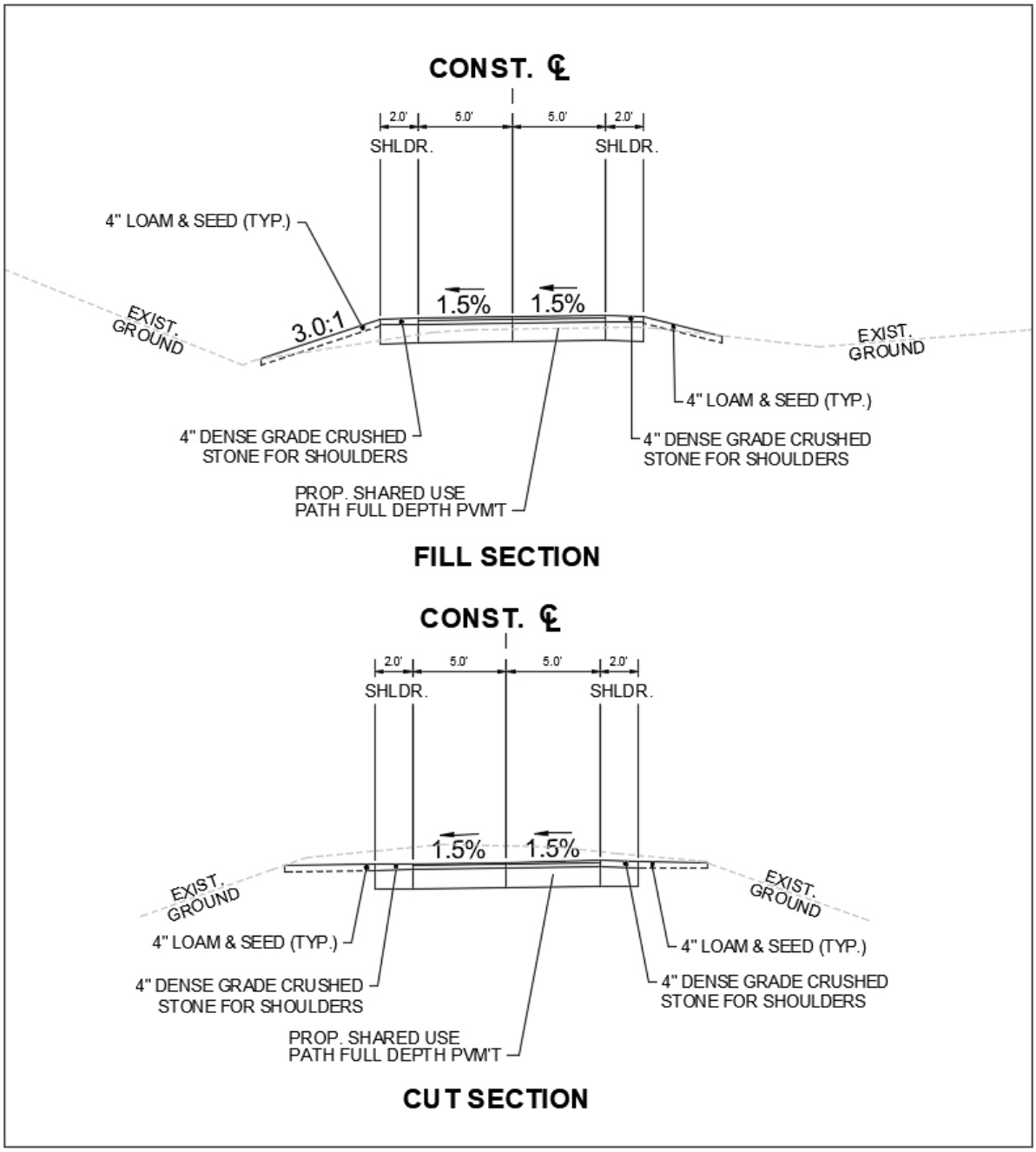


Image 11: Typical sections for areas of fill and cut, respectively.

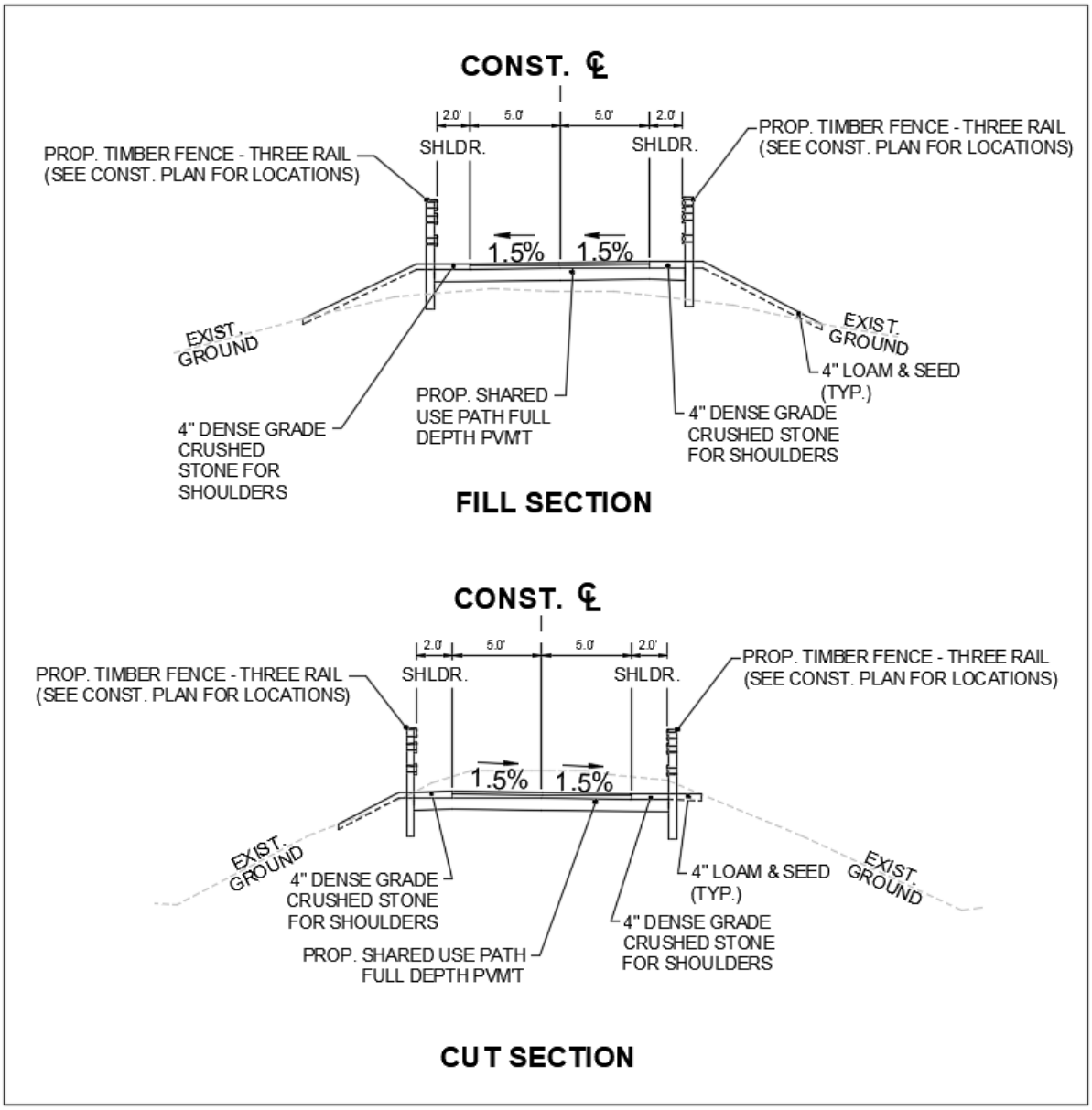


Image 12: Typical sections for areas of fill and cut, respectively, shown with protective timber fencing.

8. Right-of-Way Impacts

In general, the proposed rail trail pathway stays within the right-of-way corridor that was previously occupied by the railroad. This corridor was purchased from CSX Railroad by the Town of Sudbury in 2020. MassDOT Highway Division retains ownership of Boston Post Road (Rt. 20). The Chiswick Park grade crossing may also have access agreements which may need to be updated with the Town. The ROW is otherwise entirely owned by the Town of Sudbury, which will allow unencumbered construction of the trail and parking area.

Temporary easements will be required for construction and several permanent easements will be required for grading and drainage. There may be additional locations where permanent easements or fee takings are required which will be shown once preliminary design plans are prepared. Table 12 summarizes the possible permanent and temporary easements expected based on the preferred alternative at this time and based on available property information.

Table 12: Potential Temporary/Permanent Easements (Preferred Alternative #2)

Property Address	Current Property Owner	Type of Easement	Reason for Easement/Taking
465 Boston Post Road	Sudbury Holdings LLC	Temporary	Potential upgrade to pedestrian curb ramps
454 Boston Post Road	Middlesex Savings Bank	Permanent	Sidewalk changes and to implement path for BFRT users to access trail
450 Boston Post Road	Twin Holdings LLC	Temporary	Potential sidewalk reconstruction
447 Boston Post Road	1776 Plaza Limited Partnership	Temporary	Potential sidewalk and grading
Union Avenue	Chiswick Park LLC	Temporary	grading of slopes
Nobscot Road	Town of Sudbury	Permanent	Potential parking lot (easement required by Federal Highway)
88 Eaton Road W	Vayda, Phyllis C, & Michael J T	Temporary (City of Framingham)	Construction access
91 Eaton Road W	Ebeling, Allan M & Cheryl A	Temporary (City of Framingham)	Construction access

9. Existing Structures Evaluation

Fuss & O'Neill performed a preliminary structural evaluation of culvert and cattle crossings along Phase 3 of the BFRT. Table 13 summarizes the condition of these structures and recommendations for improvement. *Appendix G* provides the full structural report memo for this section of trail.

Table 13: Existing Structures Evaluation

Approx. Location	Size/Type	Existing Condition	Recommended Improvements	Structure ID
12+40	40" x 46" Cattle Crossing	Good	Repoint and clean	CX3-1
25+80	36" x 42" 3-Sided Granite Box Culvert	Good	Repoint and clean	C3-1
30+60	18" x 36" Granite Box Culvert	Unknown	Partial repair required. Further inspection is recommended and may result in full replacement.	C3-2
36+35	45" x 41" Granite and Steel Box Culvert	Good	Repoint and clean	C3-3
46+05	24" x 24" Granite Box Culvert	Poor	Further inspection is recommended. Repair or replacement of this culvert is likely necessary	C3-4
52+00	36" x 36" Granite Box Culvert	Fair	Repoint and clear surrounding vegetation	C3-5
58+00	12" RCP Culvert	Good	Clear entrance points	C3-6
68+60	10" CI Culvert	Poor	Abandon	C3-7

- **In total, Fuss & O'Neill proposes the repointing and cleaning of most structures to address flood vulnerability, reduce flooding impacts, and increase stream continuity for aquatic organism passage. Fuss & O'Neill also recommends further examination of structures C3-2 and C3-4 to determine whether full replacement is necessary for either culvert.**

Most structures along the path are in good condition and will only require minor improvements. Due to the high water level during the site visit, two structures are recommended to be further inspected at a time when the inside of the structure can be examined. These two structures are anticipated to require more extensive work related to the headwall stability and overall structural stability.

10. Environmental Impacts

The amount of permitting associated with this project is expected to be less than in Phase 2D in Sudbury, however there will continue to be an extensive list of required environmental permits needed to be obtained prior to construction. Table 14 lists the environmental permits/reviews that are anticipated to be required for this project.

Table 14: Anticipated Environmental Resource Permits / Reviews

MassDOT 25% Early Environmental Coordination Design Submission Checklist
Hist./Arch. - Federal Section 106 and State Chapter 254 Review
NEPA - Categorical Exclusion (CE)
ACOE – Section 404 Programmatic General Permit (PGP)
Programmatic Section 4(f) Evaluation
WPA Notice of Intent (NOI)
Wildlife/Rare Species Assessment
Impaired Waterbody Assessment and Water Quality Data Form
Wetland Replication Plan
Town of Sudbury – Local Stormwater Bylaw/Report
Potential Environmental Permits - MEPA - Environmental Notification Form (ENF) - Article 97 Open Space – No adverse Impact

Vegetated wetlands are located along both sides of the trail at locations shown on the concept alignment plans. The proposed preferred alignment generally avoids these wetlands and avoids major impacts; however, some impacts are proposed for which mitigation and replication will be required. We expect below 5,000 s.f. of combined temporary/permanent impact for the preferred alternative.

A storm water infiltration basin is included at the proposed parking lot to manage storm water runoff and prevent flooding and erosion.

Segments of the trail, especially towards Route 20, are low lying near wetlands that could easily flood into the path. Due to the concern of flooding, a possible solution would be to use dense graded crushed stone subbase with geotextile reinforcement matting at these locations. This measure, along with a raised profile at some of these locations, will help prevent flooding, degradation of the trail subbase, and contain runoff. More information regarding environmental impacts can be found in the environmental report in *Appendix H*.

11. Anticipated Construction Cost

The anticipated construction costs are based on projects of similar size and scope, scaled for this project length, and adjusted for inflation. Costs also include contingencies for unforeseen conditions during construction, temporary traffic management, utility relocations, and adjustments for inflation over a 3-year period. Table 15 below breaks down the anticipated costs for each alternative. See *Appendix E* for a detailed opinion of probable cost for alternative 2.

Table 15: Anticipated Construction Costs for Each Alternative

	Alternatives				
	1 – Un-signalized	2 - Signalized	3 - Roundabout	4 – Over-pass	5 - Tunnel
Approximate Construction Cost	$5,440,765.76	$7,254,354.34	$8,850,312.30	$13,057,837.82	$14,145,990.97
Design/Permitting Cost*	$820,000.00	$1,240,000.00	$1,780,000.00	$1,960,000.00	$2,130,000.00
ROW Acquisition**	$137,000.00	$182,000.00	$222,000.00	$327,000.00	$354,000.00
Misc. Town Expenditures***	$68,500.00	$91,000.00	$111,000.00	$163,500.00	$177,000.00
Total Project Cost (Rounded)	**$6,398,000.00**	**$8,677,000.00**	**$10,853,000.00**	**15,345,000.00**	**16,630,000.00**
Notes: *Values are approximately 15-20% of construction cost and assumes MassDOT Project administration oversight and construction **Assumed 2.5% of construction value based on property values and easement types in Sudbury ***Non-engineering fees such as appraisals, the MIIA Insurance, Town Legal Council, etc.					

12. Conclusion and Final Recommendations

This feasibility study has concluded that alternative 2 is the recommended plan to advance into further design development based on the scoring criteria documented above. The ability to safely accommodate the trail users at grade at the existing signalized intersection without degradation to vehicular level of service on Route 20 as well as allowing for future expansion of bike/pedestrian surface network around the Route 20 corridor were primary factors in this choice. Ease of implementation, minimal ROW impacts, and the lowest construction cost also allowed for an objective result as the preferred alternative. Because Route 20 is owned by MassDOT, there is the potential in the future for project scope to expand at their request resulting in a full intersection reconstruction. Should the project scope expand, a roundabout should be considered as a viable intersection control alternative.

12.1 Phasing

This project was reviewed for potential phased implementation depending on the selected alternative and funding sources. Feedback was solicited through the Bruce Freeman Advisory Task Force at two separate public meeting events related to phasing and other factors that would define a successful implementation of the trail. It was noted by the Task Force that only advancing the trail ¼ mile to the north side of Route 20 (without crossing) would not result in any additional trail user benefit as it would not create final (and, safe) connectivity to major points of interest, including the Sudbury Farms Plaza. Therefore, the Task Force did not support a phased project approach. It was documented that "1/4 mile + project", which consists of adding in the crossing for Route 20 and a parking lot on Nobscott Road to the short segment would be supported by the Task Force however the cost to construct the remaining 1 mile of trail to Framingham was negligible in comparison to the crossing and parking lot additions and

therefore determined most practicable from both a design and construction cost to finish the trail in it's entirety.

Because we were able to eliminate the need for full intersection reconstruction at Route 20 as well as bridge/tunnel options, we recommend abandoning the idea of phasing due to availability of State funding through the TIP for a singular project for a project of this moderate design complexity and relatively low cost as compared to others in the Boston MPO region.

We recommend this project be pursued using State and/or Federal funding, as administered through the MassDOT Transportation Improvement Program (TIP) to ensure that the BFRT remains consistent with the design standards and enhancements on other portions of the BFRT in Sudbury and Concord. Using the TIP as a funding source would allow the Town to focus investment efforts on the design/permitting while using state and federal partners to pay for construction. Although the TIP process is typically double or sometimes triple the time for project development, it is a reliable source for construction funding and implementation. In the case of this segment of the BFRT, we would expect that it would take approximately 3-5 years for design and development of bid documents through the TIP.

Should the Town be able to acquire $4 million or more using other funding sources, advancement outside of the TIP should be considered due to a faster design/implementation timeline (2-3 years design). Currently, there are not any grant programs large enough that are specifically targeted for off-road trail networks and projects of this magnitude. The MassTrails program and Recreational Trails Program (RTP) through DCR exist but with much smaller funding amounts than what would be required to build even a phased approach of the remaining BFRT in Sudbury. The Community One Stop program, specifically MassWorks through MassDevelopment would be an unconventional potential source should there be larger housing and economic development components associated with the trail implementation. The Town should continue to work with local, state, and U.S. congressional representatives to monitor other programs that may be applicable under the federal Bi-Partisan Infrastructure Law (BIL).

Appendix A

Locus Map

APPENDIX A - LOCUS MAP

FUSS & O'NEILL

PROJ. NO: 20200875.A30

SUDBURY MA - BRUCE FREEMAN RAIL TRAIL (PHASE 3)

JULY 2023

FUSS & O'NEILL

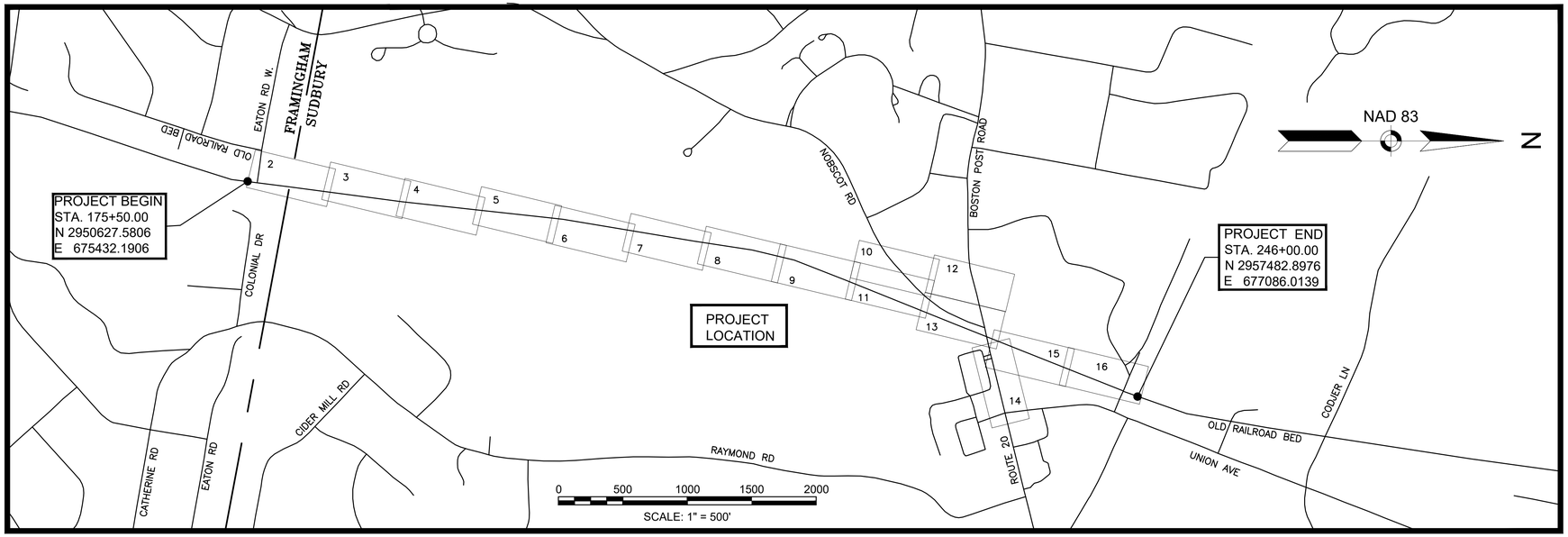
Appendix B

Raw Survey

SUDBURY
BRUCE FREEMAN RAIL TRAIL

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	######	01	16
PROJECT FILE NO.	######		

TITLE SHEET, LEGEND & ABBREVIATIONS



PLAN REFERENCES

1. 1952 COUNTY LAYOUT OF NOBSCOT ROAD.
2. RIGHT OF WAY AND TRACK MAP SHEETS V7 / 4 & 5 DATED JUNE 30, 1915.
3. "PLAN OF LAND IN SUDBURY, MA", PREPARED FOR TOWN OF SUDBURY, PREPAED BY DGT ASSOCIATES, DATED OCTOBER 28, 2020.
4. 1999 STATE HIGHWAY LAYOUT No. 7482
5. 1902 STATE HIGHWAY LAYOUT No. 669
6. PLANS RECORDED AT SOUTHERN MIDDLESEX REGISTRY OF DEEDS:

26 OF 2006	32 OF 1978	193 OF 1964
212 OF 1963	244 OF 1988	248 OF 1986
298 OF 1958	306 OF 1976	326 OF 1969
340 OF 1956	344 OF 1974	382 OF 1961
416 OF 1955	416 OF 1984	559 OF 1963
560 OF 1963	607 OF 1973	664 OF 1970
667 OF 1941	798 OF 1958	804 OF 2007
940 OF 1998	972 OF 1966	997 OF 1961
1093 OF 1959	1172 OF 2001	1248 OF 1970
1321 OF 1957	1328 OF 1979	1354 OF 1967
1406 OF 1952	1415 OF 1951	1415 OF 1983
1465 OF 2005	1808 OF 1956	PB278 PL50

ABBREVIATIONS

AUX	AUXILARY
BD	BOUND
BIT	BITUMINOUS
℄	BASELINE
BLDG	BUILDING
BM	BENCHMARK
BR	BRIDGE
BRK	BRICK
BWL	BROKEN WHITE LINE
BYL	BROKEN YELLOW LINE
CAB	CABINET
CB	CATCH BASIN
CC	CEMENT CONCRETE
CCB	CAPE COD BERM
CEN	CENTER
CI	CURB INLET
CIP	CAST IRON PIPE
℄	CENTER LINE
CLF	CHAIN LINK FENCE
CMH	CABLE MANHOLE
CMP	CORRUGATED METAL PIPE
CO	COUNTY
CO BD	COUNTY BOUND
CON	CONIFEROUS
CONC	CONCRETE
CPP	CORRUGATED PLASTIC PIPE
CSP	CORRUGATED STEEL PIPE
CULV	CULVERT
CW	CROSSWALK
DBWL	DOUBLE WHITE LINE
DBYL	DOUBLE YELLOW LINE
DEC	DECIDUOUS
DH	DRILL HOLE
DI	DROP INLET
DIA	DIAMETER
DIP	DUCTILE IRON PIPE
DMH	DRAIN MANHOLE
DSK	DISK
DWL	DOTTED WHITE LINE
DYL	DOTTED YELLOW LINE
EB	EASTBOUND
EL	ELEVATION
EMH	ELECTRIC MANHOLE
EP	EDGE OF PAVEMENT
EPLP	ESCUTCHEON PIN IN LEAD PLUG
ETW	EDGE OF TRAVELED WAY
EX	EXISTING
FF	FINISH FLOOR
FGS	FLAGSTONE
FL	FLOWLINE
FLDSTN	FIELDSTONE
GAR	GARAGE
GD	GROUND
GIP	GALVANIZED IRON PIPE
GMH	GAS MANHOLE
GRAN	GRANITE
GRAV	GRAVEL
GRD	GUARD
GRL	GUARDRAIL
HDW	HEADWALL
HYD	HYDRANT
INV	INVERT
IP	IRON PIPE
JB	JERSEY BARRIER
L	LENGTH OF CURVE
LB	LEACHING BASIN
LC	LAND COURT
LCB	LAND COURT BOUND
LCD	LAND COURT DISK
LO	LAYOUT
LP	LIGHT POLE
LPD	LIGHT POLE DOUBLE LIGHT
LSA	LANDSCAPED AREA
MAG	MAG NAIL
MBE	MIDDLE BACK EDGE
MED	MEDIAN
MH	MANHOLE
MP	MILE POST
MTL	METAL
N/F	NOW OR FORMERLY
NB	NORTHBOUND
OH	OVERHANG
OHW	OVERHEAD WIRE
PC	POINT OF CURVATURE
PCC	POINT OF COMPOUND CURVATURE
PED	PEDESTRIAN
PI	POINT OF INTERSECTION
PK	PK NAIL
℄	PROPERTY LINE
PP	PRICK PUNCH
PRC	POINT OF REVERSE CURVATURE
PT	POINT OF TANGENCY
PVC	POLYVINYL CHLORIDE PIPE
PVMT	PAVEMENT
PWW	PAVED WATERWAY
PZ	PIEZOMETER
R	RADIUS OF CURVATURE
RB	REBAR
RC	REINFORCED CONCRETE
RCP	REINFORCED CONCRETE PIPE
RET	RETAINING
ROW	RIGHT OF WAY
RR	RAILROAD
RRS	RAILROAD SPIKE
S BD	SOUTHBOUND
SB	STONE BOUND
SD	SUBDRAIN
SGE	SLOPED GRANITE EDGING
SHLD	SHOULDER
SHLO	STATE HIGHWAY LAYOUT
SK	SKEW
SL	STOP LINE
SMH	SEWER MANHOLE
SPK	SPIKE
STA	STATION
STN	STONE
SW	SIDEWALK
SWL	SOLID WHITE LINE
SYL	SOLID YELLOW LINE
T	TANGENT DISTANCE
TAN	TANGENT
TEMP	TEMPORARY
TMH	TELEPHONE MANHOLE
TR	TOP OF RAIL
TSC	TRAFFIC SIGNAL CONDUIT
TYP	TYPICAL
VAR	VARIABLE
VCP	VITRIFIED CLAY PIPE
VGC	VERTICAL GRANITE CURB
VLT	VAULT
WB	WESTBOUND
WCR	WHEELCHAIR RAMP
WD	WOOD
WIP	WROUGHT IRON PIPE

LEGEND

BF#	BANK FLAG	MAG	MAG NAIL
BHL #	BORE HOLE	MB	MAIL BOX
	BUSH	MHB	MASSACHUSETTS HIGHWAY BOUND
BM #	BENCHMARK	MW	MONITORING WELL
	BOUND (CONC, STONE, LAND COURT, ETC.)	OIL	OIL FILL
C	CABLE MANHOLE		OTHER MANHOLE
CB	CATCH BASIN - SQUARE	PB	PULL BOX
CB	CATCH BASIN - D-FRAME	PED	PEDESTRIAN SIGNAL
CB	CATCH BASIN - ROUND		PHOTO CONTROL - H & V
DSK	DISK (CA/T, USC&GS, LAND COURT, ETC.)		PHOTO CONTROL - V ONLY
DH	DRILL HOLE	PK	PK NAIL
D	DRAIN MANHOLE	PM	PARKING METER
EHH	ELECTRIC HANDHOLE	POST	CIRCULAR POST
E	ELECTRIC MANHOLE	POST	SQUARE POST
EM	ELECTRIC METER	RB	REBAR/IRON PIN
EPLP	ESCUTCHEON PIN IN LEAD PLUG	RRS	RAILROAD SPIKE
FB	FLASHING BEACON	RRSG	RAILROAD SIGNAL
FES	FLARED END SECTION	RRSW	RAILROAD SWITCH
FP	FLAG POLE	SN	STAKE AND NAIL
GF	GAS FILL	SP	STAND PIPE
GG	GAS GATE	S	SEWER MANHOLE
GM	GAS METER	ST	STEAM MANHOLE
GP	GAS PUMP		STUMP
G	GAS MANHOLE	TB	TOWN LINE BOUND (CORNER)
GPL	GUY POLE	TCB	TRAFFIC SIGNAL CONTROL CABINET
	HANDICAP SYMBOL	T	TELEPHONE MANHOLE
	GUY WIRE ANCHOR	TFMR	TRANSFORMER
HTP	HIGH TENSION POWER POLE	TLRS	TOWN LINE ROAD STONE
	FIRE HYDRANT	TPIT #	TEST PIT
IP	IRON PIPE	TPL	TROLLEY POLE
	LIGHT POLE		TRAVERSE POINT
	LIGHT POLE DOUBLE LIGHT	22"M	TREE

TS	TRAFFIC SIGNAL
TS	TRAFFIC SIGNAL MAST ARM/SPAN WIRE POLE
	SIGN
	SIGN - DOUBLE POST
UFB#	UTILITY POLE W/ FIRE PULL BOX
ULT#	UTILITY POLE W/ LIGHT
UPDL#	UTILITY POLE W/ DOUBLE LIGHT
UPL#	UTILITY POLE
VP	VENT PIPE
W	WATER MANHOLE
WG	WATER GATE
WM	WATER METER
WSO	WATER SHUTOFF
WELL	WELL (POTABLE)
WF#	WETLAND FLAG
X–CUT	X-CUT

NOTES

1. THIS PLAN IS BASED UPON A ON–THE–GROUND INSTRUMENT SURVEY PERFORMED BY GCG ASSOCIATES BETWEEN SEPTEMBER 27, 2022 AND APRIL 18, 2023.
2. NORTH IS BASED UPON THE NORTH AMERICAN DATUM OF 1983 (NAD–83)(2011) EPOCH 2010, MASSACHUSETTS STATE PLAN COORDINATE SYSTEM, MAINLAND ZONE.
3. VERTICAL CONTROL IS BASED UPON THE NORTH AMERICAN VERTICAL DATUM OF 1988 DERIVED BY RTK GPS
4. ALL UNITS ARE COLLECTED AND SHOWN IN US SURVEY FEET.
5. RAILROAD LAYOUTS ARE POSITIONED TO RECOVERED BASELINE MONUMENTS AS SHOWN ON PLAN. STATE HIGHWAY LAYOUTS ARE INDEPENDENTLY HELD FROM RAILROAD LAYOUT AND POSITIONED BY RECOVERED BOUNDS.
6. CONTOUR INTERVAL: 1 FOOT
7. OWNERSHIP AND DEED INFORMATION WAS OBTAINED FROM THE TOWN OF SUDBURY AND CITY OF FRAMINGHAM ASSESSORS OFFICE AND THE SOUTH MIDDLESEX REGISTRY OF DEEDS. ALL INFORMATION WAS CURRENT AS OF THE DATE OF THIS SURVEY.
8. PROPERTY LINES SHOWN HEREON ARE APPROXIMATE ONLY AND ARE BASED UPON RECORD DEEDS, PLANS AND ASSESSORS INFORMATION.
9. SUBSURFACE UTILITY LINES, AS SHOWN HEREON, ARE APPROXIMATE AND WERE COMPILED FROM SURFACE EVIDENCE. GCG ASSOCIATES, INC. ASSUMES NO RESPONSIBILITY FOR DAMAGES INCURRED AS A RESULT OF UTILITIES OMITTED OR INACCURATELY SHOWN. BEFORE DESIGNING FUTURE CONNECTIONS, THE APPROPRIATE UTILITIES MUST BE CONSULTED. BEFORE CONSTRUCTION, ALL UTILITIES, PUBLIC AND PRIVATE MUST BE NOTIFIED (SEE MASSACHUSETTS GENERAL LAWS, CHAPTER 82 SECTION 40.) CALL "DIG SAFE" 1 (888) 344–7233.

COMMONWEALTH OF MASSACHUSETTS
HAVELOCK J. PURSEGLOVE
No. 54318
REGISTERED PROFESSIONAL LAND SURVEYOR

Havelock Purseglove 4/24/2023
HAVELOCK J. PURSEGLOVE, PLS
MASSACHUSETTS REG. No. 54318

REVISIONS

REV.	COMMENTS	DATE

PREPARED BY:
GCG ASSOCIATES
84 MAIN STREET
WILMINGTON, MASSACHUSETTS 01887
PHONE: (978) 657-9714
FAX: (978) 657-7915

SCALE: 20 FEET TO THE INCH

FILE NAME:
FIELD BOOK. NO: BAI_22-23
DRAWN BY: BAI | CHECKED BY: HJP
FIELD CHIEF: BAI | PARS. NO:

PLAN OF TOPOGRAPHIC SURVEY OF
BRUCE FREEMAN RAIL TRAIL
(PHASE 3)
IN THE TOWN OF
SUDBURY

DATE: 04/24/2023 | SHEET 2 OF 16

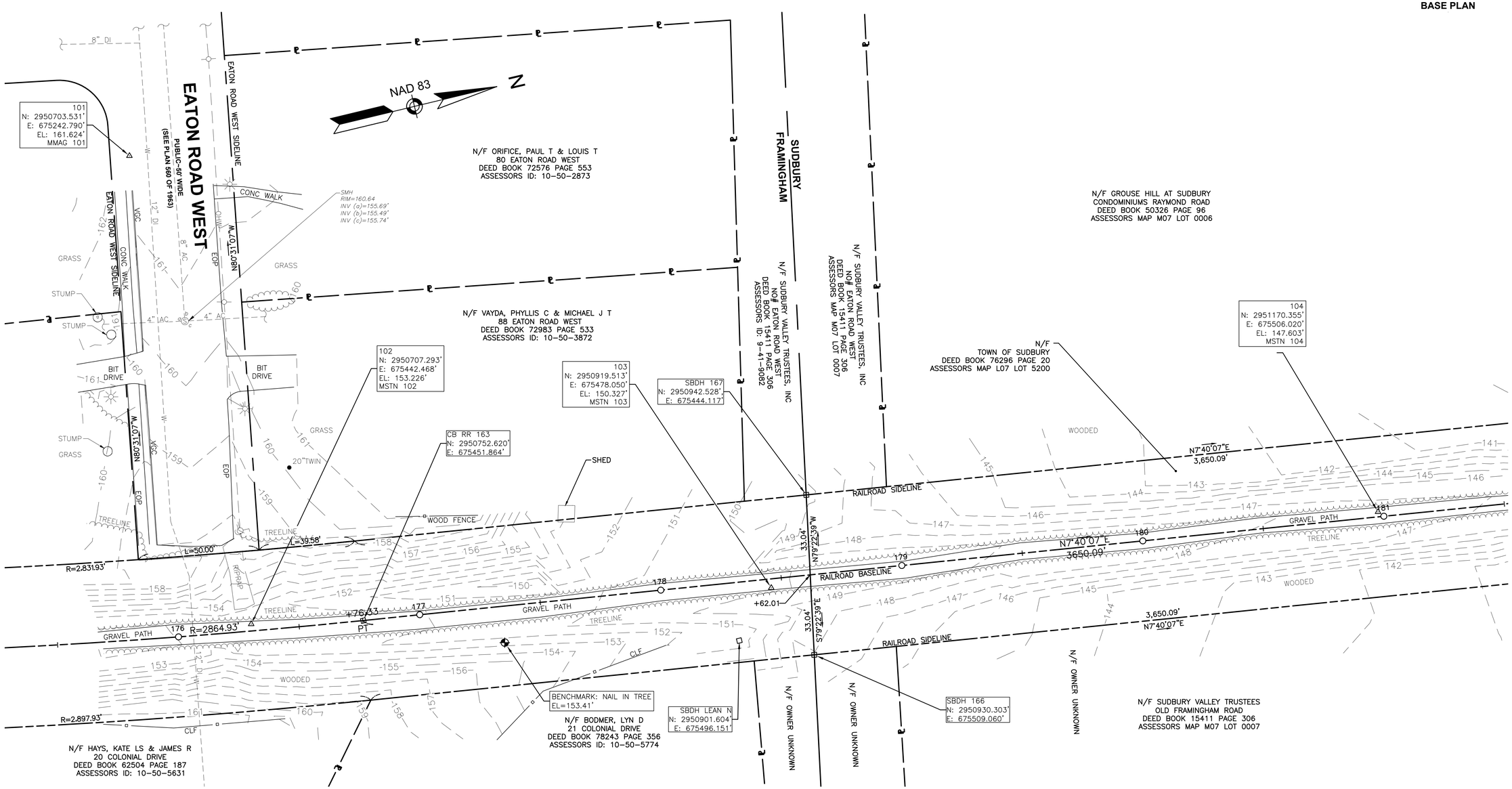
2275-BASE.DWG Plotted on 25-Apr-2023 12:43 PM

SUDBURY
BRUCE FREEMAN RAIL TRAIL

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	######	02	16
PROJECT FILE NO.	######		

BASE PLAN

2275-BASE.DWG Plotted on 25-Apr-2023 12:43 PM



PREPARED BY:
GCG ASSOCIATES
84 MAIN STREET
WILMINGTON, MASSACHUSETTS 01887
PHONE: (978) 657-9714
FAX: (978) 657-7915

PLAN OF TOPOGRAPHIC SURVEY OF
BRUCE FREEMAN RAIL TRAIL
(PHASE 3)
IN THE TOWN OF
SUDBURY

COMMONWEALTH OF MASSACHUSETTS
HAVELOCK J. PURSEGLOVE
No. 54318
REGISTERED PROFESSIONAL LAND SURVEYOR

Havelock Purseglove 4/24/2023
HAVELOCK J. PURSEGLOVE, PLS
MASSACHUSETTS REG. No. 54318

REVISIONS		
REV.	COMMENTS	DATE

SCALE: 20 FEET TO THE INCH

FILE NAME: 2275-BASE.dwg		
FIELD BOOK. NO: BAI_22-23		
DRAWN BY: BAI	CHECKED BY: HJP	
FIELD CHIEF: BAI	PARS. NO:	DATE: 04/24/2023

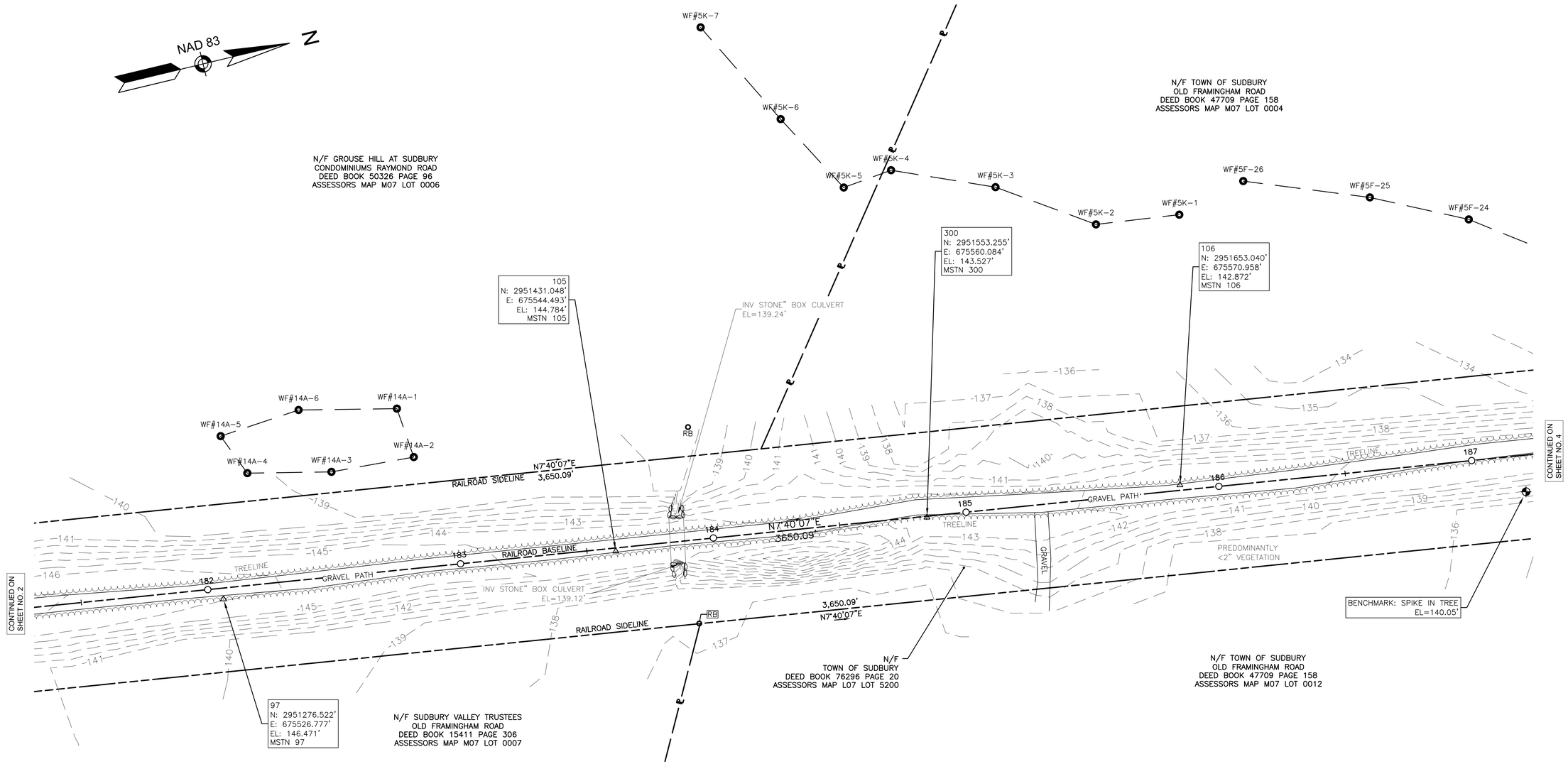
SHEET 2 OF 16

SUDBURY
BRUCE FREEMAN RAIL TRAIL

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	######	03	16
PROJECT FILE NO.	######		

BASE PLAN

2275-BASE.DWG Plotted on 25-Apr-2023 12:44 PM



COMMONWEALTH OF MASSACHUSETTS
HAVELOCK J. PURSEGLOVE
No. 54318
REGISTERED PROFESSIONAL LAND SURVEYOR

Havelock Purseglove 4/24/2023
HAVELOCK J. PURSEGLOVE, PLS
MASSACHUSETTS REG. No. 54318

REVISIONS		
REV.	COMMENTS	DATE

PREPARED BY:
GCG ASSOCIATES
84 MAIN STREET
WILMINGTON, MASSACHUSETTS 01887
PHONE: (978) 657-9714
FAX: (978) 657-7915

SCALE: 20 FEET TO THE INCH

FILE NAME: 2275-BASE.dwg
FIELD BOOK. NO: BAI_22-23
DRAWN BY: BAI | CHECKED BY: HJP
FIELD CHIEF: BAI | PARS. NO:

PLAN OF TOPOGRAPHIC SURVEY OF
BRUCE FREEMAN RAIL TRAIL
(PHASE 3)
IN THE TOWN OF

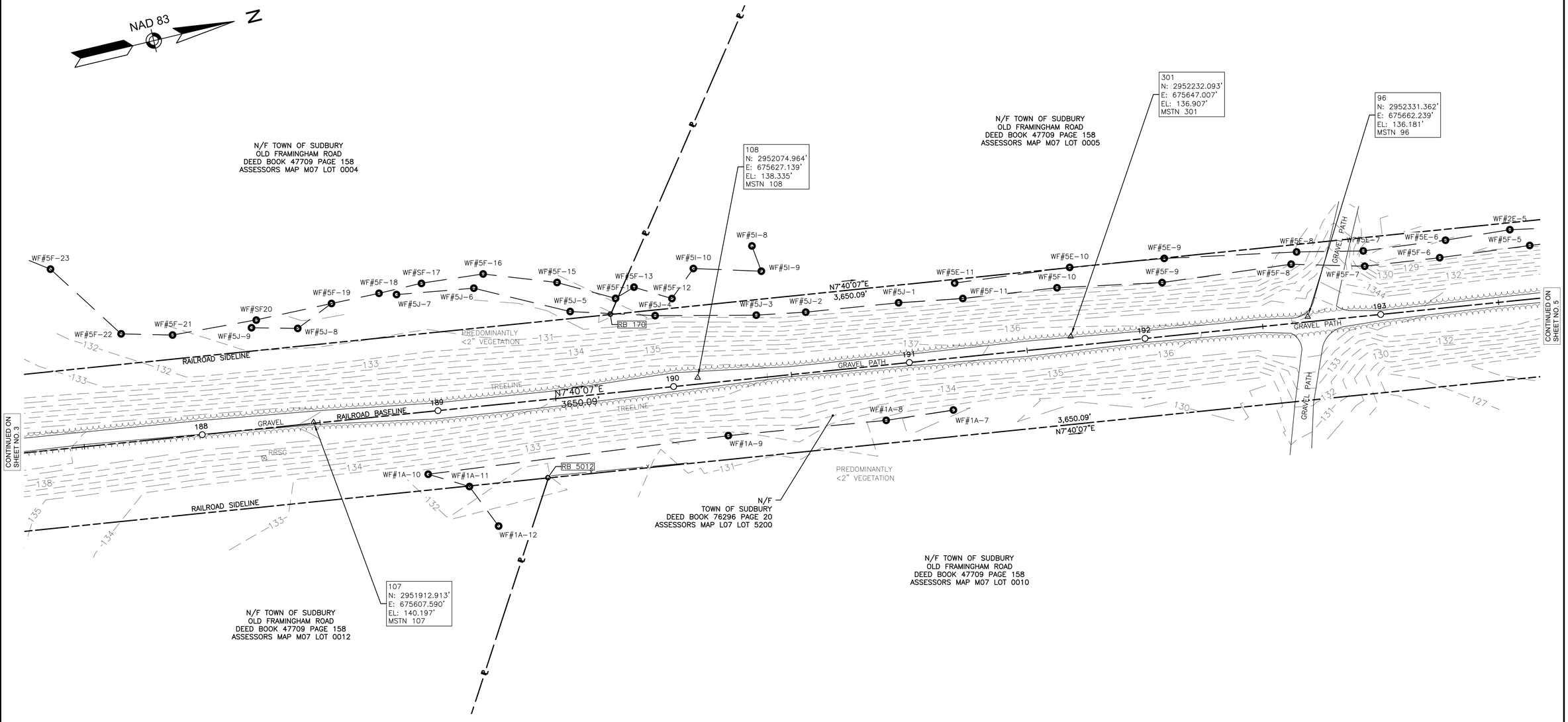
DATE: 04/24/2023

SUDBURY
BRUCE FREEMAN RAIL TRAIL

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	#######	04	16
PROJECT FILE NO.	#######		

BASE PLAN

2275-BASE.DWG Plotted on 25-Apr-2023 12:45 PM



COMMONWEALTH OF MASSACHUSETTS
HAVELOCK J. PURSEGLOVE
No. 54318
REGISTERED PROFESSIONAL LAND SURVEYOR

Havelock Purseglove 4/24/2023
HAVELOCK J. PURSEGLOVE, PLS
MASSACHUSETTS REG. No. 54318

REVISIONS		
REV.	COMMENTS	DATE

PREPARED BY:
GCG ASSOCIATES
84 MAIN STREET
WILMINGTON, MASSACHUSETTS 01887
PHONE: (978) 657-9714
FAX: (978) 657-7915

SCALE: 20 FEET TO THE INCH

FILE NAME: 2275-BASE.dwg
FIELD BOOK. NO: BAI_22-23
DRAWN BY: BAI | CHECKED BY: HJP
FIELD CHIEF: BAI | PARS. NO:

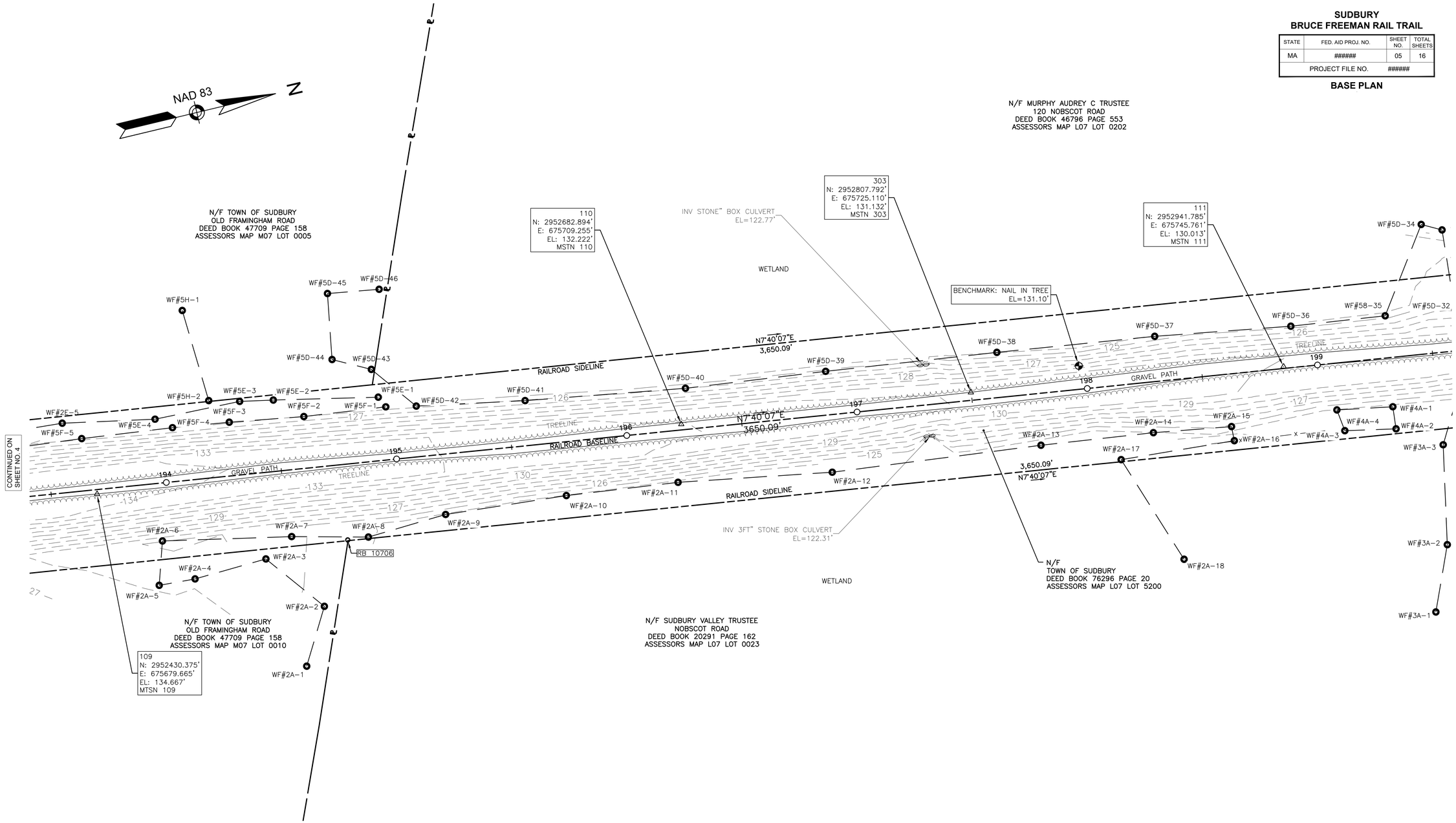
PLAN OF TOPOGRAPHIC SURVEY OF
BRUCE FREEMAN RAIL TRAIL
(PHASE 3)
IN THE TOWN OF

DATE: 04/24/2023 | SHEET 4 OF 16

SUDBURY
BRUCE FREEMAN RAIL TRAIL

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	#######	05	16
PROJECT FILE NO.	#######		

BASE PLAN



COMMONWEALTH OF MASSACHUSETTS
HAVELOCK J. PURSEGLOVE
No. 54318
REGISTERED PROFESSIONAL LAND SURVEYOR

Havelock Purseglove 4/24/2023
HAVELOCK J. PURSEGLOVE, PLS
MASSACHUSETTS REG. No. 54318

REVISIONS		
REV.	COMMENTS	DATE

PREPARED BY:
GCG ASSOCIATES
84 MAIN STREET
WILMINGTON, MASSACHUSETTS 01887
PHONE: (978) 657-9714
FAX: (978) 657-7915

SCALE: 20 FEET TO THE INCH

FILE NAME: 2275-BASE.dwg
FIELD BOOK. NO: BAI_22-23
DRAWN BY: BAI | CHECKED BY: HJP
FIELD CHIEF: BAI | PARS. NO:
DATE: 04/24/2023

PLAN OF TOPOGRAPHIC SURVEY OF
BRUCE FREEMAN RAIL TRAIL
(PHASE 3)
IN THE TOWN OF

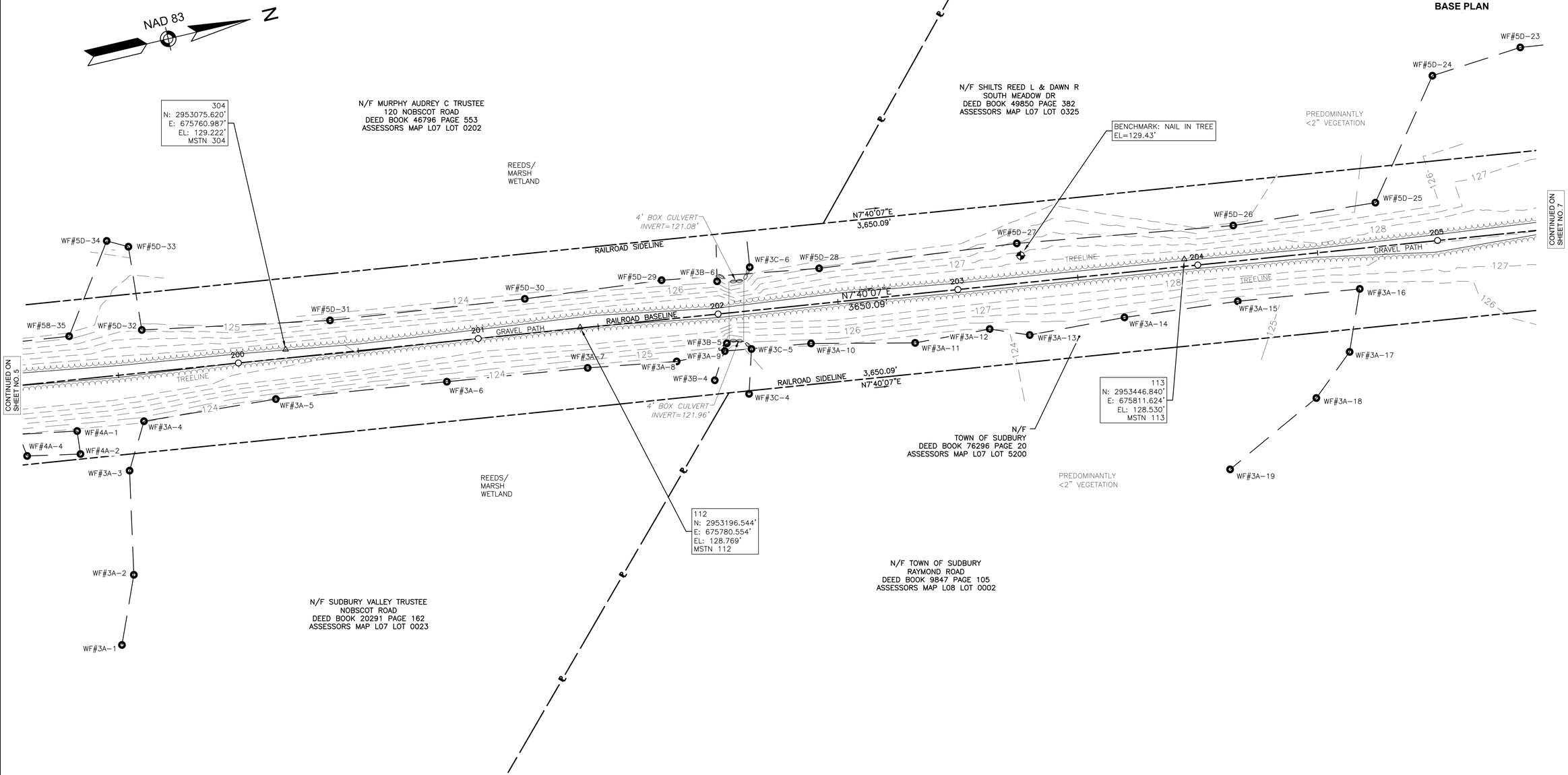
SHEET 5 OF 16

2275-BASE.DWG Plotted on 25-Apr-2023 12:45 PM

SUDBURY
BRUCE FREEMAN RAIL TRAIL

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	#######	06	16
PROJECT FILE NO.	#######		

BASE PLAN



COMMONWEALTH OF MASSACHUSETTS
HAVELOCK J. PURSEGLOVE
No. 54318
REGISTERED PROFESSIONAL LAND SURVEYOR

Havelock Purseglove 4/24/2023

HAVELOCK J. PURSEGLOVE, PLS
MASSACHUSETTS REG. No. 54318

REVISIONS		
REV.	COMMENTS	DATE

PREPARED BY:
GCG ASSOCIATES
84 MAIN STREET
WILMINGTON, MASSACHUSETTS 01887
PHONE: (978) 657-9714
FAX: (978) 657-7915

SCALE: 20 FEET TO THE INCH

PLAN OF TOPOGRAPHIC SURVEY OF

BRUCE FREEMAN RAIL TRAIL
(PHASE 3)

IN THE TOWN OF

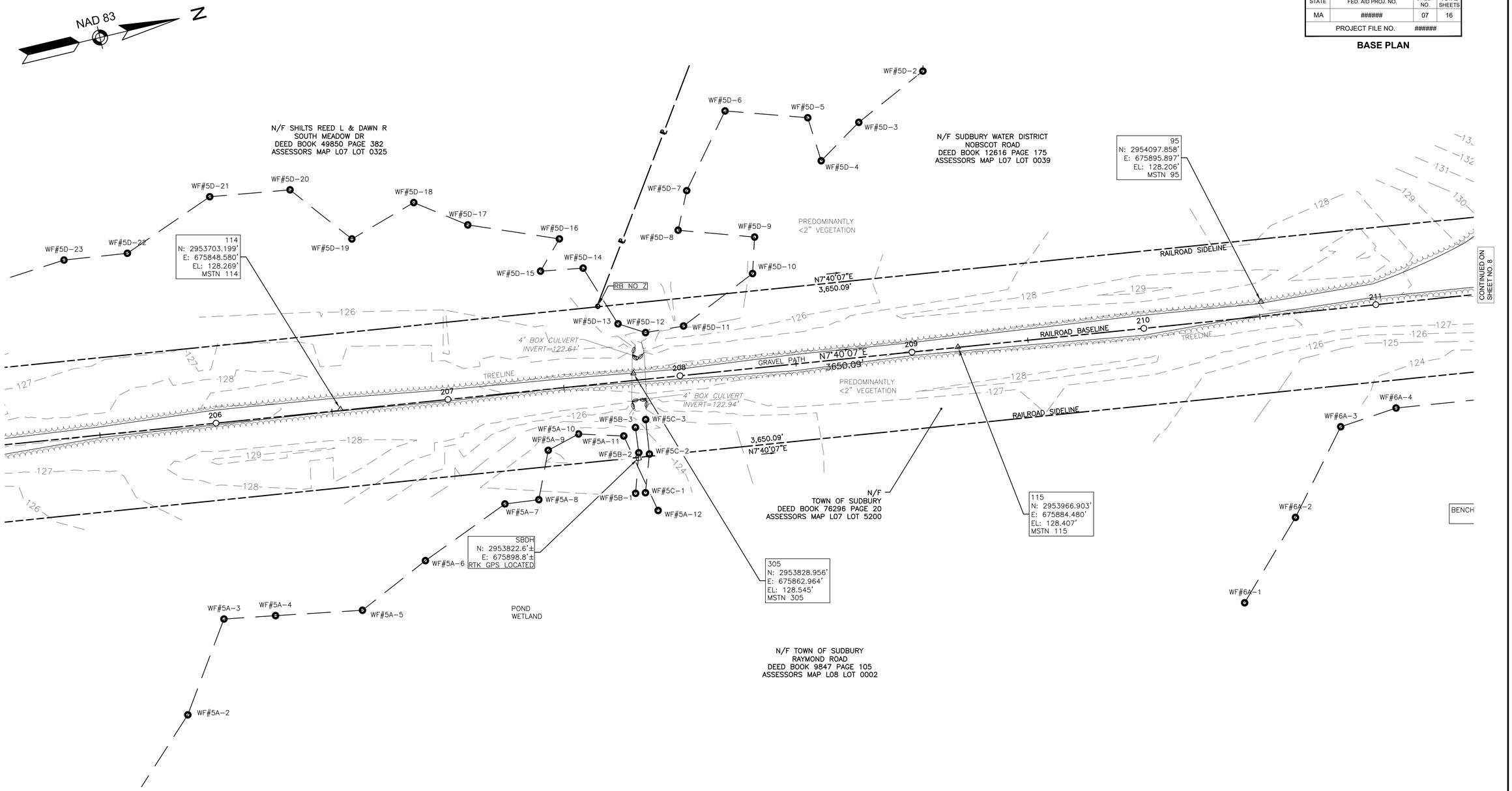
FILE NAME: 2275-BASE.dwg			
FIELD BOOK. NO: BAI_22-23			
DRAWN BY: BAI	CHECKED BY: HJP		
FIELD CHIEF: BAI	PARS. NO:	DATE: 04/24/2023	SHEET 6 OF 16

2275-BASE.DWG Plotted on 25-Apr-2023 12:46 PM

SUDBURY
BRUCE FREEMAN RAIL TRAIL

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	#######	07	16
PROJECT FILE NO.	#######		

BASE PLAN



2275-BASE.DWG Plotted on 25-Apr-2023 12:46 PM

COMMONWEALTH OF MASSACHUSETTS
HAVELOCK J. PURSEGLOVE
No. 54318
REGISTERED PROFESSIONAL LAND SURVEYOR

Havelock Purseglove 4/24/2023
HAVELOCK J. PURSEGLOVE, PLS
MASSACHUSETTS REG. No. 54318

PREPARED BY:

GCG ASSOCIATES
84 MAIN STREET
WILMINGTON, MASSACHUSETTS 01887
PHONE: (978) 657-9714
FAX: (978) 657-7915

PLAN OF TOPOGRAPHIC SURVEY OF

BRUCE FREEMAN RAIL TRAIL
(PHASE 3)

IN THE TOWN OF

REVISIONS		
REV.	COMMENTS	DATE

SCALE: 20 FEET TO THE INCH

FILE NAME: 2275-BASE.dwg	
FIELD BOOK. NO: BAI_22-23	
DRAWN BY: BAI	CHECKED BY: HJP
FIELD CHIEF: BAI	PARS. NO:

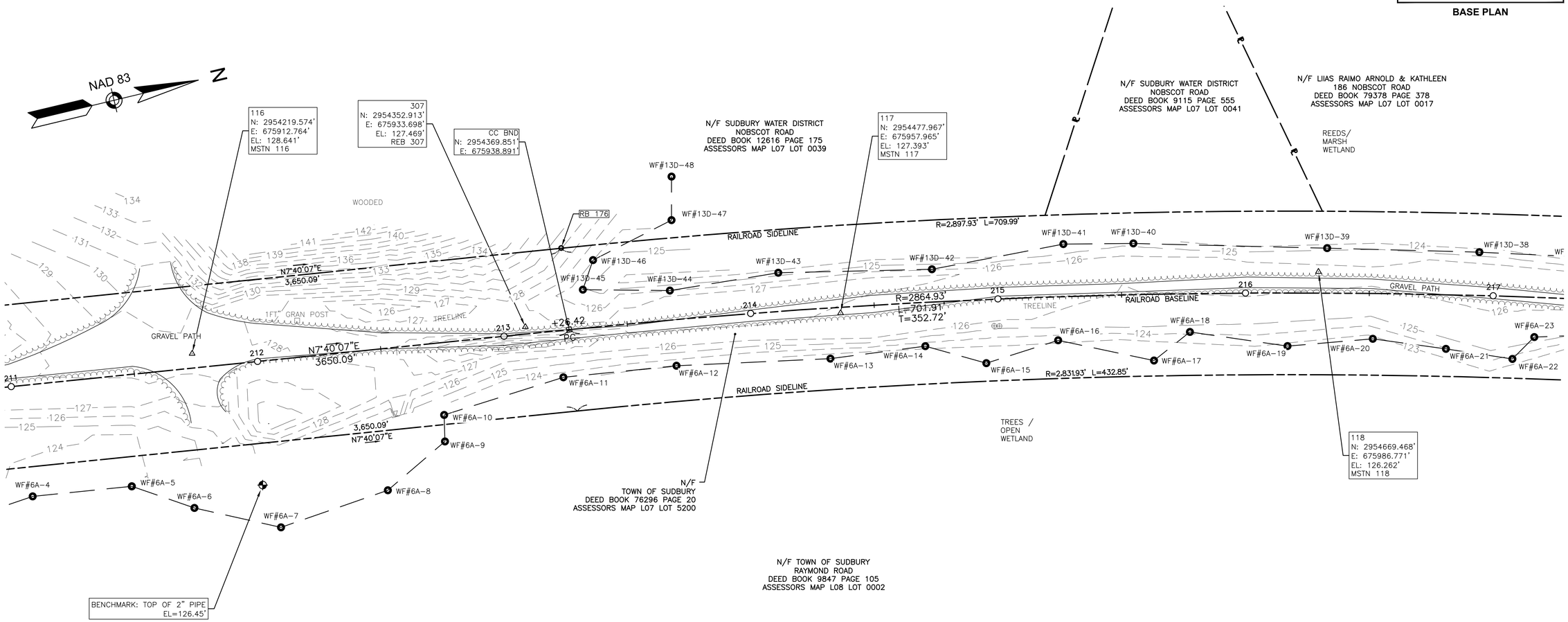
DATE: 04/24/2023

SHEET 7 OF 16

SUDBURY
BRUCE FREEMAN RAIL TRAIL

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	#######	08	16
PROJECT FILE NO.	#######		

BASE PLAN



CONTINUED ON SHEET NO. 7

CONTINUED ON SHEET NO. 9

2275-BASE.DWG Plotted on 25-Apr-2023 12:47 PM

COMMONWEALTH OF MASSACHUSETTS
HAVELOCK J. PURSEGLOVE
No. 54318
REGISTERED PROFESSIONAL LAND SURVEYOR

Havelock Purseglove 4/24/2023
HAVELOCK J. PURSEGLOVE, PLS
MASSACHUSETTS REG. No. 54318

REVISIONS		
REV.	COMMENTS	DATE

PREPARED BY:
GCG ASSOCIATES
84 MAIN STREET
WILMINGTON, MASSACHUSETTS 01887
PHONE: (978) 657-9714
FAX: (978) 657-7915

SCALE: 20 FEET TO THE INCH

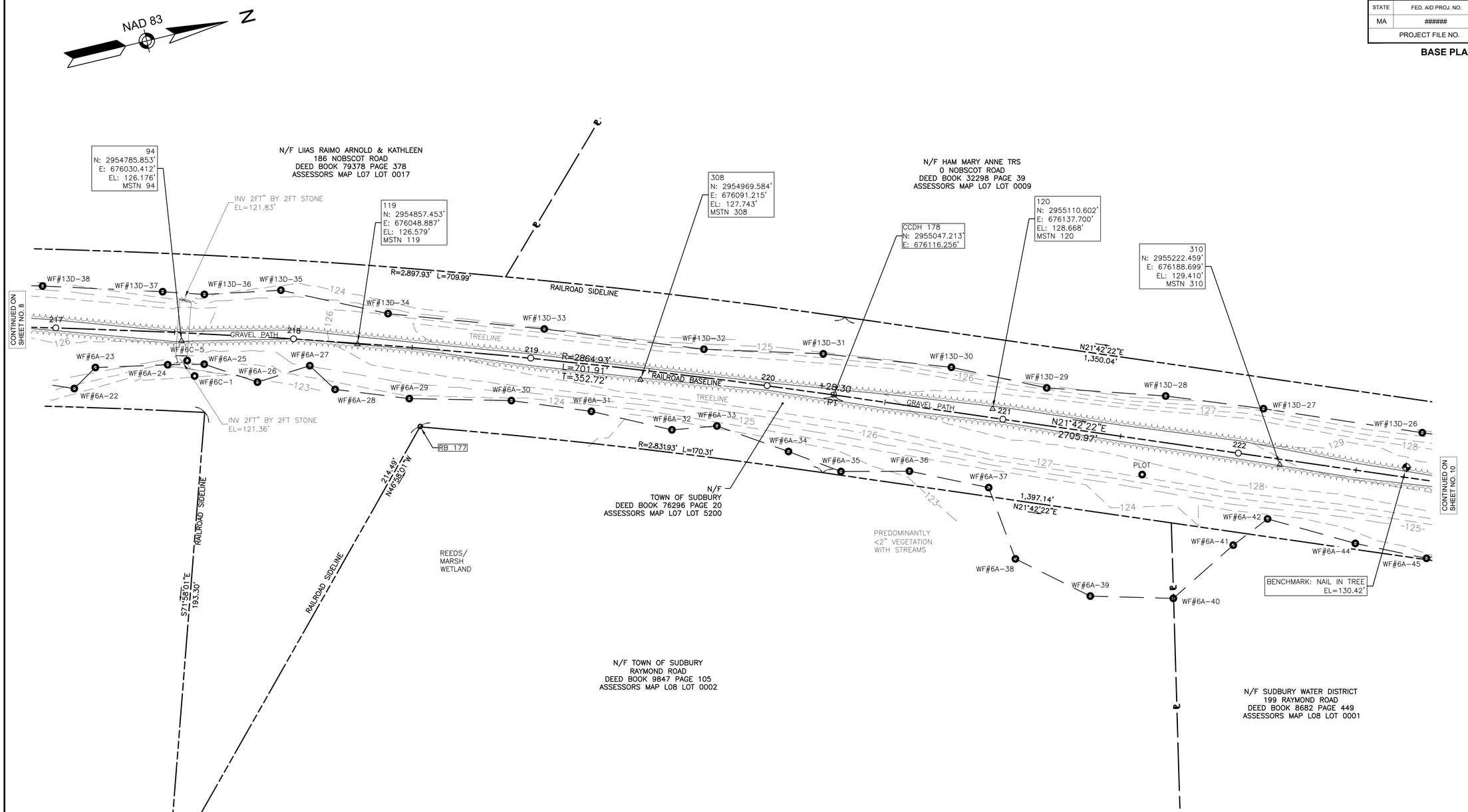
FILE NAME: 2275-BASE.dwg
FIELD BOOK. NO: BAI_22-23
DRAWN BY: BAI | CHECKED BY: HJP
FIELD CHIEF: BAI | PARS. NO:
DATE: 04/24/2023 | SHEET 8 OF 16

PLAN OF TOPOGRAPHIC SURVEY OF
BRUCE FREEMAN RAIL TRAIL
(PHASE 3)
IN THE TOWN OF

SUDBURY
BRUCE FREEMAN RAIL TRAIL

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	#######	09	16
PROJECT FILE NO.	#######		

BASE PLAN



COMMONWEALTH OF MASSACHUSETTS
HAVELOCK J. PURSEGLOVE
No. 54318
REGISTERED PROFESSIONAL LAND SURVEYOR

Havelock Purseglove 4/24/2023

HAVELOCK J. PURSEGLOVE, PLS
MASSACHUSETTS REG. No. 54318

REVISIONS		
REV.	COMMENTS	DATE

PREPARED BY:
GCG ASSOCIATES
84 MAIN STREET
WILMINGTON, MASSACHUSETTS 01887
PHONE: (978) 657-9714
FAX: (978) 657-7915

SCALE: 20 FEET TO THE INCH

FILE NAME: 2275-BASE.dwg	
FIELD BOOK. NO: BAI_22-23	
DRAWN BY: BAI	CHECKED BY: HJP
FIELD CHIEF: BAI	PARS. NO:

PLAN OF TOPOGRAPHIC SURVEY OF

BRUCE FREEMAN RAIL TRAIL
(PHASE 3)

IN THE TOWN OF

DATE: 04/24/2023

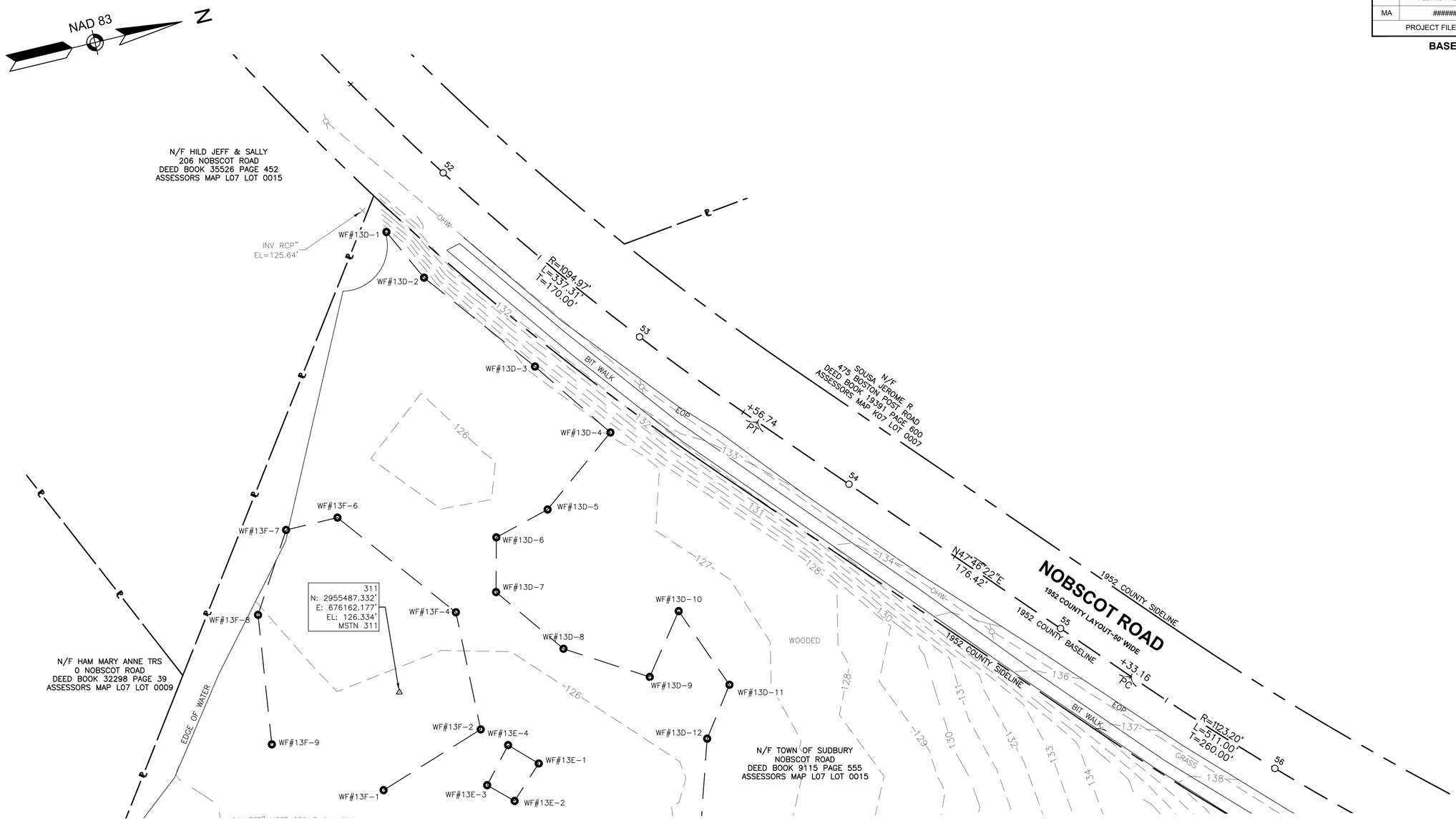
SHEET 9 OF 16

2275-BASE.DWG Plotted on 25-Apr-2023 12:47 PM

SUDBURY
BRUCE FREEMAN RAIL TRAIL

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	######	10	16
PROJECT FILE NO.	######		

BASE PLAN



CONTINUED ON SHEET NO.11

COMMONWEALTH OF MASSACHUSETTS
HAVELOCK J. PURSEGLOVE
No. 54318
REGISTERED PROFESSIONAL LAND SURVEYOR

Havelock Purseglove 4/24/2023
HAVELOCK J. PURSEGLOVE, PLS
MASSACHUSETTS REG. No. 54318

REVISIONS		
REV.	COMMENTS	DATE

PREPARED BY:
GCG ASSOCIATES
84 MAIN STREET
WILMINGTON, MASSACHUSETTS 01887
PHONE: (978) 657-9714
FAX: (978) 657-7915

SCALE: 20 FEET TO THE INCH

FILE NAME: 2275-BASE.dwg
FIELD BOOK. NO: BAI_22-23
DRAWN BY: BAI | CHECKED BY: HJP
FIELD CHIEF: BAI | PARS. NO:
DATE: 04/24/2023 | SHEET 10 OF 16

PLAN OF TOPOGRAPHIC SURVEY OF
BRUCE FREEMAN RAIL TRAIL
(PHASE 3)
IN THE TOWN OF

2275-BASE.DWG Plotted on 25-Apr-2023 12:48 PM

SUDBURY
BRUCE FREEMAN RAIL TRAIL

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	#######	11	16
PROJECT FILE NO.	#######		

BASE PLAN

N

NAD 83

CONTINUED ON SHEET NO. 10

CONTINUED ON SHEET NO. 9

CONTINUED ON SHEET NO. 13

N/F HAM MARY ANNE TRS
0 NOBSCOT ROAD
DEED BOOK 32298 PAGE 39
ASSESSORS MAP L07 LOT 0009

N/F TOWN OF SUDBURY
NOBSCOT ROAD
DEED BOOK 9115 PAGE 555
ASSESSORS MAP L07 LOT 0015

N/F
SOUSA JEROME R
475 BOSTON POST ROAD
DEED BOOK 19391 PAGE 600
ASSESSORS MAP K07 LOT 0007

N/F
TOWN OF SUDBURY
DEED BOOK 76296 PAGE 20
ASSESSORS MAP L07 LOT 5200

N/F SUDBURY WATER DISTRICT
199 RAYMOND ROAD
DEED BOOK 8682 PAGE 449
ASSESSORS MAP L08 LOT 0001

NOBSCOT ROAD
1952 COUNTY LAYOUT-50' WIDE

1952 COUNTY SIDELINE
1952 COUNTY BASELINE
1952 COUNTY SIDELINE

N47°46'22"E
176.42'

+33.16
PC
R=1123.20'
L=511.00'
T=260.00'

311
N: 2955487.332'
E: 676162.177'
EL: 126.334'
MSTN 311

122
N: 2955599.084'
E: 676334.983'
EL: 132.485'
MSTN 122

123
N: 2955754.140'
E: 676398.780'
EL: 133.626'
MSTN 123

121
N: 2955348.721'
E: 676236.128'
EL: 129.889'
SPIKE 121

93
N: 2955826.012'
E: 676428.662'
EL: 134.041'
MSTN 93

BENCHMARK: NAIL IN TREE
EL=133.69'

RAILROAD SIDELINE
N21°42'22"E
1,350.04'

RAILROAD BASELINE
N21°42'22"E
2705.97'

RAILROAD SIDELINE
1,397.14'
N21°42'22"E

INV 3FT" X3FT STONE CULVERT
EL=122.61'

INV 3FT" X 3FT STONE
EL=122.58'

RB 179
RB 181

EDGE OF WATER
TREELINE
GRAVEL PATH
BIT WALK
GRASS
WOODED
OHW
EOP

PREDOMINANTLY
<2" VEGETATION
WITH STREAMS

WF#13F-6
WF#13F-7
WF#13F-8
WF#13F-9
WF#13F-4
WF#13F-2
WF#13F-1
WF#13E-4
WF#13E-1
WF#13E-3
WF#13E-2
WF#13D-5
WF#13D-6
WF#13D-7
WF#13D-8
WF#13D-9
WF#13D-10
WF#13D-11
WF#13D-12
WF#13D-13
WF#13D-14
WF#13D-15
WF#13D-16
WF#13D-17
WF#13D-18
WF#13D-19
WF#13D-20
WF#13D-21
WF#13D-22
WF#13D-23
WF#13D-24
WF#13D-25
WF#13C-11
WF#13C-10
WF#13C-9
WF#13C-8
WF#13C-7
WF#13C-6
WF#13C-5
WF#13C-4
WF#13C-3
WF#13C-2
WF#13B-15
WF#13B-14
WF#13B-13
WF#13B-12
WF#13B-11
WF#13B-10
WF#13B-9
WF#13B-8
WF#13B-7
WF#13B-6
WF#13B-5
WF#13B-4
WF#13B-3
WF#13B-2
WF#8E-7
WF#6D-6
WF#6D-5
WF#6D-4
WF#6D-3
WF#6D-2
WF#6D-1
WF#6E-5
WF#6E-4
WF#6E-3
WF#6E-2
WF#6E-1
WF#6A-46
WF#6A-47
WF#6A-48
WF#6A-49
WF#6A-51
WF#6A-52
WF#6A-53
WF#6A-54
WF#8A-1
WF#8A-2
WF#7A-3
WF#7A-4
WF#7A-5

REVISIONS		
REV.	COMMENTS	DATE

COMMONWEALTH OF MASSACHUSETTS
HAVELOCK J. PURSEGLOVE
No. 54318
REGISTERED PROFESSIONAL LAND SURVEYOR

Havelock Purseglove 4/24/2023
HAVELOCK J. PURSEGLOVE, PLS
MASSACHUSETTS REG. No. 54318

PREPARED BY:
GCG ASSOCIATES
84 MAIN STREET
WILMINGTON, MASSACHUSETTS 01887
PHONE: (978) 657-9714
FAX: (978) 657-7915

SCALE: 20 FEET TO THE INCH

FILE NAME:	2275-BASE.dwg
FIELD BOOK. NO:	BAI_22-23
DRAWN BY: BAI	CHECKED BY: HJP
FIELD CHIEF: BAI	PARS. NO:

PLAN OF TOPOGRAPHIC SURVEY OF
BRUCE FREEMAN RAIL TRAIL
(PHASE 3)
IN THE TOWN OF
SUDBURY

DATE: 04/24/2023

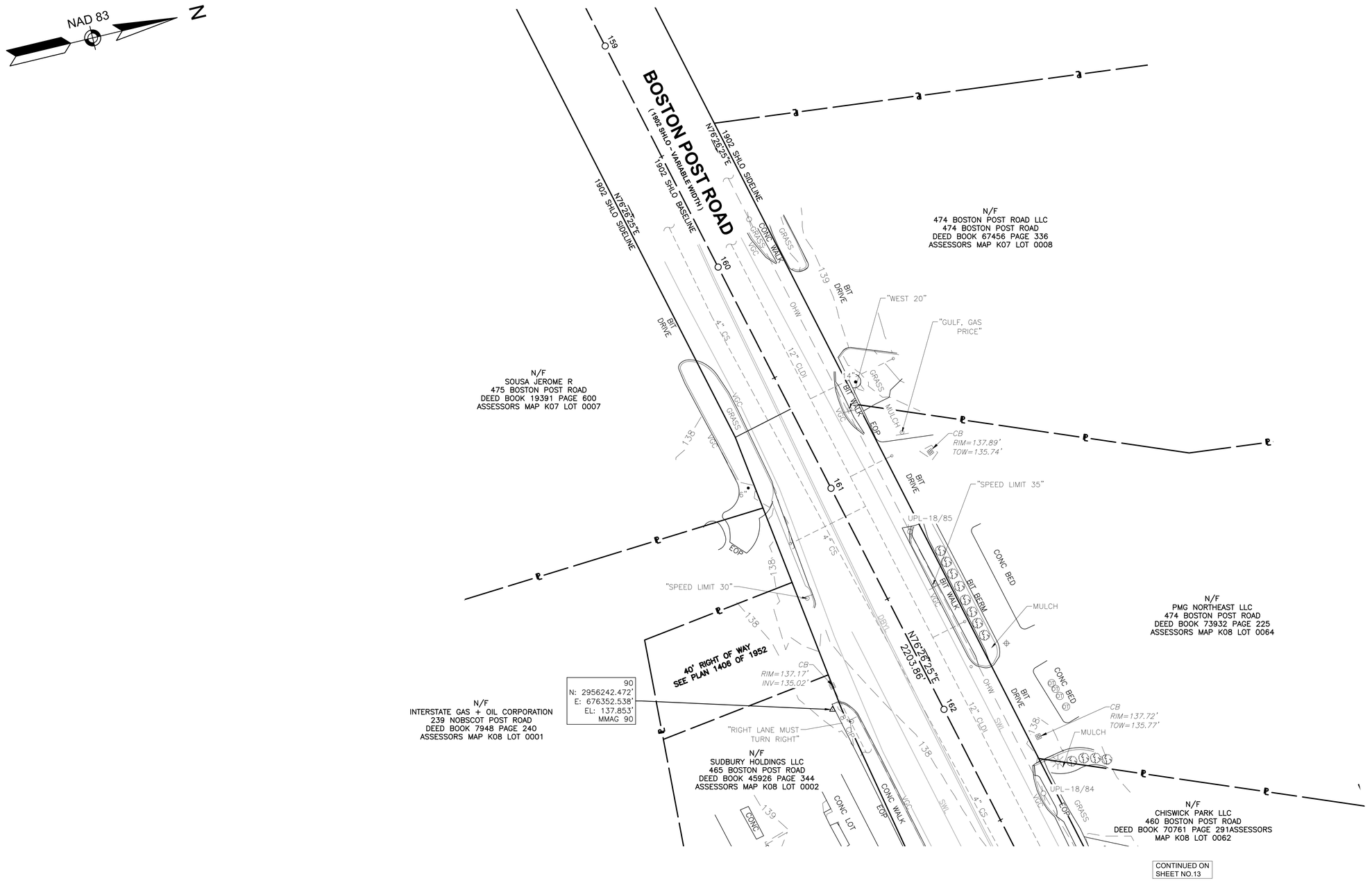
SHEET 11 OF 16

2275-BASE.DWG Plotted on 25-Apr-2023 12:48 PM

SUDBURY
BRUCE FREEMAN RAIL TRAIL

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	######	12	16
PROJECT FILE NO.	######		

BASE PLAN



PREPARED BY:
GCG ASSOCIATES
84 MAIN STREET
WILMINGTON, MASSACHUSETTS 01887
PHONE: (978) 657-9714
FAX: (978) 657-7915

PLAN OF TOPOGRAPHIC SURVEY OF

BRUCE FREEMAN RAIL TRAIL
(PHASE 3)

IN THE TOWN OF

COMMONWEALTH OF MASSACHUSETTS
HAVELOCK J. PURSEGLOVE
No. 54318
REGISTERED PROFESSIONAL LAND SURVEYOR

Havelock Purseglove 4/24/2023

HAVELOCK J. PURSEGLOVE, PLS
MASSACHUSETTS REG. No. 54318

REVISIONS		
REV.	COMMENTS	DATE

SCALE: 20 FEET TO THE INCH

FILE NAME: 2275-BASE.dwg
FIELD BOOK. NO: BAI_22-23
DRAWN BY: BAI | CHECKED BY: HJP
FIELD CHIEF: BAI | PARS. NO:
DATE: 04/24/2023
SHEET 12 OF 16

2275-BASE.DWG Plotted on 25-Apr-2023 12:57 PM

SUDBURY
BRUCE FREEMAN RAIL TRAIL

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	#######	13	16
PROJECT FILE NO.		#######	

BASE PLAN

NAD 83 N

N/F
SOUSA JEROME R
475 BOSTON POST ROAD
DEED BOOK 19391 PAGE 600
ASSESSORS MAP K07 LOT 0007

N/F
INTERSTATE GAS + OIL CORPORATION
239 NOBSCOT POST ROAD
DEED BOOK 7948 PAGE 240
ASSESSORS MAP K08 LOT 0001

ASSESSORS MAP K08 LOT 0002

N/F
CHISWICK PARK LLC
460 BOSTON POST ROAD
DEED BOOK 70761 PAGE 291ASSESSORS
MAP K08 LOT 0062

N/F
SUDBURY HOLDINGS LLC
465 BOSTON POST ROAD
DEED BOOK 45926 PAGE 344
ASSESSORS MAP K08 LOT 0002

N/F
MIDDLESEX SAVINGS BANK
454 BOSTON POST ROAD
DEED BOOK 49392 PAGE 161
ASSESSORS MAP K08 LOT 0065

N/F
SUDBURY WATER DISTRICT
199 RAYMOND ROAD
DEED BOOK 8682 PAGE 449
ASSESSORS MAP L08 LOT 0001

N/F
TOWN OF SUDBURY
DEED BOOK 76296 PAGE 20
ASSESSORS MAP L07 LOT 5200

CONTINUED ON SHEET NO. 12

CONTINUED ON SHEET NO. 11

CONTINUED ON SHEET NO. 14

CONTINUED ON SHEET NO. 15

NOBSCOT ROAD
1952 COUNTY LAYOUT-50' WIDE
R=1123.20'
L=511.00'
T=260.00'

BOSTON POST ROAD
(1902 SHLO - VARIABLE WIDTH)

1952 COUNTY SIDELINE
1952 COUNTY BASELINE
RAILROAD SIDELINE
RAILROAD BASELINE
1902 SHLO BASELINE

R=1147.36' L=494.77'
R=1099.06' L=500.01'
R=64.00' L=49.50'
R=49.27' L=65.86'

N21°42'22"E 1,350.04'
N21°42'22"E 2705.97'
N21°42'22"E 1,397.14'
N21°42'22"E 166.00'
N71°23'34"E 157.86'
N76°26'25"E 220.38'
N76°26'25"E 77.14'
N23°04'47"E 34.71'
N77°29'26"E 58.74'
S76°49'54"E 59.54'

+44.16 PT
50.69'
3.95'
54.27'

164+15.76 1902 SHLO BASELINE =
62+09.72 1952 COUNTY BASELINE
(CALCULATED EQUATION)

164+80.68 1902 SHLO BASELINE =
234+32.72 RAILROAD BASELINE
(CALCULATED EQUATION)

STAKE AND NAIL
N: 2955994.455
E: 676487.525

92
N: 2956162.463'
E: 676518.826'
EL: 139.759'
MSTN 92

32
N: 2956269.306'
E: 676591.453'
EL: 136.069'

BENCHMARK:
NAIL IN UPL
EL=138.83'

BENCHMARK:
NAIL IN UPL
EL=138.27'

"RIGHT LANE MUST TURN RIGHT"
"BICYCLE STOP ON LINE FOR GREEN"
"KEEP RIGHT"
"RIGHT LANE MUST TURN RIGHT"
"BICYCLE STOP ON LINE FOR GREEN"
"LEFT LANE MUST TURN LEFT"
"ENTER"
"EAST 20"
"ON ROADWAY"

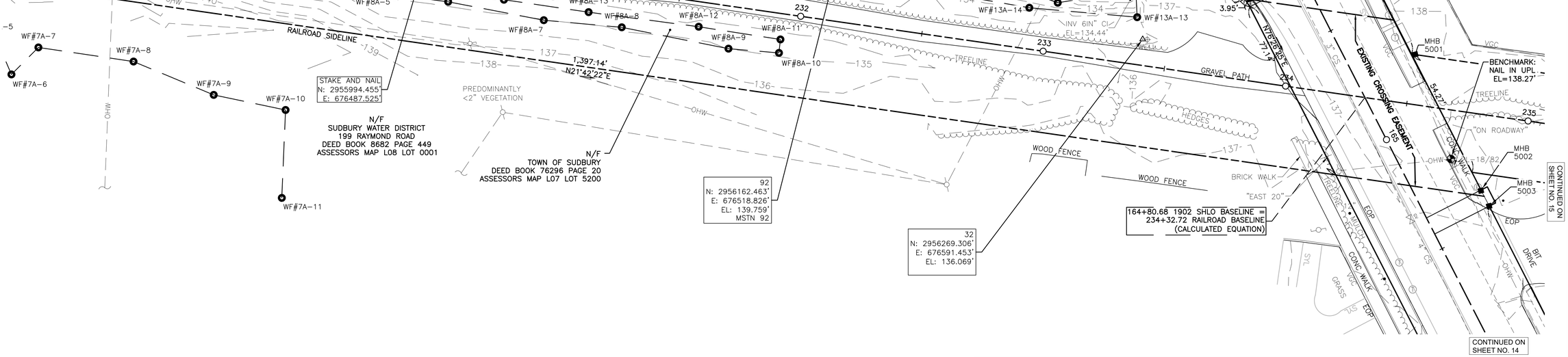
EXISTING CROSSING EASEMENT
165

INV 12IN" RCP FE EL=133.02'
INV 12IN" RCP FE EL=133.18'
INV 6IN" CI EL=134.44'

MHB 413
MHB 421
MHB 5004
MHB 5001
MHB 5002
MHB 5003

CB RIM=136.81' INV=134.81'
CB RIM=137.10' BOLTED SHUT
MHO RIM=138.89' FILLED WITH CONCRETE

WF#13C-2, WF#13B-2, WF#13C-1, WF#13B-1, WF#13A-1, WF#13A-2, WF#13A-20, WF#13A-3, WF#13A-4, WF#13A-5, WF#13A-16, WF#13A-6, WF#BLANK, WF#13A-7, WF#13A-17, WF#13A-8, WF#13A-16, WF#13A-9, WF#13A-10, WF#13A-11, WF#13A-12, WF#13A-13, WF#13A-14, WF#13A-15
WF#8A-1, WF#8A-18, WF#8A-2, WF#8A-3, WF#8A-17, WF#8A-16, WF#8A-4, WF#8A-15, WF#8A-6, WF#8A-14, WF#8A-5, WF#8A-13, WF#8A-8, WF#8A-12, WF#8A-7, WF#8A-11, WF#8A-9, WF#8A-10
WF#7A-7, WF#7A-8, WF#7A-6, WF#7A-9, WF#7A-10, WF#7A-11



COMMONWEALTH OF MASSACHUSETTS
HAVELOCK J. PURSEGLOVE
No. 54318
REGISTERED PROFESSIONAL LAND SURVEYOR

Havelock Purseglove 4/24/2023
HAVELOCK J. PURSEGLOVE, PLS
MASSACHUSETTS REG. No. 54318

REVISIONS		
REV.	COMMENTS	DATE

PREPARED BY:
GCG ASSOCIATES
84 MAIN STREET
WILMINGTON, MASSACHUSETTS 01887
PHONE: (978) 657-9714
FAX: (978) 657-7915

SCALE: 20 FEET TO THE INCH

FILE NAME: 2275-BASE.dwg
FIELD BOOK. NO: BAI_22-23
DRAWN BY: BAI | CHECKED BY: HJP
FIELD CHIEF: BAI | PARS. NO:
DATE: 04/24/2023

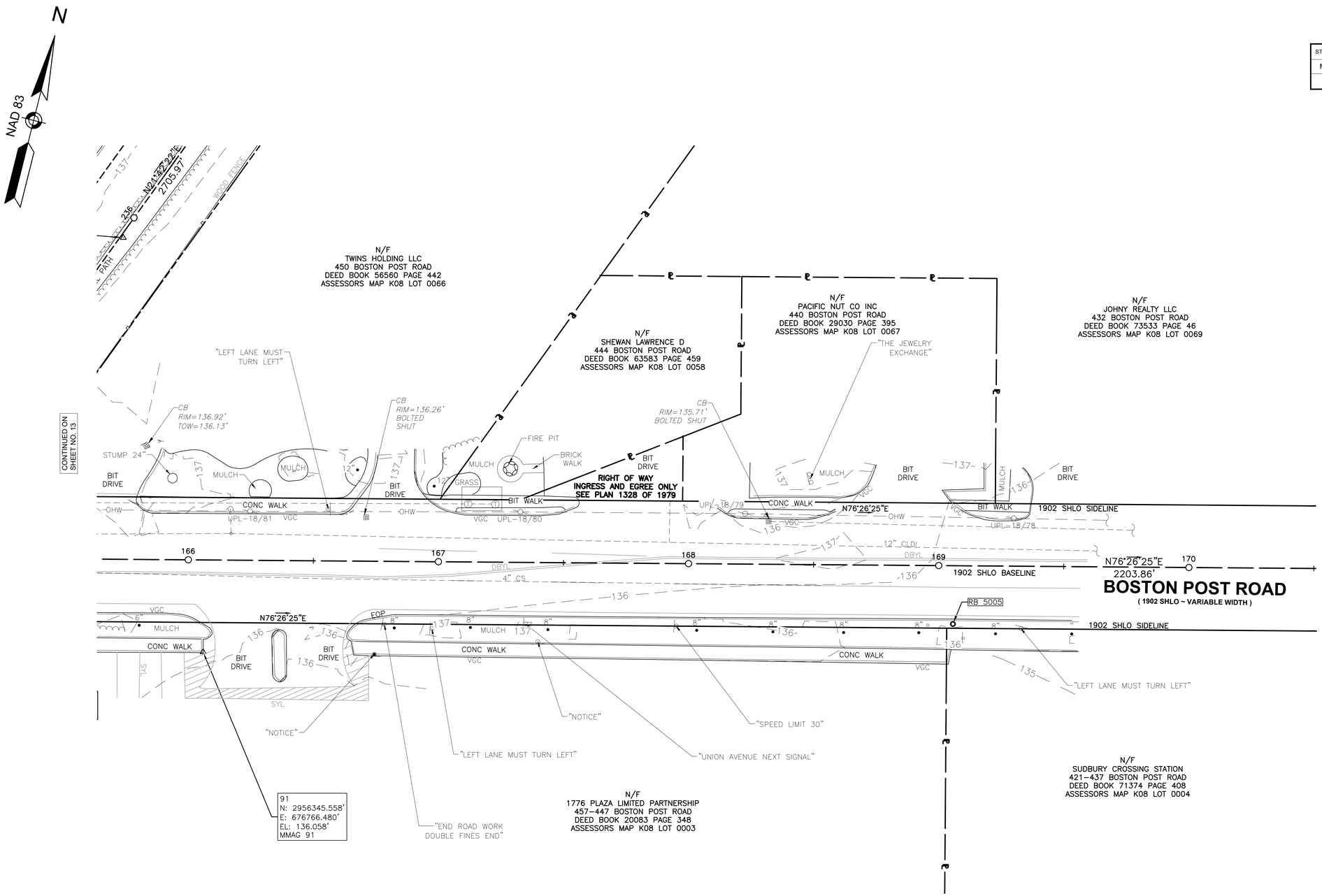
PLAN OF TOPOGRAPHIC SURVEY OF
BRUCE FREEMAN RAIL TRAIL
(PHASE 3)
IN THE TOWN OF

2275-BASE.DWG Plotted on 25-Apr-2023 12:49 PM

SUDBURY
BRUCE FREEMAN RAIL TRAIL

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	#######	14	16
PROJECT FILE NO.	#######		

BASE PLAN



COMMONWEALTH OF MASSACHUSETTS
HAVELOCK J. PURSEGLOVE
No. 54318
REGISTERED PROFESSIONAL LAND SURVEYOR

Havelock Purseglove 4/24/2023

HAVELOCK J. PURSEGLOVE, PLS
MASSACHUSETTS REG. No. 54318

PREPARED BY:

GCG ASSOCIATES
84 MAIN STREET
WILMINGTON, MASSACHUSETTS 01887
PHONE: (978) 657-9714
FAX: (978) 657-7915

REVISIONS		
REV.	COMMENTS	DATE

SCALE: 20 FEET TO THE INCH

PLAN OF TOPOGRAPHIC SURVEY OF

BRUCE FREEMAN RAIL TRAIL
(PHASE 3)

IN THE TOWN OF

FILE NAME: 2275-BASE.dwg			
FIELD BOOK. NO: BAI_22-23			
DRAWN BY: BAI	CHECKED BY: HJP		
FIELD CHIEF: BAI	PARS. NO:	DATE: 04/24/2023	SHEET 14 OF 16

2275-BASE.DWG Plotted on 25-Apr-2023 12:49 PM

SUDBURY
BRUCE FREEMAN RAIL TRAIL

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	######	15	16
PROJECT FILE NO.	######		

BASE PLAN

2275-BASE.DWG Plotted on 25-Apr-2023 12:52 PM

NAD 83 N

126
N: 2956498.614'
E: 676695.441'
EL: 136.015'
MSTN 126

127
N: 2956758.373'
E: 676793.464'
EL: 136.023'
MSTN 127

BENCHMARK:
NAIL IN UPL
EL=138.27'

BENCHMARK: NAIL IN TREE
EL=137.95'

N/F
MIDDLESEX SAVINGS BANK
454 BOSTON POST ROAD
DEED BOOK 49392 PAGE 161
ASSESSORS MAP K08 LOT 0065

N/F
TWINS HOLDING LLC
450 BOSTON POST ROAD
DEED BOOK 56560 PAGE 442
ASSESSORS MAP K08 LOT 0066

N/F
TOWN OF SUDBURY
DEED BOOK 76296 PAGE 20
ASSESSORS MAP K08 LOT 5200

N/F
MCNEILL A ELLIOTT
21 UNION AVENUE
DEED BOOK 23052 PAGE 461
ASSESSORS MAP K08 LOT 0090

20-FOOT WIDE TRAIL EASEMENT SEE DEED BK 51388, PG 565

N21°42'22"E 2705.97'
N21°42'22"E 671.88'
N21°42'22"E 1,068.23'
N68°17'38"W 12.69'
N76°23'25"E 126.36'

RAILROAD BASELINE
RAILROAD SIDELINE
GRAVEL PATH
TREELINE
WOOD FENCE
BIT DRIVE
CONC WALK
EOP
VGC
CLF
OHW
BIT PARKING LOT
PREDOMINANTLY <2" VEGETATION
RB 173

MHB 5002
MHB 5003
CB RIM=136.92' TOW=136.13'
CB RIM=136.26' BOLTED SHUT
STUMP 24"
MULCH
"LEFT LANE MUST TURN LEFT"
UPL

WF#12A-8, WF#12A-7, WF#12A-6, WF#12A-5, WF#12A-4, WF#12A-3, WF#12A-2, WF#12A-1
WF#11B-9, WF#11B-8, WF#11B-7, WF#11B-6, WF#11B-5, WF#11B-4, WF#11B-3, WF#11B-2, WF#11B-1
WF#11A-22, WF#11A-21, WF#11A-20, WF#11A-23, WF#11A-18, WF#11A-17, WF#11A-16, WF#11A-15
WF#9A-13, WF#9A-1, WF#9A-12, WF#9A-2, WF#9A-3, WF#9A-11, WF#9A-4, WF#9A-10, WF#9A-5, WF#9A-9, WF#9A-6, WF#9A-8, WF#9A-7
WF#10A-5, WF#10A-4, WF#10A-6, WF#10A-3, WF#1, WF#10A-2, WF#10A-9, WF#10A-1

235, 236, 237, 238, 239, 240, 241, 166, 167

CONTINUED ON SHEET NO. 13
CONTINUED ON SHEET NO. 16
CONTINUED ON SHEET NO. 13

COMMONWEALTH OF MASSACHUSETTS
HAVELOCK J. PURSEGLOVE
No. 54318
REGISTERED PROFESSIONAL LAND SURVEYOR

Havelock Purseglove 4/24/2023
HAVELOCK J. PURSEGLOVE, PLS
MASSACHUSETTS REG. No. 54318

REVISIONS		
REV.	COMMENTS	DATE

PREPARED BY:
GCG ASSOCIATES
84 MAIN STREET
WILMINGTON, MASSACHUSETTS 01887
PHONE: (978) 657-9714
FAX: (978) 657-7915

SCALE: 20 FEET TO THE INCH

FILE NAME: 2275-BASE.dwg
FIELD BOOK. NO: BAI_22-23
DRAWN BY: BAI | CHECKED BY: HJP
FIELD CHIEF: BAI | PARS. NO:
DATE: 04/24/2023

PLAN OF TOPOGRAPHIC SURVEY OF
BRUCE FREEMAN RAIL TRAIL
(PHASE 3)
IN THE TOWN OF

SUDBURY
BRUCE FREEMAN RAIL TRAIL

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	######	16	16
PROJECT FILE NO.	######		

BASE PLAN

NAD 83 N

20' WIDE DRAINAGE EASEMENT (SEE PLAN 607 OF 1973)

50' WIDE RIGHT OF WAY (SEE PLAN 607 OF 1973)

EOP

TREELINE

3" PE

SPEED BUMP

EASEMENT SIDELINE

302
N: 2957443.360'
E: 676848.027'
EL: 138.672'
MMAG 302

WF#11A-10

WF#11A-2

WF#11A-3

WF#11A-4

WF#11A-5

WF#11A-6

WF#11A-7

WF#11A-8

WF#11A-9

WF#11A-10

WF#11A-11

WF#11A-12

WF#11A-13

WF#11A-14

WF#11A-15

WF#11A-16

128
N: 2957008.619'
E: 676903.336'
EL: 135.877'
MSTN 128

129
N: 2957179.416'
E: 676960.202'
EL: 136.080'
MSTN 129

N/F
MIDDLESEX SAVINGS BANK
454 BOSTON POST ROAD
DEED BOOK 49392 PAGE 161
ASSESSORS MAP K08 LOT 0065

APPROXIMATE LOCATION OF DRAINAGE EASEMENT (SEE PLAN 607 OF 1973)

APPROXIMATE LOCATION OF RAILROAD TRACK EASEMENT (SEE PLAN 607 OF 1973)

N68°17'38"W
12.69'

RB 171

N/F
CHISWICK PARK LLC
UNION AVENUE
DEED BOOK 70761 PAGE 297
ASSESSORS MAP K08 LOT 0057

WF#12A-1

WF#12A-2

WF#12A-3

WF#12A-4

WF#12A-5

WF#12A-6

WF#12A-7

N/F
TOWN OF SUDBURY
DEED BOOK 76296 PAGE 20
ASSESSORS MAP K08 LOT 5200

RAILROAD SIDELINE

N/F
EOT, MASS BAY TRANSPORTATION RAILWAY
DEED BOOK 13117 PAGE 113
ASSESSORS MAP K08 LOT 5100

50
N: 2957419.257'
E: 677058.945'
EL: 137.623'
MMAG 50

RAILROAD TRACKS

4" PE

8" AC

OHW

SYL

CONTINUED ON SHEET NO. 16

241

242

243

244

245

246

N21°42'22"E
2705.97'

RAILROAD BASELINE

GRAVEL PATH

IRON POST

WOODED

WF#10A-1

WF#10A-2

WF#10A-3

WF#10A-5

WF#10A-6

WF#10A-7

WF#10A-8

WF#10A-9

WF#10A-10

WF#10A-11

WF#10A-12

WF#10A-13

WF#10A-14

WF#10A-15

WF#10A-16

WF#10A-17

WF#10A-18

WF#10A-19

WF#10A-20

WF#10A-22

1,068.23'
N21°42'22"E

BENCHMARK: SPIKE
EL=137.15'

PASSAGEWAY
SEE PLAN 1083 OF 1959

N/F
CHISWICK PARK LLC
0 UNION AVENUE
DEED BOOK 70761 PAGE 297
ASSESSORS MAP K08 LOT 0073

N21°42'22"E
429.68'

RB 172

+49.38

BENCHMARK:
NAIL IN UPL

Plotted on 26-Apr-2023 12:50 PM
2275-BASE.DWG

COMMONWEALTH OF MASSACHUSETTS
HAVELOCK J. PURSEGLOVE
No. 54318
REGISTERED PROFESSIONAL LAND SURVEYOR

Havelock Purseglove 4/24/2023
HAVELOCK J. PURSEGLOVE, PLS
MASSACHUSETTS REG. No. 54318

PREPARED BY:
GCG ASSOCIATES
84 MAIN STREET
WILMINGTON, MASSACHUSETTS 01887
PHONE: (978) 657-9714
FAX: (978) 657-7915

REVISIONS		
REV.	COMMENTS	DATE

SCALE: 20 FEET TO THE INCH

FILE NAME: 2275-BASE.dwg
FIELD BOOK. NO: BAI_22-23
DRAWN BY: BAI | CHECKED BY: HJP
FIELD CHIEF: BAI | PARS. NO:

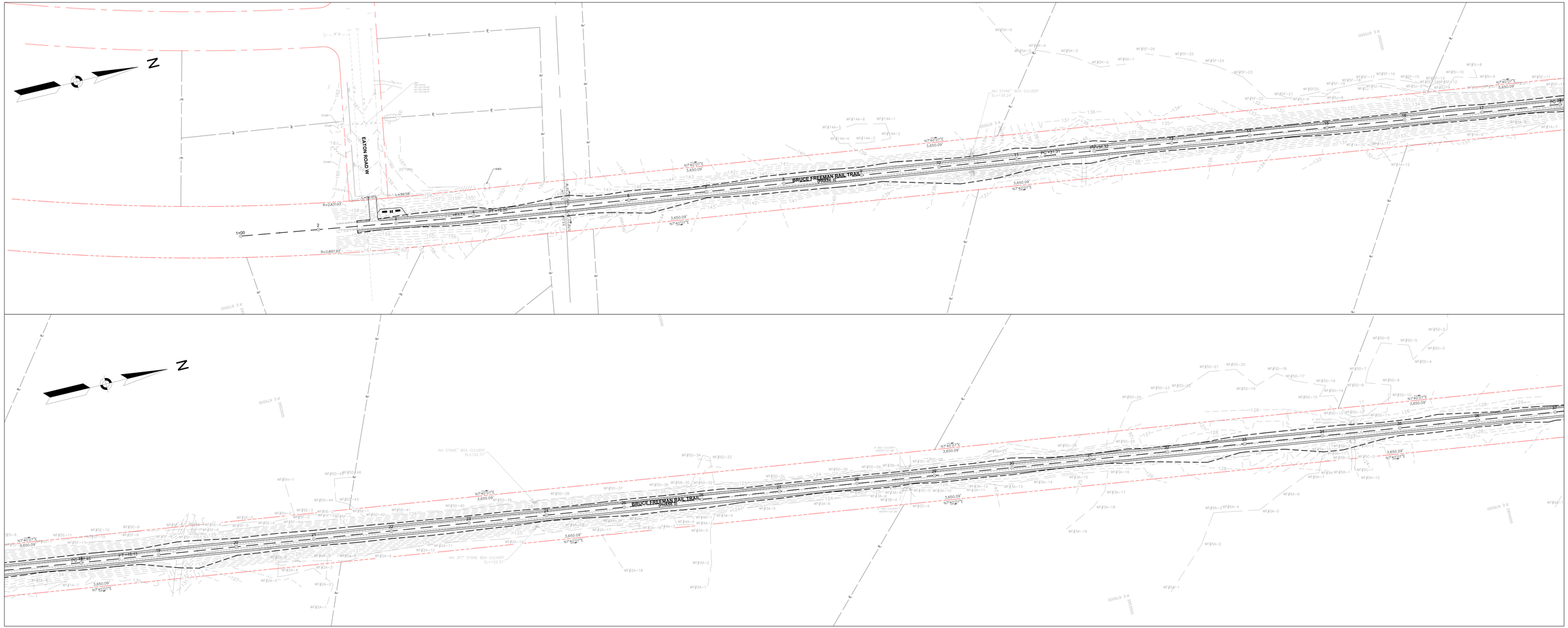
PLAN OF TOPOGRAPHIC SURVEY OF
BRUCE FREEMAN RAIL TRAIL
(PHASE 3)
IN THE TOWN OF

DATE: 04/24/2023 | SHEET 16 OF 16

FUSS & O'NEILL

Appendix C

Alternative 2 Concept Roll Plan

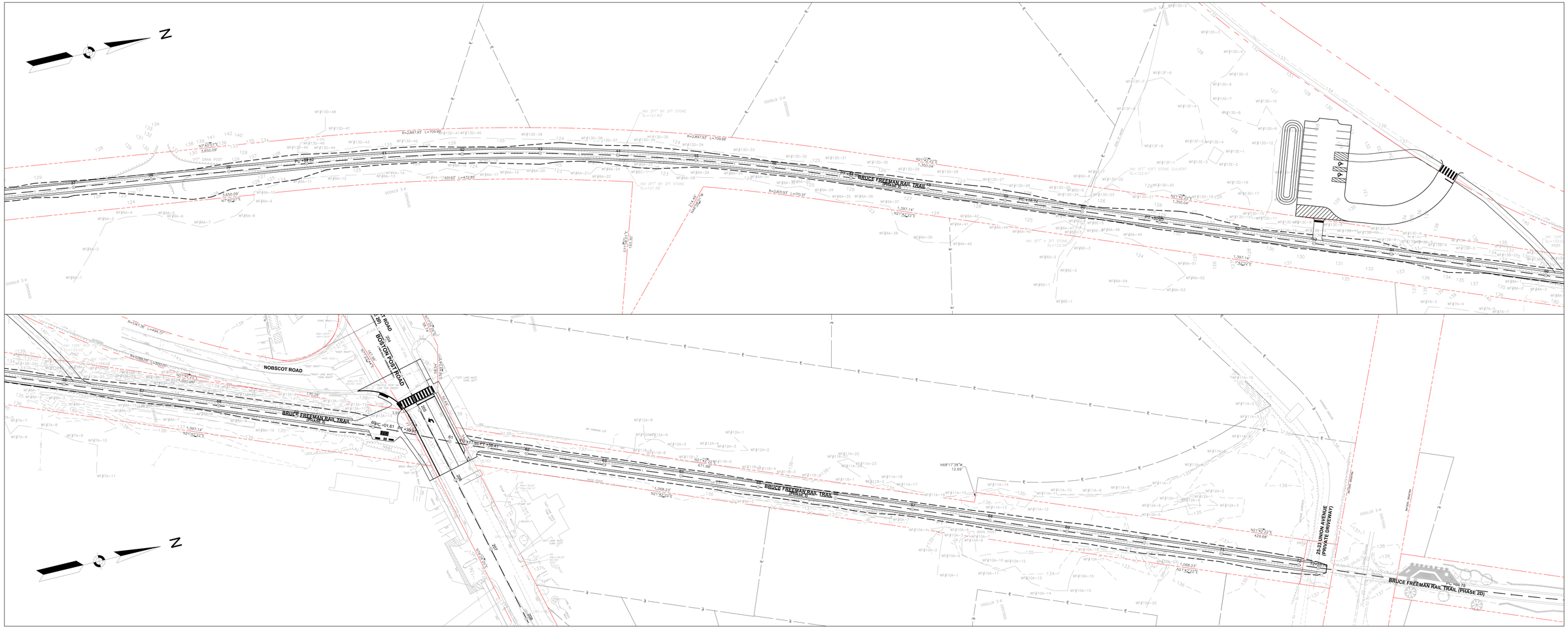


FUSS & O'NEILL

APPENDIX C - CONCEPT ROLL PLAN

PROJ. NO: 20200785.A30 SUDBURY, MA - BRUCE FREEMAN RAIL TRAIL (PHASE 3) July 2023

DRAFT



FUSS & O'NEILL

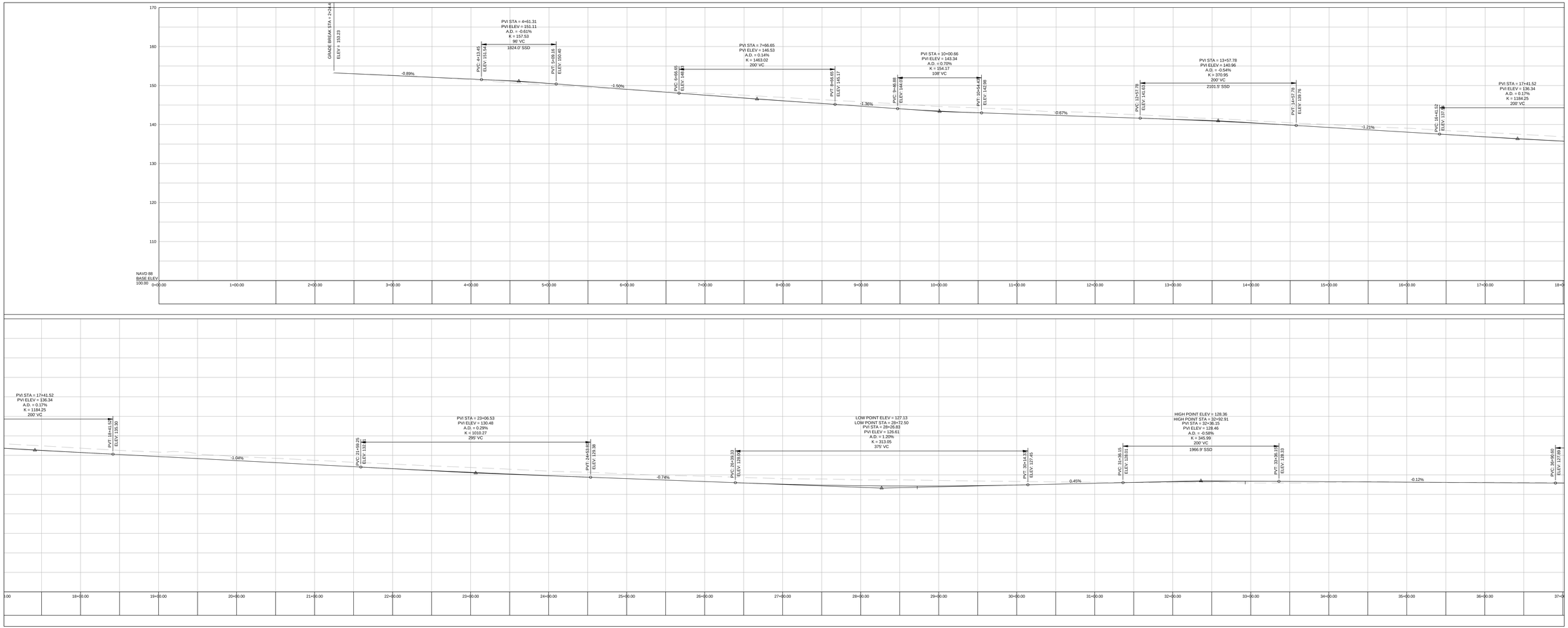
APPENDIX C - CONCEPT ROLL PLAN

PROJ. NO: 20200785.A30 SUDBURY, MA - BRUCE FREEMAN RAIL TRAIL (PHASE 3) July 2023

DRAFT

Appendix D

Trail Profile

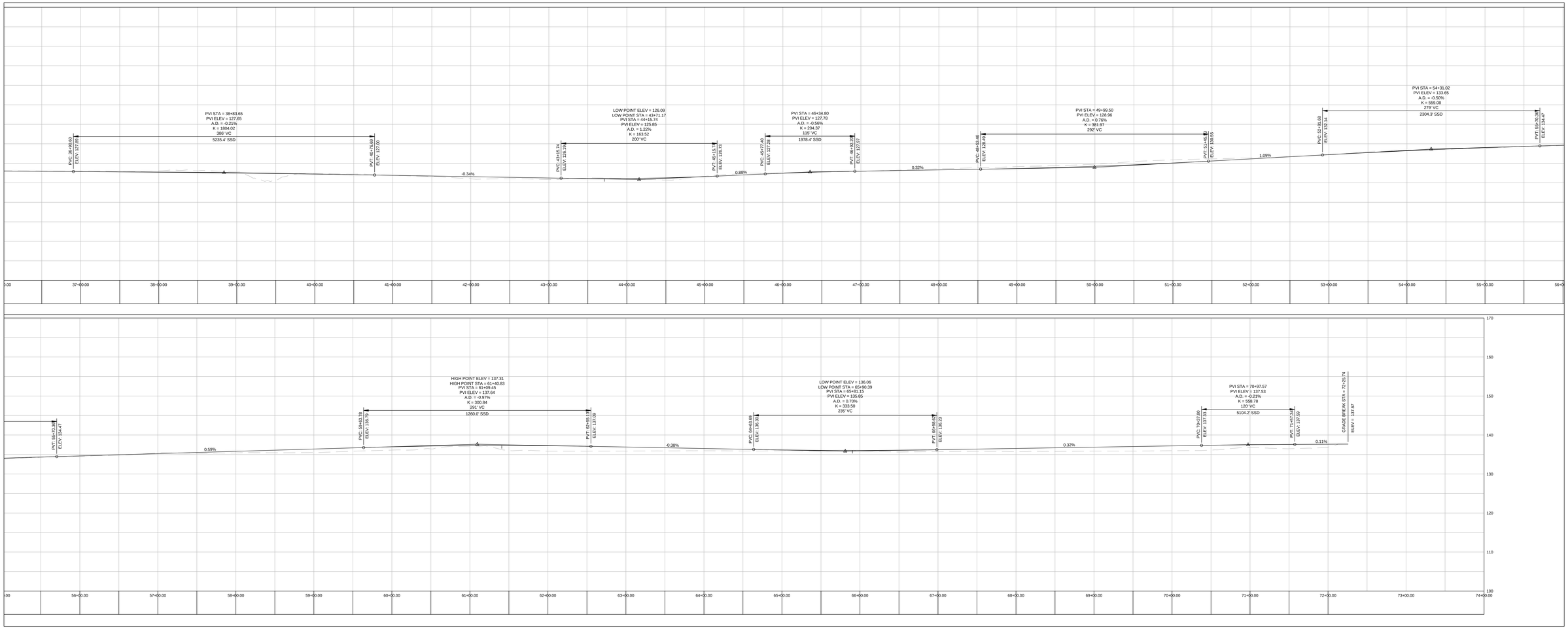


FUSS & O'NEILL

APPENDIX D - PROFILE

PROJ. NO: 20200785.A30 SUDBURY, MA - BRUCE FREEMAN RAIL TRAIL (PHASE 3) July 2023

SCALE: 1" = 50'



FUSS & O'NEILL

APPENDIX D - PROFILE

PROJ. NO: 20200785.A30 SUDBURY, MA - BRUCE FREEMAN RAIL TRAIL (PHASE 3) July 2023

SCALE: 1" = 50'

FUSS & O'NEILL

Appendix E

Alternative 2 Opinion of Probable Cost

FUSS & O'NEILL

Massachusetts Department of Transportation
Highway Division
Bruce Freeman Rail Trail (Phase 3)
Sudbury, MA

MassDOT Proj. #TBD

Alt. #2 Opinion of Probable Construction Cos
April 19, 2023

Computed By: TJM/MT
Checked By: NL

ITEM NO.	FED. PART. QUANTITY	NON PART. QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	FEDERAL AID PART. COST (CMAQ, STBG, TAP)	NON-PARTICIPATING
100.*	1		LS	SCHEDULE OF OPERATIONS - FIXED PRICE $	$32,000.00	$32,000.00	$0.00
101.2*	6		A	CLEARING AND GRUBBING - RAIL TRAIL	$40,000.00	$240,000.00	$0.00
102.001*	40		HR	TREE TRIMMING CREW	$625.00	$25,000.00	$0.00
102.1	4,200		FT	TREE TRIMMING	$7.00	$29,400.00	$0.00
102.3*	90		HR	HERBICIDE TREATMENT FOR INVASIVE PLANTS	$400.00	$36,000.00	$0.00
102.33*	80		HR	INVASIVE PLANT MANAGMENT STRATEGY	$150.00	$12,000.00	$0.00
102.511*	3		EA	TREE PROTECTION - ARMORING AND PRUNING	$100.00	$300.00	$0.00
104.	1		EA	TREE REMOVED - DIAMETERS 24 INCHES AND OVER	$3,000.00	$3,000.00	$0.00
105.40*	4		EA	TREE REMOVED (EXCLUDING STUMP) DIAMETER UNDER 24 INCHES	$400.00	$1,600.00	$0.00
120.	6,250		CY	EARTH EXCAVATION	$35.00	$218,750.00	$0.00
121.	297		CY	CLASS A ROCK EXCAVATION	$100.00	$29,700.00	$0.00
129.5*	7,000		FT	TRACK EXCAVATION	$32.00	$224,000.00	$0.00
129.7*	7,000		FT	HANDLING AND TRANSPORTATION OF RAIL COMPONENTS	$4.00	$28,000.00	$0.00
129.71*	200		TON	HANDLING AND TRANSPORTATION OF OTHER TRACK MATERIALS	$150.00	$30,000.00	$0.00
141.	120		CY	CLASS A TRENCH EXCAVATION	$43.50	$5,220.00	$0.00
141.1	100		CY	TEST PIT FOR EXPLORATION	$100.00	$10,000.00	$0.00
144.	120		CY	CLASS B ROCK EXCAVATION	$250.00	$30,000.00	$0.00
146.	8		EA	DRAINAGE STRUCTURE REMOVED	$750.00	$6,000.00	$0.00
151.	4,030		CY	GRAVEL BORROW	$37.00	$149,110.00	$0.00
152.	200		CY	PROCESSED GRAVEL	$83.00	$16,600.00	$0.00
156.	65		TON	CRUSHED STONE	$75.00	$4,875.00	$0.00
170.	11,100		SY	FINE GRADING AND COMPACTING - SUBGRADE AREA	$6.00	$66,600.00	$0.00
170.4*	300		SY	SCARIFYING AND RESHAPING	$7.00	$2,100.00	$0.00
180.01*	1		LS	ENVIRONMENTAL HEALTH AND SAFETY PROGRAM	$10,000.00	$10,000.00	$0.00
180.02*	40		HR	PERSONNEL PROTECTION LEVEL C UPGRADE	$8.00	$320.00	$0.00
180.03*	120		HR	LICENSED SITE PROFESSIONAL SERVICES	$140.00	$16,800.00	$0.00
181.11*	200		TON	DISPOSAL OF UNREGULATED SOIL	$40.00	$8,000.00	$0.00
181.12*	200		TON	DISPOSAL OF REGULATED SOIL - IN-STATE FACILITY	$100.00	$20,000.00	$0.00
181.13*	200		TON	DISPOSAL OF REGULATED SOIL - OUT-OF-STATE FACILITY	$120.00	$24,000.00	$0.00
181.14*	11		TON	DISPOSAL OF HAZARDOUS WASTE	$400.00	$4,400.00	$0.00
184.1*	400		TON	DISPOSAL OF TREATED WOOD PRODUCTS	$300.00	$120,000.00	$0.00
201.	10		EA	CATCH BASIN	$5,000.00	$50,000.00	$0.00
202.	3		EA	MANHOLE	$4,650.00	$13,950.00	$0.00
204.	5		EA	GUTTER INLET	$2,300.00	$11,500.00	$0.00
221.	3		EA	FRAME AND COVER	$900.00	$2,700.00	$0.00
222.1	10		EA	FRAME AND GRATE - MASSDOT CASCADE TYPE	$1,200.00	$12,000.00	$0.00
223.1*	2		EA	FRAME AND GRATE (OR COVER) REMOVED AND STACKED	$100.00	$200.00	$0.00
227.3		2	CY	REMOVAL OF DRAINAGE STRUCTURE SEDIMENT	$250.00	$0.00	$500.00
227.31		70	FT	REMOVAL OF DRAINAGE PIPE SEDIMENT	$7.00	$0.00	$490.00
227.5*	1		LS	TRAPEZOIDAL AQUATIC EXCLUSIONARY FENCING	$1,000.00	$1,000.00	$0.00
236.01*	1		LS	PRECAST CONCRETE CULVERT - 60 INCH RCP	$125,000.00	$125,000.00	$0.00
241.12	190		FT	12 INCH REINFORCED CONCRETE PIPE	$110.00	$20,900.00	$0.00

FUSS & O'NEILL

Massachusetts Department of Transportation
Highway Division
Bruce Freeman Rail Trail (Phase 3)
Sudbury, MA

MassDOT Proj. #TBD

Concept 1 Oppinion of Probable Construction Cost
April 19, 2023

Computed By: TJM/MT
Checked By: NL

ITEM NO.	FED. PART. QUANTITY	NON PART. QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	FEDERAL AID PART. COST (CMAQ, STBG, TAP)	NON-PARTICIPATING
241.15	50		FT	15 INCH REINFORCED CONCRETE PIPE	$120.00	$6,000.00	$0.00
242.12	2		EA	12 INCH REINFORCED CONCRETE PIPE FLARED END	$1,150.00	$2,300.00	$0.00
281.2*	1,167		SY	JUTE MESH (WATERWAYS)	$10.00	$11,666.67	$0.00
336.101*		136	FT	1 INCH POLYETHYLENE WATER LINE	$105.00	$0.00	$14,280.00
358.	6		EA	GATE BOX ADJUSTED	$250.00	$1,500.00	$0.00
363.1		2	EA	1 INCH CORPORATION COCK	$403.00	$0.00	$806.00
377.*	1		EA	HYDRATION STATION	$4,500.00	$4,500.00	$0.00
381.		1	EA	SERVICE BOX	$350.00	$0.00	$350.00
384.		2	EA	CURB STOP	$500.00	$0.00	$1,000.00
402.12*	450		CY	DENSE GRADED CRUSHED STONE FOR SHOULDERS	$70.00	$31,500.00	$0.00
415.1	4,860		SY	PAVEMENT STANDARD MILLING	$7.00	$34,020.00	$0.00
431.	560		SY	HIGH EARLY STRENGTH CEMENT CONCRETE BASE COURSE	$75.00	$42,000.00	$0.00
440.	38,670		LB	CALCIUM CHLORIDE FOR ROADWAY DUST CONTROL	$0.45	$17,401.50	$0.00
443.	39		MGL	WATER FOR ROADWAY DUST CONTROL	$60.00	$2,340.00	$0.00
450.22	710		TON	SUPERPAVE SURFACE COURSE - 9.5 (SSC - 9.5)	$150.00	$106,500.00	$0.00
450.231	1,310		TON	SUPERPAVE SURFACE COURSE - 12.5 POLYMER (SSC - 12.5 - P)	$150.00	$196,500.00	$0.00
450.32	1,400		TON	SUPERPAVE INTERMEDIATE COURSE - 19.0 (SIC - 19.0)	$150.00	$210,000.00	$0.00
451.	65		TON	HMA FOR PATCHING	$220.00	$14,300.00	$0.00
452.	1,650		GAL	ASPHALT EMULSION FOR TACK COAT	$7.00	$11,550.00	$0.00
453.	730		FT	HMA JOINT SEALANT	$1.00	$730.00	$0.00
472.	160		TON	TEMPORARY ASPHALT PATCHING	$200.00	$32,000.00	$0.00
482.5	290		FT	SAWCUTTING ASPHALT PAVEMENT FOR BOX WIDENING	$2.25	$652.50	$0.00
506.	1,460		FT	GRANITE CURB TYPE VB - STRAIGHT	$45.00	$65,700.00	$0.00
506.1	95		FT	GRANITE CURB TYPE VB - CURVED	$60.00	$5,700.00	$0.00
509.	210		FT	GRANITE TRANSITION CURB FOR PEDESTRIAN CURB RAMPS - STRAIGHT	$57.00	$11,970.00	$0.00
509.1	50		FT	GRANITE TRANSITION CURB FOR PEDESTRIAN CURB RAMPS - CURVED	$65.00	$3,250.00	$0.00
511.1	360		FT	GRANITE EDGING TYPE SB - STRAIGHT	$40.00	$14,400.00	$0.00
580.	200		FT	CURB REMOVED AND RESET	$26.00	$5,200.00	$0.00
590.*	1,200		FT	CURB REMOVED AND STACKED	$9.00	$10,800.00	$0.00
620.11*	250		FT	TIMBER POST GUARDRAIL	$40.00	$10,000.00	$0.00
655.02*	3,880		FT	TIMBER FENCE - THREE RAIL	$62.00	$240,560.00	$0.00
655.04*	1		EA	ENTRANCE SIGN - WOOD	$3,500.00	$3,500.00	$0.00
669.5*	50		FT	FENCE REMOVED AND DISCARDED	$25.00	$1,250.00	$0.00
675.3*	4		EA	LANDSCAPE BOULDER BARRIER	$500.00	$2,000.00	$0.00
697.1*	10		EA	SILT SACK	$190.00	$1,900.00	$0.00
698.3*	1,350		SY	GEOTEXTILE FABRIC FOR SEPERATION	$5.00	$6,750.00	$0.00
699.1*	500		SY	GEOGRID FOR SOIL REINFORCEMENT	$10.00	$5,000.00	$0.00
701.	925		SY	CEMENT CONCRETE SIDEWALK	$75.00	$69,375.00	$0.00
701.2	75		SY	CEMENT CONCRETE PEDESTRIAN CURB RAMP	$100.00	$7,500.00	$0.00

FUSS & O'NEILL

Massachusetts Department of Transportation
Highway Division
Bruce Freeman Rail Trail (Phase 3)
Sudbury, MA

MassDOT Proj. #TBD

Concept 1 Oppinion of Probable Construction Cost
April 19, 2023

Computed By: TJM/MT
Checked By: NL

ITEM NO.	FED. PART. QUANTITY	NON PART. QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	FEDERAL AID PART. COST (CMAQ, STBG, TAP)	NON-PARTICIPATING
701.992*	30		SY	STAMPED & COLORED CONCRETE - COLONIAL RED	$180.00	$5,400.00	$0.00
702.	60		TON	HOT MIX ASPHALT SIDEWALK OR DRIVEWAY	$200.00	$12,000.00	$0.00
707.1*	8		EA	PARK BENCH	$2,250.00	$18,000.00	$0.00
707.2*	3		EA	TRASH RECEPTACLE	$1,750.00	$5,250.00	$0.00
707.7*	2		EA	DISPLAY BOARD	$7,500.00	$15,000.00	$0.00
707.9*	10		EA	BICYCLE RACK	$1,000.00	$10,000.00	$0.00
707.91*	1		EA	BICYCLE REPAIR STATION	$2,500.00	$2,500.00	$0.00
708.35*	96		SY	PERVIOUS CEMENT CONCRETE PAVER	$220.00	$21,120.00	$0.00
710.65*	1		EA	GRANITE TOWN LINE MARKER	$3,000.00	$3,000.00	$0.00
710.8*	5		EA	GRANITE MILE MARKER	$1,750.00	$8,750.00	$0.00
710.85*	3		EA	GRANITE POST INTERPRETIVE SIGN	$2,400.00	$7,200.00	$0.00
710.9*	4		EA	GRANITE BRUCE FREEMAN RAIL TRAIL PIER	$2,000.00	$8,000.00	$0.00
711.	2		EA	BOUND REMOVED AND RESET	$500.00	$1,000.00	$0.00
712.11*	1		EA	BOUND REMOVED AND DISCARDED	$1,300.00	$1,300.00	$0.00
734.2*	1		EA	SIGN-INTERPRETIVE-NPS STANDARD	$3,000.00	$3,000.00	$0.00
740.*	26		MO	ENGINEERS FIELD OFFICE AND EQUIPMENT (TYPE A)	$3,200.00	$83,200.00	$0.00
748.	1		LS	MOBILIZATION	$115,000.00	$115,000.00	$0.00
751.	973		CY	LOAM FOR ROADSIDES	$50.00	$48,625.00	$0.00
751.72*	183		SY	COMPOST BLANKET	$10.00	$1,825.00	$0.00
755.35*	1		LS	INLAND WETLAND REPLICATION AREA	$30,000.00	$30,000.00	$0.00
755.45*	50		SY	WETLAND RESTORATION	$85.00	$4,250.00	$0.00
755.75*	450		HR	WETLAND SPECIALIST	$135.00	$60,750.00	$0.00
755.76*	1		LS	WETLAND MONITORING REPORTS	$20,000.00	$20,000.00	$0.00
756.*	1		LS	NPDES STORMWATER POLLUTION PREVENTION PLAN	$4,500.00	$4,500.00	$0.00
765.	240		SY	SEEDING	$2.30	$552.00	$0.00
765.21*	40		LB	ANNUAL COVER CROP FOR NATIVE SEEDING	$2.00	$80.00	$0.00
765.423*	2		LB	SEEDING MID-HEIGHT POLLINATOR MIX	$30.00	$60.00	$0.00
765.453*	70		LB	SEEDING - WOODLAND EDGE SHADE MIX	$30.00	$2,100.00	$0.00
765.554*	22		LB	SEEDING - WETLAND/BASIN MIX	$100.00	$2,200.00	$0.00
765.635*	8,280		SY	NATIVE SEED AND ESTABLISHMENT	$3.00	$24,840.00	$0.00
767.121*	10,947		FT	SEDIMENT CONTROL BARRIER	$6.00	$65,682.00	$0.00
767.7*	1,203		SY	MATTING FOR EROSION CONTROL	$7.00	$8,421.00	$0.00
769.	280		FT	PAVEMENT MILLING MULCH UNDER GUARDRAIL	$9.00	$2,520.00	$0.00
772.335*	9		EA	CEDAR - RED 4-5 FEET	$500.00	$4,500.00	$0.00
772.376	25		EA	FIR - WHITE 5-6 FEET	$600.00	$15,000.00	$0.00
773.436*	22		EA	PINE - WHITE 4-5 FEET	$500.00	$11,000.00	$0.00
775.142*	1		EA	LINDEN - AMERICAN 2-3 INCH CALIPER	$710.00	$710.00	$0.00
776.839*	1		EA	MAPLE - SUGAR 2-3 INCH CALIPER	$900.00	$900.00	$0.00
777.04*	1		EA	OAK - NORTHERN RED 2-3 INCH CALIPER	$690.00	$690.00	$0.00
778.16*	2		EA	BIRCH - RIVER 2-2.5 INCH CALIPER	$750.00	$1,500.00	$0.00
780.1*	7		EA	DOGWOOD & WILLOW - 1 GAL	$350.00	$2,450.00	$0.00
782.02*	9		EA	CANADIAN SERVICEBERRY - 2-3 INCH CALIPER	$250.00	$2,250.00	$0.00
782.54*	20		EA	REDBUD - EASTERN 2-3 INCH CALIPER	$300.00	$6,000.00	$0.00
785.7*	79		EA	INKBERRY 3 GAL	$115.00	$9,085.00	$0.00
792.01*	30		EA	HYDRANGEA - SMOOTH 3 GAL	$90.00	$2,700.00	$0.00
794.804*	4		EA	SWEET FERN - PLUG	$20.00	$80.00	$0.00
795.052*	91		EA	VIBURNUM - HIGHBUSH CRANBERRY 3 GAL	$95.00	$8,645.00	$0.00
796.442*	75		EA	PENNSYLVANIA SEDGE - PLUG	$35.00	$2,625.00	$0.00
796.456*	4		EA	SWITCH GRASS - PLUG	$20.00	$80.00	$0.00

FUSS & O'NEILL

Massachusetts Department of Transportation
Highway Division
Bruce Freeman Rail Trail (Phase 3)
Sudbury, MA

MassDOT Proj. #TBD

Concept 1 Oppinion of Probable Construction Cost
April 19, 2023

Computed By: TJM/MT
Checked By: NL

ITEM NO.	FED. PART. QUANTITY	NON PART. QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	FEDERAL AID PART. COST (CMAQ, STBG, TAP)	NON-PARTICIPATING
796.706*	4		EA	SMOOTH ASTER - PLUG	$20.00	$80.00	$0.00
796.722*	4		EA	BUTTERFLY WEED - PLUG	$20.00	$80.00	$0.00
796.798*	4		EA	MEADOW SWEET - PLUG	$20.00	$80.00	$0.00
797.001*	3		EA	MAPLE - RED - 'ACER' 4-6 FEET	$525.00	$1,575.00	$0.00
797.002*	2		EA	BIRCH - YELLOW 4-6 FEET	$715.00	$1,430.00	$0.00
797.003*	1		EA	ASH - GREEN 4-6 FEET	$325.00	$325.00	$0.00
797.004*	1		EA	ELM - SLIPPERY 4-6 FEET	$325.00	$325.00	$0.00
797.005*	2		EA	SWEET PEPPERBUSH 2-3 FEET	$60.00	$120.00	$0.00
797.006*	2		EA	HOLLY - 'WINTERBERRY' 2-3 FEET	$65.00	$130.00	$0.00
797.007*	2		EA	SPICEBUSH 2-3 FEET	$60.00	$120.00	$0.00
797.008*	2		EA	BLUEBERRY - HIGHBUSH 2-3 FEET	$60.00	$120.00	$0.00
797.009*	2		EA	VIRBURNUM - ARROWWOOD 2-3 FEET	$60.00	$120.00	$0.00
797.010*	2		EA	VIRBURNUM - NANNYBERRY 2-3 FEET	$70.00	$140.00	$0.00
804.2	110		FT	2 INCH ELECTRICAL CONDUIT TYPE NM - PLASTIC (UL)	$30.00	$3,300.00	$0.00
804.3	780		FT	3 INCH ELECTRICAL CONDUIT TYPE NM - PLASTIC (UL)	$45.00	$35,100.00	$0.00
811.21	3		EA	ELECTRIC HANDHOLE - SD2.021	$1,400.00	$4,200.00	$0.00
811.31	6		EA	PULL BOX 12 X 12 INCHES - SD2.031	$750.00	$4,500.00	$0.00
813.32	200		FT	WIRE TYPE 7 NO. 6 GENERAL PURPOSE	$2.50	$500.00	$0.00
813.801*	1		LS	SERVICE CONNECTION (OVERHEAD) - LOCATION NO. 1	$3,500.00	$3,500.00	$0.00
815.1*	1		LS	TRAFFIC CONTROL SIGNAL LOCATION NO. 1 TRANSPORTED & DISCARDED	$8,500.00	$8,500.00	$0.00
816.1*	1		LS	TRAFFIC SIGNAL RECONSTRUCTION LOCATION NO. 1	$190,000.00	$190,000.00	$0.00
819.95*	1		EA	NON-MOTORIZED TRAFFIC COUNTING STATION	$2,500.00	$2,500.00	$0.00
823.72*	6		EA	HIGHWAY LIGHTING POLE AND LUMINAIRE (TOWN STANDARD)	$2,000.00	$12,000.00	$0.00
832.	200		SF	WARNING-REGULATORY AND ROUTE MARKER - ALUM. PANEL (TYPE A)	$15.00	$3,000.00	$0.00
832.1*	3		EA	TRAIL RULES SIGN	$150.00	$450.00	$0.00
832.2*	6		EA	WAYFINDING SIGN TYPE DS	$1,200.00	$7,200.00	$0.00
833.7	8		EA	DELINEATION FOR GUARD RAIL TERMINI	$55.00	$440.00	$0.00
847.11*	25		EA	TIMBER SIGN POST	$75.00	$1,875.00	$0.00
847.12*	15		EA	SIGN SUP (N/GUIDE)+RTE MKR W/1 BRKWAY POST ASSEMBLY - PAINTED STEEL	$110.00	$1,650.00	$0.00
850.41	385		HR	ROADWAY FLAGGER	$60.00	$23,100.00	$0.00
851.1	220		DAY	TRAFFIC CONES FOR TRAFFIC MANAGEMENT	$100.00	$22,000.00	$0.00
852.	395		SF	SAFETY SIGNING FOR TRAFFIC MANAGEMENT	$22.00	$8,690.00	$0.00
852.11*	1,000		FT	TEMPORARY PEDESTRIAN BARRICADE	$24.00	$24,000.00	$0.00
852.12*	5		EA	TEMPORARY PEDESTRIAN CURB RAMP	$500.00	$2,500.00	$0.00
853.1	15		EA	PORTABLE BREAKAWAY BARRICADE TYPE III	$150.00	$2,250.00	$0.00
854.016	2,950		FT	TEMPORARY PAVING MARKINGS - 6 IN. (PAINTED)	$0.50	$1,475.00	$0.00
854.1	1,730		SF	PAVEMENT MARKING REMOVAL	$1.50	$2,595.00	$0.00
856.	88		DAY	ARROW BOARD	$10.00	$880.00	$0.00
856.12	780		DAY	PORTABLE CHANGEABLE MESSAGE SIGN	$25.00	$19,500.00	$0.00
859.	46,200		DAY	REFLECTORIZED DRUM	$0.30	$13,860.00	$0.00
860.106	650		FT	6 INCH REFLECTORIZED WHITE LINE (PAINTED)	$1.75	$1,137.50	$0.00
860.112	110		FT	12 INCH REFLECTORIZED WHITE LINE (PAINTED)	$2.00	$220.00	$0.00
861.106	1,950		FT	6 INCH REFLECTORIZED YELLOW LINE (PAINTED)	$1.75	$3,412.50	$0.00
862.1*	670		SF	GORE LINES - REFLECTORIZED WHITE (PAINTED)	$1.25	$837.50	$0.00
862.2*	300		SF	GORE LINES - REFLECTORIZED YELLOW (PAINTED)	$1.25	$375.00	$0.00

FUSS & O'NEILL

Massachusetts Department of Transportation
Highway Division
Bruce Freeman Rail Trail (Phase 3)
Sudbury, MA
Concept 1 Oppinion of Probable Construction Cost
April 19, 2023

MassDOT Proj. #TBD

Computed By: TJM/MT
Checked By: NL

ITEM NO.	FED. PART. QUANTITY	NON PART. QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	FEDERAL AID PART. COST (CMAQ, STBG, TAP)	NON-PARTICIPATING
864.	990		SF	PAVEMENT ARROW REFLECTORIZED WHITE (PAINTED)	$2.00	$1,980.00	$0.00
864.04	620		SF	PAVEMENT ARROWS AND LEGENDS REFLECTORIZED WHITE (THERMOPLASTIC)	$7.00	$4,340.00	$0.00
865.*	1,980		SF	CROSS WALKS REFLECTORIZED WHITE (THERMOPLASTIC)	$1.50	$2,970.00	$0.00
868.106*	1,200		FT	6 INCH WET REFLECTORIZED RECESSED WHITE LINE (THERMOPLASTIC)	$1.35	$1,620.00	$0.00
868.112*	170		FT	12 INCH WET REFLECTORIZED RECESSED WHITE LINE (THERMOPLASTIC)	$6.00	$1,020.00	$0.00
869.106*	1,750		FT	6 INCH WET REFLECTORIZED RECESSED YELLOW LINE (THERMOPLASTIC)	$1.35	$2,362.50	$0.00
874.	4		EA	STREET NAME SIGN	$100.00	$400.00	$0.00
874.2*	5		EA	TRAFFIC SIGN REMOVED AND RESET	$100.00	$500.00	$0.00
874.4*	12		EA	TRAFFIC SIGN REMOVED AND STACKED	$25.00	$300.00	$0.00
874.75*	1		EA	MISCELLANEOUS SIGNS REMOVED AND RESET	$500.00	$500.00	$0.00
876.1*	2		EA	ELECTRIC POLE AND METER REMOVED AND DISCARDED	$700.00	$1,400.00	$0.00
901.	70		CY	4000 PSI, 1.5 INCH, 565 CEMENT CONCRETE	$1,000.00	$70,000.00	$0.00
905.	8		CY	4000 PSI, 3/8 INCH, 660 CEMENT CONCRETE	$4,000.00	$32,000.00	$0.00
910.1	2,000		LB	STEEL REINFORCEMENT FOR STRUCTURES - EPOXY COATED	$8.00	$16,000.00	$0.00
986.	300		TON	MODIFIED ROCK FILL	$100.00	$30,000.00	$0.00
991.3*	1		LS	CONTROL OF WATER - PRECAST CONCRETE CULVERT 48 INCH RCP	$10,000.00	$10,000.00	$0.00

*-Denotes item has special provision

Subtotal:	**$4,081,265.67**	**$17,426.00**
3 year Inflation (at 5%/yr)	**$643,309.50**	**$2,746.77**
25% Design Contingency	**$1,020,316.42**	**$4,356.50**
Subtotal:	**$5,744,891.58**	**$24,529.27**
10% Construction Engineering:	**$574,489.16**	**$2,452.93**
10% Construction Contingency:	**$574,489.16**	**$2,452.93**
Subtotal:	**$6,893,869.90**	**$29,435.13**
Uniformed Traffic Officer Control:	**$86,173.37**	
Utility Force Account 50% Reimb.(Assume 6% of Raw Cost):	**$244,875.94**	
Grand Total (Sudbury):	**$7,254,354.34**	

Notes:

This estimate assumes intersection of Nobscott/Boston Post Road is fully reconstructed with new equipment and paved to be conservative at this time. It is not the projects intent for this work to occur.

Construction Cost Estimate Prepared For:

Construction Cost Estimate Prepared By: FUSS & O'NEILL

Estimated by: TJM - 06-27-2022
Checked by: NJL, MT - 06-27-2022

FUSS & O'NEILL

Appendix F

Traffic Analysis Tables

APPENDIX F-1
WEEKDAY MORNING PEAK HOUR
INTERSECTION CAPACITY ANALYSIS: LEVEL OF SERVICE SUMMARY: SYNCHRO (SIDRA FOR THE ROUNABOUT)

Intersection	Movement	2022 Existing					2042 No Build					2042 No Build: Optimized Signals					2042 Build: At Grade Mid-Block Crossing					2042 Build: At Grade At Intersection Crossing					2042 Build: Roundabout				
		Delay	LOS	V/C	50% Q (ft)	95% Q (ft)	Delay	LOS	V/C	50% Q (ft)	95% Q (ft)	Delay	LOS	V/C	50% Q (ft)	95% Q (ft)	Delay	LOS	V/C	50% Q (ft)	95% Q (ft)	Delay	LOS	V/C	50% Q (ft)	95% Q (ft)	Delay	LOS	V/C	50% Q (ft)	95% Q (ft)
Boston Post Road at Nobscot Road & Parking Lot		Signalized (HCM 2000)					Signalized (HCM 2000)					Signalized (HCM 2000)					Signalized (HCM 2000)					Signalized (HCM 2000)					Roundabout (HCM 6)				
Boston Post Road (RTE 20)	EB T/L	19.8	B	0.76	307	798	29.4	C	0.88	393	903	32.5	C	0.90	364	835	33.5	C	0.91	342	923	35.0	D	0.92	352	772	16.5	C	0.76	152	377
Boston Post Road (RTE 20)	EB R	7.8	A	0.02	0	0	9.1	A	0.02	0	0	9.7	A	0.02	0	0	5.1	A	0.02	0	5	10.4	B	0.02	0	0	16.5	C	0.76	152	377
Boston Post Road (RTE 20)	WB T/R	6.8	A	0.41	98	246	8.3	A	0.45	126	282	9.4	A	0.49	109	294	7.6	A	0.48	87	385	7.7	A	0.49	70	198	10.2	B	0.59	51	126
Boston Post Road (RTE 20)	WB L	18.5	B	0.39	23	89	38.7	D	0.52	48	100	33.3	C	0.60	22	82	15.5	B	0.56	18	128	43.4	D	0.67	46	140	10.2	B	0.59	51	126
Nobscot Road	NB T/L	60.0	E	0.72	55	102	51.1	D	0.67	60	110	47.4	D	0.63	58	161	41.5	D	0.60	50	94	42.6	D	0.61	49	146	25.1	D	0.72	64	158
Nobscot Road	NB R	2.6	A	0.16	0	19	2.6	A	0.17	0	19	2.5	A	0.18	0	19	2.9	A	0.16	0	22	4.1	A	0.16	0	22	25.1	D	0.72	64	158
Parking Lot	SB T/L/R	40.7	D	0.00	0	0	39.2	D	0.00	0	0	38.6	D	0.00	0	0	34.7	C	0.00	0	0	35.2	D	0.00	0	0	6.3	A	0.01	0	1
	Overall:	15.2	B	0.70			20.8	C	0.77			21.8	C	0.75			20.0	C	0.78			23.2	C	0.75			15.9	C	0.76		
Boston Post Road at Union Avenue & Parking Lot																															
Boston Post Road (RTE 20)	EB L	33.2	C	0.53	180	261	37.9	D	0.53	180	261	28.8	C	0.70	101	214	49.5	D	0.85	149	270	44.2	D	0.83	182	218					
Boston Post Road (RTE 20)	EB T/R	6.4	A	0.65	106	288	7.7	A	0.65	106	288	9.2	A	0.71	149	272	7.6	A	0.65	190	324	8.7	A	0.65	152	332					
Boston Post Road (RTE 20)	WB L	24.5	C	0.14	13	33	23.8	C	0.14	13	33	15.4	B	0.15	8	25	13.2	B	0.11	10	31	12.8	B	0.11	10	33					
Boston Post Road (RTE 20)	WB T/R	40.3	D	0.81	267	373	41.3	D	0.81	267	373	31.5	C	0.83	151	301	19.0	B	0.60	208	342	18.5	B	0.61	207	371					
Parking Lot	NB L	38.6	D	0.15	12	33	37.8	D	0.15	12	33	22.9	C	0.14	7	25	35.2	D	0.15	11	33	35.3	D	0.15	11	33					
Parking Lot	NB T/R	38.9	D	0.19	22	58	38.0	D	0.19	22	58	23.0	C	0.20	12	45	35.4	D	0.21	19	58	35.5	D	0.20	19	57					
Union Avenue	SB T/L	50.8	D	0.70	73	117	50.6	D	0.70	73	117	36.3	D	0.72	41	102	51.2	D	0.72	59	123	45.9	D	0.70	60	112					
Union Avenue	SB R	0.6	A	0.19	0	0	0.6	A	0.19	0	0	1.0	A	0.19	0	0	0.7	A	0.18	0	0	0.7	A	0.18	0	0					
	Overall:	21.4	C	0.69			22.7	C	0.74			18.2	C	0.80			19.0	B	0.74			20.0	C	0.73							

KEY:

2022 Existing: Current operation of the intersection
2042 No Build: Current intersection with future traffic volumes
2042 No Build: Optimized Signals: Future traffic volumes with optimized signal timings
2042 Build: At Grade Mid-Block Crossing: Operation of alternative one
2042 Build: At Grade At Intersection Crossing: Operation of alternative two
2042 Build: Roundabout: Operation of alternative three

APPENDIX F-2
WEEKDAY AFTERNOON PEAK HOUR
INTERSECTION CAPACITY ANALYSIS: LEVEL OF SERVICE SUMMARY: SYNCHRO (SIDRA FOR THE ROUNDABOUT)

Intersection	Movement	2022 Existing					2042 No Build					2042 No Build: Optimized Signals					2042 Build: At Grade Mid-Block Crossing					2042 Build: At Grade At Intersection Crossing					2042 Build: Roundabout				
		Delay	LOS	V/C	50% Q (ft)	95% Q (ft)	Delay	LOS	V/C	50% Q (ft)	95% Q (ft)	Delay	LOS	V/C	50% Q (ft)	95% Q (ft)	Delay	LOS	V/C	50% Q (ft)	95% Q (ft)	Delay	LOS	V/C	50% Q (ft)	95% Q (ft)	Delay	LOS	V/C	50% Q (ft)	95% Q (ft)
Boston Post Road at Nobscot Road & Parking Lot		Signalized (HCM 2000)					Signalized (HCM 2000)					Signalized (HCM 2000)					Signalized (HCM 2000)					Signalized (HCM 2000)					Roundabout (HCM 6)				
Boston Post Road (RTE 20)	EB T/L	49.3	D	0.93	337	676	100.6	F	1.11	415	759	41.0	D	0.88	463	712	28.2	C	0.87	217	652	27.0	C	0.97	389	661	20.0	C	0.79	164	409
Boston Post Road (RTE 20)	EB R	18.7	B	0.05	0	11	20.9	C	0.06	0	14	16.9	B	0.06	0	16	10.6	B	0.05	0	10	13.8	B	0.05	0	13	20.0	C	0.79	164	409
Boston Post Road (RTE 20)	WB T/R	11.4	B	0.57	198	502	15.4	B	0.63	321	664	13.0	B	0.65	328	473	9.9	A	0.72	133	655	12.5	B	0.70	288	498	35.4	E	0.95	570	1415
Boston Post Road (RTE 20)	WB L	36.4	D	0.62	174	399	27.4	C	0.62	171	415	100.7	F	1.01	226	396	28.3	C	0.84	45	280	29.5	C	0.74	138	373	35.4	E	0.95	570	1415
Nobscot Road	NB T/L	51.7	D	0.69	68	30	52.7	D	0.71	75	32	74.9	E	0.81	106	40	65.8	E	0.85	47	181	57.6	E	0.74	71	174	13.9	B	0.51	34	84
Nobscot Road	NB R	2.4	A	0.10	0	17	2.5	A	0.11	0	18	3.0	A	0.11	0	17	29.0	C	0.14	0	66	3.5	A	0.11	0	18	13.9	B	0.51	34	84
Parking Lot	SB T/L/R	39.0	D	0.13	14	7	38.4	D	0.13	14	6	46.0	D	0.19	17	8	28.8	C	0.10	6	31	39.8	D	0.09	8	33	10.7	B	0.06	2	5
	Overall:	28.7	C	0.75			45.1	D	0.84			36.6	D	0.78			23.1	C	0.84			31.8	C	0.79			26.7	D	0.95		
Boston Post Road at Union Avenue & Parking Lot		Signalized (HCM 2000)					Signalized (HCM 2000)										Signalized (HCM 2000)					Signalized (HCM 2000)									
Boston Post Road (RTE 20)	EB L	35.3	D	0.53	144	164	52.3	D	0.57	130	175	40.9	D	0.74	84	195	52.2	D	0.82	123	288	60.3	E	0.79	145	193					
Boston Post Road (RTE 20)	EB T/R	2.3	A	0.46	30	37	3.3	A	0.51	25	39	7.0	A	0.53	100	168	7.5	A	0.56	158	302	3.2	A	0.51	40	74					
Boston Post Road (RTE 20)	WB L	20.9	C	0.33	41	66	21.6	C	0.32	39	60	15.2	B	0.33	25	48	14.8	B	0.26	28	68	15.2	B	0.23	32	68					
Boston Post Road (RTE 20)	WB T/R	28.6	C	0.73	331	469	35.8	D	0.83	305	407	27.8	C	0.84	204	383	27.8	C	0.83	303	525	24.7	C	0.74	341	502					
Parking Lot	NB L	37.6	D	0.44	44	72	36.9	D	0.47	41	66	25.2	C	0.46	29	55	30.2	C	0.34	32	74	37.3	D	0.39	72	74					
Parking Lot	NB T/R	35.4	D	0.21	43	70	34.5	C	0.23	27	62	23.7	C	0.23	18	54	29.1	C	0.21	24	73	35.6	D	0.21	27	72					
Union Avenue	SB T/L	55.6	E	0.79	111	149	59.9	E	0.83	102	135	55.9	E	0.87	71	136	42.9	D	0.73	87	162	57.3	E	0.79	99	160					
Union Avenue	SB R	0.7	A	0.27	0	0	0.7	A	0.29	0	0	1.1	A	0.29	0	0	0.8	A	0.27	0	0	0.7	A	0.24	0	0					
	Overall:	19.8	B	0.69			23.8	C	0.76			20.1	C	0.82			20.8	C	0.80			21.0	B	0.76							

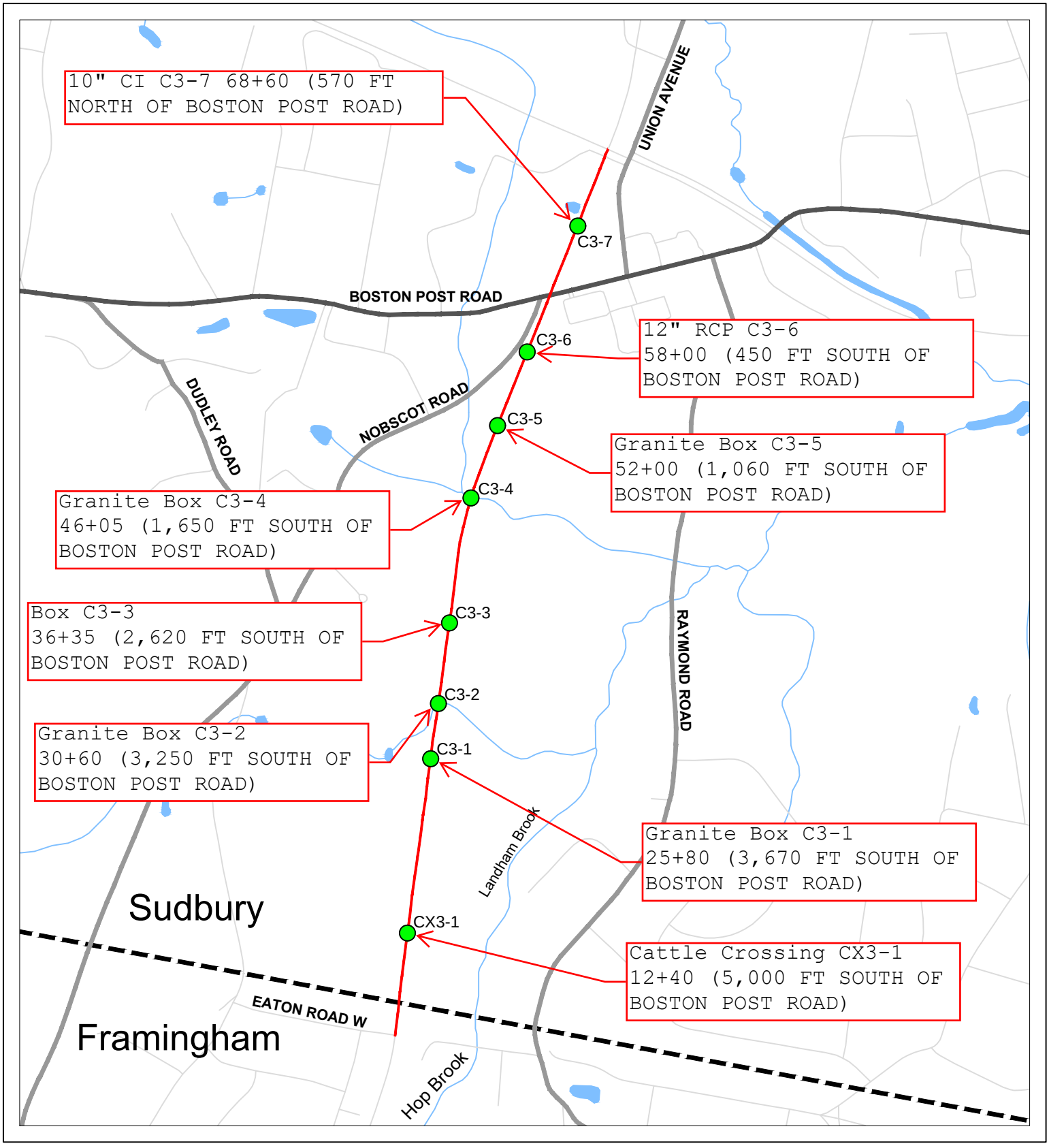
KEY:

2022 Existing: Current operation of the intersection
2042 No Build: Current intersection with future traffic volumes
2042 No Build: Optimized Signals: Future traffic volumes with optimized signal timings
2042 Build: At Grade Mid-Block Crossing: Operation of alternative one
2042 Build: At Grade At Intersection Crossing: Operation of alternative two
2042 Build: Roundabout: Operation of alternative three

FUSS & O'NEILL

Appendix G

Existing Structures Memo



0 1000 2000

SCALE IN FEET
SCALE: 1"=1000'

N

FUSS&O'NEILL

LEGEND

- Inspected Crossing
- Rail Trail Location
- Other Numbered Highway
- Major Road - Collector
- Minor or Local Road
- Town Boundary

BRUCE FREEMAN RAIL TRAIL CROSSINGS

Sudbury, Massachusetts

April 2023

Bruce Freeman Rail Trail (Phase 3) - MCRT to Framingham Line

Fuss & O'Neill, Inc - Summary of Structural Condition Analysis of Culverts and Other Structures

4/5/2023

Culvert No.	Location	Size/Type	Approx. Prop. Cover (Ft)	Wetland Upstream	Wetland Downstream	Recommended Improvement Measures
CX3-1	12+40	Cattle Crossing	8-12"	No	No	Point areas of missing mortar. Remove vegitation and debris around and above the structure
C3-1	25+80	Box Culvert	4'	Yes	Yes	Point areas of missing mortar. Clean and clear the entrances of debris. Clean and clear debris from the aquatic exclusionary fencing. Remove trees and vegetation from around the headwalls and roof
C3-2	30+60	Box Culvert	4'	Yes	Yes	Further investigate the interior of the culvert when water levels are lower, a full examination was not possible due to high water level and a potentially collapsed headwall. Replace the left headwall. Clean and clear around both headwalls. Clean and clear the aquatic exclusionary fencing.
C3-3	36+35	Box Culvert	1'	Yes	Yes	Point areas of missing mortar. Clean and clear both entrances. Clear the roof and more thoroughly examine the structural stability and condition of the roof. Remove trees and vegetation from around the headwalls and roof.
C3-4	46+05	Box Culvert	indeterminate	Yes	Yes	Fully replace culvert.
C3-5	52+00	Box Culvert	3'	Yes	Yes	Point areas of missing mortar. Trees and vegetation should be removed from around the headwalls and roof
C3-6	58+00	12" RCP	1'	Yes	Yes	Entrance points should be cleaned and cleared of debris
C3-7	68+60	10" cast iron	indeterminate	No	Yes	Fill the pipe and abandon

FUSS & O'NEILL

MEMORANDUM

TO: Adam Duchesneau,
Director of Planning and Community Development, Town of Sudbury

FROM: Matthew Taylor, PE

DATE: April 25, 2023

RE: Bruce Freeman Rail Trail Crossing Field Inspection

On March 31st, Fuss & O'Neill performed a field inspection of the cattle crossings and drainage structures along the Bruce Freeman Rail Trail. Below are descriptions of the conditions and recommendations for each structure.

CX3-1: 40 in. x 46 in. Cattle Crossing – Station 12+40:

This cattle crossing is a masonry structure and appears to be in fair condition. The masonry components include cut stone blocks with mortar joints; however, some joints appear to be missing mortar. There did not appear to be any scour at the base of the structure. The inside of the structure was mostly cleared of debris and appeared clean. The entrances on both sides also appeared clean but had some debris that didn't block the entrance but could potentially impede access to the inside of the structure. There is approximately 8 to 12 inches of material over the stone top slabs.

Recommendation: Point areas of missing mortar of missing mortar. Also, all vegetation and debris around and above the structure should be removed.

DRAFT

Western entrance and headwall

Interior of cattle crossing

C3-1: 36 in. x 42 in. 3-Sided Granite Box Culvert– Station 25+80:

This structure consists of stone slabs spanning field stone abutments with mortared joints. Water flows slowly under the structure, so it was indeterminate whether there was scour at the base, but the structural stability did not appear to be compromised. The headwalls and roof all appeared to be in good condition. The cover over the roof also appeared to be satisfactory with a measured cover of approximately 4 feet.

Aquatic exclusionary fencing was present on the western side of the culvert. A 12 inch HDPE pipe extended from within the aquatic exclusionary fencing to the face of the western headwall.

Recommendation: The culvert should be pointed in areas where mortar is not currently present or is cracked. It is also recommended that both entrances of the culvert be cleaned of debris. The aquatic exclusionary fencing should also be cleaned and cleared of debris. Trees and vegetation should be removed around the headwall and roof.

DRAFT

Eastern headwall

Western headwall shown with the HDPE pipe and aquatic exclusionary fencing.

Interior of the culvert

C3-2: 18 in. x 36 in. Granite Box Culvert – Sta. 30+60

This culvert appears to be a masonry structure; however, the interior of the culvert was unable to be examined due to a potentially collapsed headwall and high water level. The standing water level and limited access to the culvert opening made it difficult to determine if the culvert headwall is intentionally low or if it is collapsed. The western headwall may need to be reset and the eastern headwall is covered with debris and will need to be cleaned. There is also aquatic exclusionary fencing located on the west side of the trail.

Recommendation: Further inspection is highly recommended during a dryer period to determine the structural stability and condition of the culvert. The eastern headwall appears intact but will need to be cleaned. Both entrances are recommended to be thoroughly cleaned and cleared of debris. The aquatic exclusionary fencing should also be cleaned and cleared of debris.

DRAFT

Potentially collapsed headwall on west side of culvert


Headwall on the east side of the culvert

DRAFT

C3-3: 45 in. x 41 in. 3-Sided Granite and Steel Box Culvert – Station 36+35

This structure consists of a concrete top with steel railroad rails reinforcement set on cut stone block abutments. The stone abutments and mortar joints appear in good condition. Stagnant water was present in the channel, so the base of the abutments was not able to be examined, however, no visible scour was found. The steel rail reinforced roof appears in serviceable condition, with surface rust observed. Trees and other vegetation were present near the roof and headwalls. There were also old railroad ties repurposed as short retaining walls holding back soil on at the entrances (see pictures below).

Recommendations: Point areas where mortar is missing between stone blocks. Cleaning and clearing of both entrances are recommended. Although the roof appeared structurally sound, it is recommended to clear the cover above the roof so the top of the roof can be more thoroughly examined. Remove trees and vegetation around the headwalls and roof while leaving any tree trunks growing from the blocks in place. The railroad ties used as retaining walls should be replaced.


Western entrance and wingwalls


Interior of the culvert

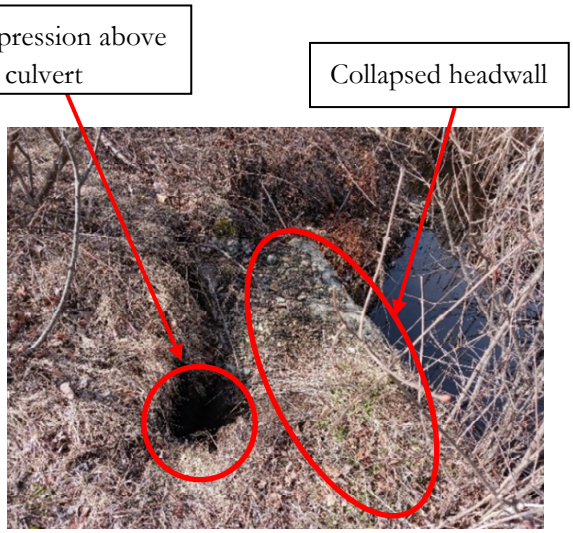
C3-4: 24 in. x 24 in. Granite Box Culvert – Station 46+05:

The western headwall appears to have collapsed which allowed for very limited access to examine the interior of the culvert. The eastern headwall appears in working condition. A major concern is the existing ground above the trail near the western headwall. Near this headwall, depressions in the ground were observed causing concern for potential erosion or even a full collapse of the culvert.

Recommendations: High water levels and low headwalls prohibited the examination of the inside of the culvert so further examination during a dryer period is recommended. However, given the observed conditions, a replacement of this culvert and reconstruction of headwalls is likely needed.

DRAFT


Western entrance and wingwalls



Collapsed headwall at the eastern entrance

C3-5: 36 in. x 36 in. 3-Sided Granite Box Culvert – Station 52+00:

The headwalls and roof appear in good condition. The headwalls and interior appear to be missing mortar on some of the joints. Trees and other vegetation are growing near the headwalls and roof.

Recommendations: Pointing in some locations where mortar is missing is recommended. Vegetation and trees should be removed around and above the structure with any stumps growing in or immediately around the headwalls to be left in place.

Eastern entrance and headwall

Interior of the culvert

Western entrance and headwall

DRAFT

C3-6: 12 in. Reinforced Concrete Pipe Culvert – Station 58+00:

The inside of the pipe appeared clean and in good condition. A cover of approximately one foot was determined. This culvert does not cross under the future trail location but rather is offset approximately 15 feet west of the alignment.

Recommendations: The entrance points should be cleaned and cleared to allow for unobstructed flow.

Obstructed entrance to the culvert

Interior of the culvert

DRAFT

C3-7: 10 in. Cast Iron Pipe Culvert – Station 68+60:

The pipe was observed to be rusted and was chipped around the end of the pipe. The inside of the pipe was filled with debris and appeared to be clogged approximately 4 to 5 feet from the opening. The other opening was not able to be found. The opening of the pipe is approximately 15 feet east of the centerline meaning that this culvert does not span under the proposed path area.

Recommendations: The use of this culvert should be confirmed. If the pipe is no longer in use, it should be abandoned. If the pipe is still in use, it should be thoroughly cleaned and cleared of all debris.

Exterior condition of the pipe

Interior of the pipe

DRAFT

FUSS & O'NEILL

Appendix H

Environmental Report

Massachusetts Inland Resource Area Delineation Report

Report Date: February 23, 2023

Prepared For: Beth Suedmeyer
Planning and Community Development Department
Town of Sudbury
Sudbury, MA 01776

Site Location: 1.3 Mile Segment Bruce Freeman Rail Trail and
Sudbury Parcel IDs: K08-0057 and L-07-0015
Framingham and Sudbury, Massachusetts

Delineation Date(s): September 14, 20, 28, 2022 and October 4 and 7, 2022

Regulated & Protected Resource Areas[1] within the Review Area:

- ☒ Bank
- ☒ Land Under Water Bodies and Waterways
- ☒ Riverfront Area
- ☒ Isolated Vegetated Wetlands (IVW)
- ☐ Priority Habitats of Rare Species
- ☒ Bordering Vegetated Wetland (BVW)
- ☒ Land Subject to Flooding
- ☒ Buffer Zone
- ☐ Estimated Habitats of Rare Wildlife
- ☒ Vernal Pool (Certified and/or **Potential**)

Inland resource areas were delineated in accordance with applicable local, state, and federal statutes, as detailed within the Resource Area Description. This delineation does not constitute an official wetland boundary until such time as it is accepted and approved by local, state, or federal regulatory agencies.

The wetland delineation was conducted by:

April Doroski, PWS, CPSS
Water Resources and Climate Resilience Specialist

1550 Main Street
Suite 400
Springfield, MA
01103
t 413.452.0445
800.286.2469
f 860.533.5143

www.fando.com

California
Connecticut
Maine
Massachusetts
New Hampshire
Rhode Island
Vermont

[1]Under the Massachusetts Wetlands Protection Act (MAWPA), Sudbury Wetlands Administration Bylaw and Regulations, and Massachusetts Endangered Species Act (MESA)

ATTACHMENTS

A **Wetland Sketch**

B **Site Photographs**

C **Supplemental information**

- FEMA FIRM (Map No. 25017C0506F, effective July 7, 2014)
- FEMA Flood Insurance Study (No. 25017CV005C, revised July 6, 2016) Flood Profile 288P
- StreamStats

Resource Areas Description

1.1 Introduction

On September 14, 20, 28, 2022 and October 4 and 7, 2022, a Fuss & O'Neill Inc. wetland and soil scientist performed a wetland resource area delineation within the Project Area. The Project Area includes a segment of the Bruce Freeman Rail Trail, in Framingham and Sudbury, Massachusetts and select parcels as identified below.

The purpose of this investigation was to identify and delineate the jurisdictional limits of regulated and protected resource areas in accordance with local, state, and federal regulations. This report also includes an assessment of areas protected under the Massachusetts Endangered Species Act (M.G.L. c. 131A).

This report provides a summary of wetland resource areas within the Project Area and includes a wetland sketch (*Attachment A*), site photographs (*Attachment B*), and supplemental information (*Attachments C*).

1.2 Project Area

The Project Areas reviewed during the wetland resource area delineation include:

- 1.3-Mile segment of the CSX Transportation right-of-way corridor (rail trail) generally from Eaton Road West in Framingham, MA to Station Road in Sudbury, MA
    - Start: 42.344842, -71.428558, End: 42.363447, -71.422715
- 1.02-acre Sudbury Parcel ID: K-08-0057 (0 Union Ave)
- 1.94-acre Sudbury Parcel ID: L07-0015 (0 Nobscot Road)

1.2.1 General Description

The rail trail generally runs in a north south direction and consists of a gravel path that slopes down on both sides. The gravel path was approximately 5 to 10 feet wide and consisted of vegetation, often invasive species, growing along the margins of the path. A compact gravel surface was exposed in the center of the trail. When wetlands and streams were observed within the Project Area, they were generally located at the toe of the rail trail slope. The rail trail is primarily bordered by wetland and upland forests and some crop land. Portions of the rail trail are bordered by protected open space for conservation and water supply.

1.2.1.1 Invasive Species

Multiple invasive species were observed growing within the rail trail and adjacent to the rail trial. Refer to Table 1-1 for a list of invasive species observed during the wetland resource area delineation.

Table 1-1
Invasives observed within the Project Area

Common Name	Botanical Name	Invasive Category[1]
Garlic Mustard	*Alliaria petiolata*	Invasive
Glossy Buckthorn	*Frangula alnus*	Invasive
Japanese Honeysuckle	*Lonicera japonica*	Invasive
Multiflora Rose	*Rosa multiflora*	Invasive
Norway Maple	*Acer platanoides*	Invasive
Oriental Bittersweet	*Celastrus orbiculatus*	Invasive
Common Reed	*Phragmites australis*	Invasive
Purple Loosestrife	*Lythrum salicaria*	Invasive
Winged Euonymus	*Euonymus alatus*	Invasive

[1]According to the Massachusetts Invasive Plant Advisory Group (MIPAG). "Invasive" plants are non-native species that have spread into native or minimally managed plant systems in Massachusetts.

1.3 Methodology of Resource Area Delineation

The wetland delineation was conducted in conformance with local, state, and federal regulations and guidelines including:

- *Massachusetts Wetlands Protection Act* ("MAWPA"; M.G.L. c. 131, § 40), its implementing regulations set forth at 310 CMR 10.00
- Massachusetts Department of Environmental Protection (MassDEP) *Delineating Bordering Vegetated Wetlands Under the Massachusetts Wetlands Protection Act* (March 1995)
- *Corps of Engineers Wetlands Delineation Manual*, Technical Report Y-87-1 (January 1987)
- *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region* (January 2012)
- *Field Indicators for Identifying Hydric Soils in New England in New England* (Version 4, April 2019)

- *Town of Sudbury General Wetlands Administration Bylaw (Article XXII)* and associated *Regulations*

During the wetland resource area delineation, the Fuss & O'Neill wetland and soil scientist identified wetlands generally within 100 feet of the Project Area. Fuss & O'Neill observed vegetation throughout the subject parcel as well as soils, verifying the presence or absence of wetlands.

Where Bordering Vegetated Wetlands (BVW), Isolated Vegetated Wetlands (IVW), or Bank was observed, the resource area boundaries were delineated and information regarding vegetation, soils, and hydrology was collected. Each flag location was named based on a numeric-alpha-numeric nomenclature and collected by a professional land surveyor. The initial number indicates the wetland system, the alpha indicates the line of the wetland system, followed by the flag number.

Fuss & O'Neill also conducted a desktop review of available online resources prior to performing the wetland delineation including Massachusetts Mapper (MassMapper) and FEMA mapping. The Middlesex County FEMA Flood Insurance Rate Map (FIRMs, Map No. 25017C0506F, effective July 7, 2014) and the Natural Heritage & Endangered Species Program (NHESP) database 15th Edition, effective August 1, 2021 was reviewed for the Project Area.

1.4 Resource Areas

1.4.1 Resource Areas Not Present

The following resource areas are not located within the Project Area according to MassMapper

- Natural Heritage Endangered Species Program (NHESP) Estimated Habitats of Rare Wildlife
- NHESP Priority Habitats of Rare Species
- NHESP Certified Vernal Pools
- NHESP Potential Vernal Pools
- DFW Coldwater Fisheries Resources

1.4.2 Summary of Wetland Resource Areas

Wetland resource areas were identified within the Project Area within Sudbury. No wetland resource areas were identified within Framingham.

Table 1-2
Summary of Wetland Delineation Flag Series

Flag Series	Flag Number	Delineation Date	Resource Area[1]
1A	1A-1 → 1A-12	9/14/22	BVW
2A	2A-1 → 2A-18	9/14/22	BVW
3A	3A-1 → 3A-19	9/14/22	BVW
3B/C	3B-1 → 3B-7, 3C-1 → 3C-6	9/14/22	Bank/ MAHW
4A	4A-1 → 4A-4	9/14/22	IVW, PVP
5A	5A-1 → 5A-7	9/14/22	Bank
5A	5A-8 → 5A-12	9/14/22	BVW
5B/C	5B-1 → 5B-3, 5C-1 → 5C-3	9/14/22	Bank
5D	5D-1 → 2D-46	10/4/22, 10/7/22	BVW
5E/F	5E-1 → 5E-11, 5F-1 → 5F-26	10/7/22	Bank
5G/H	5G-1 → 5G-4, 5H-1 → 5H-2	10/7/22	BVW
5I/J	5I -1 → 5I-10, 5J-1 → 5J-7	10/7/22	BVW
5K	5K-1 → 5K-7	10/7/22	BVW
6A	6A-1 → 6A-54	9/14/22, 9/20/22	BVW
6B/C	6B-1 → 6B-4, 6C-1 → 6C-5	9/20/22	Bank/MAHW
6D/E	6D-1 → 6D-6, 6E-1 → 6E-7	9/20/22, 10/4/22	Bank
7A	7A-1 → 7A-11	9/20/22	BVW, PVP
8A	8A-1 → 8A-18	9/20/22	IVW
9A	9A-1 → 9A-13	9/28/22	PVP

Table 1-2
Summary of Wetland Delineation Flag Series

Flag Series	Flag Number	Delineation Date	Resource Area[1]
10A	10A-1 → 10A-22	9/28/22	BVW
11A	11A-1 → 11A-23	9/28/22	BVW, PVP
11B	11B-1 → 11B-9	9/28/22	Bank (upgradient of BVW; jurisdictional under local bylaw but not under MAWPA)
12A	12A-1 → 12A-8	9/28/22	BVW
13A	13A-1 → 13A-20	9/28/22	BVW
13B/C	13B-1 → 13B-15, 13C-1 → 13C-11	9/28/22, 10/4/22	Bank
13D/F	13D-1 → 13D-49, 13F-1 → 13F-9	10/4/22	BVW, PVP
13E	13E-1 → 13E-4	10/4/22	PVP
14A	14A-1 → 14A-6	10/7/22	IVW, PVP
15A	15A-1 → 12A-7	9/28/22	IVW, PVP

[1]BVW = Bordering Vegetated Wetland, IVW = isolated vegetated wetland, PVP = potential vernal pool.

Bank: Regulatory Framework

Inland Bank is defined at 310 CMR 10.54(2)(a) as "*the portion of the land surface which normally abuts and confines a water body. It occurs between a water body and a vegetated bordering wetland and adjacent floodplain, or, in the absence of these, it occurs between a water body and an upland.*"

Bank is also regulated under the Sudbury Wetlands Administration Bylaw (Sudbury Wetlands Bylaw). Banks of six streams and one pond found to be jurisdictional under the MAWPA and Sudbury Wetlands Bylaw were identified during the wetland delineation. Banks associated with one stream (11B) which did not originate from a wetland and is therefore not jurisdictional under the MAWPA are also included here as jurisdictional under the Sudbury Wetlands Bylaw.

Bank: Resource Area Description

Table 1-3 below includes descriptions of delineated Bank and a description of the stream and its designation.

Table 1-3
Bank and Stream Descriptions

Flag Series	Designation[1]	Description
3 B/C	Perennial	Shown as a perennial stream on the USGS topographic map. Tributary to Allowance Brook. Bank is generally coincident with Mean Annual High Water (MAHW). Bank is defined by a change in slope and change in vegetation. Bank/MAHW is more defined closer to the cross culvert. Along the Bank, there is a clear distinction between woody species, glossy buckthorn (*Frangula alnus*, FAC), and silky dogwood (*Cornus amomum*, FACW) which grow along the Bank and emergent vegetation growing within LUW. Emergent species observed growing within LUW include water pepper (*Polygonum hydropiper*, OBL), American bur-reed (*Sparganium americanum*, OBL) and purple loosestrife (*Lythrum salicaria*, OBL). The LUW appeared more vegetated than typical for a perennial stream. Bank/MAHW became diffuse on the west side of the wetland. Wetland Sketch Page(s): 13
5A	Pond	Bank of Pond defined by a change in vegetation. Wracking and water-stained debris was observed along the Bank. Water level appeared lower than normal based on location of wrack-lines compared to inundated areas and exposed water-stained areas and prevalence of water-stained tree trunks outside of inundated areas. Vegetation observed in the vicinity of Bank includes glossy buckthorn, cinnamon fern (*Osmunda cinnamomea*, FACW), red maple trees (*Acer rubrum*, FAC), highbush blueberry (*Vaccinium corymbosum*, FACW), and white pine (*Pinus strobus*, FACU). Aquatic vegetation was observed within the pond. Wetland Sketch Page(s): 11-12
5B/C	Intermittent	No mapped stream in this location on the USGS topographic map. Streamstats determined drainage area of 0.05 square miles. During the September 14, 2022 delineation, no flow was observed. Flow originates from the vegetated wetland (BVW 5D) on the west side of the rail trail, is conveyed through a cross culvert, where flow becomes more channelized on the east side of the rail trail where Bank was delineated. Flow is to the east into the pond defined by Bank 5A. Non-aquatic plants with indicator status of

Table 1-3
Bank and Stream Descriptions

Flag Series	Designation[1]	Description
		facultative and drier species were observed growing within the streambed including: glossy buckthorn, poison ivy (*Toxicodendron radicans*; FAC), and Oriental bittersweet (*Celastrus orbiculatus*; FACU). Observations and desktop analysis support that this stream is an intermittent headwater stream originating from BVW 5D. Bank is defined by a break in slope and change in vegetation. LUW consists of gravel. Wetland Sketch Page(s): 11
5E/F	Intermittent	No mapped stream in this location on the USGS topographic map. Streamstats determined drainage area of 0.0888 square miles. The stream associated with Banks 5E/F originates from BVW 5K, flows to the north within a shallow channel (1 foot wide with pocjets of water), dissipates in BVW 5K, and re-emerges as a wider stream (4 to 8 feet) at the toe of the rail trail slope adjacent to the agricultural fields. No Bank was observed between flags 5F-14 and 5F-15. LUW generally consisted of sandy loam. The topographic gradient was shallow between flags 5F-1 and 5F-11. Flow direction to the north was confirmed based on a review of the topographic map and observations of dried flow patterns in BVW 5K. Observations and desktop analysis support that this stream is an intermittent headwater stream originating from BVW 5K. Wetland Sketch Pages 15-17
6B/C	Perennial	Mapped as a perennial stream on the USGS topographic map. Banks defined by a change in slope and vegetation. Tributary to Allowance Brook. Banks not accessible on west side of rail trail due to inundation in wetland system. Banks densely vegetated with silky dogwood and cattail. LUW consists of sandy substrate. Flow originates from a channel within BVW 13D and is conveyed east through a cross culvert beneath the rail trail. Wetland Sketch page(s): 8
6D/E	Intermittent (MAWPA) Perennial (Bylaw)	No mapped stream in this location on the USGS topographic map. Streamstats determined drainage area of 0.42 square miles. Bank is defined by a change in slope and vegetation. Bank was well defined and vegetated with jewelweed (*Impatiens capensis*, FACW), silky dogwood, honey suckle (*Lonicera spp.*), and glossy buckthorn. Bankfull width ranged between 4 to 8 feet wide. Water was 3 inches deep and was flowing east. LUW consisted of cobble streambed. This stream is an intermittent stream under MAWPA,

Table 1-3
Bank and Stream Descriptions

Flag Series	Designation[1]	Description
		but based on the well-defined channel, streambed substrate, and observation of flow this stream is assumed as perennial under the local Bylaw. Wetland Sketch page(s): 6-7
11B	Not jurisdictional (MAWPA) Intermittent (Bylaw only)	No mapped stream in this location on the USGS topographic map. Streamstats determined drainage area of less than 0.01 square miles. Bank is defined in some locations and diffuse in others. Channel does not originate from wetlands. The channel defined by Bank 11B appears to be a manmade swale at the toe of slope of the rail trail and lined with riprap. No flow was observed at time of delineation. Flow direction is to the north into BVW 11A. Because the stream confined by this Bank does not originate from a wetland, it is not jurisdictional under MAWPA. Based on observations of no flow, diffuse bank and a small drainage area, this bank is presumed to meet the definition of an intermittent stream under the Bylaw. Wetland Sketch page(s): 2-3
13B/C	Intermittent	No mapped stream in this location on the USGS topographic map. Streamstats determined drainage area of 0.42 square miles. Banks 13B/C originate from a culvert that is fed from hydrology of BVW 13A. BVW 13A is located within a vegetated swale at the toe of slope of the rail trail. Flow becomes more channelized south of the culvert crossing (i.e., where Banks 13B/C begin). Flow from Banks 13B/C discharge into BVW 13D/F. Bankfull width is approximately 6 feet wide. No flow was observed during the delineation, but pockets of water were observed near flag 13B. LUW consists of silty material. Wracking and sediment deposition were observed within this stream. Observations and desktop analysis support that this stream is an intermittent headwater stream originating from BVW 13A. Wetland Sketch page(s): 5-6

[1]Stream status determined in accordance with MAWPA regulations set forth at 310 CMR 10.58(2)(a)(1) and Sudbury Wetlands Administration Bylaw Regulations Section 2.4 If stream status differs between MAWPA and the Bylaw, stream status is specified followed by regulatory authority in parenthesis.

Bordering Vegetated Wetlands (BVW): Regulatory Framework

Bordering Vegetated Wetlands are defined under 310 CMR 10.55(2)(a) as "*freshwater wetlands which border on creeks, rivers, streams, ponds, and lakes. The types of freshwater wetlands are wet meadows, marshes, swamps and bogs. Bordering Vegetated Wetlands are areas where the soils are saturated and/or inundated such that they support a predominance of wetland indicator plants. The ground and surface water regime and the vegetation community which occur in each type of freshwater wetland are specified in M.G.L. c. 131, § 40.*"

Bordering Vegetated Wetlands are also regulated under the Sudbury Wetlands Bylaw. Fifteen (15) BVWs were identified during the wetland delineation.

BVW: Resource Area Description

Table 1-4 below includes a description of BVWs by flag series. Bordering status of BVWs 1A, 2A, 7A, 10A, and 11A were conservatively assumed as the wetlands may border streams, ponds, or lakes beyond the CSX ROW area reviewed. Bordering status of these wetlands was not observed within the review area.

Table 1-4
Bordering Vegetated Wetlands Descriptions

Flag Series	Wetland Type[1]	Description
1A	PEM	Wetland located along the edge of forested area and within agricultural field. Approximately 0.24 miles north of Easton Road W, east of CSX ROW. Wetland Sketch page(s): 16
2A	PSS	Wetland located at toe of slope of CSX ROW. Approximately 0.34 miles north of Easton Road W, east of CSX ROW. Wetland Sketch page(s): 14-15
3A	PSS/ PFO	Wetland located at toe of slope of CSX ROW. Borders perennial tributary (MAHW/Bank 3B/C) to Allowance Brook. Approximately 0.45 miles north of Easton Road W, east of CSX ROW. Wetland Sketch page(s): 12-13
5A	PFO	Wetland in forested area. Borders unnamed pond (Bank 5A) and intermittent stream (Banks 5B/C). Approximately 0.6 miles north of Easton Road W, east of CSX ROW. Wetland Sketch page(s): 11
5D	PFO	Wetland in forested area. Hydrology fed by intermittent stream (Banks 5B/C). Approximately 0.35 miles north of Easton Road W, west of CSX ROW. Wetland Sketch page(s): 10-15

Table 1-4
Bordering Vegetated Wetlands Descriptions

Flag Series	Wetland Type[1]	Description
5G/H	PEM, PSS	Wetland located along the edge of forested area and within agricultural field. Borders intermittent stream (Banks 5 E/F). Approximately 0.33 miles north of Easton Road W, west of CSX ROW. Wetland Sketch page(s): 15
5I/J	PSS	Wetland located along the edge of forested area and within agricultural field. Borders intermittent stream (Banks 5 E/F). Approximately 0.23 miles north of Easton Road W, west of CSX ROW. Wetland Sketch page(s): 15-17
5K	PEM	Wetland located 75 feet west of CSX ROW. Flows into intermittent stream (Bank 5F). Approximately 0.15 miles north of Easton Road W, west of CSX ROW. Wetland Sketch page(s): 17-18
6A	PEM, PSS, PFO	Wetland generally at toe of slope of CSX ROW. Borders perennial tributary (Banks 6B/C) to Allowance Brook and intermittent stream (Bank 6D/E). Approximately 0.65 miles north of Easton Road W, east of CSX ROW. Wetland Sketch page(s): 6-10
7A	PFO	Wetland generally at toe of slope in forested area. Approximately 1 mile north of Easton Road W, east of CSX ROW. Contains a PVP. Wetland Sketch page(s): 5
10A	PEM/PSS	Wetland generally at toe of slope surrounded by forested area. Approximately 0.12 miles north of Boston Post Road, east of CSX ROW. Wetland Sketch page(s): 1-2
11A	PSS	Wetland generally at toe of slope surrounded by forested area. Approximately 0.1 miles north of Boston Post Road, west of CSX ROW. Contains a PVP. Wetland Sketch page(s): 1-2
12A	PSS	Wetland generally at toe of slope surrounded by forested area. Approximately 0.05 miles north of Boston Post Road, west of CSX ROW. Wetland Sketch page(s): 3
13A	PEM	Wetland in depression area surrounded by maintained areas. Hydrology flows into intermittent stream (Banks 13B/C). Approximately 0.01 miles south of Boston Post Road, west of CSX ROW. Wetland Sketch page(s): 4-5
13D/F	PFO	Wetland generally at toe of slope. Approximately 0.15 miles south of Boston Post Road, west of CSX ROW. Contains a PVP. Wetland Sketch page(s): 6-9

[1]PEM = Palustrine Emergent Wetlands, PSS = Palustrine Scrub Shrub Wetlands, PFO = Palustrine Forested Wetland

Land Under Waterbodies and Waterways (LUW): Regulatory Framework
Land Under Waterbodies and Waterways (LUW) is defined at 310 CMR 10.56(2)(a) as "*the land beneath any creek, river, stream, pond or lake.*"

LUW is also regulated under the Sudbury Wetlands Bylaw. LUW associated with six streams and one pond jurisdictional under the MAWPA and Sudbury Wetlands Bylaw were identified during the wetland delineation. LUW of one additional stream (11B) jurisdictional only under the Sudbury Wetlands Bylaw was identified during the wetland delineation.

LUW: Resource Area Description
Refer to Table 1-3 for a descriptions of LUW.

Bordering Land Subject to Flooding (BLSF): Regulatory Framework
Bordering Land Subject to Flooding (BLSF) is defined at 310 CMR 10.57(2), as "*an area with low, flat topography adjacent to and inundated by flood waters rising from creeks, rivers, streams, ponds or lakes. It extends from the banks of these waterways and water bodies; where a bordering vegetated wetland occurs, it extends from said wetland.*"

BLSF is also regulated under the Sudbury Wetland Bylaw. BLSF within the site is associated with Allowance Brook and its tributaries.

BLSF: Resource Area Description

According to the most recent Flood Insurance Rate Maps (FIRM) and FEMA Flood Profile provided by the Federal Emergency Management Agency (FEMA), the portions of the project area are mapped within the limits of the 100-year flood zone with a base flood elevation (BFE) of 124 to 126 feet. The limits of BLSF within the project area are mapped directly adjacent to the rail trail and overlap with areas of delineated wetlands. Refer to Appendix C for FEMA information.

Riverfront Area: Regulatory Framework

Riverfront Area is defined at 310 CMR 10.58(2), as "*the area of land between a river's mean annual high water line and a parallel line measured horizontally. The riverfront area may include or overlap other resource areas or their buffer zones. The riverfront area does not have a buffer zone."*

Riverfront Area is also regulated under the Sudbury Wetland Bylaw. Riverfront within the site is associated with two unnamed perennial tributaries (Banks 3B/C and 6B/C) to Allowance Brook. The stream associated with Banks 6D/E is considered intermittent under MAWPA, and perennial under the Sudbury Wetlands Bylaw and therefore has Riverfront Area under the Bylaw only.

Riverfront Area: Resource Area Description

Riverfront Area within the project areas includes BVWs 3A, 5A, 6A, and 13D and portions of the rail trail. Riverfront Area within the rail trail may be considered previously "degraded" as set forth at 310 CMR 10.58(5).

Isolated Vegetated Wetlands (IVW)

Isolated wetlands are protected under the Sudbury Bylaw Regulations under Section 2.1. Isolated wetlands are not regulated or protected resource areas under the MAWPA and are therefore only regulated under the local bylaw and regulations. Three IVWs were identified within the Project Area and are summarized in Table 1-5 below.

Table 1-5 below includes a description of IVWs by flag series.

Table 1-5
Isolated Vegetated Wetlands Descriptions

Flag Series	Wetland Type[1]	Description
4A	PSS	Wetland located in a small sparsely vegetated depression (approx. 180 sf) at the toe of slope of the rail trail. Vegetation observed includes glossy buckthorn, silky dogwood, and red maple sprouts. Contains a PVP. Wetland Sketch page(s): 13
8A	PSS	Wetland located at the toe of slope within swale with vegetation dominated by the invasive species, common reed. Approximately 200 feet south of Boston Post Road. Oriental bittersweet dominated the upland east of this IVW. Wetland Sketch page(s): 4-5
14A	PSS/PFO	Wetland located in a depression with water-stained leaves. Vegetation observed includes royal fern (*Osmunda regalis*; OBL), winterberry (*Ilex verticillata*, FACW), and red maple trees. Contains a PVP. Wetland Sketch page(s): 18
15A	PSS	Wetland located in a linear depression. Contains iron staining and water-stained leaves on the base of trees and shrubs. Sparse vegetative cover (5%) consisted of royal fern, glossy buckthorn, highbush blueberry, and a patch of sedges.

Potential Vernal Pools (PVP)

Vernal Pools are protected under the Sudbury Wetlands Bylaw Regulations under Section 2.2. The Bylaw presumes vernal pool habitat exists if a wetland's physical characteristics conform with those defined for vernal pools in the Bylaw. Because of the time of year of the wetland delineation, status as a

vernal pool could not be verified. Additional data is required to verify if the PVPs identified in Table 1-6 are regulated as Vernal Pools under the Sudbury Wetlands Bylaw.

Based on observations in the field, seven total PVPs were identified. Three (3) PVPs are also identified as IVWs 4A, 14A, and 15A. Three (3) PVPs were identified within BVWs 7A, 11A, and 13D/F. Refer to descriptions above of BVW and IVWs. One (1) PVP (PVP 9A) was not located within IVW or BVW. PVPs identified within the Project Area and are summarized in Table 1-6 below.

Table 1-6
Potential Vernal Pool Descriptions

Flag Series	Description
4A	PVP is defined by the boundary of IVW 4A. Refer to Table 1-5 for a description of IVW 4A. No vernal species were observed at the time of delineation. Wetland Sketch page(s): 13
7A	A portion of BVW 7A may contain a PVP. Refer to Table 1-4 for a description of BVW 7A. No vernal species were observed at the time of delineation. Wetland Sketch page(s): 5
9A	PVP 9A was located in an unvegetated swale with water-stained leaves that received flow from a culvert outlet likely originating from the adjacent development. Vegetation bordering this PVP includes glossy buckthorn, white pine, and goldenrods. No vernal species were observed at the time of delineation. Wetland Sketch page(s): 2-3
11A	A portion of BVW 11A may contain a PVP. During the delineation standing water and potential attachment sites were observed within BVW 11A primarily between flags 11A-6 and 11A-10. Wetland Sketch page(s): 18
13E	PVP is located within BVW 13D/F and defined by the 13E flag series. This PVP consists of an approximately five (5)- foot deep depression within the BVW. This depression was unvegetated and contained water-stained leaves and large woody debris. Two (2) frogs (species not identified) were observed within this PVP. No vernal species were identified at the time of delineation. Wetland Sketch page(s): 6
14A	PVP is defined by the boundary of IVW 14A. Refer to Table 1-5 for a description of IVW 14A. No vernal species were observed at the time of delineation. Wetland Sketch page(s): 18
15A	PVP is within IVW 15A Refer to Table 1-5 for a description of IVW 15A. No vernal species were observed at the time of delineation. Wetland Sketch page(s): 1

FUSS & O'NEILL

Attachment A
Wetland Sketch

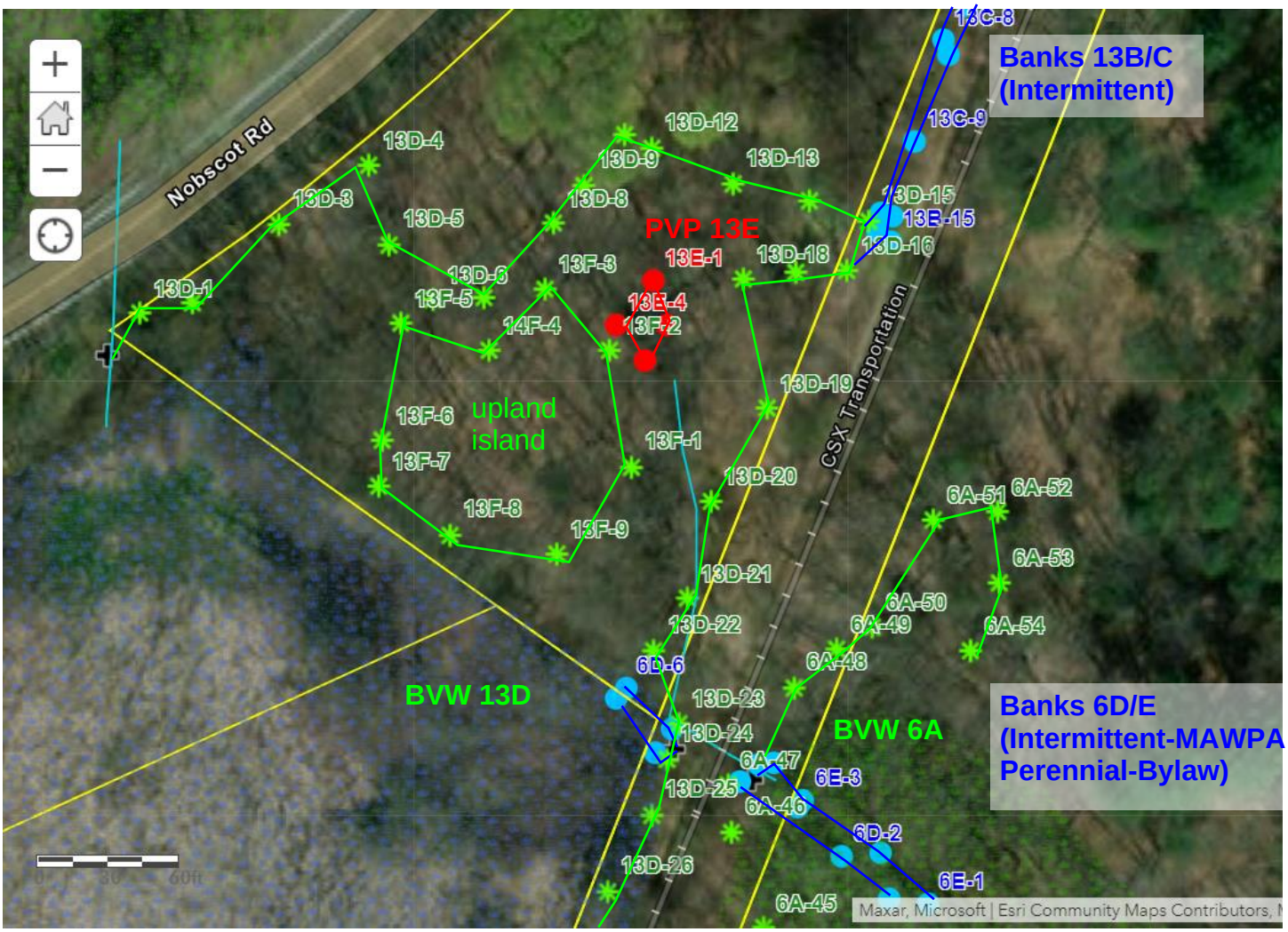
Bruce Freeman Rail Trail (Sudbury, MA)
Wetland Delineation Flags

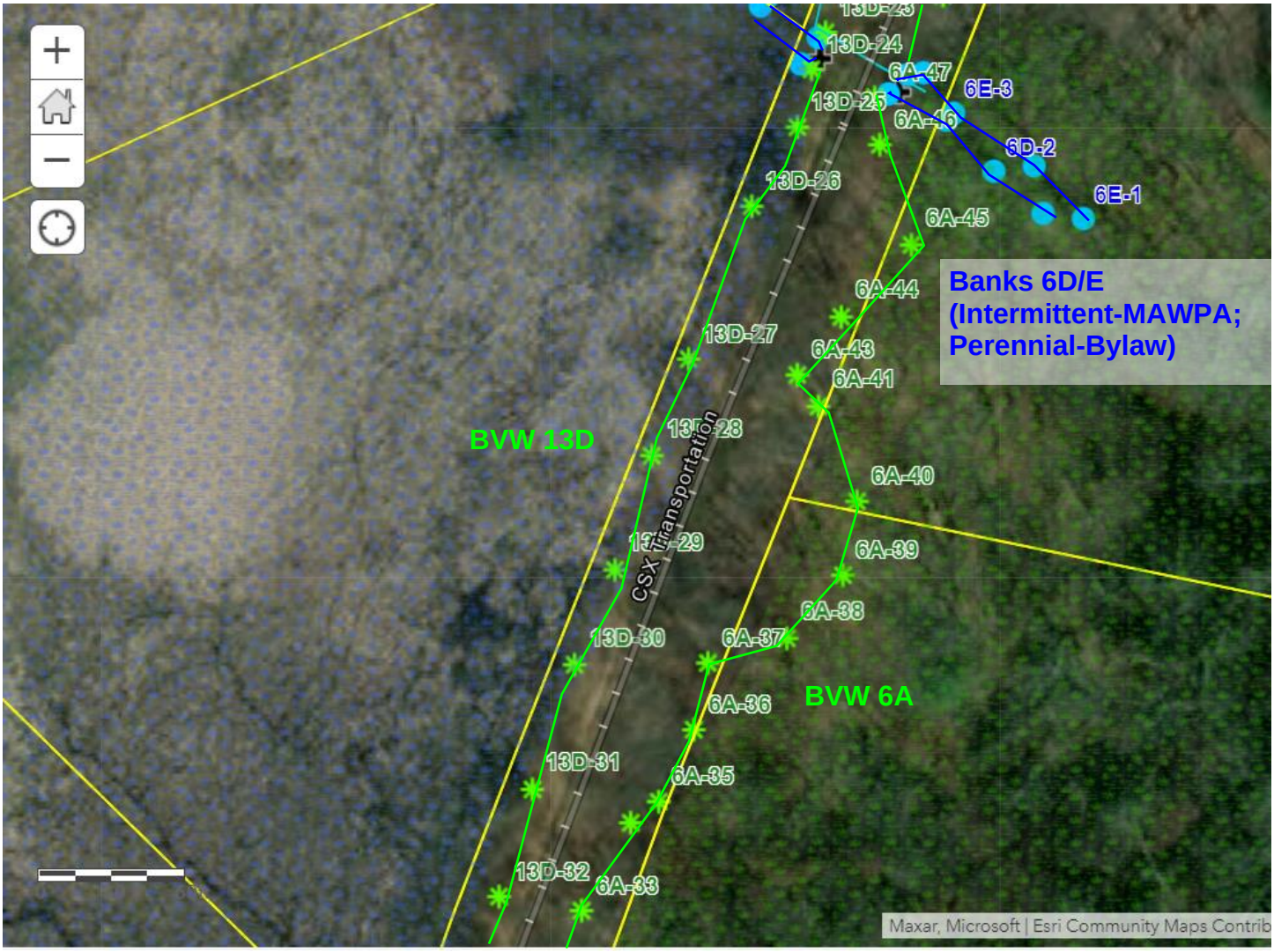

11A-10
10A-16
11A-11
10A-14
11A-12
11A-13
11A-14
BVW 11A
10A-11
11A-15
10A-8
BVW 10A
11A-16
10A-4
10A-1
11A-18
9A-8
11A-19
11A-20
11A-21
11B-1
9A-10
11B-2
9A-4
11B-3
PVP 9A
11B-4
9A-3
Bank 11B
(Not jurisdictional MWPA;
Intermittent - Bylaw)
Maxar, Microsoft | Esri Community Maps Contributors, Mass

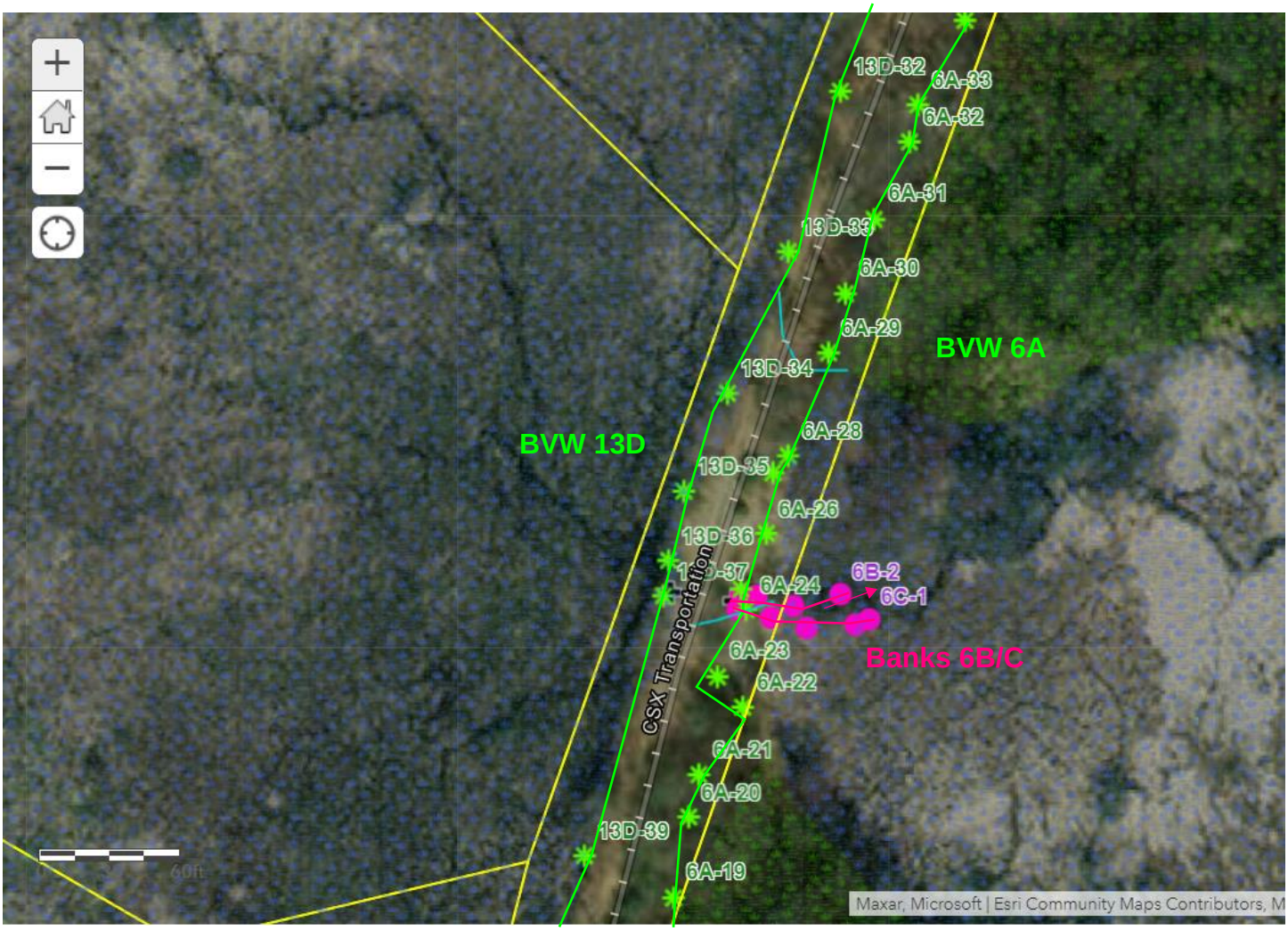

11B-4
9A-3
12A-2
12A-1
12A-3
12A-4
PVP 9A
9A-13
BVW 12A
11B-7
12A-5
12A-6
11B-8
2A-7
11B-9
Bank 11B
(Not jurisdictional MWPA;
Intermittent - Bylaw)
Fireplace Shop
& Grill Center
Boston Post Rd
20
Maxar, Microsoft | Esri Community Maps Contributors, MassGIS,

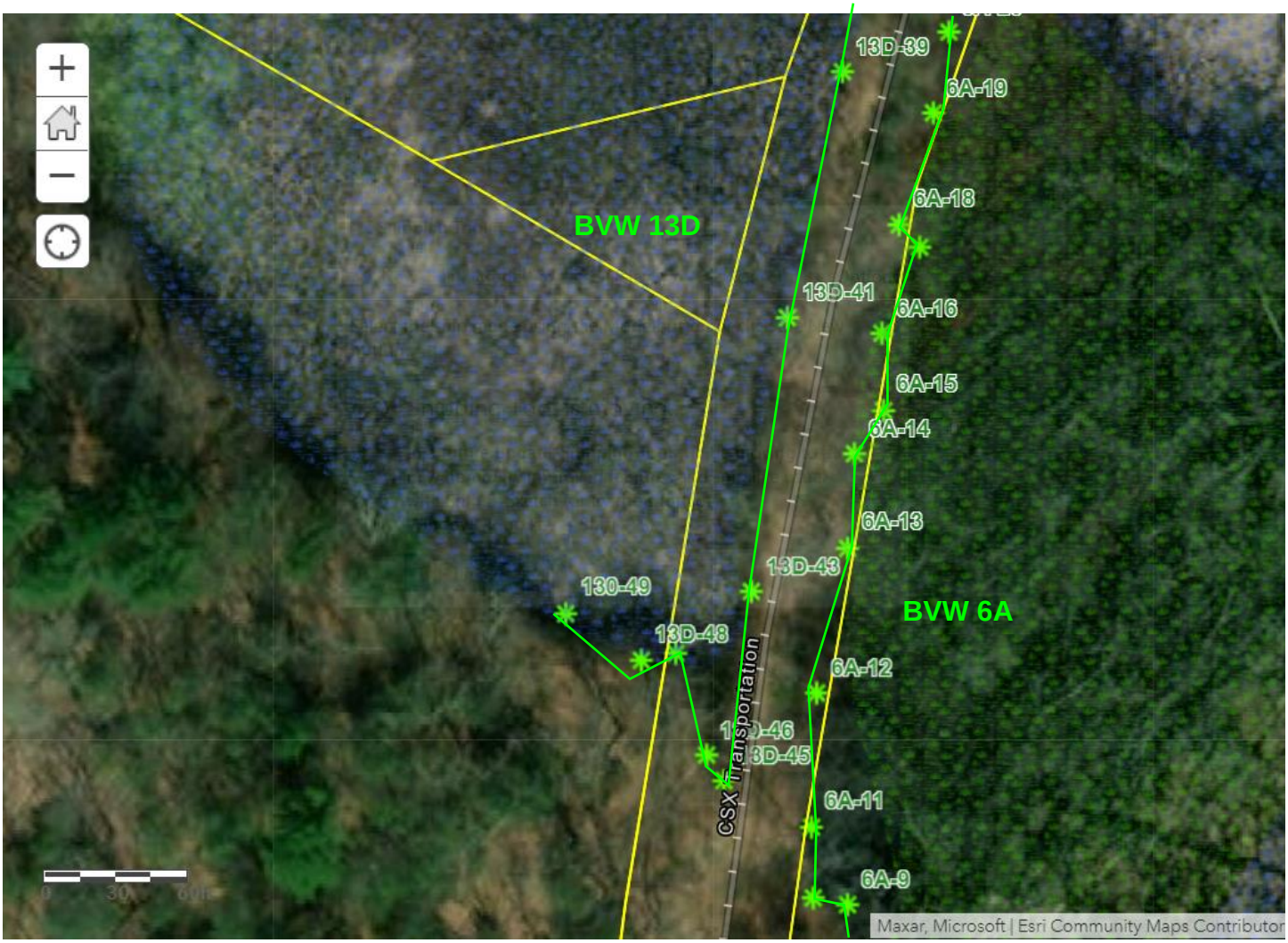

20
Rd
Nobscot Rd
Nobscot Rd
Nobscot Rd
CSX Transportation
CSX Transportation
13A-12
BVW 13A
13A-14
13A-9
13A-16
8A-10
IVW 8A
8A-12
8A-8
8A-13
13A-5
8A-7
13A-18
8A-14
8A-6
13A-19
8A-5
13A-2
8A-16
Maxar, Microsoft | Esri Community Maps Cont


Nobscot Rd
Nobscot Rd
CSX Transportation
CSX
IVW 8A
Banks 13B/C
(Intermittent)
13A-2
8A-16
13A-1
8A-4
7A-10
7A-11
8A-3
7A-9
13B-1
8A-2
7A-8
13C-2
7A-7
13B-2
7A-5
13B-3
13B-4
7A-4
13C-4
13B-8
7A-2
7A-1
13B-9
13B-10
13B-11
13C-8
13C-9
13D-12
Maxar, Microsoft | Esri Community Maps Contributors


Nobscot Rd
13D-1
13D-3
13D-4
13D-5
13D-6
13D-8
13D-9
13D-12
13D-13
13D-15
13D-16
13D-18
13D-19
13D-20
13D-21
13D-22
13D-23
13D-24
13D-25
13D-26
13F-1
13F-2
13F-3
13F-4
13F-5
13F-6
13F-7
13F-8
13F-9
14F-4
13E-1
13E-4
13E-15
13C-8
13C-9
PVP 13E
upland island
BVW 13D
BVW 6A
CSX Transportation
Banks 13B/C (Intermittent)
Banks 6D/E (Intermittent-MAWPA; Perennial-Bylaw)
6D-6
6D-2
6E-1
6E-3
6A-45
6A-46
6A-47
6A-48
6A-49
6A-50
6A-51
6A-52
6A-53
6A-54
Maxar, Microsoft | Esri Community Maps Contributors,

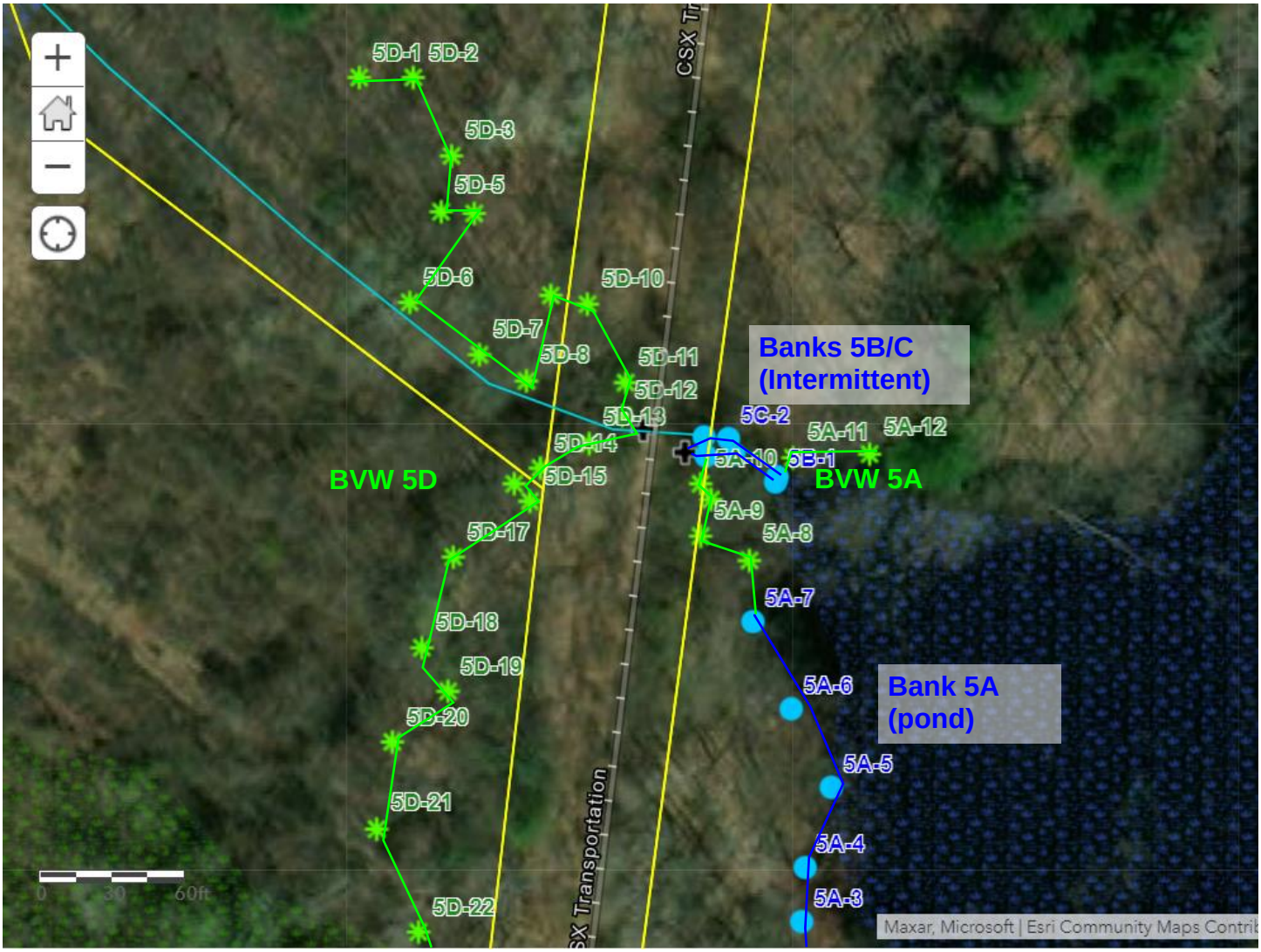

13D-24
6A-47
6E-3
13D-25
6A-46
6D-2
13D-26
6E-1
6A-45
Banks 6D/E
(Intermittent-MAWPA;
Perennial-Bylaw)
6A-44
13D-27
6A-43
6A-41
BVW 13D
13D-28
CSX Transportation
6A-40
13D-29
6A-39
6A-38
13D-30
6A-37
BVW 6A
6A-36
13D-31
6A-35
13D-32
6A-33
Maxar, Microsoft | Esri Community Maps Contrib

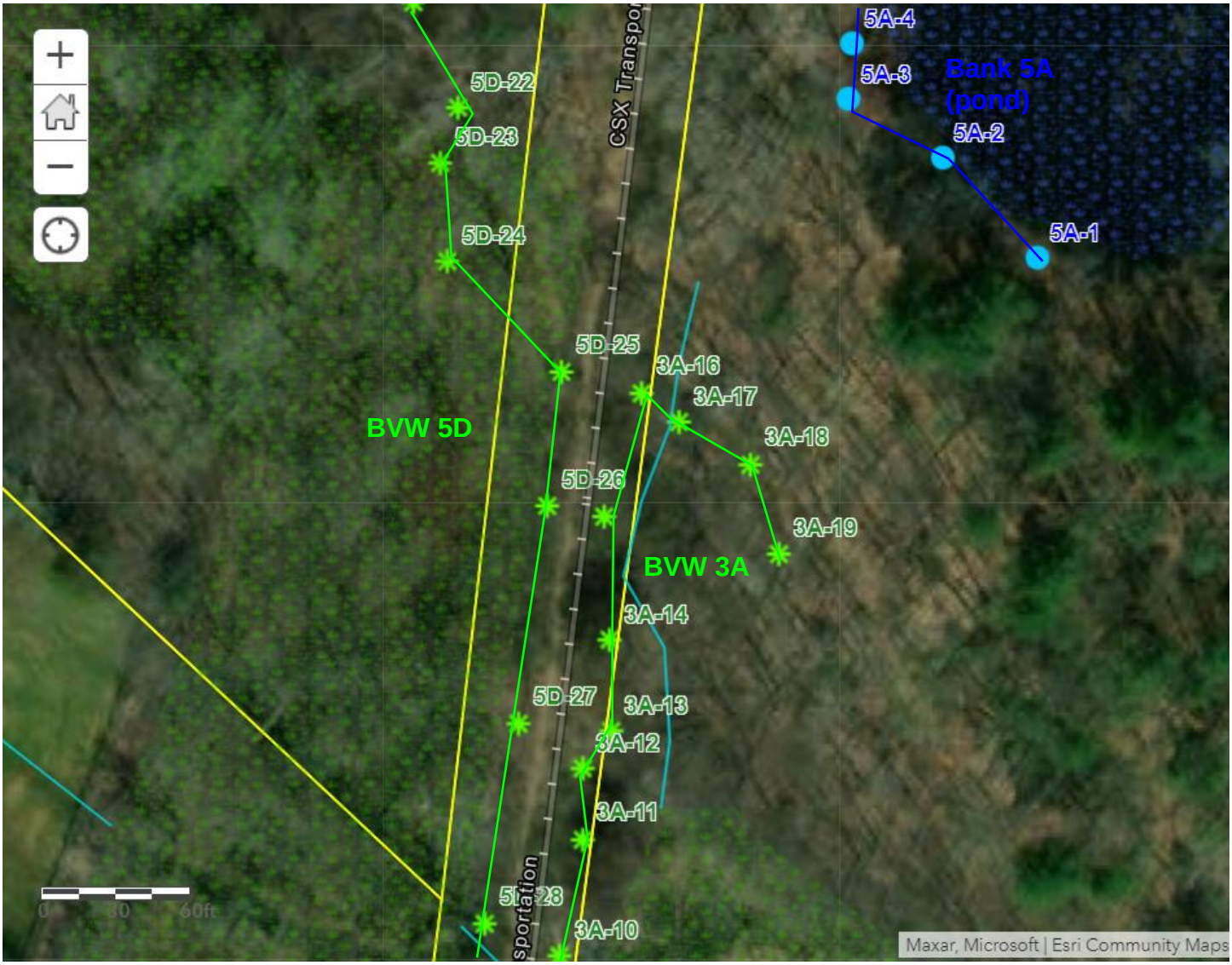

13D-32
6A-33
6A-32
6A-31
13D-33
6A-30
6A-29
BVW 6A
13D-34
BVW 13D
6A-28
13D-35
6A-26
13D-36
13D-37
6A-24
6B-2
6C-1
CSX Transportation
6A-23
Banks 6B/C
6A-22
6A-21
6A-20
13D-39
6A-19
60ft
Maxar, Microsoft | Esri Community Maps Contributors, M


13D-39
6A-19
6A-18
BVW 13D
13D-41
6A-16
6A-15
6A-14
6A-13
13D-43
130-49
BVW 6A
13D-48
6A-12
CSX Transportation
13D-45
6A-11
6A-9
Maxar, Microsoft | Esri Community Maps Contributor


6A-9
6A-8
6A-7
6A-6
6A-5
BVW 6A
6A-4
6A-3
6A-2
6A-1
CSX Transportation
5D-1 5D-2
0
30
60ft
Maxar, Microsoft | Esri Community Maps Contributors, MassG

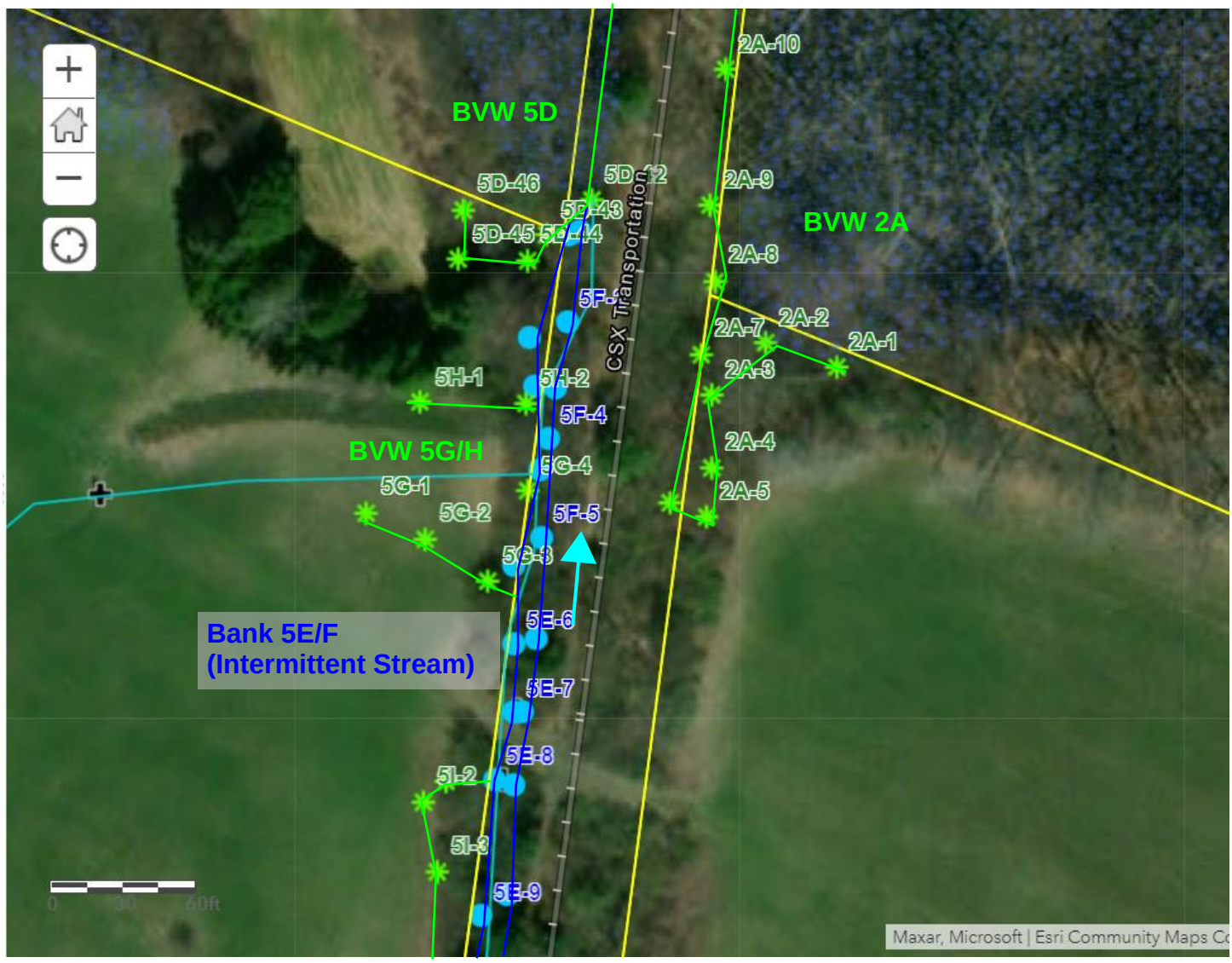
Bruce Freeman Rail Trail (Sudbury, MA)
Wetland Delineation Flags

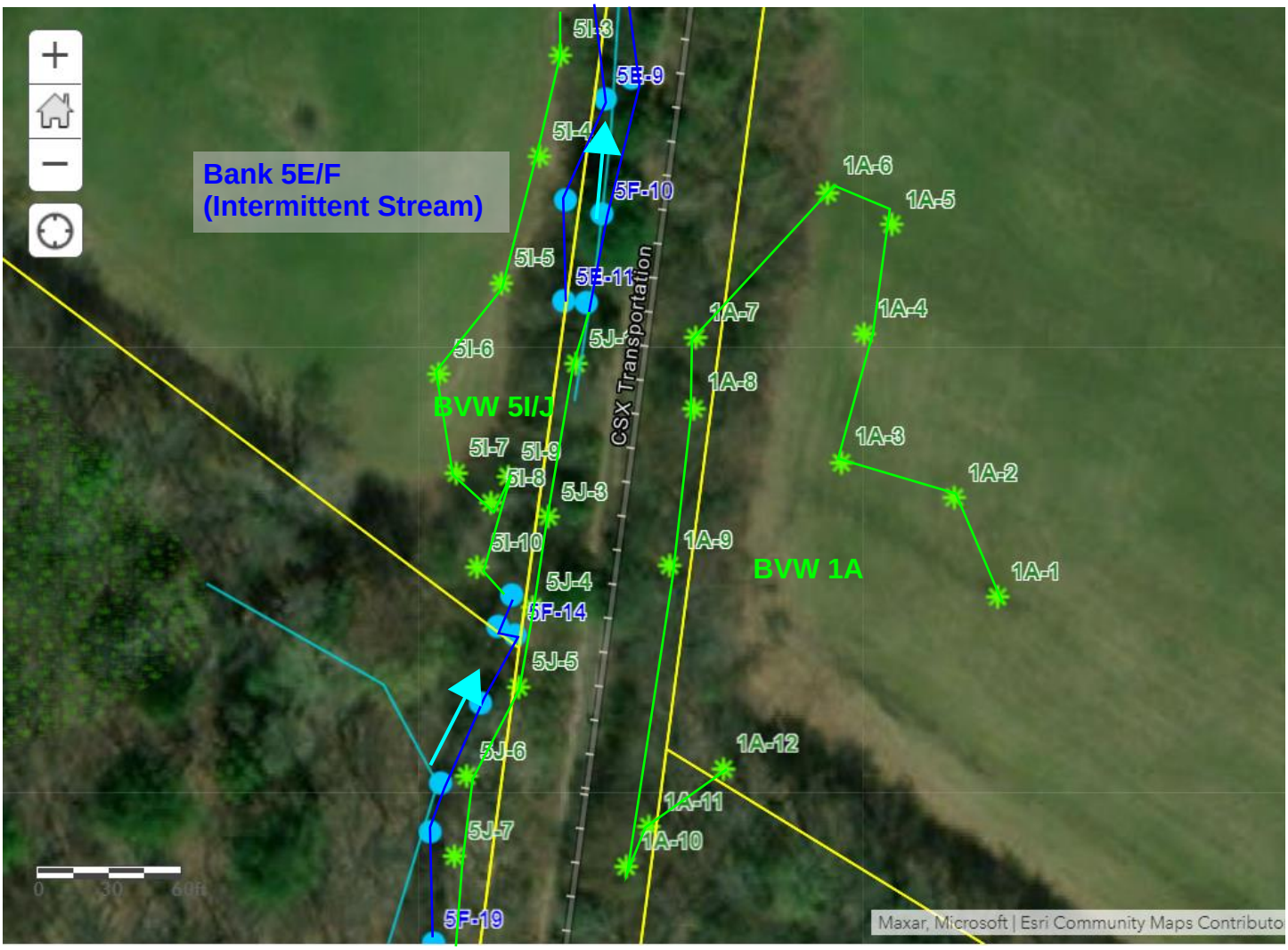



5A-4
5A-3
Bank 5A
(pond)
5A-2
5A-1
5D-22
5D-23
5D-24
5D-25
3A-16
3A-17
3A-18
5D-26
3A-19
BVW 5D
BVW 3A
3A-14
5D-27
3A-13
3A-12
3A-11
3A-10
0
30
60ft
Maxar, Microsoft | Esri Community Maps


BVW 3A
3A-10
3C-4
3B-7
3A-9
CSX Transportation
5D-29
3A-8
3C-3
3B-3
3C-2
Bank/MAHW
3B/C
BVW 5D
3A-7
3C-1
5D-30
3B-1
3A-6
BVW 3A
5D-31
3A-5
5D-33
5D-34
5D-32
3A-4
3A-3
3A-2
3A-1
5D-35
4A-1
4A-4
IVW 4A,
PVP
Maxar, Microsoft | Esri Community Maps Contributors,


5D-36
CSX Transportation
2A-16
5D-37
2A-14
2A-18
2A-17
BVW 5D
2A-13
5D-38
CSX Transportation
BVW 2A
5D-39
2A-12
5D-40
2A-11
2A-10
30
60
Maxar, Microsoft | Esri Commun


BVW 5D
BVW 2A
BVW 5G/H
CSX Transportation
Bank 5E/F
(Intermittent Stream)
2A-10
2A-9
2A-8
2A-7
2A-2
2A-1
2A-3
2A-4
2A-5
5D-46
5D-45
5D-44
5D-43
5D-42
5F-6
5F-5
5F-4
5H-1
5H-2
5G-1
5G-2
5G-3
5G-4
5E-6
5E-7
5E-8
5E-9
5I-2
5I-3
0
30
60ft
Maxar, Microsoft | Esri Community Maps Co


Bank 5E/F
(Intermittent Stream)
5I-3
5E-9
5I-4
5F-10
1A-6
1A-5
5I-5
5E-11
CSX Transportation
1A-7
1A-4
5I-6
5J-
1A-8
BVW 5I/J
5I-7
5I-9
1A-3
5I-8
5J-3
1A-2
5I-10
1A-9
BVW 1A
1A-1
5J-4
5F-14
5J-5
1A-12
5J-6
1A-11
5J-7
1A-10
0
30
60ft
5F-19
Maxar, Microsoft | Esri Community Maps Contributo


BVW 5I/J
1A-11
1A-10
5J-7
5F-19
5J-8
5J-9
5F-21
5F-23
5F-24
5F-25
5F-26
Bank 5E/F
(Intermittent Stream)
CSX Transportation
BVW 5K
5K-1
5K-2
5K-3
60ft
Maxar, Microsoft | Esri Community Maps Contributors, MassGIS,


5K-3
5K-4
5K-5
5K-6
5K-7
CSX Transportation
IVW 14A,
PVP
14A-2
14A-3
14A-6
15A-4
14A-5
0
30
60ft
Maxar, Microsoft | Esri Community Maps Contributors, MassGIS, ©

FUSS & O'NEILL

Attachment B
Site Photographs

Photo 1: Overview of rail trail from the entrance near Eaton Road W in Framingham, MA (9/14/22).

Photo 2: View of the rail trail between BVW 2A and BVW 5D in Sudbury, MA (9/14/22).

Photo 3: View of sensitive fern growing within BVW 1A within the agricultural field (9/14/22).

Photo 4: View of BVW 2A dominated by silky dogwood and sensitive fern (9/14/22).

Photo 5: View of BVW 3A dominated by cattail (9/14/22).

Photo 6: View of perennial stream associated with Bank/MAHW 3B/C defined by a change in vegetation (9/14/22).

Photo 7: View of IVW 4A, PVP dominated by glossy buckthorn (9/14/22).

Photo 8: View of Bank 5A of the unnamed pond. Yellow line approximates delineated Bank (9/14/22).

Photo 9: View of where Bank of the pond transitions to BVW 5A (9/14/22).

Photo 10: View of Banks 5B/C defined by a break in slope and change in vegetation (9/14/22).

Photo 11: View of interior of BVW 5D approximately 25 feet west of the culvert inlet (10/4/22).

Photo 12: View of intermittent stream associated with Banks 5E/F from flag 5F-1 (10/7/22).

Photo 13: View of BVW 5G/H within the swale in the agricultural field (10/7/22).

Photo 14: View of BVW I/J from flag 5I-1 (10/7/22).

Photo 15: View of BVW 5K from flag 5K-2 (10/7/22).

Photo 16: View of BVW 6A-1 within the vicinity of flag 6A-2 (9/14/22).

Photo 17: View of perennial stream associated with Bank/MAHW 6B/C near flag 6C-1 (9/20/22).

Photo 18: View of Banks 6D/E from flag 6D-1. This stream is classified as intermitted under MAWPA and perennial under the Sudbury Wetlands Bylaw (9/20/22)

Photo 19: View of BVW 7A which contains a PVP from flag 7A-1 (9/20/22).

Photo 20: View of IVW 8A dominated by common reed (9/20/22).

Photo 21: View of PVP 9A located within a sparsely vegetated swale (9/28/22).

Photo 22: View of BVW 10A from flag 10A-1 (9/28/22).

Photo 23: View of BVW 11A near flag 11A-3 (9/28/22).

Photo 24: View of the diffuse Bank 11B which is not jurisdictional under MAWPA and considered an intermittent stream under the Sudbury Wetlands Bylaw (9/28/22).

Photo 25: View of the interior of BVW 12A from flag 12A-5 (9/28/22).

Photo 26: View of BVW 13A from the rail trail (9/28/22).

Photo 27: View of Banks 13B/C from the culvert inlet near flag 13B-1 (9/28/22).

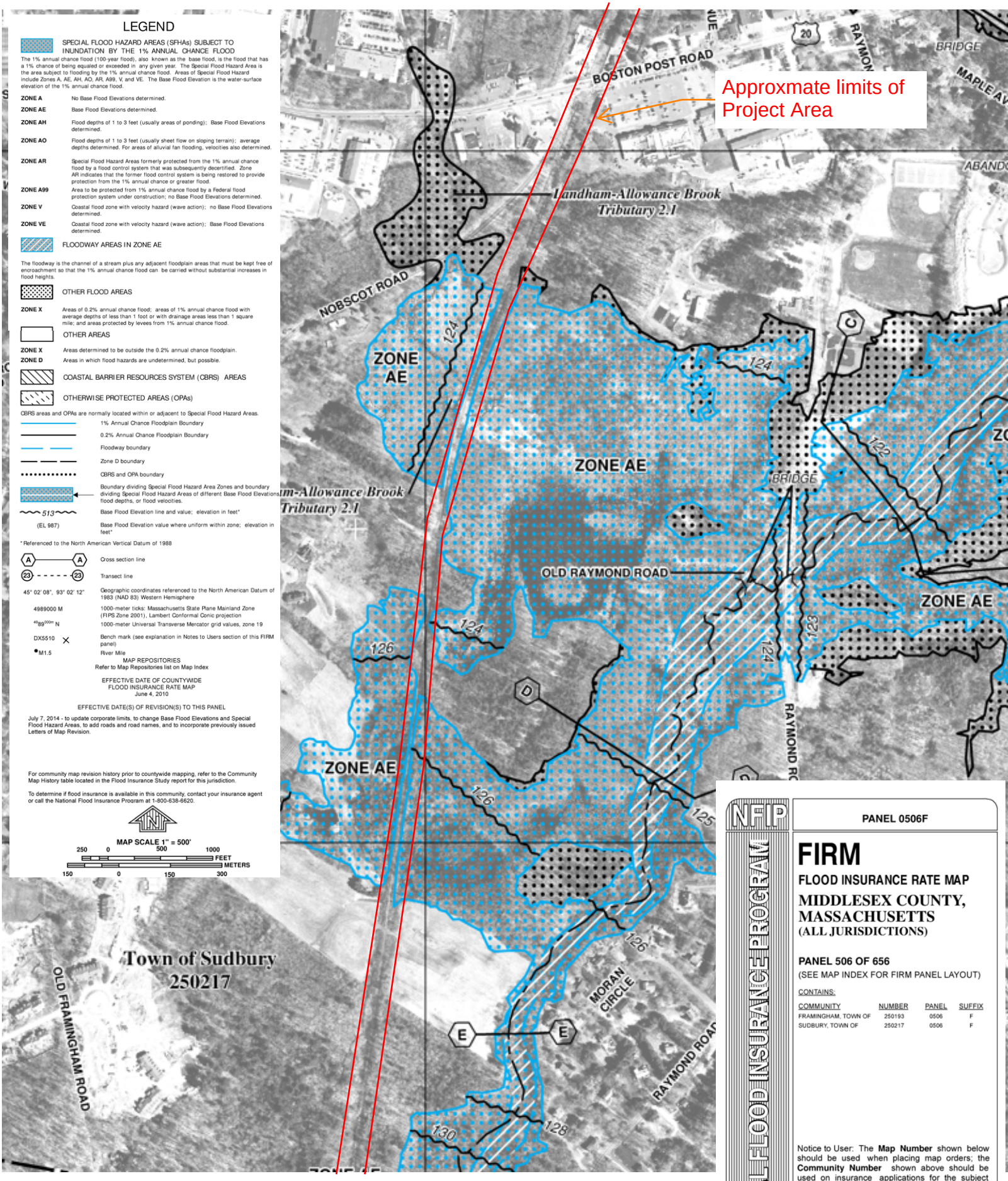
Photo 28: View of BVW 13D/F near flag 13F-1 (10/4/22).

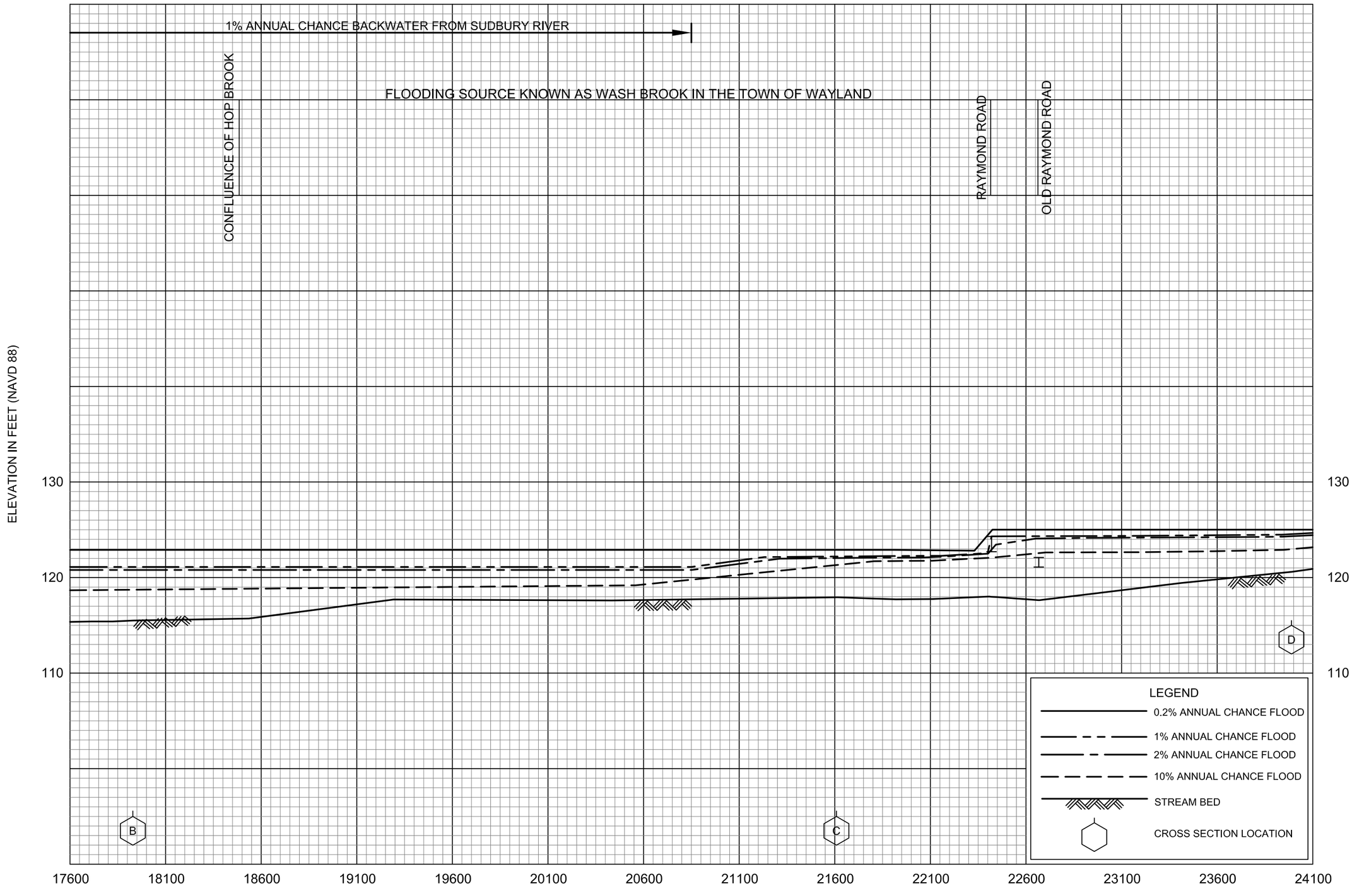
Photo 29: View of IVW 14A which includes a PVP (10/7/22).

Photo 30: View of PVP 15A (9/28/22).

FUSS & O'NEILL

Attachment C
Supplemental Information


LEGEND
SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD
The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.
ZONE A No Base Flood Elevations determined.
ZONE AE Base Flood Elevations determined.
ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.
FLOODWAY AREAS IN ZONE AE
The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.
OTHER FLOOD AREAS
ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.
OTHER AREAS
ZONE X Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D Areas in which flood hazards are undetermined, but possible.
COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS
OTHERWISE PROTECTED AREAS (OPAs)
CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.
1% Annual Chance Floodplain Boundary
0.2% Annual Chance Floodplain Boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
513 Base Flood Elevation line and value; elevation in feet*
(EL 987) Base Flood Elevation value where uniform within zone; elevation in feet*
* Referenced to the North American Vertical Datum of 1988
A A Cross section line
23 23 Transect line
45° 02' 08", 93° 02' 12" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
4989000 M 1000-meter ticks: Massachusetts State Plane Mainland Zone (FIPS Zone 2001), Lambert Conformal Conic projection
4989000 N 1000-meter Universal Transverse Mercator grid values, zone 19
DX5510 Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5 River Mile
MAP REPOSITORIES
Refer to Map Repositories list on Map Index
EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
June 4, 2010
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
July 7, 2014 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to add roads and road names, and to incorporate previously issued Letters of Map Revision.
For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.
To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.
MAP SCALE 1" = 500'
250 0 500 1000 FEET
150 0 150 300 METERS
Approxmate limits of Project Area
BOSTON POST ROAD
Landham-Allowance Brook Tributary 2.1
NOBSCOT ROAD
ZONE AE
OLD RAYMOND ROAD
BRIDGE
RAYMOND ROAD
MORAN CIRCLE
OLD FRAMINGHAM ROAD
Town of Sudbury
250217
124
126
128
130
122
123
125
NFIP
NATIONAL FLOOD INSURANCE PROGRAM
PANEL 0506F
FIRM
FLOOD INSURANCE RATE MAP
MIDDLESEX COUNTY, MASSACHUSETTS
(ALL JURISDICTIONS)
PANEL 506 OF 656
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
FRAMINGHAM, TOWN OF 250193 0506 F
SUDBURY, TOWN OF 250217 0506 F
Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.
MAP NUMBER
25017C0506F
MAP REVISED
JULY 7, 2014
Federal Emergency Management Agency



FLOOD PROFILES

LANDHAM - ALLOWANCE BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

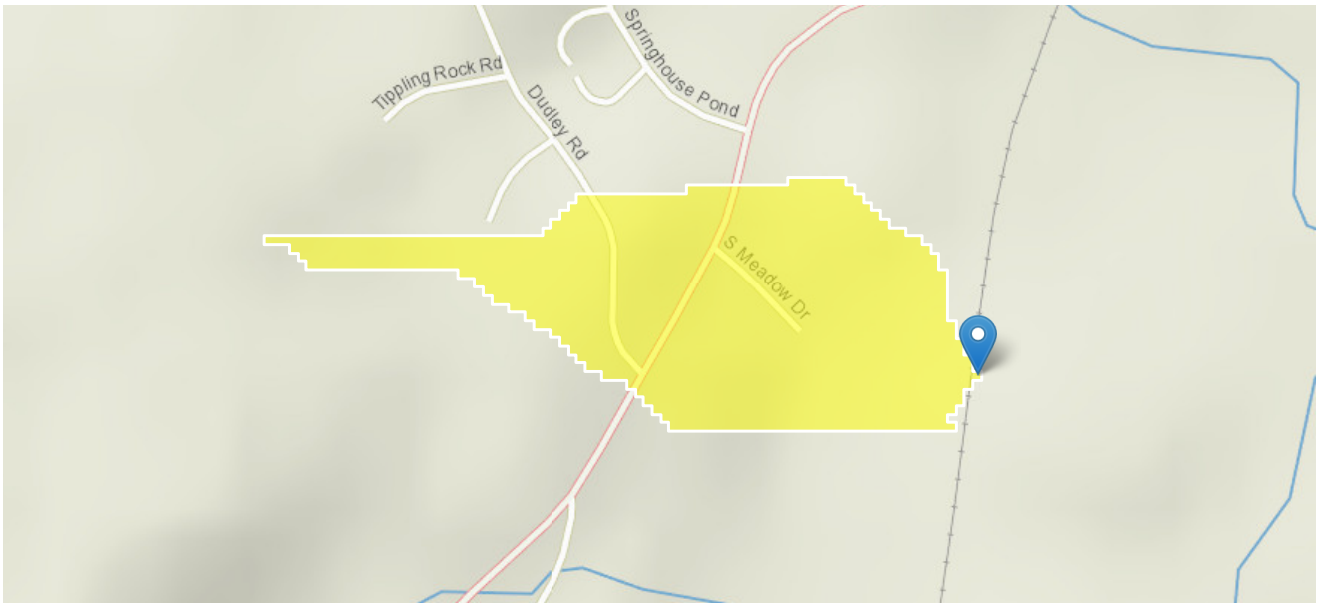
MIDDLESEX COUNTY, MA

(ALL JURISDICTIONS)

288P

StreamStats Report (Intermittent Stream 5B/C)

Region ID: MA
Workspace ID: MA20230203201138946000
Clicked Point (Latitude, Longitude): 42.35347, -71.42701
Time: 2023-02-03 15:12:00 -0500



Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
ACRSDFT	Area underlain by stratified drift	0.0305	square miles
BSLDEM10M	Mean basin slope computed from 10 m DEM	5.573	percent
BSLDEM250	Mean basin slope computed from 1:250K DEM	4.295	percent
CAT1ROADS	Length of interstates lmtd access highways and ramps for lmtd access highways, includes cloverleaf interchanges (USGS Ntl Transp Dataset)	0	miles
CAT2ROADS	Length of sec hwy or maj connecting roads; main arteries & hwys not lmtd access, usually in the US Hwy or State Hwy systems (USGS Ntl Transp Dataset)	0	miles
CAT3ROADS	Length of local connecting roads; roads that collect traffic from local roads & connect towns, subdivisions & neighborhoods (USGS Nat Transp Dataset)	0.17	miles
CAT4ROADS	Length of local roads; generally paved street, road, or byway that usually have single lane of traffic in each direction (USGS Ntnl Transp Dataset)	0.26	miles
CENTROIDX	Basin centroid horizontal (x) location in state plane coordinates	205712.2	meters
CENTROIDY	Basin centroid vertical (y) location in state plane units	900420.7	meters
CROSCOUNT1	Number of intersections between streams and roads, where the roads are interstate, limited access highway, or ramp (CAT1ROADS)	0	dimensionless
CROSCOUNT2	Number of intersections between streams and roads, where the roads are secondary highway or major connecting road (CAT2ROADS)	0	dimensionless
CROSCOUNT3	Number of intersections between streams and roads, where roads are local conecting roads (CAT3ROADS)	0	dimensionless

Parameter Code	Parameter Description	Value	Unit
CROSCOUNT4	Number of intersections between streams and roads, where roads are local roads (CAT4ROADS)	0	dimensionless
CRSDFT	Percentage of area of coarse-grained stratified drift	56.25	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	250	feet per mi
DRFTPERSTR	Area of stratified drift per unit of stream length	-100000	square mile per mile
DRNAREA	Area that drains to a point on a stream	0.0541	square miles
ELEV	Mean Basin Elevation	165	feet
FOREST	Percentage of area covered by forest	70.52	percent
LAKEAREA	Percentage of Lakes and Ponds	0	percent
LC06STOR	Percentage of water bodies and wetlands determined from the NLCD 2006	2.57	percent
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	42.6	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	10.9	percent
LFPLENGTH	Length of longest flow path	0.6	miles
MAREGION	Region of Massachusetts 0 for Eastern 1 for Western	0	dimensionless
MAXTEMPC	Mean annual maximum air temperature over basin area, in degrees Centigrade	15.3	degrees C
OUTLETX	Basin outlet horizontal (x) location in state plane coordinates	206015	feet
OUTLETY	Basin outlet vertical (y) location in state plane coordinates	900335	feet
PCTSNDGRV	Percentage of land surface underlain by sand and gravel deposits	56.25	percent
PRECPRIS00	Basin average mean annual precipitation for 1971 to 2000 from PRISM	47	inches
STRMTOT	total length of all mapped streams (1:24,000-scale) in the basin	0	miles
WETLAND	Percentage of Wetlands	1.78	percent

Peak-Flow Statistics

Peak-Flow Statistics Parameters [Peak Statewide 2016 5156]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.0541	square miles	0.16	512
ELEV	Mean Basin Elevation	165	feet	80.6	1948
LC06STOR	Percent Storage from NLCD2006	2.57	percent	0	32.3

Peak-Flow Statistics Disclaimers [Peak Statewide 2016 5156]

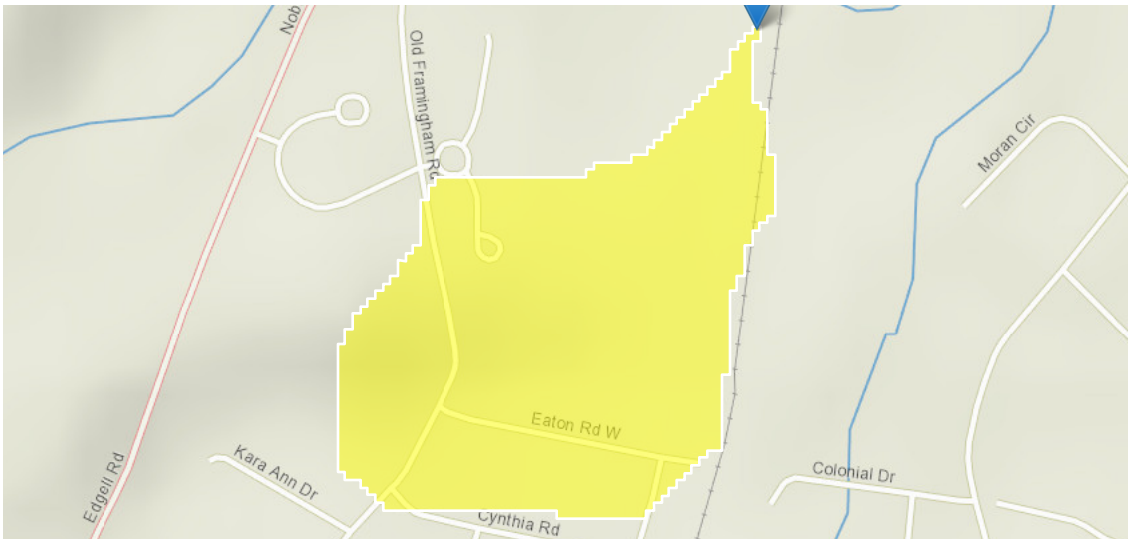
One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Peak-Flow Statistics Flow Report [Peak Statewide 2016 5156]

Statistic	Value	Unit
50-percent AEP flood	4.14	ft^3/s

StreamStats Report Bank 5E/F

Region ID: MA
Workspace ID: MA20230214211038692000
Clicked Point (Latitude, Longitude): 42.34997, -71.42809
Time: 2023-02-14 16:11:02 -0500



Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
ACRSDFT	Area underlain by stratified drift	0.0343	square miles
BSLDEM10M	Mean basin slope computed from 10 m DEM	7.233	percent
BSLDEM250	Mean basin slope computed from 1:250K DEM	5.716	percent
CAT1ROADS	Length of interstates lmtd access highways and ramps for lmtd access highways, includes cloverleaf interchanges (USGS Ntl Transp Dataset)	0	miles
CAT2ROADS	Length of sec hwy or maj connecting roads; main arteries & hwys not lmtd access, usually in the US Hwy or State Hwy systems (USGS Ntl Transp Dataset)	0	miles
CAT3ROADS	Length of local connecting roads; roads that collect traffic from local roads & connect towns, subdivisions & neighborhoods (USGS Nat Transp Dataset)	0.27	miles
CAT4ROADS	Length of local roads; generally paved street, road, or byway that usually have single lane of traffic in each direction (USGS Ntnl Transp Dataset)	0.3	miles
CENTROIDX	Basin centroid horizontal (x) location in state plane coordinates	205668.4	meters
CENTROIDY	Basin centroid vertical (y) location in state plane units	899552.3	meters
CROSCOUNT1	Number of intersections between streams and roads, where the roads are interstate, limited access highway, or ramp (CAT1ROADS)	0	dimensionless
CROSCOUNT2	Number of intersections between streams and roads, where the roads are secondary highway or major connecting road (CAT2ROADS)	0	dimensionless
CROSCOUNT3	Number of intersections between streams and roads, where roads are local conecting roads (CAT3ROADS)	0	dimensionless
CROSCOUNT4	Number of intersections between streams and roads, where roads are local roads (CAT4ROADS)	0	dimensionless
CRSDFT	Percentage of area of coarse-grained stratified drift	38.67	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	119	feet per mi

Parameter Code	Parameter Description	Value	Unit
DRFTPERSTR	Area of stratified drift per unit of stream length	-100000	square mile per mile
DRNAREA	Area that drains to a point on a stream	0.0888	square miles
ELEV	Mean Basin Elevation	176	feet
FOREST	Percentage of area covered by forest	57.2	percent
LAKEAREA	Percentage of Lakes and Ponds	0	percent
LC06STOR	Percentage of water bodies and wetlands determined from the NLCD 2006	18.27	percent
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	44	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	15.8	percent
LFPLENGTH	Length of longest flow path	0.68	miles
MAREGION	Region of Massachusetts 0 for Eastern 1 for Western	0	dimensionless
MAXTEMPC	Mean annual maximum air temperature over basin area, in degrees Centigrade	15.3	degrees C
OUTLETX	Basin outlet horizontal (x) location in state plane coordinates	205925	feet
OUTLETY	Basin outlet vertical (y) location in state plane coordinates	899945	feet
PCTSNDGRV	Percentage of land surface underlain by sand and gravel deposits	38.67	percent
PRECPRIS00	Basin average mean annual precipitation for 1971 to 2000 from PRISM	46.9	inches
STRMTOT	total length of all mapped streams (1:24,000-scale) in the basin	0	miles
WETLAND	Percentage of Wetlands	12.53	percent

Peak-Flow Statistics

Peak-Flow Statistics Parameters [Peak Statewide 2016 5156]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.0888	square miles	0.16	512
ELEV	Mean Basin Elevation	176	feet	80.6	1948
LC06STOR	Percent Storage from NLCD2006	18.27	percent	0	32.3

Peak-Flow Statistics Disclaimers [Peak Statewide 2016 5156]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Peak-Flow Statistics Flow Report [Peak Statewide 2016 5156]

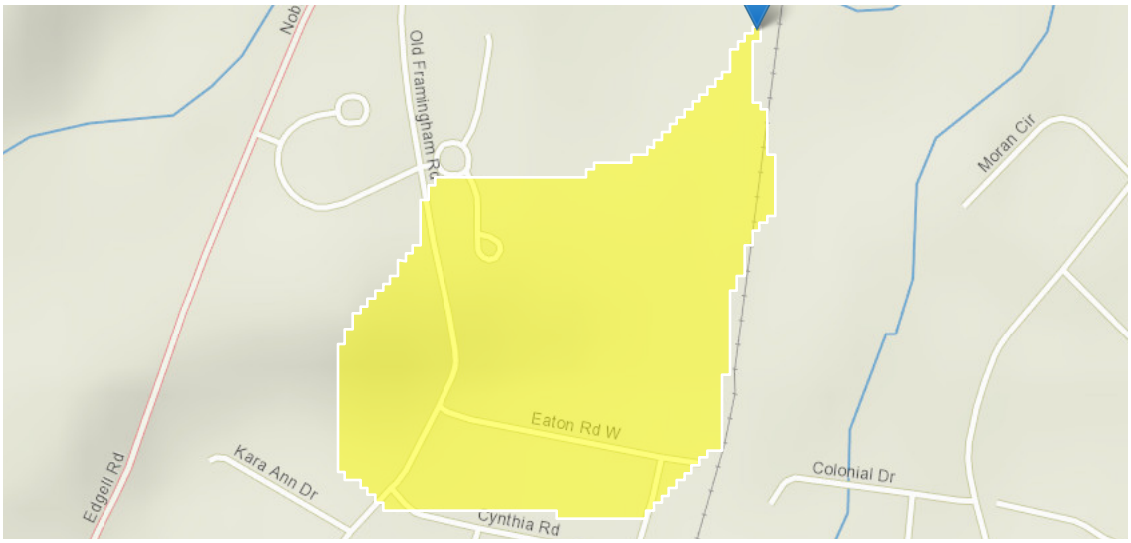
Statistic	Value	Unit
50-percent AEP flood	4.1	ft^3/s
20-percent AEP flood	7.06	ft^3/s
10-percent AEP flood	9.5	ft^3/s
4-percent AEP flood	13.1	ft^3/s
2-percent AEP flood	16	ft^3/s
1-percent AEP flood	19.2	ft^3/s
0.5-percent AEP flood	22.7	ft^3/s
0.2-percent AEP flood	27.7	ft^3/s

Peak-Flow Statistics Citations

Zarriello, P.J.,2017, Magnitude of flood flows at selected annual exceedance probabilities for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2016–5156, 99 p. (https://dx.doi.org/10.3133/sir20165156)

StreamStats- Bank 5 G/H

Region ID: MA
Workspace ID: MA20230203213430820000
Clicked Point (Latitude, Longitude): 42.34994, -71.42801
Time: 2023-02-03 16:34:56 -0500



Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
ACRSDFT	Area underlain by stratified drift	0.0343	square miles
BSLDEM10M	Mean basin slope computed from 10 m DEM	7.233	percent
BSLDEM250	Mean basin slope computed from 1:250K DEM	5.716	percent
CAT1ROADS	Length of interstates lmtd access highways and ramps for lmtd access highways, includes cloverleaf interchanges (USGS Ntl Transp Dataset)	0	miles
CAT2ROADS	Length of sec hwy or maj connecting roads; main arteries & hwys not lmtd access, usually in the US Hwy or State Hwy systems (USGS Ntl Transp Dataset)	0	miles
CAT3ROADS	Length of local connecting roads; roads that collect traffic from local roads & connect towns, subdivisions & neighborhoods (USGS Nat Transp Dataset)	0.27	miles
CAT4ROADS	Length of local roads; generally paved street, road, or byway that usually have single lane of traffic in each direction (USGS Ntnl Transp Dataset)	0.3	miles
CENTROIDX	Basin centroid horizontal (x) location in state plane coordinates	205668.4	meters
CENTROIDY	Basin centroid vertical (y) location in state plane units	899552.3	meters
CROSCOUNT1	Number of intersections between streams and roads, where the roads are interstate, limited access highway, or ramp (CAT1ROADS)	0	dimensionless
CROSCOUNT2	Number of intersections between streams and roads, where the roads are secondary highway or major connecting road (CAT2ROADS)	0	dimensionless
CROSCOUNT3	Number of intersections between streams and roads, where roads are local conecting roads (CAT3ROADS)	0	dimensionless
CROSCOUNT4	Number of intersections between streams and roads, where roads are local roads (CAT4ROADS)	0	dimensionless
CRSDFT	Percentage of area of coarse-grained stratified drift	38.67	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	119	feet per mi

Parameter Code	Parameter Description	Value	Unit
DRFTPERSTR	Area of stratified drift per unit of stream length	-100000	square mile per mile
DRNAREA	Area that drains to a point on a stream	0.0888	square miles
ELEV	Mean Basin Elevation	176	feet
FOREST	Percentage of area covered by forest	57.2	percent
LAKEAREA	Percentage of Lakes and Ponds	0	percent
LC06STOR	Percentage of water bodies and wetlands determined from the NLCD 2006	18.27	percent
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	44	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	15.8	percent
LFPLENGTH	Length of longest flow path	0.68	miles
MAREGION	Region of Massachusetts 0 for Eastern 1 for Western	0	dimensionless
MAXTEMPC	Mean annual maximum air temperature over basin area, in degrees Centigrade	15.3	degrees C
OUTLETX	Basin outlet horizontal (x) location in state plane coordinates	205925	feet
OUTLETY	Basin outlet vertical (y) location in state plane coordinates	899945	feet
PCTSNDGRV	Percentage of land surface underlain by sand and gravel deposits	38.67	percent
PRECPRIS00	Basin average mean annual precipitation for 1971 to 2000 from PRISM	46.9	inches
STRMTOT	total length of all mapped streams (1:24,000-scale) in the basin	0	miles
WETLAND	Percentage of Wetlands	12.53	percent

Peak-Flow Statistics

Peak-Flow Statistics Parameters [Peak Statewide 2016 5156]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.0888	square miles	0.16	512
ELEV	Mean Basin Elevation	176	feet	80.6	1948
LC06STOR	Percent Storage from NLCD2006	18.27	percent	0	32.3

Peak-Flow Statistics Disclaimers [Peak Statewide 2016 5156]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Peak-Flow Statistics Flow Report [Peak Statewide 2016 5156]

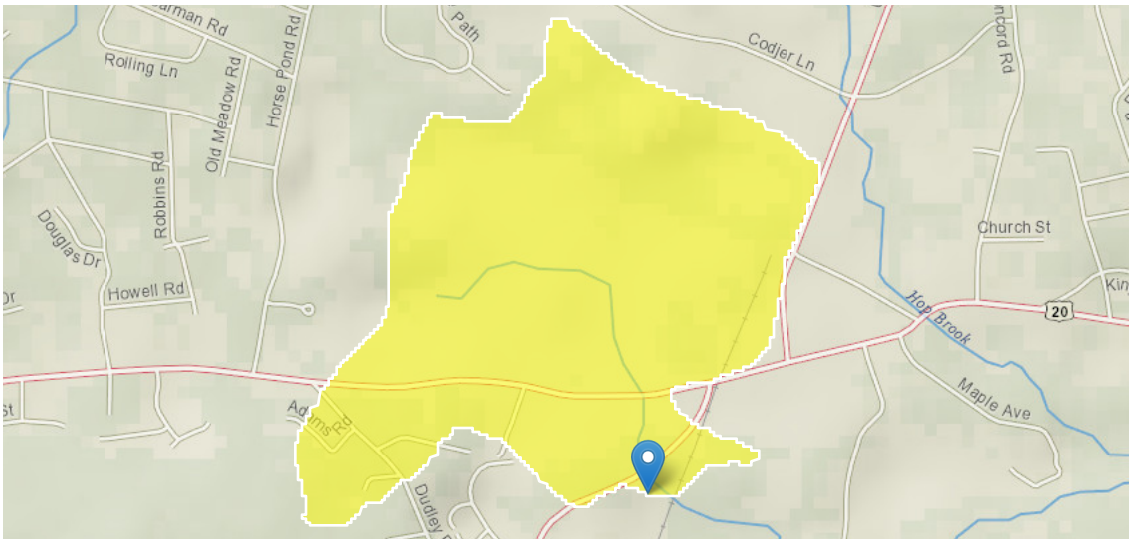
Statistic	Value	Unit
50-percent AEP flood	4.1	ft^3/s
20-percent AEP flood	7.06	ft^3/s
10-percent AEP flood	9.5	ft^3/s
4-percent AEP flood	13.1	ft^3/s
2-percent AEP flood	16	ft^3/s
1-percent AEP flood	19.2	ft^3/s
0.5-percent AEP flood	22.7	ft^3/s
0.2-percent AEP flood	27.7	ft^3/s

Peak-Flow Statistics Citations

Zarriello, P.J.,2017, Magnitude of flood flows at selected annual exceedance probabilities for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2016–5156, 99 p. (https://dx.doi.org/10.3133/sir20165156)

StreamStats Report - Banks 6D/E

Region ID: MA
Workspace ID: MA20230215162328594000
Clicked Point (Latitude, Longitude): 42.35762, -71.42592
Time: 2023-02-15 11:23:48 -0500



Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
ACRSDFT	Area underlain by stratified drift	0.4	square miles
BSLDEM10M	Mean basin slope computed from 10 m DEM	3.122	percent
BSLDEM250	Mean basin slope computed from 1:250K DEM	1.077	percent
CAT1ROADS	Length of interstates lmtd access highways and ramps for lmtd access highways, includes cloverleaf interchanges (USGS Ntl Transp Dataset)	0	miles
CAT2ROADS	Length of sec hwy or maj connecting roads; main arteries & hwys not lmtd access, usually in the US Hwy or State Hwy systems (USGS Ntl Transp Dataset)	0.58	miles
CAT3ROADS	Length of local connecting roads; roads that collect traffic from local roads & connect towns, subdivisions & neighborhoods (USGS Nat Transp Dataset)	0.28	miles
CAT4ROADS	Length of local roads; generally paved street, road, or byway that usually have single lane of traffic in each direction (USGS Ntnl Transp Dataset)	2.26	miles
CENTROIDX	Basin centroid horizontal (x) location in state plane coordinates	205828.6	meters
CENTROIDY	Basin centroid vertical (y) location in state plane units	901335.2	meters
CROSCOUNT1	Number of intersections between streams and roads, where the roads are interstate, limited access highway, or ramp (CAT1ROADS)	0	dimensionless
CROSCOUNT2	Number of intersections between streams and roads, where the roads are secondary highway or major connecting road (CAT2ROADS)	1	dimensionless
CROSCOUNT3	Number of intersections between streams and roads, where roads are local conecting roads (CAT3ROADS)	1	dimensionless
CROSCOUNT4	Number of intersections between streams and roads, where roads are local roads (CAT4ROADS)	3	dimensionless
CRSDFT	Percentage of area of coarse-grained stratified drift	66.83	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	26.5	feet per mi

Parameter Code	Parameter Description	Value	Unit
DRFTPERSTR	Area of stratified drift per unit of stream length	0.53	square mile per mile
DRNAREA	Area that drains to a point on a stream	0.42	square miles
ELEV	Mean Basin Elevation	152	feet
FOREST	Percentage of area covered by forest	26.75	percent
LAKEAREA	Percentage of Lakes and Ponds	0.07	percent
LC06STOR	Percentage of water bodies and wetlands determined from the NLCD 2006	10.1	percent
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	75.5	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	39.3	percent
LFPLENGTH	Length of longest flow path	1.1	miles
MAREGION	Region of Massachusetts 0 for Eastern 1 for Western	0	dimensionless
MAXTEMPC	Mean annual maximum air temperature over basin area, in degrees Centigrade	15.3	degrees C
OUTLETX	Basin outlet horizontal (x) location in state plane coordinates	206045	feet
OUTLETY	Basin outlet vertical (y) location in state plane coordinates	900795	feet
PCTSNDGRV	Percentage of land surface underlain by sand and gravel deposits	66.83	percent
PRECPRIS00	Basin average mean annual precipitation for 1971 to 2000 from PRISM	47	inches
STRMTOT	total length of all mapped streams (1:24,000-scale) in the basin	0.76	miles
WETLAND	Percentage of Wetlands	11.1	percent

Peak-Flow Statistics

Peak-Flow Statistics Parameters [Peak Statewide 2016 5156]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.42	square miles	0.16	512
ELEV	Mean Basin Elevation	152	feet	80.6	1948
LC06STOR	Percent Storage from NLCD2006	10.1	percent	0	32.3

Peak-Flow Statistics Flow Report [Peak Statewide 2016 5156]

PII: Prediction Interval-Lower, Plu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

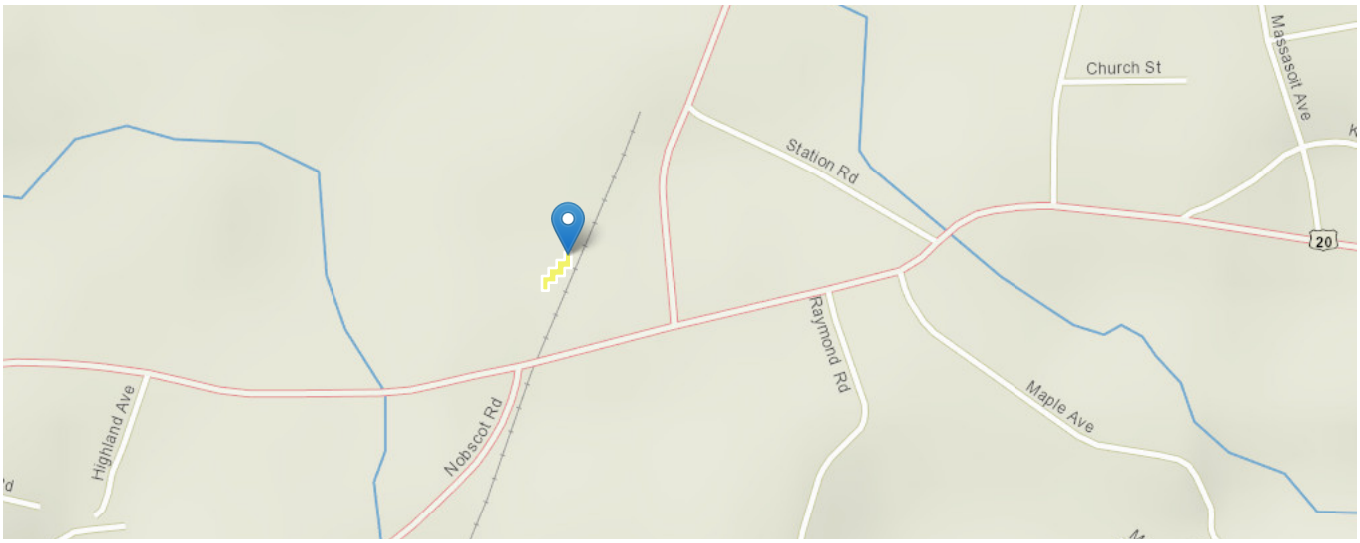
Statistic	Value	Unit	PII	Plu	ASEp
50-percent AEP flood	17.4	ft^3/s	8.79	34.4	42.3
20-percent AEP flood	29.5	ft^3/s	14.7	59.3	43.4
10-percent AEP flood	39.1	ft^3/s	19	80.6	44.7
4-percent AEP flood	53.2	ft^3/s	24.9	114	47.1
2-percent AEP flood	64.9	ft^3/s	29.4	143	49.4
1-percent AEP flood	77.4	ft^3/s	33.9	176	51.8
0.5-percent AEP flood	91	ft^3/s	38.7	214	54.1
0.2-percent AEP flood	111	ft^3/s	45	274	57.6

Peak-Flow Statistics Citations

Zarriello, P.J.,2017, Magnitude of flood flows at selected annual exceedance probabilities for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2016–5156, 99 p. (https://dx.doi.org/10.3133/sir20165156)

StreamStats Report - Bank 11B

Region ID: MA
Workspace ID: MA20230215213121877000
Clicked Point (Latitude, Longitude): 42.36156, -71.42387
Time: 2023-02-15 16:31:42 -0500



Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
ACRSDFT	Area underlain by stratified drift	0.000309	square miles
BSLDEM10M	Mean basin slope computed from 10 m DEM	1.374	percent
BSLDEM250	Mean basin slope computed from 1:250K DEM		percent
CAT1ROADS	Length of interstates lmtd access highways and ramps for lmtd access highways, includes cloverleaf interchanges (USGS Ntl Transp Dataset)	0	miles
CAT2ROADS	Length of sec hwy or maj connecting roads; main arteries & hwys not lmtd access, usually in the US Hwy or State Hwy systems (USGS Ntl Transp Dataset)	0	miles
CAT3ROADS	Length of local connecting roads; roads that collect traffic from local roads & connect towns, subdivisions & neighborhoods (USGS Nat Transp Dataset)	0	miles
CAT4ROADS	Length of local roads; generally paved street, road, or byway that usually have single lane of traffic in each direction (USGS Ntnl Transp Dataset)	0	miles
CENTROIDX	Basin centroid horizontal (x) location in state plane coordinates	206260	meters
CENTROIDY	Basin centroid vertical (y) location in state plane units	901215	meters
CROSCOUNT1	Number of intersections between streams and roads, where the roads are interstate, limited access highway, or ramp (CAT1ROADS)	0	dimensionless
CROSCOUNT2	Number of intersections between streams and roads, where the roads are secondary highway or major connecting road (CAT2ROADS)	0	dimensionless
CROSCOUNT3	Number of intersections between streams and roads, where roads are local conecting roads (CAT3ROADS)	0	dimensionless
CROSCOUNT4	Number of intersections between streams and roads, where roads are local roads (CAT4ROADS)	0	dimensionless
CRSDFT	Percentage of area of coarse-grained stratified drift	0	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	0	feet per mi

Parameter Code	Parameter Description	Value	Unit
DRFTPERSTR	Area of stratified drift per unit of stream length	-100000	square mile per mile
DRNAREA	Area that drains to a point on a stream	0.000309	square miles
ELEV	Mean Basin Elevation	137	feet
FOREST	Percentage of area covered by forest	37.5	percent
LAKEAREA	Percentage of Lakes and Ponds	0	percent
LC06STOR	Percentage of water bodies and wetlands determined from the NLCD 2006	25	percent
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	100	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	11.9	percent
LFPLENGTH	Length of longest flow path	0.0326	miles
MAREGION	Region of Massachusetts 0 for Eastern 1 for Western	0	dimensionless
MAXTEMPC	Mean annual maximum air temperature over basin area, in degrees Centigrade	15.3	degrees C
OUTLETX	Basin outlet horizontal (x) location in state plane coordinates	206275	feet
OUTLETY	Basin outlet vertical (y) location in state plane coordinates	901235	feet
PCTSNDGRV	Percentage of land surface underlain by sand and gravel deposits	0	percent
PRECPRIS00	Basin average mean annual precipitation for 1971 to 2000 from PRISM	46.9	inches
STRMTOT	total length of all mapped streams (1:24,000-scale) in the basin	0	miles
WETLAND	Percentage of Wetlands	50	percent

Peak-Flow Statistics

Peak-Flow Statistics Parameters [Peak Statewide 2016 5156]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.000309	square miles	0.16	512
ELEV	Mean Basin Elevation	137	feet	80.6	1948
LC06STOR	Percent Storage from NLCD2006	25	percent	0	32.3

Peak-Flow Statistics Disclaimers [Peak Statewide 2016 5156]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Peak-Flow Statistics Flow Report [Peak Statewide 2016 5156]

Statistic	Value	Unit
50-percent AEP flood	0.0363	ft^3/s
20-percent AEP flood	0.0669	ft^3/s
10-percent AEP flood	0.0936	ft^3/s
4-percent AEP flood	0.134	ft^3/s
2-percent AEP flood	0.167	ft^3/s
1-percent AEP flood	0.205	ft^3/s
0.5-percent AEP flood	0.246	ft^3/s
0.2-percent AEP flood	0.306	ft^3/s

Peak-Flow Statistics Citations

Zarriello, P.J.,2017, Magnitude of flood flows at selected annual exceedance probabilities for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2016–5156, 99 p. (https://dx.doi.org/10.3133/sir20165156)

Buffer Zone / Adjacent Upland Resource Area

Buffer Zone is defined in 310 CMR 10.04 as "*that area of land extending 100 feet horizontally outward from the boundary of any area specified in 310 CMR 10.02(1)(a).*" Buffer Zone is considered an area subject to protection under the MAWPA, but is not regulated as a resource area under the MAWPA.

Unlike the MAWPA, the Sudbury Wetlands Bylaw considers the adjacent upland resource areas protected as a separate jurisdictional resource area. This includes lands within 100 feet of the following resources areas listed below and identified within the Project Area:

- Bordering Vegetated Wetlands
- Isolated Vegetated Wetlands
- Bank
- Bordering Land Subject to Flooding

The adjacent upland resource area is 200 feet from top of bank for perennial streams, and varies for vernal pools, ponds under 10,000 square feet, and isolated land subject to flooding. Refer to Section 9 of the Sudbury Wetlands Bylaw for an explanation of adjacent upland resource areas.

The Buffer Zone (protected under MAPWA) and adjacent upland resource area jurisdictional under the Sudbury Wetlands Bylaw primarily consists of the rail trail. Refer to a general description of the rail trail in Section 1.2.1 above.