FUSS & O'NEILL

MEMORANDUM

TO: Amy Green, Conservation Agent, Littleton Conservation Commission

FROM: Nick Lapointe, PE, Senior Project Manager, Fuss & O'Neill
Aaron Keegan, PE, Project Engineer, Fuss & O'Neill

DATE: 12/01/2023

RE: Response to Comments on NOI for DEP #CE 204-0991, The Reconstruction of Foster Street in Littleton, MA

CC: Stephen Jahnle, DPW Director, Town of Littleton

ENC: Attachments 1 through 5

Commissioner Comments on the Topic of Stormwater

• Commissioners identified that water was flowing towards the embankment from the southeast. Commissioners suggested that F&O investigate the source and flow rates of that water and determine what impact, if any, it might have on the post-construction embankments.

F&O Response #1: Based on our review, it appears that the source of this water is likely from the draining of the detention basins from Durkee Farms development and or residual stormwater flow from upgradient areas of this wetland system. Considering the amount of rainfall we have experienced this fall; wetland areas of this nature commonly have water flowing through them well after a storm event has ended. F&O performed a hydrologic analysis of the proposed project and determined that the proposed increase in impervious area has a negligible effect on the amount of stormwater runoff flowing into the wetland at 260 Foster Street. The hydrologic analysis is provided in Attachment 1.

• Commissioners suggested that more storage capacity could be created at a hydraulically connected location within the MassDOT State highway layout surrounding the Route 2 overpass of Foster St. The Commission acknowledges that this was discussed as an option but notes that the Commission has no opinion on the viability of this option to manage flow versus other options and the ultimate determination of appropriate methods for providing additional storage capacity and peak flow attenuation should be based on modelled findings with appropriate factors of safety.

See Response #2 below.

• Commissioners suggested that more storage capacity may be necessary due to the expansion of work into the basin beyond the currently-identified extents of work. One option discussed was cutting back a slope in another location on the property. The Town does not currently own the parcel but may seek acquire the property 260 Foster St in the future.

See Response #2 below.

• The realignment of Grimes Lane will result in fill of low-lying land adjacent to the wetland that currently provides stormwater storage during peak flows within the 50 No Disturb Zone. Commissioners asked how the removal of this stormwater storage would be compensated for in the project limits as planned and furthermore as is realistic once the extents of work are adjusted to represent a realistic condition. Commissioners identified that a stormwater model may be necessary.

F&O Response #2: F&O reviewed the topography of the wetland at 260 Foster Street to determine if the project's impacts related to fill within and adjacent to the wetland area would affect the wetland's ability to store stormwater. Utilizing the 1-foot contour layer available through the MassGIS MassMapper tool (https://maps.massgis.digital.mass.gov/MassMapper/MassMapper.html), the topography of the wetland generally slopes from an elevation of 257 at the outlet of the culvert under Balsam Lane to elevation 239 at the southern end before entering the stone culvert's inlet (design point) at elevation 236.38 located underneath Grimes Lane. The topography does not depict significant berms or depressions in the vicinity of the proposed fill.

Although the wetland may have some localized low points, it is our engineering judgement that the wetland area does not provide any significant storage for stormwater. Therefore, the proposed fill will not adversely affect the wetland's ability to convey stormwater. The hydrologic analysis is provided in Attachment 1.

Additionally, the proposed areas of fill are not in BLSF or a FEMA floodway. It would be unusual to excavate for compensatory storage for fill not located in BLSF or floodways for a limited project.

• Commissioners expressed concern that leaching catch basins less capable of managing high flow events and may have less value mitigating stormwater flows during design storms.

F&O Response #3: We accept the commissioner's statement; however the leaching catch basins will still provide helpful infiltration. If the storage capacity of the leaching catch basins is exceeded, stormwater will bypass the inlet of the leaching catch basins. None of the leaching catch basins are located at low points therefore there is no risk of ponding at the leaching catch basins. Any stormwater

that bypasses the leaching catch basins will continue to the existing low points of the project where traditional deep sump catch basins are located. A detail of the standard MassDOT Leaching catch basin is provided in Attachment 2.

Commissioner Comments on the Topics of Embankment Constructability, Stability, Work Limits, and Erosion Control at Foster Street

- The edge of road is moving 3 feet toward the 260 Foster St parcel Durkee Farms. This will move the embankment of Foster St closer to the wetland basin. Commissioners raised concerns about diminished stormwater storage in the wetland basin on 260 Foster St. Commissioners raised concerns that the entire slope will need to be shifted to accommodate the top of the slope and proposed slope stability, and shifting the slope to the south will (1) include work beyond the currently identified extent of work; (2) impact buffer zone in ways that are not currently shown on the plans and may fill resource areas; (3) to the extent shifting the slope adds backfill around the base of trees, those trees will ultimately die. F&O was advised that the extents of work do not appear to be realistic given the slopes and grades. This condition was subsequently discussed at many other areas. F&O was advised by Commissioners that work outside of the plan-defined limits of work will not be allowed.

See Response #4 below.

- Commissioners requested to see the cross sections at locations where Foster St is proposed to be moved.

See Response #4 below.

- Commissioners asked about vegetation on the side slopes. The slopes are proposed to be seeded with grass. No plants are currently proposed, but additional vegetation could be added to the project. Commissioners suggested that F&O consider more robust planting plans than grass.

F&O Response #4: Cross sections are provided in Attachment 3 for where the Foster Street alignment will shift toward the frontage of 260 Foster Street. The cross sections show: 1) the fill areas proposed to stabilize the proposed shoulder embankment, 2) the placement of the proposed erosion controls, 3) the proposed limit of work, and 4) the wetland boundary.

The proposed embankment will be constructed using gravel borrow and crushed stone meeting MassDOT's material standards and then compacted for stability to MassDOT specification. Where embankment slopes are 2:1 or steeper, the project calls for the use of modified rockfill to supplement slope stability and prevent slope erosion. The specification for modified rockfill is included in Attachment 4, a detail of modified rockfill is included in Attachment 3. Callouts have been added to the construction plans showing the areas where the use of modified rockfill shall be used at the frontage of 260 Foster Street, between Stations 30+33 to 32+09.

The MassDOT specification for modified rockfill calls for the use of a geotextile fabric rated for slope stability, crushed stone, and boulders up to 8 inches in diameter. The modified rockfill slope will have a

compost surface treatment that will be seeded with a native seed mix called New England Roadside Wet Meadow Seed Mix. The specification for the native seed mix is included in Attachment 4. This native seed mix is better suited to grow on the compost fill in partial shade over the modified rockfill than plantings such as small shrubs.

The contractor will be required to use means and methods of construction that will accomplish the work without impact to the wetland boundary as shown in the plans. The proposed excavation, fill, and construction of the road embankment can be performed from the upland side of the erosion and sedimentation controls. The specification for erosion and sedimentation controls is included in Attachment 4. A separate specification detailing the contractor required work in creating a SWPPP plan is also included in Attachment 4.

F&O has observed many contractors working on MassDOT inspected projects who have successfully constructed steeply sloped road embankments adjacent to wetland areas using effective means to avoid wetland impacts such as excavating and filling earth with machinery positioned from the upland side of adjacent wetlands only.

Regarding trees within or very near to the proposed slope limit on the embankment at 260 Foster Street, a tree inventory has been created detailing the tree takings in the 100ft Buffer Zone and proposed replacement trees. The tree inventory is included in Attachment 5. The project proposes to replace trees at a 2:1 ratio. The project area is constrained as a linear transportation project, tree replacement ratios higher than 2:1 are not practical due to the narrow lateral limits of work beyond the roadside.

Commissioner Comments on the Topics of Embankment Constructability, Stability, Work Limits, and Erosion Control at Grimes Lane

- Commissioners asked about how the embankment on the east side of Grimes Lane would be kept stable during construction.

See Response #5 below.

- Commissioners questioned how the limit of grading would be kept away from the adjacent wetland on the east side of Grimes Lane.

See Response #5 below.

- Commissioners noted that the limit of work on Grimes Lane is immediately adjacent to, and in some locations directly on top of, a historic stone wall. F&O stated that no structural stability evaluations have been done on the stone wall. An unidentified member of the public who briefly joined the site walk noted that periodically sink holes form on or adjacent to the road surface as soil erodes through cracks in the wall and washes soil on the road surface away. Commissioners noted that some large stones associated with the wall have apparently fallen into the wetland. Commissioners questioned the structural stability of the wall, how F&O plans to manage the wall during construction, and potential wetland impacts if the wall were to fall during construction. F&O was advised to consider construction

impacts on the wall (e.g., vibratory rollers on top of a historic stone wall)., the wall's long-term stability, and wetland/buffer zone impacts associated with managing the wall during and after construction.

F&O Response #5: Cross sections are provided in Attachment 3 for the Grimes Lane alignment that will shift toward the parcel at 260 Foster containing an adjacent wetland.

After the Commissioner's site walk held on 11/02/2023, F&O designers adjusted the proposed edge of road at Grimes Lane starting from the beginning of work, Station 301+41, to match the existing edge of road for 15 additional feet. This was done to pull back the limit of work 1 foot away compared to previous at the shoulder of Grimes Lane to the maximum extent possible. Attachment 3 shows an updated construction plan sheet at Grimes Lane.

F&O believes the eastern shoulder of Grimes Lane is a roadside embankment constructed from large boulders compacted with gravel and soil rather than a constructed retaining wall. The embankment is approximately 3 feet in height and while steep, the embankment is not vertical in the project topographic survey. The embankment is supporting half of Grimes Lane at most, the northbound lane toward Foster St, because the road is crowned at the center.

The contractor will be directed to stabilize the embankment boulders using a work item specification already included in the project to rebuild dry stacked stone walls. Using this work item will ensure that the contractor has a payment item available for workers to stabilize the embankment boulders by manual means if necessary. No boulders that may have already dislodged from the embankment and moved outside of the limit of work will be retrieved. The contractor will be directed to supplement the embankment with new modified rockfill material as needed to achieve a stable embankment meeting MassDOT inspection standard for compaction and stability. The embankment will be fortified to provide integrity during subsequent construction of the subbase and surface of Grimes Lane.

As explained in F&O Response #4, The contractor will be required to use means and methods of construction that will accomplish the work without impact to the wetland boundary as shown in the plans. The proposed excavation, fill, and construction of the road embankment can be performed from the upland side of the erosion and sedimentation controls. The specification for erosion and sedimentation controls is included in Attachment 4. A separate specification detailing the contractor required work in creating a SWPPP plan is also included in Attachment 4.

On the Topic of Tree Replacement in the 100ft Buffer Zone:

- Commissioners requested a tree inventory of trees to be taken at the 260 Foster St parcel including station, size, and species. A commissioner stated a replacement ratio of 2:1 was advised. Older and larger trees should be replaced at a higher ratio. Commissioners noted that trees likely to die as the result of the work (e.g., due to backfill around the tree base) need to be considered as tree removals.

F&O Response #6: F&O created a tree inventory in the 100-foot Buffer Zone listing trees that will be impacted from slope construction. The inventory lists proposed replacement tree quantities and species and is included in Attachment 5. The proposed tree replacement ratio is 2:1. The replacement trees were selected from the Town of Littleton Tree Guidelines document. New planting plan sheets showing the location of proposed tree replacements are also included in Attachment 5.

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Attachment 1
Hydrologic Analysis

FUSS & O'NEILL

November 30, 2023

Ms. Amy Green
Conservation Agent
Town of Littleton
Littleton, Massachusetts 01460

RE: Stormwater Analysis
Reconstruction of Foster Street Project (MassDOT Project #609054)
MassDEP File #204-0991

Dear Ms. Green:

As requested, Fuss & O'Neill has further evaluated the impacts of the proposed additional impervious area associated the with the above referenced project on the adjacent Bordering Vegetated Wetland area and associated downstream culvert located to the east of Foster Street and North of Grimes Street (delineated as wetland flags L300 through L326). As part of this review, Fuss & O'Neill was provided a "Data Report in Support Of: Open Space Development & Definitive Subdivision; Durkee Farm Estates; 260 Foster Street/Grimes Lane; Littleton, MA" prepared by Hancock Associates dated February 18, 2015 and revised April 26, 2016 (Durkee Farm Report).

In order to determine the impacts to the adjacent wetland, Fuss & O'Neill performed a partial hydrologic analyses for existing and proposed conditions using a computer software package, HydroCAD version 10.20-2d, to determine peak runoff flow rates. The model is based on the NRCS Technical Release 20 and Technical Release 55 (TR-55) and is subject to cumulative rainfall/volume dependent routing calculations. Precipitation depths were taken from the Durkee Farm Report.

The design point for the analysis is the existing stone culvert that flows under Grimes Lane located in the vicinity of wetland flags L318 and L319. Existing and proposed watershed maps are included as *Attachment A*. The existing watershed analysis analysis is included as *Attachment B*, and the proposed watershed analyses is included as *Attachment C*.

Curve numbers for the project were selected based on table 2-2 of TR-55 and section 3 of the Massachusetts Supplement for the TR-55 Hydrology Procedure (TR-55 Supplement). Tabulations of the weighted curve numbers for the subwatershed are included in *Attachments B & C*. The following is a description of how each cover type was modeled:

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www.fando.com

Connecticut
Maine
Massachusetts
New Hampshire
New York
Rhode Island
Vermont

- Areas within the analysis for the Durkee Farm project were modeled consistent with the Durkee Farm Report
- Impervious areas (e.g., sidewalks, asphalt pavement, concrete pads, etc.) were modeled as "Paved parking, HSG A & B"
- Building roofs were modeled as "Roofs, HSG A & B"
- Pervious areas were modeled as "> 75% Grass cover, Good, HSG A & B"
- Wooded areas were modeled as "Woods, Good, HSG A &B"
- Wetland resource areas were modeled "Wetlands, HSG A & B"
- Open space from the Durkee Farm project was modeled as "Pasture/grassland/range, Good, HSG A"

The northerly limit of the watershed analysis was limited to the northerly boundary of the Durkee Farm project, consistent with the Durkee Farm Report, approximately 100 feet northeast of project limits. The western and southern limits of the watershed analysis were delineated based on the portions of the project that ultimately drain to the design point. The eastern limits of the analysis were limited to the subwatersheds from the Durkee Farm Report that flowed directly into the wetland area. These areas were noted as subwatersheds 310S, 320S, 410S, and 420S on the Durkee Farm Report Post Development Drainage Area Map and HydroCAD Routing diagram. Copies of these figures are included in *Attachment D*.

The analysis excluded the subwatersheds from the Durkee Farm Report that flowed into stormwater BMPs (e.g., infiltration basins). Based on our experience with similar projects, stormwater flows that outlet from BMPs lag behind areas that flow directly to the design point. In other words, the areas that drain directly to the design point will peak before the flows from the basins. Furthermore, the BMPs outlet relatively small amounts of water for the various storm events as compared to the amount of flow in the remaining portions of the model. Lastly, if included in the analysis, the areas would have the same overall effects to both existing and proposed conditions. Therefore, the re-creation of the complex modeling of areas upstream of the BMPs was not performed.

As a result of the proposed project, approximately 9,444 square feet of additional impervious area will drain to the design point. As a result of the re-alignment of Foster Street, the crown of the roadway will shift to the east, reducing the total amount of area that drains to the design point by approximately 3,045 square feet. The results of the analysis indicate that the increase has a

negligible effect on the peak flow rates draining to the design point. Existing and proposed peak flow rates are included in the table below.

Storm Event	Existing Flow (CFS)	Proposed Flow (CFS)	Net Change (CFS)	Net Change (%)
2-Year	1.49	1.49	0.00	0%
10-Year	8.35	8.32	-0.03	0%
25-Year	13.54	13.49	-0.05	0%
50-Year	17.83	17.75	-0.08	0%
100-Year	22.38	22.29	-0.09	0%

As mentioned previously, the watershed analysis was limited to the northerly limits of the Durkee Farm Project. Based on our review of publicly available GIS information, it appears that there is a large amount of area north of this limit that also drains to the design point. If this area was included in the analysis, it would only further negate the stormwater runoff impacts of the proposed project.

Should you have any questions, please contact Aaron Keegan at akeegan@fando.com.

Sincerely,

Jack Deninger
Civil Engineer

Kevin C. McGarry, PE
Project Manager

Attachments:

A. Existing and Proposed Watershed Maps
B. Existing Watershed Analysis
C. Proposed Watershed Analysis
D. Durkee Farm Report Figures

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Attachment A

Existing and Proposed Watershed Maps

SOIL RATING B
SOIL RATING B
SOIL RATING A
SOIL RATING A
SOIL RATING A
SOIL RATING B
FOSTER ST
FOSTER ST
GRIMES LN
BALSAM LN
DESIGN POINT
1S
SOIL RATING B
SOIL RATING B
SOIL RATING B
SOIL RATING A
SOIL RATING B
SOIL RATING A
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LEGEND

- PERVIOUS SURFACE – WOODS
- PERVIOUS SURFACE – VEGETATION
- IMPERVIOUS SURFACE – PAVEMENT
- IMPERVIOUS SURFACE – ROOF
- DURKEE FARM SUBWATERSHED
- WETLAND AREA
- OVERALL WATERSHED BOUNDARY
- SOIL BOUNDARY
- TIME OF CONCENTRATION PATH

SCALE:
HORZ.: 1" = 100'
VERT.:
DATUM:
HORZ.:
VERT.:
0 50 100
GRAPHIC SCALE

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TOWN OF LITTLETON
MASSACHUSETTS

EXISTING WATERSHED MAP

FOSTER STREET
LITTLETON

PROJ. No.: 20170044.A21
DATE: 12/01/2023

FIG. 1

File: J:\DWG\P2017\0044\A21\civil\Plan\20170044A21_DRA01_KOM.dwg Layout: EXISTING Plotted: 2023-11-30 3:57 PM Saved: 2023-11-30 3:50 PM User: IMcLain
PC3: AUTOCAD PDF (GENERAL DOCUMENTATION).PC3 STB/CTB: FO.STB
LAYER STATE:
MS VIEW:

SOIL RATING B
SOIL RATING B
SOIL RATING B
SOIL RATING A
SOIL RATING A
SOIL RATING B
FOSTER ST
FOSTER ST
GRIMES LN
BALSAM LN
DESIGN POINT
1S
SOIL RATING B
SOIL RATING B
SOIL RATING B
SOIL RATING A
SOIL RATING B
SOIL RATING A
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LEGEND

- PERVIOUS SURFACE – WOODS
- PERVIOUS SURFACE – VEGETATION
- IMPERVIOUS SURFACE – PAVEMENT
- IMPERVIOUS SURFACE – ROOF
- DURKEE FARM SUBWATERSHED
- WETLAND AREA
- OVERALL WATERSHED BOUNDARY
- SOIL BOUNDARY
- TIME OF CONCENTRATION PATH

SCALE:
HORZ.: 1" = 100'
VERT.:
DATUM:
HORZ.:
VERT.:
0 50 100
GRAPHIC SCALE

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TOWN OF LITTLETON
PROPOSED WATERSHED MAP
FOSTER STREET
LITTLETON
MASSACHUSETTS

PROJ. No.: 20170044.A21
DATE: 12/01/2023

FIG. 2

File: J:\DWG\P2017\0044A21\CivilPlan\20170044A21_DRA01_KCM.dwg Layout: PROPOSED Plotted: 2023-11-30 3:58 PM Saved: 2023-11-30 3:50 PM User: lMcLain
PC3: AUTOCAD PDF (GENERAL DOCUMENTATION).PC3 STB/CTB: FO.STB
LAYER STATE:
MS VIEW:

FUSS & O'NEILL

Attachment B

Existing Watershed Analysis

Subcat Reach Pond Link

Routing Diagram for 20170044.A21_EXISTING
Prepared by Fuss & O'Neill, Printed 11/30/2023

Summary for Subcatchment 1SE:

Runoff = 1.49 cfs @ 12.44 hrs, Volume= 14,492 cf, Depth> 0.24"
Routed to nonexistent node 1LE

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-Year Rainfall=3.10"

	Area (sf)	CN	Description
	7,810	98	Paved parking, HSG A
	16,453	98	Paved parking, HSG B
	4,395	39	>75% Grass cover, Good, HSG A
	8,600	61	>75% Grass cover, Good, HSG B
	8,831	30	Woods, Good, HSG A
	7,722	55	Woods, Good, HSG B
	93,900	39	>75% Grass cover, Good, HSG A
	47,540	39	>75% Grass cover, Good, HSG A
	2,325	98	Roofs, HSG A
	33,360	39	>75% Grass cover, Good, HSG A
	150,951	39	Pasture/grassland/range, Good, HSG A
	5,445	98	Roofs, HSG A
*	124,409	78	Wetlands, HSG A
	27,284	61	>75% Grass cover, Good, HSG B
	1,457	98	Paved parking, HSG B
	1,479	98	Roofs, HSG B
*	39,611	78	Wetlands, HSG A
*	75,586	78	Wetlands, HSG B
	15,509	61	>75% Grass cover, Good, HSG B
	57,289	55	Woods, Good, HSG B
	2,044	98	Paved parking, HSG B
	1,382	98	Roofs, HSG B
	733,382	58	Weighted Average
	694,987		94.76% Pervious Area
	38,395		5.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	73	0.2655	0.44		**Sheet Flow, 310S** Grass: Short n= 0.150 P2= 3.10"
2.1	27	0.0734	0.22		**Sheet Flow, 310S** Grass: Short n= 0.150 P2= 3.10"
0.8	93	0.0806	1.99		**Shallow Concentrated Flow, 310S** Short Grass Pasture Kv= 7.0 fps
7.7	579	0.0069	1.25		**Shallow Concentrated Flow, Wetland (214P)** Grassed Waterway Kv= 15.0 fps
0.3	45	0.0044	2.48	7.80	**Pipe Channel, 24" CMP** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.025 Corrugated metal
0.3	83	0.1141	5.07		**Shallow Concentrated Flow, 414S** Grassed Waterway Kv= 15.0 fps
0.5	43	0.0349	1.31		**Shallow Concentrated Flow, 420S** Short Grass Pasture Kv= 7.0 fps
5.0	497	0.0121	1.65		**Shallow Concentrated Flow, Wetland (340R)** Grassed Waterway Kv= 15.0 fps
0.1	43	0.0106	5.52	4.34	**Pipe Channel, 12" RCP** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
2.0	300	0.0267	2.45		**Shallow Concentrated Flow, Wetland (340R)** Grassed Waterway Kv= 15.0 fps
21.6	1,783	Total			

Summary for Subcatchment 1SE:

Runoff = 8.35 cfs @ 12.35 hrs, Volume= 45,856 cf, Depth> 0.75"
Routed to nonexistent node 1LE

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
	7,810	98	Paved parking, HSG A
	16,453	98	Paved parking, HSG B
	4,395	39	>75% Grass cover, Good, HSG A
	8,600	61	>75% Grass cover, Good, HSG B
	8,831	30	Woods, Good, HSG A
	7,722	55	Woods, Good, HSG B
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*	124,409	78	Wetlands, HSG A
	27,284	61	>75% Grass cover, Good, HSG B
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	1,479	98	Roofs, HSG B
*	39,611	78	Wetlands, HSG A
*	75,586	78	Wetlands, HSG B
	15,509	61	>75% Grass cover, Good, HSG B
	57,289	55	Woods, Good, HSG B
	2,044	98	Paved parking, HSG B
	1,382	98	Roofs, HSG B
	733,382	58	Weighted Average
	694,987		94.76% Pervious Area
	38,395		5.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	73	0.2655	0.44		**Sheet Flow, 310S** Grass: Short n= 0.150 P2= 3.10"
2.1	27	0.0734	0.22		**Sheet Flow, 310S** Grass: Short n= 0.150 P2= 3.10"
0.8	93	0.0806	1.99		**Shallow Concentrated Flow, 310S** Short Grass Pasture Kv= 7.0 fps
7.7	579	0.0069	1.25		**Shallow Concentrated Flow, Wetland (214P)** Grassed Waterway Kv= 15.0 fps
0.3	45	0.0044	2.48	7.80	**Pipe Channel, 24" CMP** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.025 Corrugated metal
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0.5	43	0.0349	1.31		**Shallow Concentrated Flow, 420S** Short Grass Pasture Kv= 7.0 fps
5.0	497	0.0121	1.65		**Shallow Concentrated Flow, Wetland (340R)** Grassed Waterway Kv= 15.0 fps
0.1	43	0.0106	5.52	4.34	**Pipe Channel, 12" RCP** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
2.0	300	0.0267	2.45		**Shallow Concentrated Flow, Wetland (340R)** Grassed Waterway Kv= 15.0 fps
21.6	1,783	Total			

Summary for Subcatchment 1SE:

Runoff = 13.54 cfs @ 12.34 hrs, Volume= 69,033 cf, Depth> 1.13"
Routed to nonexistent node 1LE

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 25-Year Rainfall=5.30"

	Area (sf)	CN	Description
	7,810	98	Paved parking, HSG A
	16,453	98	Paved parking, HSG B
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	7,722	55	Woods, Good, HSG B
	93,900	39	>75% Grass cover, Good, HSG A
	47,540	39	>75% Grass cover, Good, HSG A
	2,325	98	Roofs, HSG A
	33,360	39	>75% Grass cover, Good, HSG A
	150,951	39	Pasture/grassland/range, Good, HSG A
	5,445	98	Roofs, HSG A
*	124,409	78	Wetlands, HSG A
	27,284	61	>75% Grass cover, Good, HSG B
	1,457	98	Paved parking, HSG B
	1,479	98	Roofs, HSG B
*	39,611	78	Wetlands, HSG A
*	75,586	78	Wetlands, HSG B
	15,509	61	>75% Grass cover, Good, HSG B
	57,289	55	Woods, Good, HSG B
	2,044	98	Paved parking, HSG B
	1,382	98	Roofs, HSG B
	733,382	58	Weighted Average
	694,987		94.76% Pervious Area
	38,395		5.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	73	0.2655	0.44		**Sheet Flow, 310S** Grass: Short n= 0.150 P2= 3.10"
2.1	27	0.0734	0.22		**Sheet Flow, 310S** Grass: Short n= 0.150 P2= 3.10"
0.8	93	0.0806	1.99		**Shallow Concentrated Flow, 310S** Short Grass Pasture Kv= 7.0 fps
7.7	579	0.0069	1.25		**Shallow Concentrated Flow, Wetland (214P)** Grassed Waterway Kv= 15.0 fps
0.3	45	0.0044	2.48	7.80	**Pipe Channel, 24" CMP** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.025 Corrugated metal
0.3	83	0.1141	5.07		**Shallow Concentrated Flow, 414S** Grassed Waterway Kv= 15.0 fps
0.5	43	0.0349	1.31		**Shallow Concentrated Flow, 420S** Short Grass Pasture Kv= 7.0 fps
5.0	497	0.0121	1.65		**Shallow Concentrated Flow, Wetland (340R)** Grassed Waterway Kv= 15.0 fps
0.1	43	0.0106	5.52	4.34	**Pipe Channel, 12" RCP** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
2.0	300	0.0267	2.45		**Shallow Concentrated Flow, Wetland (340R)** Grassed Waterway Kv= 15.0 fps
21.6	1,783	Total			

Summary for Subcatchment 1SE:

Runoff = 17.83 cfs @ 12.33 hrs, Volume= 88,345 cf, Depth> 1.45"
Routed to nonexistent node 1LE

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 50-Year Rainfall=5.90"

	Area (sf)	CN	Description
	7,810	98	Paved parking, HSG A
	16,453	98	Paved parking, HSG B
	4,395	39	>75% Grass cover, Good, HSG A
	8,600	61	>75% Grass cover, Good, HSG B
	8,831	30	Woods, Good, HSG A
	7,722	55	Woods, Good, HSG B
	93,900	39	>75% Grass cover, Good, HSG A
	47,540	39	>75% Grass cover, Good, HSG A
	2,325	98	Roofs, HSG A
	33,360	39	>75% Grass cover, Good, HSG A
	150,951	39	Pasture/grassland/range, Good, HSG A
	5,445	98	Roofs, HSG A
*	124,409	78	Wetlands, HSG A
	27,284	61	>75% Grass cover, Good, HSG B
	1,457	98	Paved parking, HSG B
	1,479	98	Roofs, HSG B
*	39,611	78	Wetlands, HSG A
*	75,586	78	Wetlands, HSG B
	15,509	61	>75% Grass cover, Good, HSG B
	57,289	55	Woods, Good, HSG B
	2,044	98	Paved parking, HSG B
	1,382	98	Roofs, HSG B
	733,382	58	Weighted Average
	694,987		94.76% Pervious Area
	38,395		5.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	73	0.2655	0.44		**Sheet Flow, 310S** Grass: Short n= 0.150 P2= 3.10"
2.1	27	0.0734	0.22		**Sheet Flow, 310S** Grass: Short n= 0.150 P2= 3.10"
0.8	93	0.0806	1.99		**Shallow Concentrated Flow, 310S** Short Grass Pasture Kv= 7.0 fps
7.7	579	0.0069	1.25		**Shallow Concentrated Flow, Wetland (214P)** Grassed Waterway Kv= 15.0 fps
0.3	45	0.0044	2.48	7.80	**Pipe Channel, 24" CMP** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.025 Corrugated metal
0.3	83	0.1141	5.07		**Shallow Concentrated Flow, 414S** Grassed Waterway Kv= 15.0 fps
0.5	43	0.0349	1.31		**Shallow Concentrated Flow, 420S** Short Grass Pasture Kv= 7.0 fps
5.0	497	0.0121	1.65		**Shallow Concentrated Flow, Wetland (340R)** Grassed Waterway Kv= 15.0 fps
0.1	43	0.0106	5.52	4.34	**Pipe Channel, 12" RCP** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
2.0	300	0.0267	2.45		**Shallow Concentrated Flow, Wetland (340R)** Grassed Waterway Kv= 15.0 fps
21.6	1,783	Total			

Summary for Subcatchment 1SE:

Runoff = 22.38 cfs @ 12.33 hrs, Volume= 109,051 cf, Depth> 1.78"
Routed to nonexistent node 1LE

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=6.50"

	Area (sf)	CN	Description
	7,810	98	Paved parking, HSG A
	16,453	98	Paved parking, HSG B
	4,395	39	>75% Grass cover, Good, HSG A
	8,600	61	>75% Grass cover, Good, HSG B
	8,831	30	Woods, Good, HSG A
	7,722	55	Woods, Good, HSG B
	93,900	39	>75% Grass cover, Good, HSG A
	47,540	39	>75% Grass cover, Good, HSG A
	2,325	98	Roofs, HSG A
	33,360	39	>75% Grass cover, Good, HSG A
	150,951	39	Pasture/grassland/range, Good, HSG A
	5,445	98	Roofs, HSG A
*	124,409	78	Wetlands, HSG A
	27,284	61	>75% Grass cover, Good, HSG B
	1,457	98	Paved parking, HSG B
	1,479	98	Roofs, HSG B
*	39,611	78	Wetlands, HSG A
*	75,586	78	Wetlands, HSG B
	15,509	61	>75% Grass cover, Good, HSG B
	57,289	55	Woods, Good, HSG B
	2,044	98	Paved parking, HSG B
	1,382	98	Roofs, HSG B
	733,382	58	Weighted Average
	694,987		94.76% Pervious Area
	38,395		5.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	73	0.2655	0.44		**Sheet Flow, 310S** Grass: Short n= 0.150 P2= 3.10"
2.1	27	0.0734	0.22		**Sheet Flow, 310S** Grass: Short n= 0.150 P2= 3.10"
0.8	93	0.0806	1.99		**Shallow Concentrated Flow, 310S** Short Grass Pasture Kv= 7.0 fps
7.7	579	0.0069	1.25		**Shallow Concentrated Flow, Wetland (214P)** Grassed Waterway Kv= 15.0 fps
0.3	45	0.0044	2.48	7.80	**Pipe Channel, 24" CMP** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.025 Corrugated metal
0.3	83	0.1141	5.07		**Shallow Concentrated Flow, 414S** Grassed Waterway Kv= 15.0 fps
0.5	43	0.0349	1.31		**Shallow Concentrated Flow, 420S** Short Grass Pasture Kv= 7.0 fps
5.0	497	0.0121	1.65		**Shallow Concentrated Flow, Wetland (340R)** Grassed Waterway Kv= 15.0 fps
0.1	43	0.0106	5.52	4.34	**Pipe Channel, 12" RCP** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
2.0	300	0.0267	2.45		**Shallow Concentrated Flow, Wetland (340R)** Grassed Waterway Kv= 15.0 fps
21.6	1,783	Total			

FUSS & O'NEILL

Attachment C

Proposed Watershed Analysis

Subcat Reach Pond Link

Routing Diagram for 20170044.A21_PROPOSED
Prepared by Fuss & O'Neill, Printed 11/30/2023

Summary for Subcatchment 1SP:

Runoff = 1.49 cfs @ 12.44 hrs, Volume= 14,432 cf, Depth> 0.24"
Routed to nonexistent node 1LP

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-Year Rainfall=3.10"

	Area (sf)	CN	Description
	13,630	98	Paved parking, HSG A
	20,077	98	Paved parking, HSG B
	7,406	39	>75% Grass cover, Good, HSG A
	9,653	61	>75% Grass cover, Good, HSG B
	0	30	Woods, Good, HSG A
	0	55	Woods, Good, HSG B
	93,900	39	>75% Grass cover, Good, HSG A
	47,540	39	>75% Grass cover, Good, HSG A
	2,325	98	Roofs, HSG A
	33,360	39	>75% Grass cover, Good, HSG A
	150,951	39	Pasture/grassland/range, Good, HSG A
	5,445	98	Roofs, HSG A
*	124,409	78	Wetlands, HSG A
	27,284	61	>75% Grass cover, Good, HSG B
	1,457	98	Paved parking, HSG B
	1,479	98	Roofs, HSG B
*	39,611	78	Wetlands, HSG A
*	75,586	78	Wetlands, HSG B
	15,509	61	>75% Grass cover, Good, HSG B
	57,289	55	Woods, Good, HSG B
	2,044	98	Paved parking, HSG B
	1,382	98	Roofs, HSG B
	730,337	58	Weighted Average
	682,498		93.45% Pervious Area
	47,839		6.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	73	0.2655	0.44		**Sheet Flow, 310S** Grass: Short n= 0.150 P2= 3.10"
2.1	27	0.0734	0.22		**Sheet Flow, 310S** Grass: Short n= 0.150 P2= 3.10"
0.8	93	0.0806	1.99		**Shallow Concentrated Flow, 310S** Short Grass Pasture Kv= 7.0 fps
7.7	579	0.0069	1.25		**Shallow Concentrated Flow, Wetland (214P)** Grassed Waterway Kv= 15.0 fps
0.3	45	0.0044	2.48	7.80	**Pipe Channel, 24" CMP** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.025 Corrugated metal
0.3	83	0.1141	5.07		**Shallow Concentrated Flow, 414S** Grassed Waterway Kv= 15.0 fps
0.5	43	0.0349	1.31		**Shallow Concentrated Flow, 420S** Short Grass Pasture Kv= 7.0 fps
5.0	497	0.0121	1.65		**Shallow Concentrated Flow, Wetland (340R)** Grassed Waterway Kv= 15.0 fps
0.1	43	0.0106	5.52	4.34	**Pipe Channel, 12" RCP** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
2.0	300	0.0267	2.45		**Shallow Concentrated Flow, Wetland (340R)** Grassed Waterway Kv= 15.0 fps
21.6	1,783	Total			

Summary for Subcatchment 1SP:

Runoff = 8.32 cfs @ 12.35 hrs, Volume= 45,666 cf, Depth> 0.75"
Routed to nonexistent node 1LP

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
	13,630	98	Paved parking, HSG A
	20,077	98	Paved parking, HSG B
	7,406	39	>75% Grass cover, Good, HSG A
	9,653	61	>75% Grass cover, Good, HSG B
	0	30	Woods, Good, HSG A
	0	55	Woods, Good, HSG B
	93,900	39	>75% Grass cover, Good, HSG A
	47,540	39	>75% Grass cover, Good, HSG A
	2,325	98	Roofs, HSG A
	33,360	39	>75% Grass cover, Good, HSG A
	150,951	39	Pasture/grassland/range, Good, HSG A
	5,445	98	Roofs, HSG A
*	124,409	78	Wetlands, HSG A
	27,284	61	>75% Grass cover, Good, HSG B
	1,457	98	Paved parking, HSG B
	1,479	98	Roofs, HSG B
*	39,611	78	Wetlands, HSG A
*	75,586	78	Wetlands, HSG B
	15,509	61	>75% Grass cover, Good, HSG B
	57,289	55	Woods, Good, HSG B
	2,044	98	Paved parking, HSG B
	1,382	98	Roofs, HSG B
	730,337	58	Weighted Average
	682,498		93.45% Pervious Area
	47,839		6.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	73	0.2655	0.44		**Sheet Flow, 310S** Grass: Short n= 0.150 P2= 3.10"
2.1	27	0.0734	0.22		**Sheet Flow, 310S** Grass: Short n= 0.150 P2= 3.10"
0.8	93	0.0806	1.99		**Shallow Concentrated Flow, 310S** Short Grass Pasture Kv= 7.0 fps
7.7	579	0.0069	1.25		**Shallow Concentrated Flow, Wetland (214P)** Grassed Waterway Kv= 15.0 fps
0.3	45	0.0044	2.48	7.80	**Pipe Channel, 24" CMP** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.025 Corrugated metal
0.3	83	0.1141	5.07		**Shallow Concentrated Flow, 414S** Grassed Waterway Kv= 15.0 fps
0.5	43	0.0349	1.31		**Shallow Concentrated Flow, 420S** Short Grass Pasture Kv= 7.0 fps
5.0	497	0.0121	1.65		**Shallow Concentrated Flow, Wetland (340R)** Grassed Waterway Kv= 15.0 fps
0.1	43	0.0106	5.52	4.34	**Pipe Channel, 12" RCP** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
2.0	300	0.0267	2.45		**Shallow Concentrated Flow, Wetland (340R)** Grassed Waterway Kv= 15.0 fps
21.6	1,783	Total			

Summary for Subcatchment 1SP:

Runoff = 13.49 cfs @ 12.34 hrs, Volume= 68,747 cf, Depth> 1.13"
Routed to nonexistent node 1LP

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 25-Year Rainfall=5.30"

	Area (sf)	CN	Description
	13,630	98	Paved parking, HSG A
	20,077	98	Paved parking, HSG B
	7,406	39	>75% Grass cover, Good, HSG A
	9,653	61	>75% Grass cover, Good, HSG B
	0	30	Woods, Good, HSG A
	0	55	Woods, Good, HSG B
	93,900	39	>75% Grass cover, Good, HSG A
	47,540	39	>75% Grass cover, Good, HSG A
	2,325	98	Roofs, HSG A
	33,360	39	>75% Grass cover, Good, HSG A
	150,951	39	Pasture/grassland/range, Good, HSG A
	5,445	98	Roofs, HSG A
*	124,409	78	Wetlands, HSG A
	27,284	61	>75% Grass cover, Good, HSG B
	1,457	98	Paved parking, HSG B
	1,479	98	Roofs, HSG B
*	39,611	78	Wetlands, HSG A
*	75,586	78	Wetlands, HSG B
	15,509	61	>75% Grass cover, Good, HSG B
	57,289	55	Woods, Good, HSG B
	2,044	98	Paved parking, HSG B
	1,382	98	Roofs, HSG B
	730,337	58	Weighted Average
	682,498		93.45% Pervious Area
	47,839		6.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	73	0.2655	0.44		**Sheet Flow, 310S** Grass: Short n= 0.150 P2= 3.10"
2.1	27	0.0734	0.22		**Sheet Flow, 310S** Grass: Short n= 0.150 P2= 3.10"
0.8	93	0.0806	1.99		**Shallow Concentrated Flow, 310S** Short Grass Pasture Kv= 7.0 fps
7.7	579	0.0069	1.25		**Shallow Concentrated Flow, Wetland (214P)** Grassed Waterway Kv= 15.0 fps
0.3	45	0.0044	2.48	7.80	**Pipe Channel, 24" CMP** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.025 Corrugated metal
0.3	83	0.1141	5.07		**Shallow Concentrated Flow, 414S** Grassed Waterway Kv= 15.0 fps
0.5	43	0.0349	1.31		**Shallow Concentrated Flow, 420S** Short Grass Pasture Kv= 7.0 fps
5.0	497	0.0121	1.65		**Shallow Concentrated Flow, Wetland (340R)** Grassed Waterway Kv= 15.0 fps
0.1	43	0.0106	5.52	4.34	**Pipe Channel, 12" RCP** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
2.0	300	0.0267	2.45		**Shallow Concentrated Flow, Wetland (340R)** Grassed Waterway Kv= 15.0 fps
21.6	1,783	Total			

Summary for Subcatchment 1SP:

Runoff = 17.75 cfs @ 12.33 hrs, Volume= 87,979 cf, Depth> 1.45"
Routed to nonexistent node 1LP

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 50-Year Rainfall=5.90"

	Area (sf)	CN	Description
	13,630	98	Paved parking, HSG A
	20,077	98	Paved parking, HSG B
	7,406	39	>75% Grass cover, Good, HSG A
	9,653	61	>75% Grass cover, Good, HSG B
	0	30	Woods, Good, HSG A
	0	55	Woods, Good, HSG B
	93,900	39	>75% Grass cover, Good, HSG A
	47,540	39	>75% Grass cover, Good, HSG A
	2,325	98	Roofs, HSG A
	33,360	39	>75% Grass cover, Good, HSG A
	150,951	39	Pasture/grassland/range, Good, HSG A
	5,445	98	Roofs, HSG A
*	124,409	78	Wetlands, HSG A
	27,284	61	>75% Grass cover, Good, HSG B
	1,457	98	Paved parking, HSG B
	1,479	98	Roofs, HSG B
*	39,611	78	Wetlands, HSG A
*	75,586	78	Wetlands, HSG B
	15,509	61	>75% Grass cover, Good, HSG B
	57,289	55	Woods, Good, HSG B
	2,044	98	Paved parking, HSG B
	1,382	98	Roofs, HSG B
	730,337	58	Weighted Average
	682,498		93.45% Pervious Area
	47,839		6.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	73	0.2655	0.44		**Sheet Flow, 310S** Grass: Short n= 0.150 P2= 3.10"
2.1	27	0.0734	0.22		**Sheet Flow, 310S** Grass: Short n= 0.150 P2= 3.10"
0.8	93	0.0806	1.99		**Shallow Concentrated Flow, 310S** Short Grass Pasture Kv= 7.0 fps
7.7	579	0.0069	1.25		**Shallow Concentrated Flow, Wetland (214P)** Grassed Waterway Kv= 15.0 fps
0.3	45	0.0044	2.48	7.80	**Pipe Channel, 24" CMP** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.025 Corrugated metal
0.3	83	0.1141	5.07		**Shallow Concentrated Flow, 414S** Grassed Waterway Kv= 15.0 fps
0.5	43	0.0349	1.31		**Shallow Concentrated Flow, 420S** Short Grass Pasture Kv= 7.0 fps
5.0	497	0.0121	1.65		**Shallow Concentrated Flow, Wetland (340R)** Grassed Waterway Kv= 15.0 fps
0.1	43	0.0106	5.52	4.34	**Pipe Channel, 12" RCP** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
2.0	300	0.0267	2.45		**Shallow Concentrated Flow, Wetland (340R)** Grassed Waterway Kv= 15.0 fps
21.6	1,783	Total			

Summary for Subcatchment 1SP:

Runoff = 22.29 cfs @ 12.33 hrs, Volume= 108,598 cf, Depth> 1.78"
Routed to nonexistent node 1LP

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=6.50"

	Area (sf)	CN	Description
	13,630	98	Paved parking, HSG A
	20,077	98	Paved parking, HSG B
	7,406	39	>75% Grass cover, Good, HSG A
	9,653	61	>75% Grass cover, Good, HSG B
	0	30	Woods, Good, HSG A
	0	55	Woods, Good, HSG B
	93,900	39	>75% Grass cover, Good, HSG A
	47,540	39	>75% Grass cover, Good, HSG A
	2,325	98	Roofs, HSG A
	33,360	39	>75% Grass cover, Good, HSG A
	150,951	39	Pasture/grassland/range, Good, HSG A
	5,445	98	Roofs, HSG A
*	124,409	78	Wetlands, HSG A
	27,284	61	>75% Grass cover, Good, HSG B
	1,457	98	Paved parking, HSG B
	1,479	98	Roofs, HSG B
*	39,611	78	Wetlands, HSG A
*	75,586	78	Wetlands, HSG B
	15,509	61	>75% Grass cover, Good, HSG B
	57,289	55	Woods, Good, HSG B
	2,044	98	Paved parking, HSG B
	1,382	98	Roofs, HSG B
	730,337	58	Weighted Average
	682,498		93.45% Pervious Area
	47,839		6.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	73	0.2655	0.44		**Sheet Flow, 310S** Grass: Short n= 0.150 P2= 3.10"
2.1	27	0.0734	0.22		**Sheet Flow, 310S** Grass: Short n= 0.150 P2= 3.10"
0.8	93	0.0806	1.99		**Shallow Concentrated Flow, 310S** Short Grass Pasture Kv= 7.0 fps
7.7	579	0.0069	1.25		**Shallow Concentrated Flow, Wetland (214P)** Grassed Waterway Kv= 15.0 fps
0.3	45	0.0044	2.48	7.80	**Pipe Channel, 24" CMP** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.025 Corrugated metal
0.3	83	0.1141	5.07		**Shallow Concentrated Flow, 414S** Grassed Waterway Kv= 15.0 fps
0.5	43	0.0349	1.31		**Shallow Concentrated Flow, 420S** Short Grass Pasture Kv= 7.0 fps
5.0	497	0.0121	1.65		**Shallow Concentrated Flow, Wetland (340R)** Grassed Waterway Kv= 15.0 fps
0.1	43	0.0106	5.52	4.34	**Pipe Channel, 12" RCP** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
2.0	300	0.0267	2.45		**Shallow Concentrated Flow, Wetland (340R)** Grassed Waterway Kv= 15.0 fps
21.6	1,783	Total			

FUSS & O'NEILL

Attachment D

Durkee Farm Report Figures

OPEN SPACE DEVELOPMENT & PRELIMINARY PLAN OF A SUBDIVISION

260 Foster Street & Grimes Lane
Littleton, Massachusetts 01460

ASSESSORS:

MAP	BLOCK	LOT
R08	0	15
R08	G	13
R08	F	13

PREPARED FOR:

GRIMES ROAD, LLC

487 Groton Road, Unit C
Westford, Massachusetts 01886

HANCOCK ASSOCIATES

Civil Engineers

Land Surveyors

Wetland Scientists

34 Chelmsford Street, Chelmsford, MA 01824
Voice (978) 244-0110, Fax (978) 244-1133
www.HancockAssociates.com

NO.	BY	APP	DATE	ISSUE/REVISION DESCRIPTION
1	BG	JP	4/16/2016	PEER COMMENTS

DATE:	2/16/2016	DESIGN BY:	BG
SCALE:	AS SHOWN	DRAWN BY:	EC
APPRVD. BY:	JP	CHECK BY:	BG

POSTDEVELOPMENT DRAINAGE AREA MAP

PLOT DATE: Apr 27, 2016 5:54 pm
PATH: \\HANCHELMOT\Share\PROJECTS\18885-Grimes-Littleton\DWG\

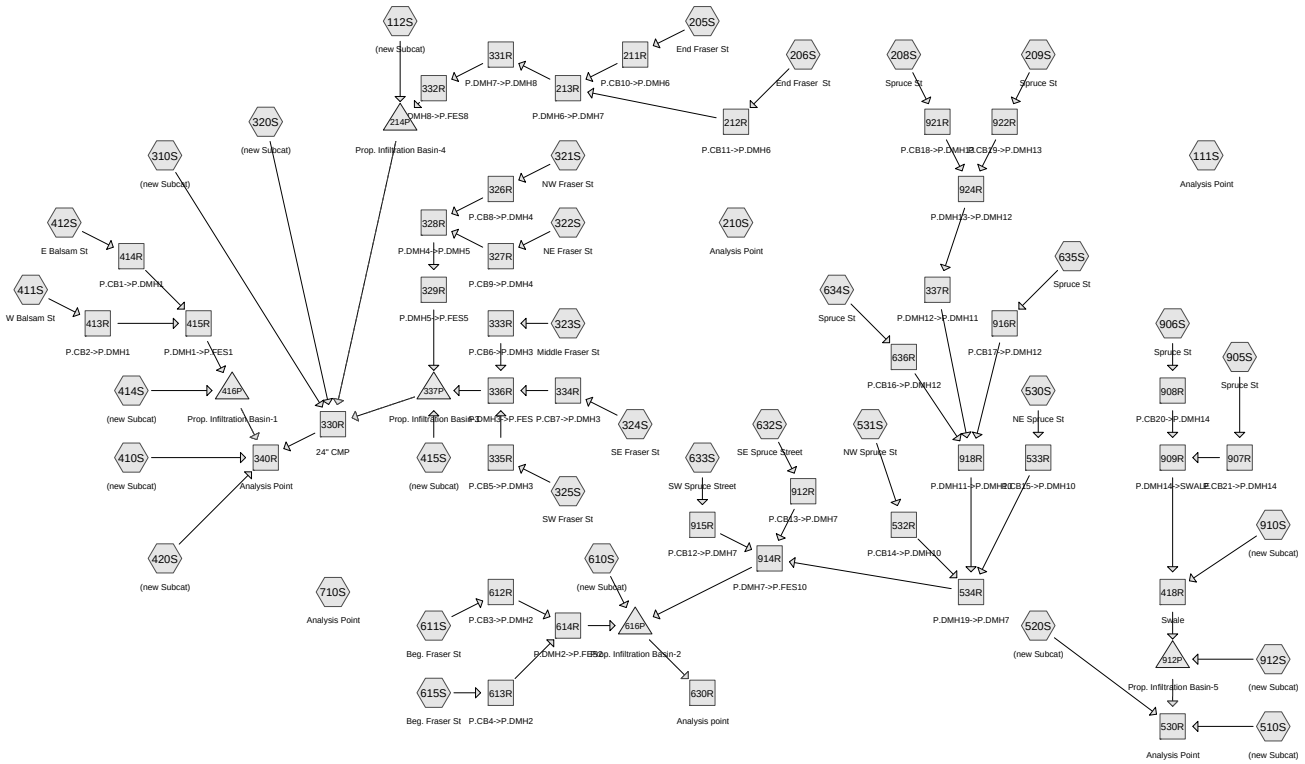
DWG: 18885eng30.dwg
LAYOUT: POST
SHEET: 1 OF 1

1

PROJECT NO.: 18885

SCALE: 1" = 80'
0 80 160 320

ROUTE 2
1949 STATE HIGHWAY LAYOUT NO. 3675
& 1950 STATE HIGHWAY LAYOUT NO. 3711



Subcat Reach Pond Link

Routing Diagram for 18885 Durkee Farm Estates Rev1
Prepared by Hancock Associates

FUSS & O'NEILL

Attachment 2
Detail of Leaching Catch Basin

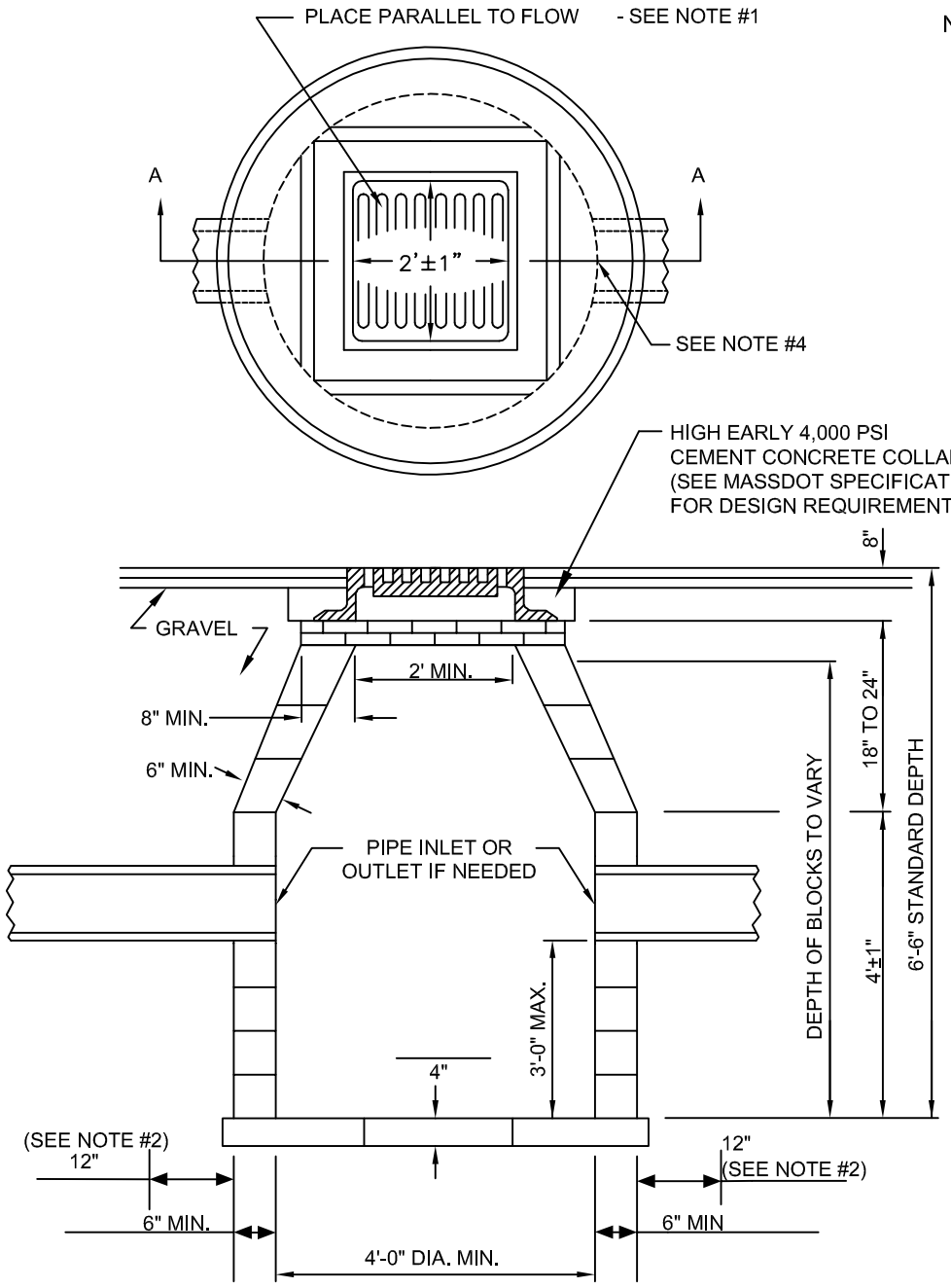
CONSTRUCTION STANDARDS

massDOT Massachusetts Department of Transportation Highway Division

CONCRETE BLOCK LEACHING BASIN

DATE OF ISSUE
OCTOBER 2017

DRAWING NUMBER
E 205.2.0

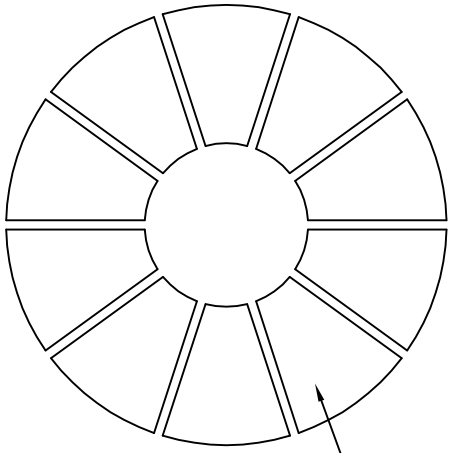


SECTION A-A

NOTES:

1. **USE CASCADE GRATE WHERE BICYCLE TRAVEL IS LEGALLY ALLOWED. SEE DRAWINGS E 201.7.0 - E 201.9.0.**
2. BACKFILL FOR FULL DEPTH OF BASIN EXCAVATION TO BE 1/2" CRUSHED STONE.
3. FOR DESCRIPTION, MATERIALS, AND METHOD OF CONSTRUCTION SEE STANDARD SPECIFICATIONS.
4. FACE OF PIPE FLUSH OR NOT TO PROJECT MORE THAN 4" FROM FACE OF WALL ALONG CENTERLINE OF PIPE.
5. THE LEACHING BASIN SHALL BE CONSTRUCTED OF CEMENT CONCRETE BLOCKS TO CONFORM TO THE REQUIREMENTS OF STANDARD SPECIFICATION SUBSECTION M4.05.1.

PLAN OF BASE



BOTTOM PLATES REQUIRE
10 PIECES PER CIRCLE WITH
1/2" SPACING BETWEEN PLATES.
4" THICK

FUSS & O'NEILL

Attachment 3

Cross Sections
Updated Construction Plan Sheets
Updated Construction Details

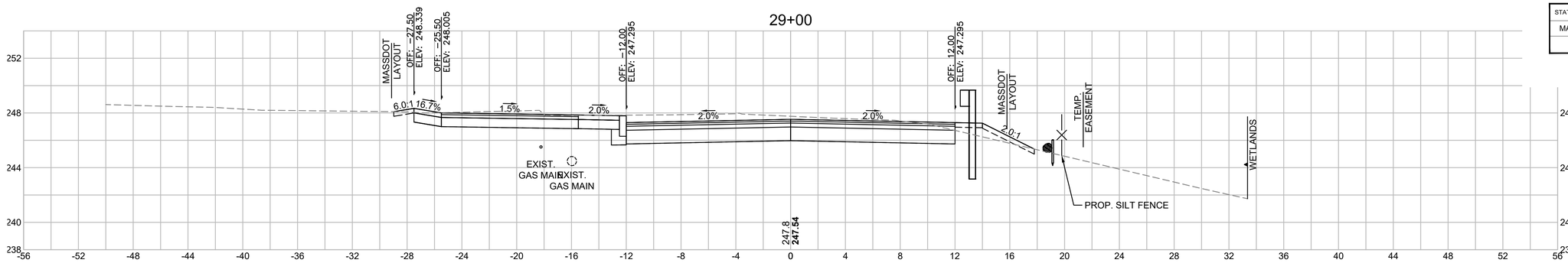
FOSTER STREET CROSS SECTIONS

LITTLETON
RECONSTRUCTION OF FOSTER STREET

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	XXX-XXXX(XXX)X	112	127
	PROJECT FILE NO. 609054		

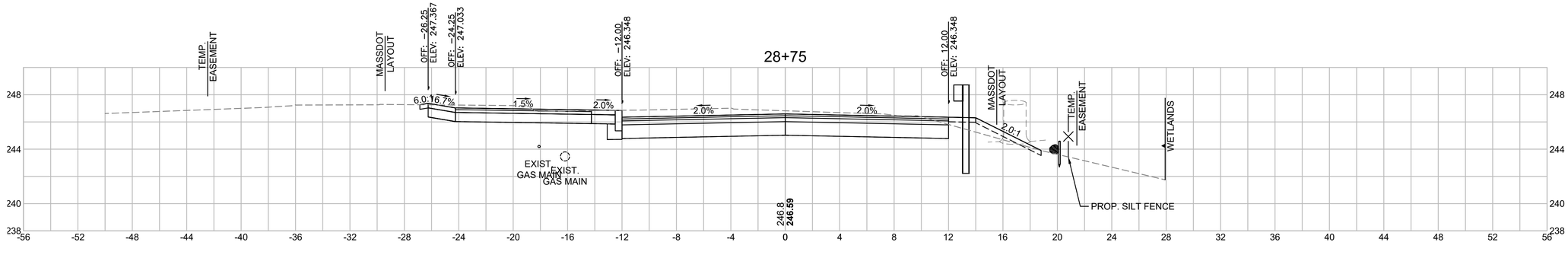
CROSS SECTIONS
##

29+00



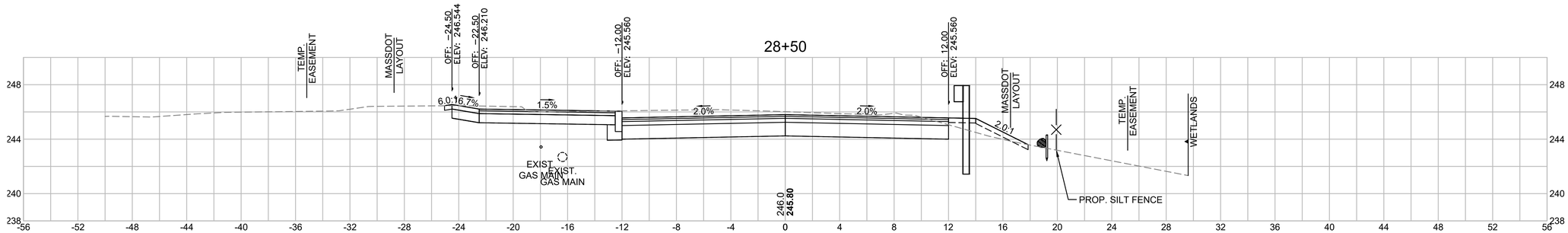
Total Volume at Station 29+00.00	
Cut Area	61.311
Fill Area	1.656
Cut Vol	56.3
Fill Vol	1.2
Cum Cut Vol	5474.6
Cum Fill Vol	304.0
Net Vol	5170.6

28+75



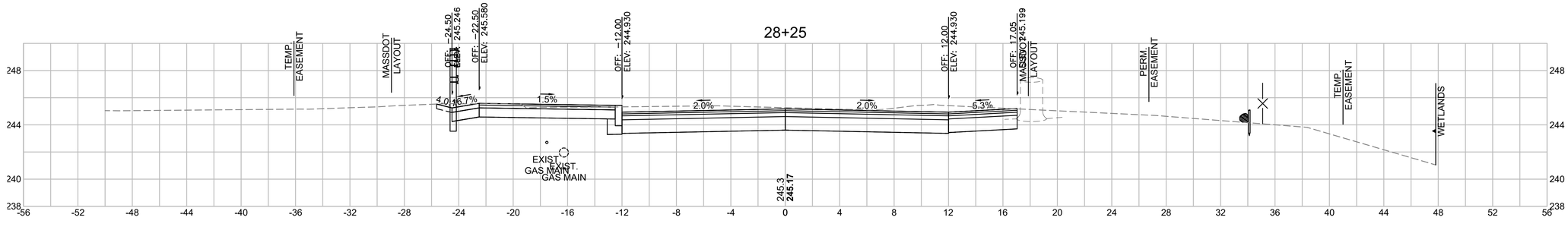
Total Volume at Station 28+75.00	
Cut Area	60.347
Fill Area	0.919
Cut Vol	55.0
Fill Vol	1.2
Cum Cut Vol	5418.2
Cum Fill Vol	302.8
Net Vol	5115.4

28+50



Total Volume at Station 28+50.00	
Cut Area	58.354
Fill Area	1.770
Cut Vol	57.3
Fill Vol	0.8
Cum Cut Vol	5363.3
Cum Fill Vol	301.6
Net Vol	5061.7

28+25



Total Volume at Station 28+25.00	
Cut Area	65.421
Fill Area	0.000
Cut Vol	76.2
Fill Vol	0.0
Cum Cut Vol	5306.0
Cum Fill Vol	300.7
Net Vol	5005.2

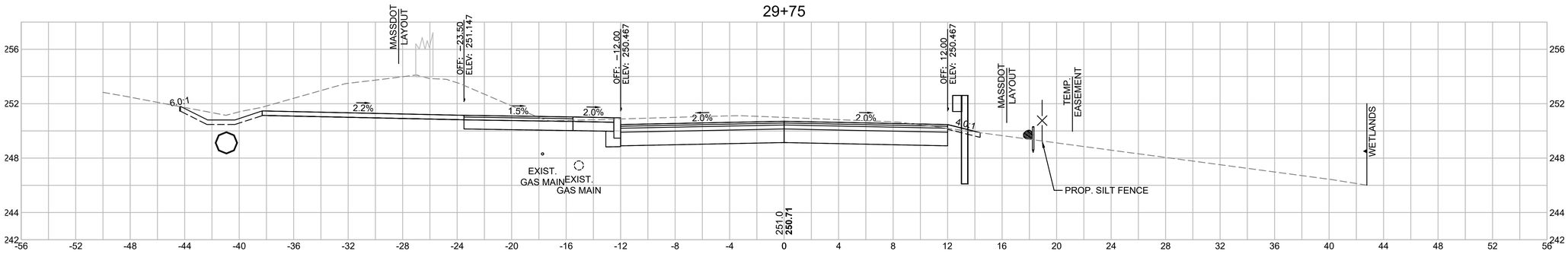
HOR. SCALE IN FEET
4 0 4 8
4 0 4 8
VER. SCALE IN FEET

FOSTER STREET CROSS SECTIONS

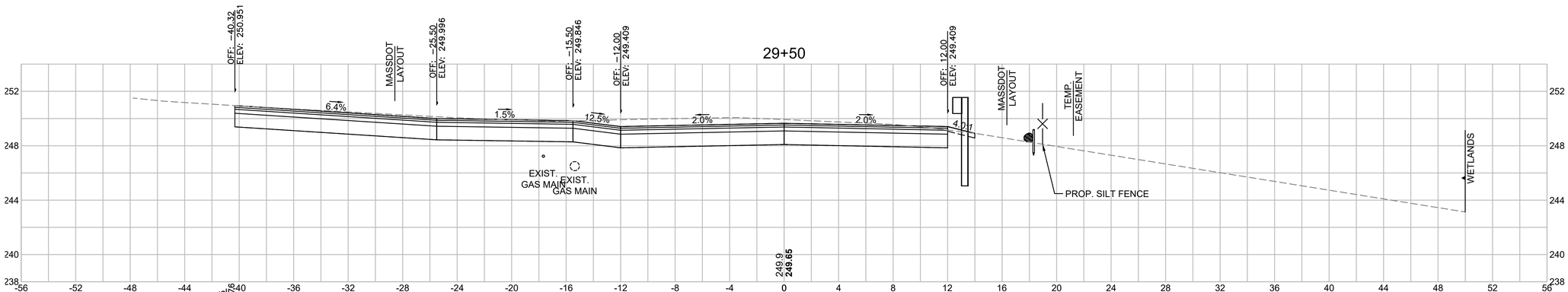
LITTLETON
RECONSTRUCTION OF FOSTER STREET

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	XXX-XXXX(XXX)X	113	127
PROJECT FILE NO.	609054		

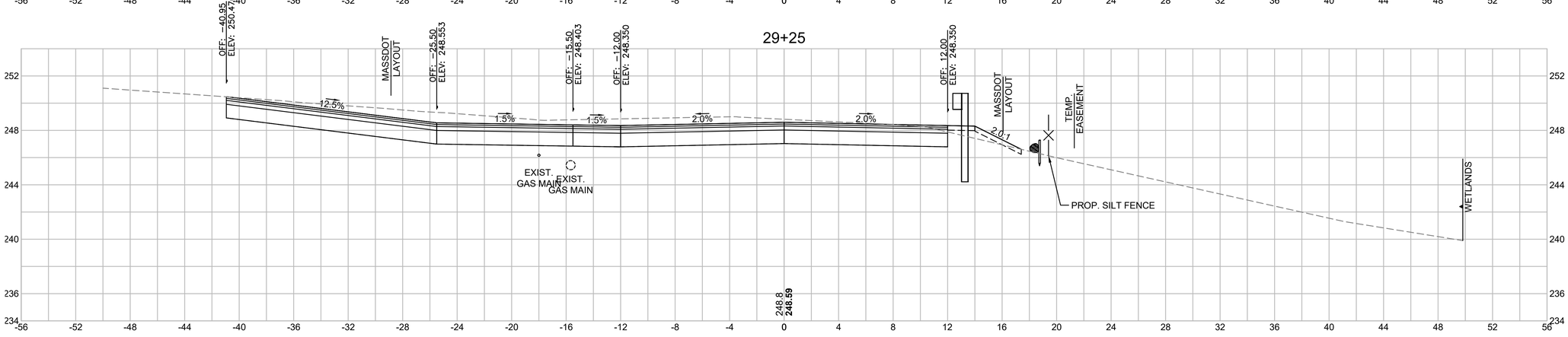
CROSS SECTIONS
##



Total Volume at Station 29+75.00	
Cut Area	100.711
Fill Area	0.000
Cut Vol	88.7
Fill Vol	0.0
Cum Cut Vol	5726.3
Cum Fill Vol	305.9
Net Vol	5420.4



Total Volume at Station 29+50.00	
Cut Area	90.870
Fill Area	0.000
Cut Vol	88.4
Fill Vol	0.6
Cum Cut Vol	5637.6
Cum Fill Vol	305.9
Net Vol	5331.7



Total Volume at Station 29+25.00	
Cut Area	100.035
Fill Area	1.233
Cut Vol	74.7
Fill Vol	1.3
Cum Cut Vol	5549.3
Cum Fill Vol	305.3
Net Vol	5243.9

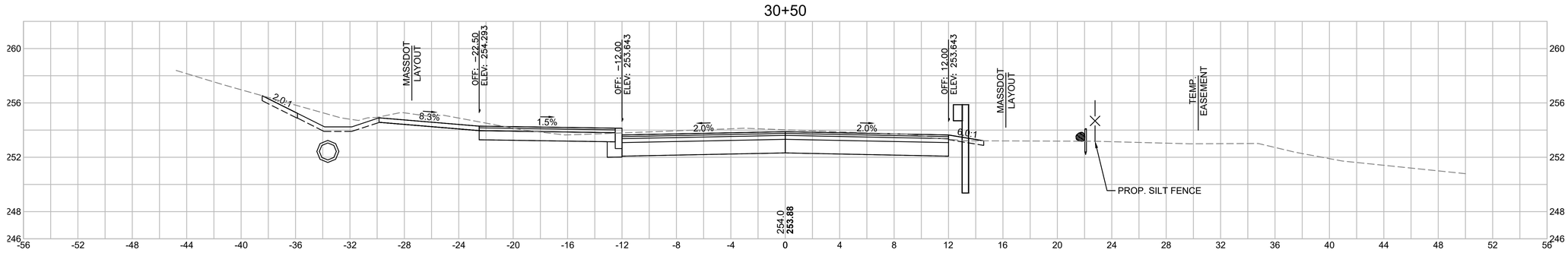
HOR. SCALE IN FEET
4 0 4 8
4 0 4 8
VER. SCALE IN FEET

FOSTER STREET CROSS SECTIONS

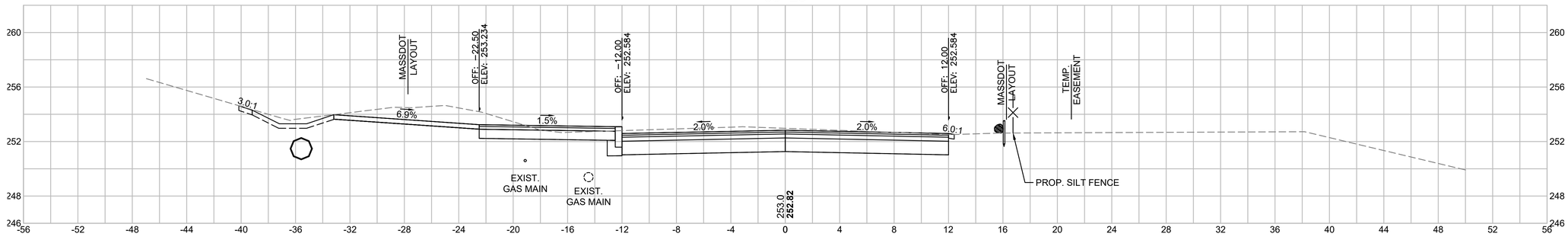
LITTLETON
RECONSTRUCTION OF FOSTER STREET

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	XXX-XXXX(XXX)X	114	127
PROJECT FILE NO.	609054		

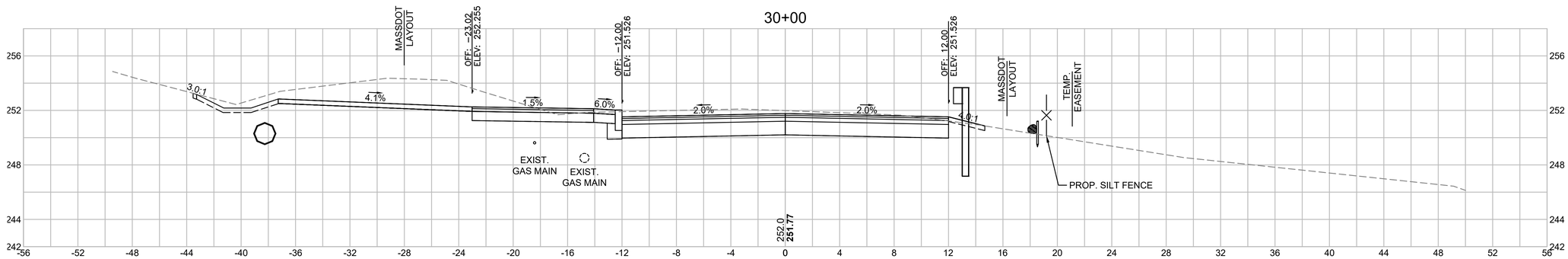
CROSS SECTIONS
##



Total Volume at Station 30+50.00	
Cut Area	62.419
Fill Area	0.000
Cut Vol	60.4
Fill Vol	0.0
Cum Cut Vol	5945.3
Cum Fill Vol	305.9
Net Vol	5639.4



Total Volume at Station 30+25.00	
Cut Area	68.011
Fill Area	0.000
Cut Vol	71.7
Fill Vol	0.0
Cum Cut Vol	5885.0
Cum Fill Vol	305.9
Net Vol	5579.1



Total Volume at Station 30+00.00	
Cut Area	86.963
Fill Area	0.000
Cut Vol	86.9
Fill Vol	0.0
Cum Cut Vol	5813.2
Cum Fill Vol	305.9
Net Vol	5507.3

HOR. SCALE IN FEET
4 0 4 8

VER. SCALE IN FEET
4 0 4 8

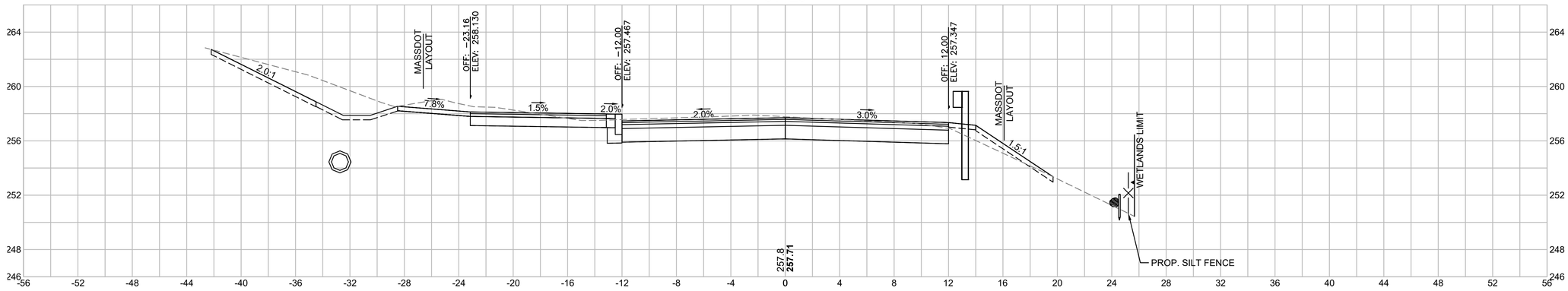
FOSTER STREET CROSS SECTIONS

LITTLETON
RECONSTRUCTION OF FOSTER STREET

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	XXX-XXXX(XXX)X	115	127
PROJECT FILE NO.	609054		

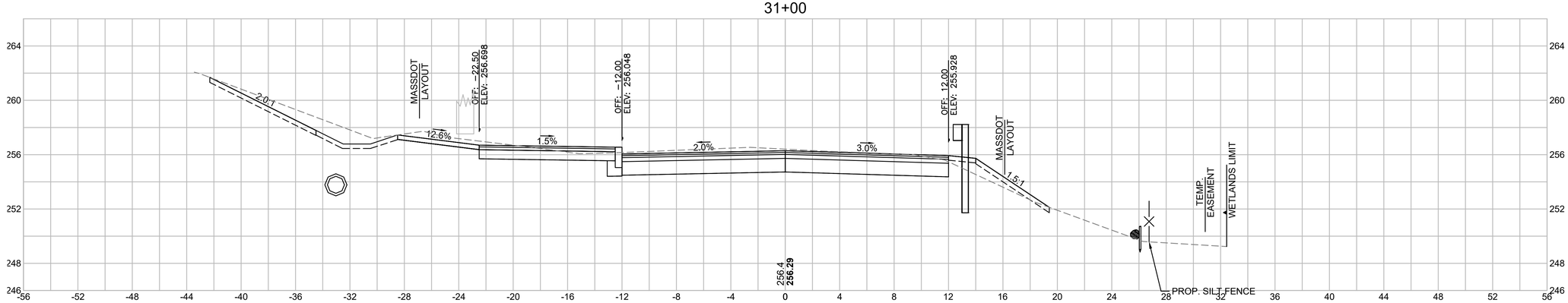
CROSS SECTIONS
##

31+25



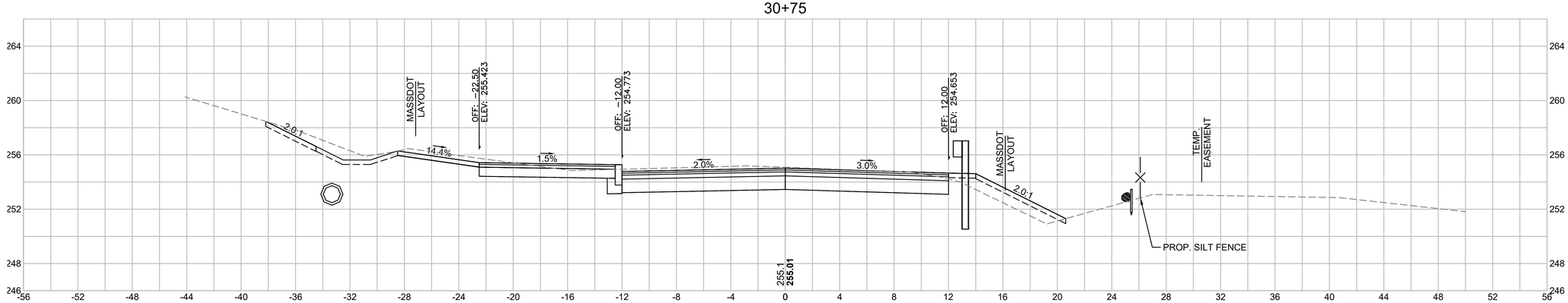
Total Volume at Station 31+25.00	
Cut Area	74.350
Fill Area	2.149
Cut Vol	65.3
Fill Vol	2.2
Cum Cut Vol	6126.4
Cum Fill Vol	314.0
Net Vol	5812.4

31+00



Total Volume at Station 31+00.00	
Cut Area	66.640
Fill Area	2.543
Cut Vol	58.9
Fill Vol	3.6
Cum Cut Vol	6061.2
Cum Fill Vol	311.8
Net Vol	5749.3

30+75



Total Volume at Station 30+75.00	
Cut Area	60.551
Fill Area	5.145
Cut Vol	56.9
Fill Vol	2.4
Cum Cut Vol	6002.3
Cum Fill Vol	308.3
Net Vol	5694.0

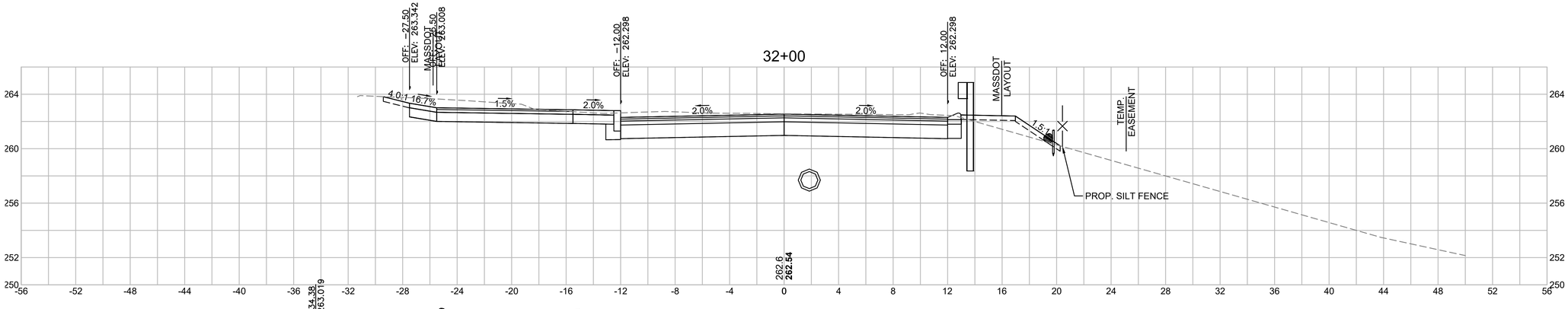
HOR. SCALE IN FEET
4 0 4 8
4 0 4 8
VER. SCALE IN FEET

FOSTER STREET CROSS SECTIONS

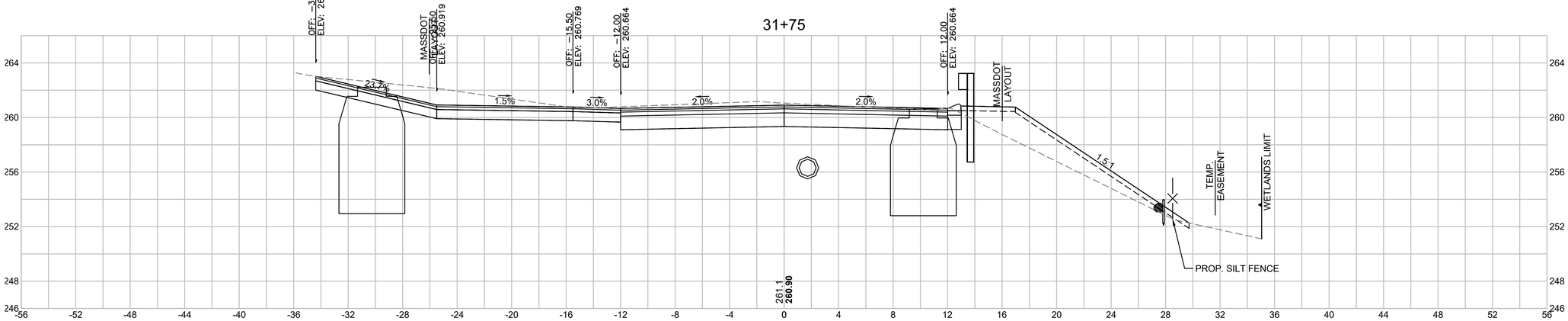
LITTLETON
RECONSTRUCTION OF FOSTER STREET

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	XXX-XXXX(XXX)X	116	127
PROJECT FILE NO.	609054		

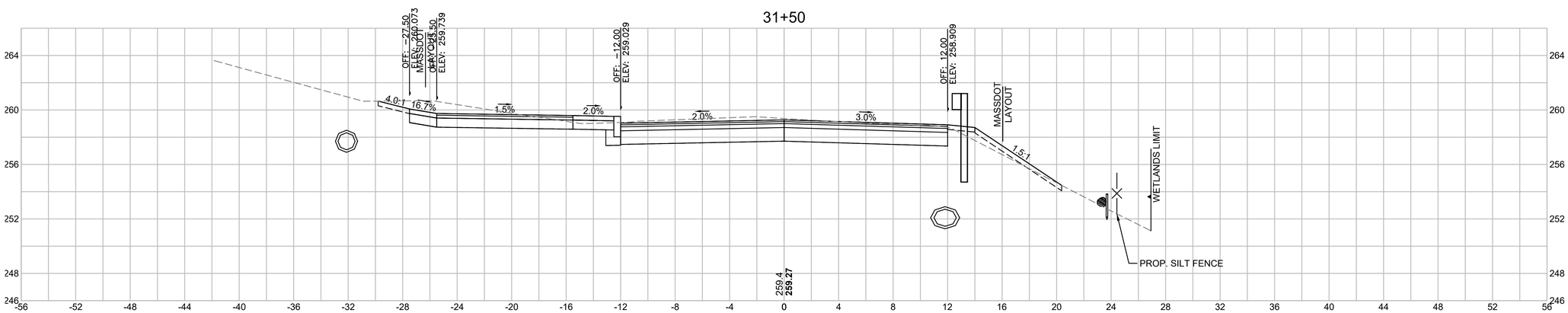
CROSS SECTIONS
##



Total Volume at Station 32+00.00	
Cut Area	64.705
Fill Area	2.547
Cut Vol	64.9
Fill Vol	9.3
Cum Cut Vol	6315.9
Cum Fill Vol	333.8
Net Vol	5982.1



Total Volume at Station 31+75.00	
Cut Area	75.480
Fill Area	17.497
Cut Vol	62.5
Fill Vol	8.8
Cum Cut Vol	6251.0
Cum Fill Vol	324.5
Net Vol	5926.5



Total Volume at Station 31+50.00	
Cut Area	59.583
Fill Area	1.484
Cut Vol	62.0
Fill Vol	1.7
Cum Cut Vol	6188.4
Cum Fill Vol	315.7
Net Vol	5872.7

HOR. SCALE IN FEET
4 0 4 8

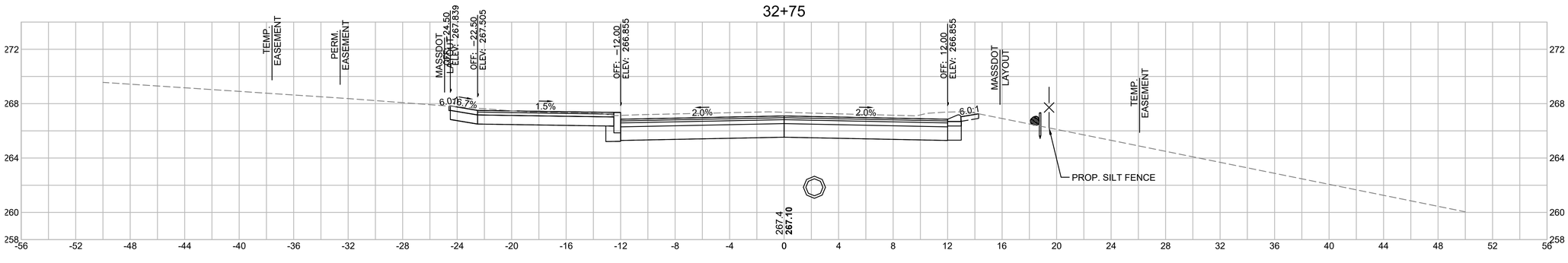
4 0 4 8
VER. SCALE IN FEET

FOSTER STREET CROSS SECTIONS

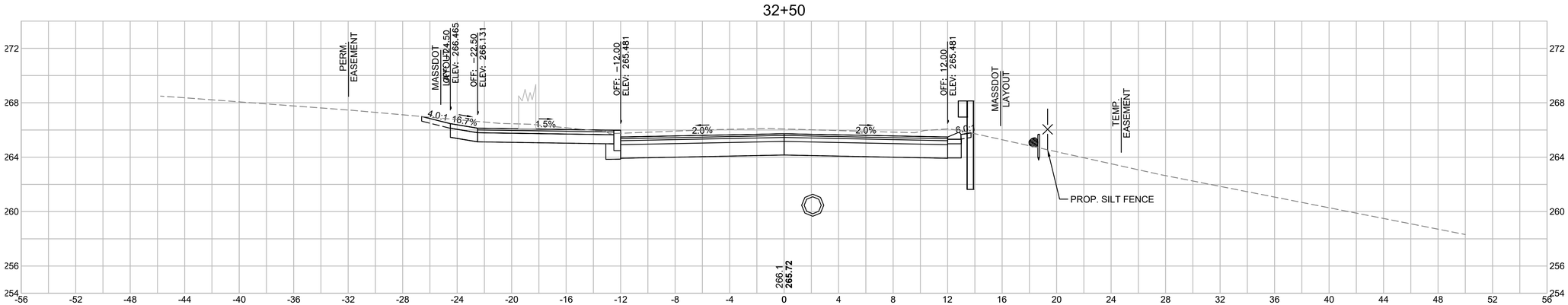
LITTLETON
RECONSTRUCTION OF FOSTER STREET

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	XXX-XXXX(XXX)X	117	127
PROJECT FILE NO.	609054		

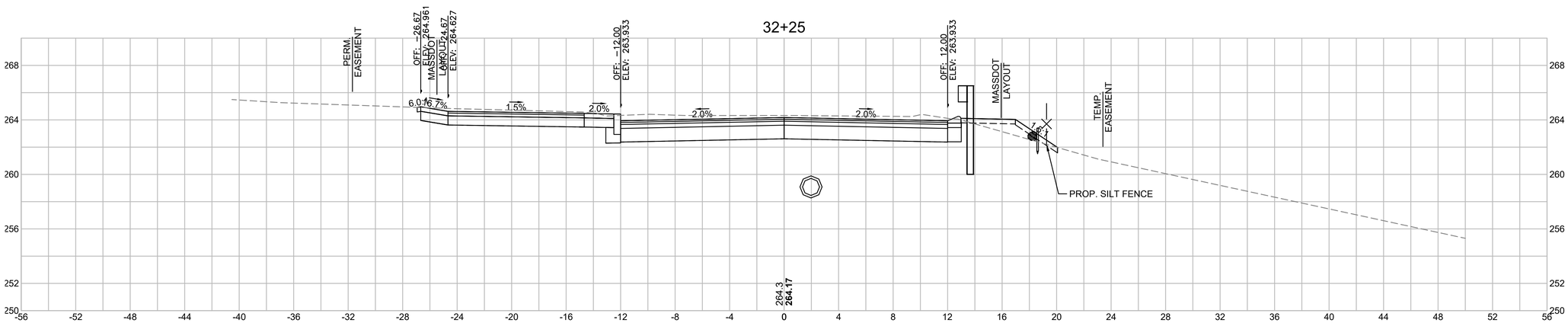
CROSS SECTIONS
##



Total Volume at Station 32+75.00	
Cut Area	60.769
Fill Area	0.000
Cut Vol	58.7
Fill Vol	0.0
Cum Cut Vol	6493.7
Cum Fill Vol	336.9
Net Vol	6156.7



Total Volume at Station 32+50.00	
Cut Area	66.050
Fill Area	0.000
Cut Vol	59.9
Fill Vol	1.0
Cum Cut Vol	6435.0
Cum Fill Vol	336.9
Net Vol	6098.0



Total Volume at Station 32+25.00	
Cut Area	63.237
Fill Area	2.157
Cut Vol	59.2
Fill Vol	2.2
Cum Cut Vol	6375.1
Cum Fill Vol	335.9
Net Vol	6039.2

HOR. SCALE IN FEET
4 0 4 8
4 0 4 8
VER. SCALE IN FEET

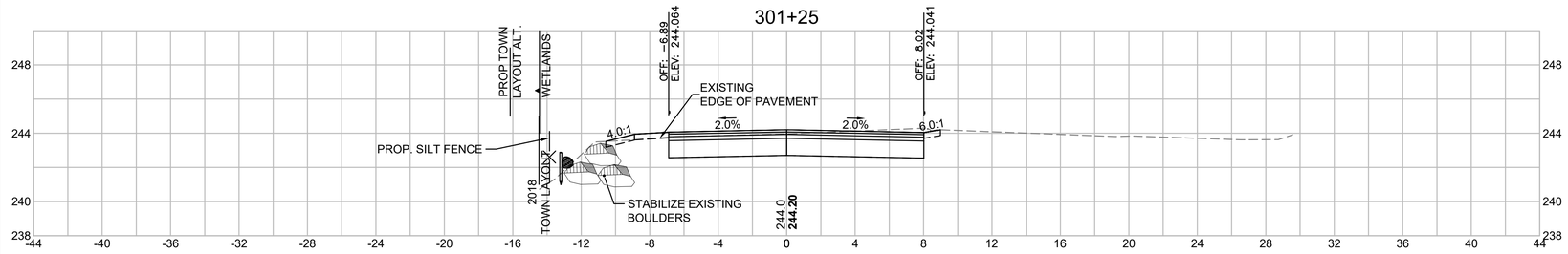
GRIMES LANE CROSS SECTIONS

HOR. SCALE IN FEET
4 0 4 8
VER. SCALE IN FEET
4 0 4 8

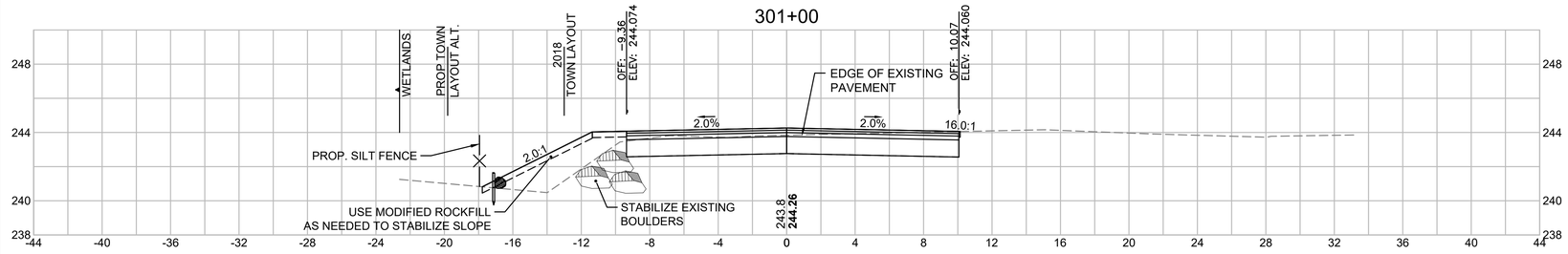
LITTLETON
RECONSTRUCTION OF FOSTER STREET

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	XXX-XXX(XXX)X 20170044A21_XSEC01_LAYOUTS - GRIMES	01	04
	PROJECT FILE NO. 608054		

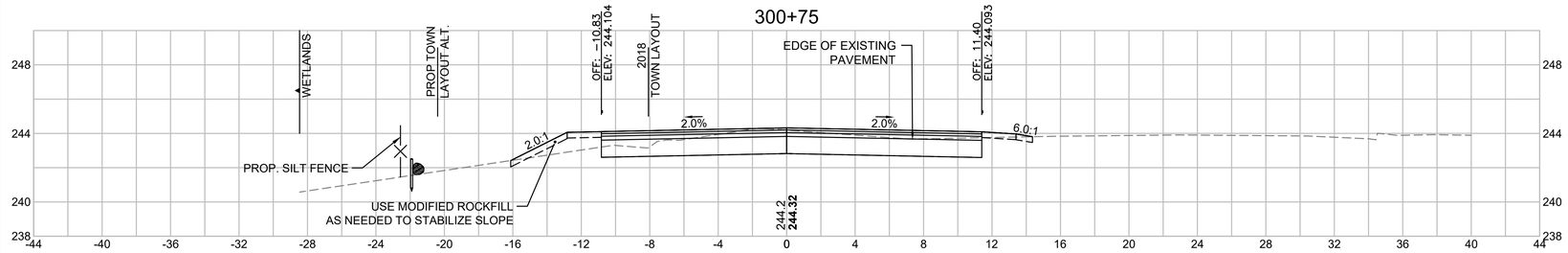
GRIMES LANE - CROSS SECTIONS



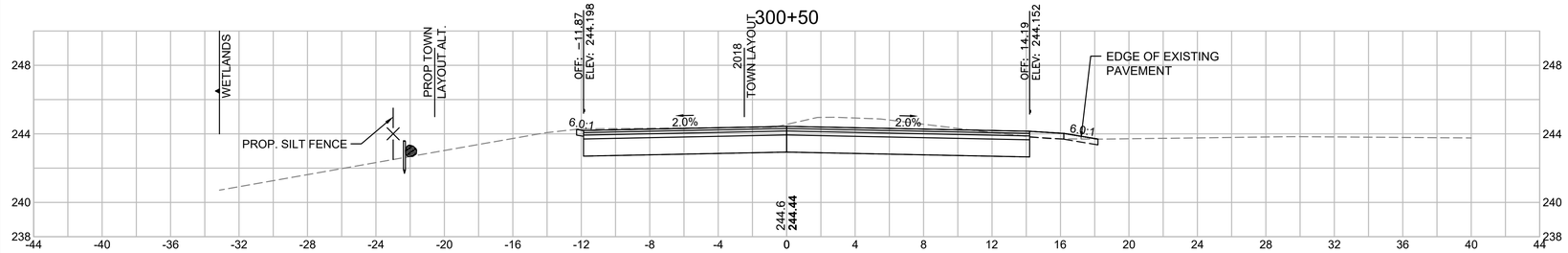
Total Volume at Station 301+25.00	
Cut Area	21.384
Fill Area	0.000
Cut Vol	20.6
Fill Vol	4.0
Cum Cut Vol	74.4
Cum Fill Vol	10.1
Net Vol	64.2



Total Volume at Station 301+00.00	
Cut Area	23.138
Fill Area	8.672
Cut Vol	22.1
Fill Vol	5.1
Cum Cut Vol	53.8
Cum Fill Vol	6.1
Net Vol	47.6



Total Volume at Station 300+75.00	
Cut Area	24.699
Fill Area	2.280
Cut Vol	31.6
Fill Vol	1.1
Cum Cut Vol	31.6
Cum Fill Vol	1.1
Net Vol	30.5



Total Volume at Station 300+50.00	
Cut Area	43.567
Fill Area	0.018
Cut Vol	0.0
Fill Vol	0.0
Cum Cut Vol	0.0
Cum Fill Vol	0.0
Net Vol	0.0

HIGHWAY GUARD DETAILS

STEEL W-BEAM GUARDRAIL (TL-2) W/ WOOD POST & TANGENT END STA. 23+26 LT TO TANGENT END STA 26+04 LT
STEEL W-BEAM GUARDRAIL (TL-2) W/ WOOD POST & TANGENT END STA. 24+52 RT TO TANGENT END STA 25+62 RT
STEEL W-BEAM GUARDRAIL (TL-2) W/ WOOD POST & TANGENT END STA. 28+49 RT TO FLARED END STA 32+83 RT
STEEL W-BEAM GUARDRAIL (TL-2) W/ WOOD POST & TANGENT END STA. 301+41 LT TO TANGENT END STA 300+48 LT

WATER SUPPLY ALTERATIONS

SEE SHEET 57-64

TRAFFIC SIGNAL CONDUIT

NONE

DRAINAGE DETAILS

SEE SHEET NOS. 65-67

LEGEND:

PROPOSED PEDESTRIAN CURB RAMP DETAIL # X#

PROPOSED DRIVEWAY TYPE # DR#

LITTLETON
RECONSTRUCTION OF FOSTER STREET

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	XXX-XXXX(XXX)X	14	127
PROJECT FILE NO.	609054		

CONSTRUCTION PLANS

20170044A21_HPN01.DWG Plotted on 1-Dec-2023 2:39 AM

HIGHWAY GUARD DETAILS

STEEL W-BEAM GUARDRAIL (TL-2) W/ WOOD POST & TANGENT END STA. 28+49 RT TO FLARED END STA 32+83 RT

WATER SUPPLY ALTERATIONS

SEE SHEET 57-64

TRAFFIC SIGNAL CONDUIT

NONE

DRAINAGE DETAILS

SEE SHEET NOS. 65-67

LEGEND:

PROPOSED PEDESTRIAN CURB RAMP DETAIL # X#

PROPOSED DRIVEWAY TYPE # DR#

LITTLETON

RECONSTRUCTION OF FOSTER STREET

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	XXX-XXXX(XXX)X	15	127
PROJECT FILE NO.	609054		

CONSTRUCTION PLANS

CONTINUED ON SHEET NO. 14

CONTINUED ON SHEET NO. 16

NAD 83

N

MASSACHUSETTS BAY TRANSORTATION AUTHORITY (PARCEL FBL 3-A) BK/PG 57072/384 BK/PG 57072/376 PLAN NO 435 OF 2011 PARCEL #R11 3 5 263 FOSTER STREET

MASSACHUSETTS BAY TRANSORTATION AUTHORITY (PARCEL FBL 3-B) BK/PG 57072/384 BK/PG 57072/376 PLAN NO 435 OF 2011 PARCEL #R11 3 5 263 FOSTER STREET

SNS FOSTER, LLC & C/O ROBERT LONG BK/PG 72045/170 PLAN NO 435 OF 2011 PARCEL #R11 3 0 245 FOSTER STREET

DURKEE FARM BUILDERS, INC. BK/PG 67620/69 PARCEL #R08 15 0 260 FOSTER STREET

RICHARD B. VIGNON BK/PG 13250/70 PLAN NO 847 OF 1969 PARCEL #R08 13 242 FOSTER STREET

FOSTER STREET (PUBLIC)

CONSTRUCTION ℄

2018 TOWN LAYOUT

R&R STONE BOUND (AS NEEDED)

BEGIN PROP. GRAN. CURB

LIMIT OF PVM'T RECONSTRUCTION SAWCUT PVM'T MATCH EXISTING

END PROP. GRAN. CURB

PROP. CEM. CONC. PCR

PROP. TEMP. EASEMENT

PROP. MODIFIED ROCK FOR SWALE

R&D BOULDERS

PROP. MODIFIED ROCK FOR SWALE

PROP. LOAM & SEED

RET. CONC. PAD

PROP. TEMP. EASEMENT

R&D EXIST. GUARDRAIL

APPROX. SLOPE LIMIT

PROP. LOAM & SEED

PROP. TREE (SEE LANDSCAPING PLAN) - TYP.

PROP. FULL DEPTH PVM'T RECONSTRUCTION

PROP. SILT FENCE

BEGIN PROP. HMA BERM TYPE A MODIFIED

PROP. COMPOST FILL COVER & SEED OVER PROP. MODIFIED ROCKFILL W ITH GEOTEXTILE FABRIC (ITEM 986) USE SEED ITEM 765.490

PROP. EROSION & SEDIMENT CONTROL BARRIER (TYP.)

PROP. EROSION & SEDIMENT CONTROL BARRIER (TYP.)

PROP. CLEARING & GRUBBING STA. 28+20 TO STA. 37+60

END PROP. STEEL W-BEAM GUARDRAIL, TL-2, W/ WOOD POST, DEEP POST PROP. FLARED END TREATMENT (SEE NOTE) STA. 32+83

PROP. LIMIT OF CLEARING AND GRUBBING BEHIND SLOPE LIMIT

PROP. TEMP. EASEMENT

PROP. PERM. EASEMENT

PROP. CLEARING & GRUBBING STA. 32+40 TO STA. 38+75

SELECTIVE CLEARING AND THINNING 10' FROM PROP. OHW (TYP.)

PROP. 10' SHARED-USE PATH

PROP. LOAM & SEED

RET. STONE WALL

RET. TREE

RET. POST

RET. STONE WALLS

R&R MAILBOX

PROP. LOAM & SEED

PROP. HMA DRIVEWAY

PROP. TEMP. EASEMENT

END PROP. EROSION & SEDIMENT CONTROL BARRIER STA. 33+84

RET. STONE WALL

PC +86.16

T.B.M. SPIKE IN U.P. ELEV.=266.98

NOTE: NO RECORD OF WATER LINE NORTHEAST OF THIS HYDRANT. WATER LINE IS BELIEVED TO CONTINUE AND IS SHOWN SCHEMATICALLY FOR ILLUSTRATIVE PURPOSES ONLY.

NOTE: GAS LINE RECORDS NORTHEAST OF THIS VICINITY ARE SCHEMATIC AND ARE SHOWN SCHEMATICALLY, FOR ILLUSTRATIVE PURPOSES ONLY.

100' BUFFER TO RESOURCE AREA

50' BUFFER RESOURCE AREA (LITTLETON)

FOR PROFILE: SEE SHEET NO. 22 & 23

0 20 50 100

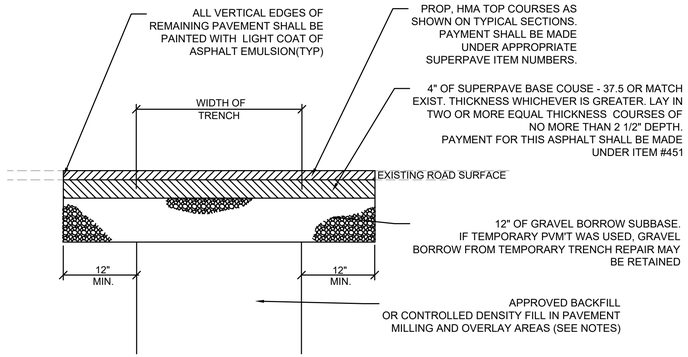
SCALE: 1" = 20'

LITTLETON
RECONSTRUCTION OF FOSTER STREET

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	XXX-XXXX(XXX)X	76	127
PROJECT FILE NO.	609054		

CONSTRUCTION DETAILS

20170044A21_DET01.DWG 1-Dec-2023



NOTES:
OVERLAY AREAS:THE TRENCH SHALL BE REPAIRED TO THE TOP OF THE BASE COURSE. THE TOP COURSES SHALL BE PLACED WITH OVERLAY OF THE ROADWAY

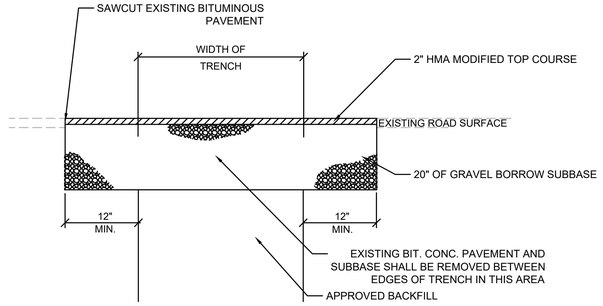
ROADWAY TRENCHING OUTSIDE OF FULL DEPTH AND OVERLAY: THE TRENCH SHALL BE REPAIRED WITH TOP COURSES INSTALLED WITH THE BASE COURSE.

CONTROLLED DENSITY FILL MAY BE USED IN LIEU OF APPROVED BACKFILL IN PAVEMENT MILLING AND OVERLAY AREAS WHERE NORMAL BACKFILL CANNOT PLACED OR TO REDUCE AMOUNT OF TIME NEED TO BACKFILL THE TRENCH. USE OF CONTROLLED DENSITY FILL TO BACKFILL TRENCHES SHALL BE APPROVED BY ENGINEER.

PERMANENT ASHPALT SHALL BE PAID FOR UNDER ITEM #451.

12 PERMANENT PAVEMENT TRENCH REPAIR IN ROADWAYS

SCALE: N.T.S.

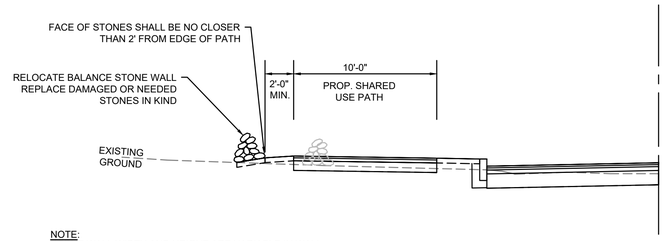


NOTES:
THE TEMPORARY PAVEMENT TRENCH REPAIR SHALL BE USED DURING THE TIME BETWEEN COMPLETION OF THE UTILITY CONSTRUCTION AND CONSTRUCTION OF THE PROPOSED ROADWAY PAVEMENT STRUCTURE OR PERMANENT PAVEMENT TRENCH REPAIR.

TEMPORARY ASHPALT SHALL BE PAID FOR UNDER ITEM #472

13 TEMPORARY PAVEMENT TRENCH REPAIR

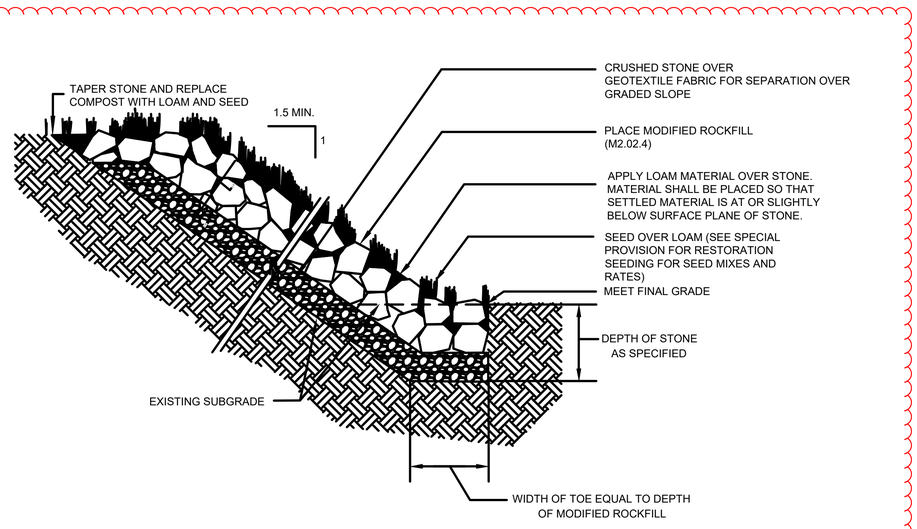
SCALE: N.T.S.



NOTE:
STONE WALL WIDTH AND HEIGHT ARE VARIABLE IN WALL REPLACEMENT AREAS. REPLACE IN KIND AT LOCATIONS SHOWN ON THE CONSTRUCTION PLANS.

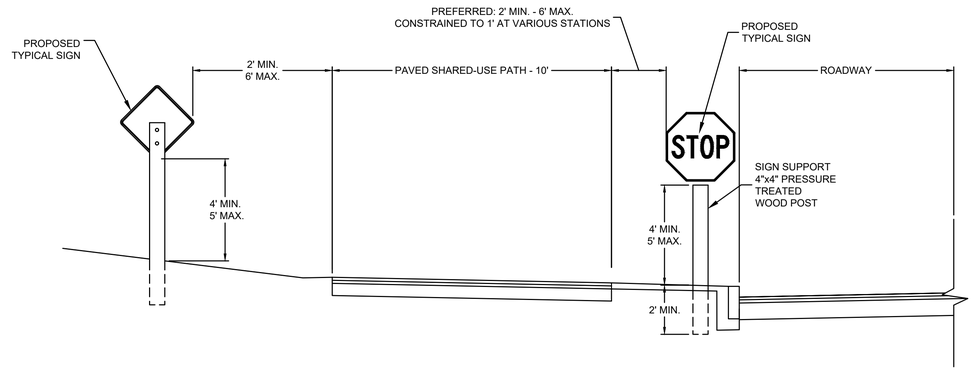
14 BALANCE STONE WALL REMOVED AND REBUILT, DRY

SCALE: N.T.S.



15 MODIFIED ROCKFILL WITH COMPOST AND SEED COVER

SCALE: N.T.S.



16 SHARED–USE PATH TYPICAL SIGN PLACEMENT

SCALE: N.T.S.

NOTES:
1. ALL HARDWARE SHALL BE GALVANIZED.

2. WOOD POSTS SHALL BE PAID FOR UNDER ITEM 847.11*.

FUSS & O'NEILL

Attachment 4
Specifications

Item 691.01 Balance Stone Wall Removed and Rebuilt
Item 756 NPDES Storm Water Pollution Prevention Plan
Item 765.490 New England Roadside Wet Meadow Seed Mix
Item 767.121 Sediment Control Barrier
Item 767.78 Composted Mulch Over Modified Rock
Item 986 Modified Rockfill

ITEM 691.01 BALANCE STONE WALL REMOVED AND REBUILT FT

The work under this Item shall conform to the applicable provisions of Sections 685, 690, 901, of the Standard Specifications, the Plans, and the following:

DESCRIPTION

The work under this heading consists of carefully removing, storing, and resetting the fieldstone rubble masonry stones of the existing balance stone walls located within the project area. The work shall be done in accordance with these specifications, and in close conformity with the lines and grades shown on the plans or established by the Engineer.

Balance stone walls to be removed and reset are identified on the plans. The reconstructed walls shall maintain the appearance and character of the existing dry-laid balance stone walls to as great a degree as possible. **Any fieldstone rubble balance walls noted on plans as 'Remove & Discard' shall be stockpiled for reuse at other locations where additional stone masonry materials may be needed.** The work shall include the total volume of adjusted masonry, disassembly of existing masonry, cleaning of existing masonry, and reconstructing masonry wall complete as shown on the plans and as directed by the Engineer. This shall include but not be limited to digging and trenching, labor, tools, equipment and all incidentals required to complete the work as stated herein, shown on the contract plans, and as directed by the Engineer to the satisfaction of the Engineer.

MATERIALS

The stones in the existing walls shall be salvaged and reset as new stone balance walls. Any supplemental stones that are required shall be field stones which match the size, color, and texture of the existing stones as closely as is feasible. Preference shall be given to stockpiled stones from walls removed within the project area.

The Contractor shall take care not to damage the existing stones during the disassembly and reconstruction of the balance stone walls, to retain the character and natural appearance of the finished walls. The Contractor shall provide a secure location for stockpiling stone prior to reconstruction, so that stones will not be damaged, lost or stolen.

CONSTRUCTION METHODS

The stonework shall be set up by masons who, in the opinion of the Engineer, are experienced in this class of work. At least one of the masons shall have 10 years or more experience constructing dry-laid balance stone walls.

Prior to the disassembly of the existing wall, photographs of the existing conditions of the wall shall be taken to serve as a guide for its reconstruction. The Contractor shall take care not to damage the existing stones during the disassembly and reconstruction of the wall. The stones shall be laid so as to break joints and all vertical spaces shall be packed full with spalls or chinking stones. No spalls or chinking shall be allowed in the beds and at least 25% of the stones in the face shall be headers evenly distributed throughout the wall.

ITEM 691.01 (continued)

A trench for rebuilding the balance stone walls shall be excavated to a minimum depth of 12 in. asdirected and to a width sufficient to place the largest bottom stones of the present wall. All the stones from the present walls to be rebuilt, shall be removed and used to rebuild the newwalls in addition to furnishing such new stones as may be necessary to provide rebuilt walls of uniform appearances and cross-sectional dimensions throughout their length. The open spaces about the base of the wall shall be filled with the materials excavated from the trench and all surplus excavation shall be used as directed on the slopes of the new embankment.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

The work under this Item shall be paid for at the Contract unit price per foot for Item 691.01 – Balance Stone Walls Removed and Rebuilt complete and to the satisfaction of the Engineer. Balance Stone Walls Removed and Rebuilt will be measured in place and shall be the length of balance stone walls rebuilt. Excavation at the new location will be paid for at the contract unit price per cubic yard under theitem for Class A Trench Excavation or Class B Rock Excavation. The cost for this work shall include full compensation for, including, but not limited to, all labor, equipment, worker protection, environmental compliance, materials, tools, material testing, and any incidentals required to complete the work to the satisfaction of the Engineer in accordance will all requirements of the contract.

ITEM 756. NPDES STORM WATER POLLUTION PREVENTION PLAN LUMP SUM

GENERAL

This Item addresses the preparation and implementation of a Storm Water Pollution Prevention Plan required by the National Pollutant Discharge Elimination System (NPDES) and applicable Construction General Permit.

METHODS

Pursuant to the Federal Clean Water Act, construction activities which disturb one acre or more are required to apply to the U.S. Environmental Protection Agency (EPA) for coverage under the NPDES General Permit for Storm Water Discharges From Construction Activities. On July 14, 2008 (73 FR 40338), EPA issued the final NPDES Construction General Permit (CGP) for construction activity.

The NPDES CGP requires the submission of a Notice of Intent (NOI) to the U.S. EPA prior to the start of construction (defined as any activity which disturbs land, including clearing and grubbing). There is a seven (7) day review period commencing from the date on which EPA enters the Notice into their database. The Contractor is advised that, based on the review of the NOI, EPA may require additional information, including but not limited to, the submission of the Storm Water Pollution Prevention Plan for review. Work may not commence on the project until final authorization has been granted by EPA. Any additional time required by EPA for review of submittals will not constitute a basis for claim of delay.

In addition, if the project discharges to an Outstanding Resource Water, vernal pool, or is within a coastal ACEC as identified by the Massachusetts Department of Environmental Protection (DEP), a separate notification to DEP is required. DEP may also require submission of the Storm Water Pollution Prevention Plan for review and approval. Filing fees associated with the notification to DEP and, if required, the SWPPP filing to DEP shall be paid by the Contractor.

The General Permit also requires the preparation and implementation of a Storm Water Pollution Prevention Plan (SWPPP) in accordance with the afore-mentioned statutes and regulations. The Plan will include the General Permit conditions and detailed descriptions of controls of erosion and sedimentation to be implemented during construction. It is the responsibility of the Contractor to prepare the SWPPP to meet the requirements of the most recently issued CGP. The Contractor shall submit the Plan to the Engineer for approval at least four weeks prior to any site activities. It is the responsibility of the Contractor to be familiar with the General Permit conditions and the conditions of any state Wetlands Protection Act Order, Water Quality Certification, Corps of Engineers Section 404 Permit and other environmental permits applicable to this project and to include in the Stormwater Pollution Prevention Plan the methods and means necessary to comply with applicable conditions of said permits.

ITEM 756. (Continued)

It is the responsibility of the Contractor to complete the SWPPP in accordance with the EPA Construction General Permit, provide all information required, and obtain any and all certifications as required by the Construction General Permit. Any amendments to the SWPPP required by site conditions, schedule changes, revised work, construction methodologies, and the like are the responsibility of the Contractor. Amendments will require the approval of the Engineer prior to implementation.

Included in the General Permit conditions is the requirement for inspection of all erosion controls and site conditions on a weekly basis as well as after each incidence of rainfall exceeding 0.5 inches in twenty-four hours. The Contractor shall choose a qualified individual who will be on-site during construction to perform these inspections. The Engineer must approve the contractor's inspector. In addition, if the Engineer determines at any time that the inspector's performance is inadequate, the Contractor shall provide an alternate inspector. Written weekly inspection forms, storm event inspection forms, and Monthly Summary Reports must be completed and provided to the Engineer. Monthly Summary Reports must include a summary of construction activities undertaken during the reporting period, general site conditions, erosion control maintenance and corrective actions taken, the anticipated schedule of construction activities for the next reporting period, any SWPPP amendments, and representative photographs.

The Contractor is responsible for preparation of the Plan, all SWPPP certifications, inspections, reports and any and all corrective actions necessary to comply with the provisions of the General Permit. Work associated with performance of inspections is not included under this Item. The Standard Specifications require adequate erosion control for the duration of the Contract. Inspection of these controls is considered incidental to the applicable items. This Item addresses acceptable completion of the SWPPP, any revisions/amendments required during construction, and preparation of monthly reports. In addition, any erosion controls beyond those specified in bid items elsewhere in this contract which are selected by the Contractor to facilitate and/or address the Contractor's schedule, methods and prosecution of the work shall be considered incidental to this item.
The CGP requires the submission of a Notice of Termination (NOT) from all operators when final stabilization has been achieved. Approval of final stabilization by the Engineer and confirmation of submission of the NOT will be required prior to submission of the Resident Engineer's Final Estimate.

COMPENSATION

Payment for all work under this Item shall be made at the contract unit price, lump sum, which shall include all work detailed above, including Plan preparation, required revisions, revisions/addenda during construction, monthly reports and filing fees.
Payment of fifty (50) % of the contract price shall be made upon acceptance of the Stormwater Pollution Prevention plan. Payment of forty (40) % of the contract price shall be made in equal installments for implementation of the Stormwater Pollution Prevention plan. Payment of the final ten (10) % of the contract price shall be paid upon satisfactory submissions of a Notice of termination (NOT) when final stabilization has been achieved.

ITEM 765.490 NEW ENGLAND ROADSIDE WET MEADOW SEED MIX POUND

Work under this item shall consist of furnishing the mix(es) specified below in the required quantity.

SUBMITTALS

1) Pre-Verification of Seed Availability. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer the supplier's verification of availability of seed species in the required quantities and for the anticipated date of seeding. Verification shall be on the supplier's letterhead and notarized by the supplier's notary. Species not expected to be available should be noted and substitutions recommended.

2) Final Verification of Seed Availability. No earlier than 21 days prior to ordering, the Contractor shall submit to the Engineer the supplier's verification of availability of seed species and in the required quantities. Verification shall be on the supplier's letterhead and notarized by the supplier's notary. A copy of this submittal shall be forwarded to the MassDOT Landscape Design Section. Substitutions or changes in the mix at this time must be approved by MassDOT Landscape Design Section.

3) Seed Worksheet provided herein shall be submitted to the Engineer prior to ordering seed to determine the number of pounds of Pure Live Seed required.

4) Seed Tags. The contractor shall submit original seed tags from each bag of seed used on the project or ensure that each tag is photo documented by the Engineer while on the unopened bag.

   Number of tags submitted must correspond to number of bags delivered.

   Species listed on the seed tag shall match the Final Verification of Seed Availability (Submittal #2) unless approved otherwise. Tag must include: variety and species name; lot number; purity; percentage of inert matter; percentage of weeds, noxious seeds, and other crop seeds; germination, dormant or hard seed; total viability; origin of seed; germination test date, net weight, and name and address of seller. The origin of seed must be listed on the seed tag for all species in the mix to provide verification of original (generation 0) seed source. The smallest known geographic area (township, county, ecotype region, etc.) shall be listed. Ecotypes and cultivars shall be as close to Massachusetts as possible and appropriate to the site conditions.

   A copy of this submittal shall be forwarded to the MassDOT Landscape Design Section.

5) Verification of Seed Delivery. Prior to payment, contractor shall submit the Seed Delivery Verification form contained within the contract or the Supplier's Verification on company letterhead or a bill of lading. Supplier verification must include all information requested on the Verification form within this contract. The bill of lading must include variety and species name, lot number, net weight shipped, date of sale, invoice, project or seeding location, and name and address of Supplier. All information must be filled in and complete for acceptance. Information must match the seed tags and quantity of seed used on the job. A copy of this submittal shall be forwarded to the MassDOT Landscape Design Section

6) Seed Sample. If requested or if seed is from a previously opened bag, the contractor may be asked to submit to the Engineer a sample of seed from the seed bag (1-2 cups) at the time of seeding.

SEEDING SEASON

The appropriate seeding seasons are:

Spring: April 1 - May 15
Fall: October 1 - December 1 for dormant seeding

Item 765.490 (Continued)

PERMANENT SEED MIX(ES)

Calculating Pure Live Seed (PLS)

Quantities specified are PURE LIVE SEED. Greater quantities of ordered seed may be required to achieve actual specified seeding rates.

Pure Live Seed (PLS) is defined as a percentage calculated by multiplying the percent of pure seed by the percent of viable seed (total germination, hard seed, and dormant seed). For example:

If a seed label indicates 90% purity, 78% germination, 10% hard seed, and 2% dormancy, it is calculated to be 90% x [78 + 10 + 2]% = 81% PLS.

Therefore, each pound of PLS would need 1 pound / 0.81 = 1.2 pounds of seed with a 90% purity and 90% total germination

Seed Mix(es) shall be as specified below. Ecotypes and cultivars shall be as close to Massachusetts as possible and appropriate to the site conditions.

NEW ENGLAND ROADSIDE WET MEADOW SEED MIX

	Botanical Name	**Common Name**	**% PLS by Weight**
Grass	Elymus riparius	Riverbank Wild Rye	25.00%
	Elymus virginicus	Virginia Wild Rye	20.00%
	Festuca rubra	Red Fescue	10.00%
	Panicum virgatum	Switch Grass	10.00%
	Panicum virgatum	Switch Grass	8.00%
	Carex scoparia	Blunt Broom Sedge	5.00%
	Cornus amomum	Silky Dogwood	2.00%
			85.00%
Herb/Forb	Carex lurida	Lurid Sedge	4.00%
	Iris versicolor	Blue Flag	2.00%
	Asclepias incarnata	Swamp Milkweed	2.00%
	Viburnum dentatum	Arrow Wood Viburnum	2.00%
	Aster novae-angliae (Sympyotrichum novae-anglia)	New England Aster	1.50%
	Eupatorium perfoliatum	Boneset	1.00%
	Eupatorium maculatum (Eutrochium maculatum)	Spotted Joe Pye Weed	1.00%
	Sambucus canadensis	Elderberry	0.50%
	Scirpus atrovirens	Green Bulrush	0.50%
	Aster umbellatus (Doellingeria u.)	Flat Topped/Umbrellla Aster	0.50%
			15.00%
			100%

Item 765.490 (Continued)

Application Rate

Mix X: __35____ lbs/acre PLS. Option1: In addition, apply 30 pounds per acre of cover crop (grain oats or grain rye) as appropriate to the season.

Any species substitutions shall be with a species having similar characteristics and function. Substitutions must be approved by MassDOT Landscape Design Section per the documentation submittal process.

50% Increase Adjustment for Field Conditions

Seeding under the following conditions requires a 50% increase in the permanent mix at the time of construction:

- Seeding out of season
  OR
- Seeding after Compost Blanket has been applied (unless already increased for out of season).

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

New England Roadside Wet Meadow Seed Mix will be measured for payment by the pound of Pure Live Seed delivered and complete in place.

New England Roadside Wet Meadow Seed Mix will be paid at the contract unit price per pound of Pure Live Seed delivered upon approval of all Seed Submittal Documentation. Overseeding required to correct poor germination or establishment shall be incidental to the item.

Cover crop not included as part of the permanent mix composition will be paid for under Item 765.21, Annual Cover Crop.

Application and care of native seed mix will be paid for separately under Item 735.635 Native Seeding and Establishment

ITEM 767.121 SEDIMENT CONTROL BARRIER FOOT

The work under this item shall conform to the relevant provisions of Sections 751 and 767 of the Standard Specifications and Section 670 of the Standard Supplemental Specifications and shall include the furnishing and placement of a sediment control barrier. Sediment Control Barrier shall be installed prior to disturbing upslope soil.

The purpose of the sediment control barrier is to slow runoff velocity and filter suspended sediments from storm water flow. Sediment barrier may be used to contain stockpile sediments, to break slope length, and to slow or prevent upgradient water or water off road surfaces from flowing into a work zone. Contractor shall be responsible for ensuring that barriers fulfill the intent of adequately controlling siltation and runoff.

Twelve-inch diameter (after installation) compost filter tubes are intended to be the primary sedimentation control barrier.

For small areas of disturbance with minimal slope and slope length, the Engineer may approve the following sediment control methods;

- Straw tubes/wattles which shall be trenched
- Straw bales which shall be trenched

Additional barriers (adding depth or height) shall be used at specific locations of concentrated flow such as at gully points, steep slopes, or identified failure points in the sediment capture line.

Where specified or required by permits, silt fence shall be used in addition to compost filter tubes or straw bales and shall be incidental to the item.

MATERIALS AND CONSTRUCTION

Prior to initial placement of barriers, the Contractor and the Engineer shall review locations specified on the plans to ensure that the placement will provide maximum effectiveness.

Barriers shall be staked, trenched and/or wedged as specified herein and shall be securely in contact with existing soil such that there is no flow beneath the barrier.

Compost Filter Tube

Compost material inside the filter tube shall meet M1.06.0, except for the following: no manure or bio-solids shall be used; no kiln-dried wood or construction debris shall be allowed; material shall pass through a 2-inch sieve; and the C:N ratio shall be disregarded.

Outer tube fabric shall be a knitted mesh with 1/8 - 3/8” openings and made of 100% biodegradable materials (i.e., cotton, hemp or jute).

ITEM 767.121 (Continued)

Compost filter tubes shall be a minimum of 12 inches in diameter installed. Tubes shall be placed, filled, and staked in place as required to ensure stability against water flows. All tubes shall be tamped, but not trenched, to ensure good contact with soil.

Where reinforcement is necessary, additional tubes shall be installed as shown on the plans.

Straw Bales

Straw bales shall conform to the requirements of Section M6.04.3 of the Standard Specifications and the following:

Bales should be a minimum size of 12 x 16 x 36 inches and shall be placed in a single row, lengthwise on the contour, with ends of adjacent bales tightly abutting one another.

The bales shall be trenched and backfilled. The trench shall be excavated the width of the bale and the length of the proposed barrier to a depth of 4 inches. After the bales are staked the excavated soil shall be backfilled against the barrier. Backfill soil shall conform to the ground level on the downhill side and shall be built up to 4 inches against the uphill side of the barrier.

Straw Wattle

Straw wattle shall be a minimum of 12 inches in diameter. Straw filling shall conform to the requirements of Section M6.04.3, shall be encased in durable netting, and shall have a density of 3 lb/foot.

Straw wattle shall be trenched in 3 inches deep and staked according to the plans. The wattles shall be sufficiently secure on the upstream side to prevent water flowing underneath the wattle.

Silt Fence

Materials and Installation shall be per Section 670.40 of the Standard Supplemental Specifications and the following:

Silt fence shall be used when specified by Orders of Condition or other permitting.

When used with compost filter tubes, the tube shall be placed on a minimum of 8 inches of folded fabric on the upslope side of the fence. Fabric does not need to be trenched.

When used with straw bales, an 8-inch deep and 4-inch wide trench or V-trench shall be dug on the upslope side of the fence line. One foot of fabric shall be placed in the bottom of the trench followed by backfilling with compacted earth or gravel. Stakes shall be driven 16 inches into the ground on the down slope side of the trench and shall be spaced such that the fence remains vertical and effective.

Width of fabric shall be sufficient to provide a 36-inch high barrier after fabric is folded or trenched. Sagging fabric will require additional staking or other anchoring.

ITEM 767.121 (Continued)

Stakes

Stakes for anchoring Compost Filter Tubes, Straw Wattles, and Straw Bales shall be as shown on the plans and shall be a minimum of 1x1 inch diameter x 4 feet hardwood stakes.

When used with Silt Fence, stakes for Compost Filter Tubes shall be driven 12 inches into the ground, Stakes for Straw Bales shall be driven 16 inches into the ground.

Stakes of other material of equivalent strength may be used if approved by the Engineer.

MAINTENANCE

Maintenance of Sediment Control Barriers shall be per Section 670.40 of the Standard Supplemental Specifications or per the Stormwater Pollution Prevention Plan (SWPPP).

The contractor shall inspect the sediment barrier after each rain event and as specified in relevant permits to ensure that they are working effectively and as intended. Contractor shall be responsible for ensuring that an effective barrier is in place for all phases of the contract.

Barriers that decompose naturally due to weatherization over time such that they no longer provide the function required shall be repaired or replaced as directed. If the resulting berm of compost within the fabric tube is sufficiently intact and continues to provide water and sediment control, barrier does not necessarily require replacement.

DISMANTLING & REMOVING

Barriers shall be dismantled and/or removed when construction work is complete and when site conditions are sufficiently stable to prevent surface erosion and after receiving permission to do so from the Engineer.

For all instances, all nonbiodegradable material, including photo-biodegradable fabric, plastic netting, nylon twine, and silt fence, shall be removed and disposed off-site by the Contractor regardless of site context.

For naturalized areas, biodegradable, natural fabric and material may be left in place to decompose on-site. Compost filter tubes may be left as they are with stakes removed. Straw bales shall be broken down and spread evenly. All nylon or nonbiodegradable twine shall be removed along with silt fence. Wooden stakes may be left on site, placed neatly and discretely.

In urban, residential, and other locations where aesthetics is a concern, the following shall apply:

- Filter tube fabric shall be cut and removed, and compost shall be raked to blend evenly (similar to a soil amendment or mulch). Not more than a 2-inch depth shall be left on soil substrate.

ITEM 767.121 (Continued)

- Straw bales shall be removed and disposed off-site by the Contractor. Areas of trenching shall be raked smooth and disturbed soils stabilized with a seed mix matching adjacent grasses (i.e., lawn or native grass mix).
- Silt fence, stakes, and other debris shall be removed and disposed off-site. Site shall look neat and clean upon completion.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Item 767.121 will be measured and paid for at the contract unit price per foot of sediment control barrier which price shall include all labor, equipment, materials, maintenance, dismantling, removal, restoration of soil, and all incidental costs required to complete the work.

Silt fence, when used in conjunction with compost filter tubes or straw bales, will be incidental to this item.

Additional barrier, such as double or triple stacking of compost filter tubes, shall be paid for per foot of tube installed.

Barriers that have been driven over or otherwise damage by construction activities shall be repaired or replaced as directed by the Engineer at the Contractors expense.

ITEM 767.78 COMPOSTED MULCH OVER MODIFIED ROCK SQUARE YARD

GENERAL

The purpose of this item is to provide compost mulch for mixing with seed, to be placed on designated modified rockfill slopes in areas where establishment of vegetation in the rock slope is desired. This item shall conform to the requirements of Section 767 and 765 of the Standard Specifications and the following.

MATERIALS

Composted mulch

Composted Mulch shall be an aged organic substance meeting the requirements of M1.06.0 of the Supplemental Standard Specifications. No manure, bio-solids, kiln dried wood, or construction debris shall be allowed.

Organic matter content shall be between 20-100% (dry weight basis) as determined by ASTM D2974 (method A) Standard Test Methods for Moisture, Ash and Organic Matter of Peat and Other Organic Soils.

Moisture content shall be <15% by dry weight (<60% by wet weight) as measured by ASTM D2216 Standard Test Method for Laboratory Determination of Water Content of Soil and Rock and ASTM D2974 (cited above).

Particle size as measured by sieving shall be as follows:

Sieve Size	%Passing
2 in	100%
¾ in	70-100%
#4	30-75%
#20	20-40%

Soluble salts shall be <5.0 mmhos/cm (dS/m). The pH shall be between 5.5 and 8.0.

Seed

Seed shall be a native mix as specified under Item 765.453 Woodland Edge Mix.

CONSTRUCTION METHODS

Methods of installation shall be reviewed and approved by the Engineer prior to placement of material.

ITEM 767.78 (Continued)

Placement of compost mulch shall be as shown on the plans and as directed by the Engineer. Compost mulch material shall be applied pneumatically. Material shall be placed so that settled material is at or slightly below the surface plane of the stone. Contractor shall ensure that there will be adequate quantity, including adjustment for settlement.

Seeding shall be done at the same time as compost topsoil is being applied and shall be by broadcast method as specified under the seeding item and such that a very thin blanket of material covers the seed.

COMPENSATION

Compost Mulch for Modified Rock will be measured and paid for at the Contract unit price per Square Yard which price shall include all labor, materials, equipment, site preparation, and all incidental costs required to complete the work.

Seed shall be compensated at the bid price per the seeding item.
Modified Rockfill shall be compensated separately under Item 986.

Table M2.02.2-1: Gradation Requirements for Dumped Riprap

Size of Stone (lb)	Maximum Percent of Total Weight Smaller Than Given Size
400	100
300	80
200	50
*25	10
*No more than 5% by weight shall pass a 2 in. sieve.	

Each load of riprap shall be reasonably well graded from the smallest to the maximum size specified. Stones smaller than the specified 10% size and spalls will not be permitted in an amount exceeding 10% by weight of each load.

Control of gradation will be by visual inspection. The Contractor shall provide at the locations specified a mass of rock of at least 5 tons meeting the gradation for the class specified. The sample at the construction site may be a part of the finished riprap covering. At the quarry, an additional sample shall be provided. These samples shall be used as a frequent reference for judging the gradation of the riprap supplied. Any difference of opinion between the Engineer and the Contractor shall be resolved by dumping and checking the gradation of two random truckloads of stone. Mechanical equipment, a sorting site and labor needed to assist in checking gradation shall be provided by the Contractor at no additional cost to the Department.

M2.02.3: Stone for Pipe Ends

Stone for pipe ends shall be sound, durable rock which is angular in shape. Rounded stones, boulders, sandstone or similar stone or relatively thin slabs will not be acceptable. Each stone shall weigh not less than 50 lb not more than 125 lb and at least 75% of the volume shall consist of stones weighing not less than 75 lb each. The remainder of the stones shall be so graded that when placed with the larger stones the entire mass will be compact.

M2.02.4: Modified Rockfill

Modified rockfill shall consist of hard, durable angular shaped stones which are the product of the primary crushing of a stone crusher. Rounded stone, boulders, sandstone and similar soft stone or relatively thin slabs will not be acceptable.

Stone shall be free from overburden, spoil, shale, organic material and meet the following gradation requirements:

Table M2.02.4-1: Gradation Requirements for Modified Rockfill

Size of Stone (in.)	Passing Percentages
8	95-100
4	0-25
2 ½	0-5

C. Cement Concrete.

The paving shall be placed as specified in Subsection 901: Cement Concrete; the surface shall be finished as specified in 901.68: Joints, Paragraph C.

983.65: Channel Paving and Grouted Channel Paving

All stones shall be placed upon an approved bed to the lines and grades shown on the plans and as directed. The larger stones shall be placed as closely together as poss1ble throughout the surface. All stones shall be securely bedded and laid so that the exposed surfaces will be approximately parallel to and within 3 in. of the grade shown on the plans. The finished paving shall present a continuous uniform surface of stonework.

Grouting, when required, shall be done after the paving is completely in place. The paving stones shall be sprinkled with water immediately before placing the grout. The grout shall conform to M4.02.15: Cement Mortar.

983.66: Modified Rockfill

Stone shall be placed on the prepared area in a manner which will produce a reasonably well graded mass with a minimum practical percentage of voids and a minimum thickness of 1 ft. The stone will be placed to its full thickness in one operation and in such a manner as to avoid displacing the underlying material.

It is the intent of these specifications to produce a fairly compact Rockfill protection in which all sizes of material are placed in their proper proportions.

Hand-placing or rearranging of individual stones by mechanical equipment may be required to the extent necessary to secure the results specified.

Modified Rockfill shall be placed in conjunction with the adjacent construction as shown on the plans.

COMPENSATION

983.80: Method of Measurement

The quantity of Dumped Riprap, Riprap and Modified Rockfill shall be the weight of the stones.

Slope Paving, Special Slope Paving under Bridges, Channel Paving and Grouted Channel Paving will be measured in place by the square yard on the surface of the paved slope as constructed.

983.81: Basis of Payment

No deduction from the excavation pay quantities will be made for stone taken from excavation and used in any type of revetment, provided that any additional filling material made necessary by such use shall be furnished as specified in Subsection 4.09: Rights In the Use of Materials Found on the Work.

Excavation below the original ground surface at the toe of slopes when required in the construction of revetment will be paid for under the item for Class A Trench Excavation, but where the excavation is made along the slopes of an existing or proposed channel, such excavation will be paid for under the Item for Channel Excavation.

FUSS & O'NEILL

Attachment 5
Tree Inventory
Updated Landscaping Plans

Tree Replacement Inventory

MassDOT Project # 609054, The Reconstruction of Foster Street

12/1/2023

Frontage Address	Public/Private	Dia (in)	Appox. Species/Type	Qty of Takings	Frontage Address	Replacement Qty	Replacement Species	Common Name	Replacement Ratio
	Private	5	Oak	1		5	Acer Rubrum 'Kaprick'	Kaprick Red Maple	
	Private	6	Cherry	1		4	Amelanchier x Grandiflora 'Robin Hill'	Robin Hill Serviceberry	
	Private	8	Tree of Heaven-Ailanthus altissima	1		7	Nyssa Sylvatica	Black Gum	
	Private	8	Cherry	1		2	Quercus Coccinea	Scarlet Oak	
260 Foster St	Private	11	Oak	1	260 Foster St				
	Private	13	Catalpa	1					
	Private	15	Chinaberry Tree- Melia azedarach	1					
	Private	20	Catalpa	1					
	Public	28	Oak	1					
Subtotal				**9**	**Subtotal**	**18**			**2 to 1**
	Public	4	birch	1		8	Acer Rubrum 'Kaprick'	Kaprick Red Maple	
	Private	4	maple	1		19	Amelanchier x Grandiflora 'Robin Hill'	Robin Hill Serviceberry	
	Private	4	poplar	1		10	Nyssa Sylvatica	Black Gum	
	Private	4	cherry	1		18	Quercus Bicolor 'Bonnie and Mike'	Beacon Swamp White Oak	
	Private	4	bittersweet vine	1					
	Private	4	buckthorn	1					
	Private	5	cherry	1					
	Private	5	buckthorn	1					
	Private	6	elm	1					
	Private	6	birch	1					
	Private	6	maple	1					
	Private	6	maple	1					
	Private	8	cherry	1					
295 Foster St	Private	8	oak	1	295 Foster St				
	Public	8	maple	1					
	Private	8	elm	1					
	Public	8	maple	1					
	Private	10	oak	1					
	Public	11	maple	1					
	Public	13	oak	1					
	Private	13	oak	1					
	Private	13	oak	1					
	Public	13	oak	1					
	Public	13	birch	1					
	Private	17	oak	1					
	Private	19	oak	1					
Subtotal				**26**	**Subtotal**	**55**			**2 to 1**
	Private	24	Pine	1		6	Acer Rubrum 'Kaprick'	Kaprick Red Maple	
305 Foster St	Private	24	Hawthorne	1	305 Foster St	3	Amelanchier x Grandiflora 'Robin Hill'	Robin Hill Serviceberry	
	Private	24	Hawthorne	1					
Subtotal				**3**	**Subtotal**	**9**			**3 to 1**
MassDOT State Highway Layout NO.3863	Public	4	Beech	1	MassDOT State Highway Layout NO.3863	6	Amelanchier x Grandiflora 'Robin Hill'	Robin Hill Serviceberry	
	Public	8	Cedar	1					
	Public	11	Cedar	1					
Subtotal				**3**	**Subtotal**	**6**			**2 to 1**
Grand Total				**41**	**Grand Total**	**88**			**2.1 to 1**

NOTES:

1. PROPOSED PLANTINGS MAY REQUIRE FIELD ADJUSTMENT DUE TO FINAL FIELD CONDITIONS. MASSDOT LANDSCAPE ARCHITECT AND/OR TOWN OF SUDBURY SHALL APPROVE ALL LOCATIONS PRIOR TO PLANTING.

PROJECT SUMMARY PLANT LIST

KEY	BOTANICAL NAME	COMMON NAME	HT.	QTY.	SIZE
	TREES				
AR	ACER RUBRUM 'KARPICK'	KARPICK RED MAPLE	40'	19	2"–2.5" CAL.
AG	AMELANCHIER X GRANDIFLORA 'ROBIN HILL'	ROBIN HILL SERVICEBERRY	15'	32	1.5"–2" CAL. (SINGLE STEM)
NS	NYSSA SYLVATICA	BLACK GUM	30'	17	2"–2.5" CAL.
QB	QUERCUS BICOLOR 'BONNIE AND MIKE'	BEACON SWAMP WHITE OAK	35'	18	2"–2.5" CAL.
QC	QUERCUS COCCINEA	SCARLET OAK	50'	2	2"–2.5" CAL.
	SHRUBS				
RC	RHODODENDRON CATAWBIENSE 'ALBUM'	WHITE CATAWBA RHODODENDRON		19	3 GAL.

LEGEND:

PLANT QUANTITY AND SPECIES (X / XX)

LITTLETON
RECONSTRUCTION OF FOSTER STREET

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	XXX-XXXX(XXX)X	65	127
PROJECT FILE NO.	609054		

LANDSCAPING PLANS

20170044A21_LSP01.DWG Plotted on 1-Dec-2023 7:42 AM

GUTIERREZ ARTURO+CATALDO CLASS B TRUST
SWEENEY D CLASS A TRUST
BK/PG 32096/213
PARCEL #R10 6 0
TAYLOR STREET

LIMIT OF WORK
STA 205+00.00
N3012961.1405
E653254.4720

BEGINNING OF PROJECT
PROJ. NO. 609054
STA 0+00.00
N3012786.8847
E653296.9381

GUTIERREZ ARTURO+CATALDO CLASS B TRUST
SWEENEY D CLASS A TRUST
BK/PG 32096/215
PARCEL #R10 7 0
225 TAYLOR STREET

JOHN K. GRADY, TRUSTEE OF THE
FOSTER/TAYLOR REALTY TRUST
BK/PG 25198/143
PLAN NO 228 OF 1992
PARCEL #R09 32 0
230 TAYLOR STREET

2641–2651 SANTA ANNA AVENUE, LLC
BK/PG 68756/572
PLAN NO 1425 OF 1981
PARCEL #R10 2 1
305 FOSTER STREET

JOHN K. GRADY & DAVID B. RICE, TRUSTEES OF
CONCORD ASSOCIATES FOSTER STREET TRUST
BK/PG 14680/362
PLAN NO 1314 OF 1981
PARCEL #R09 33 0
300 FOSTER STREET

CONTINUED ON SHEET NO. 66

PLANT LIST

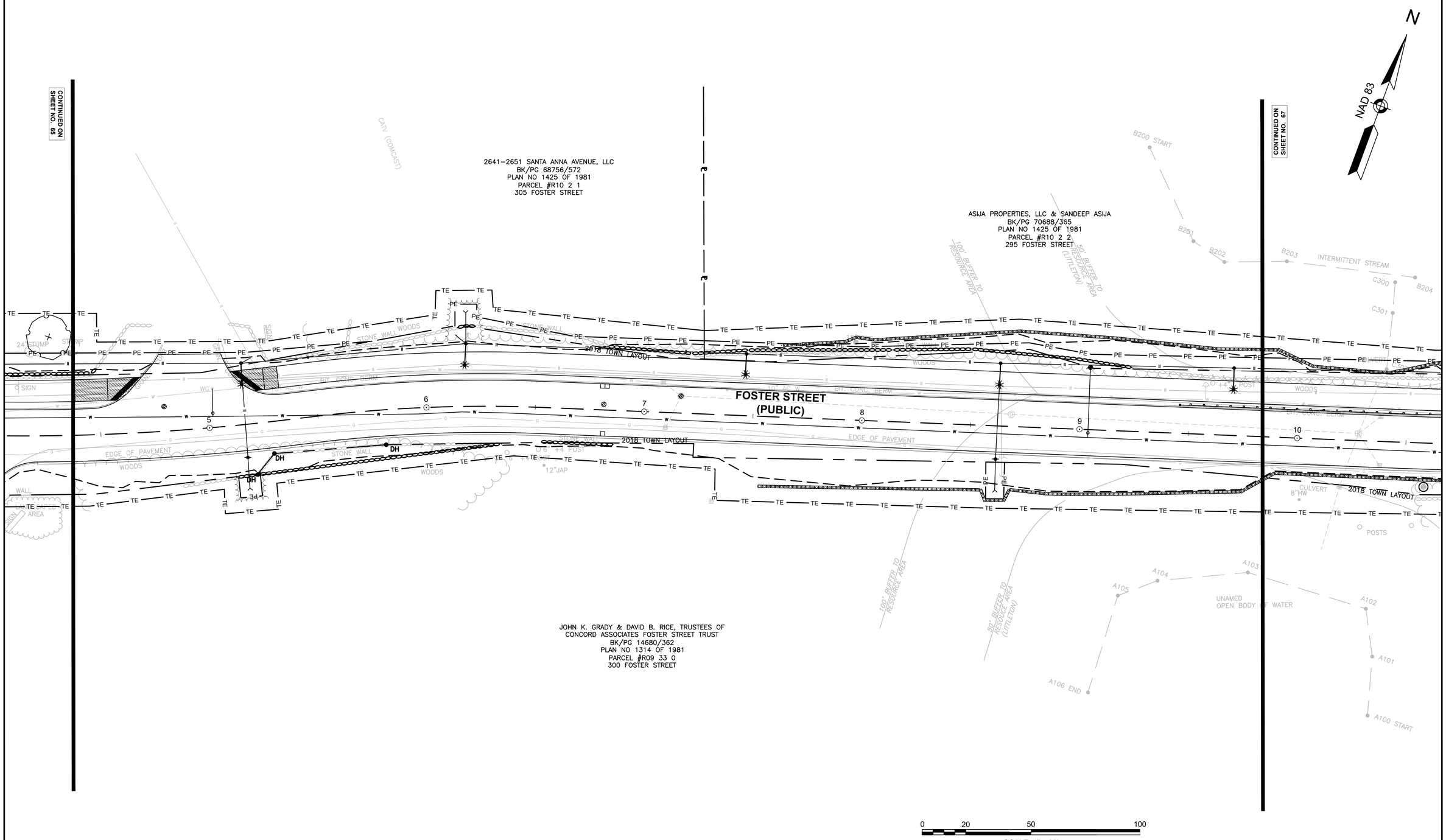
KEY	BOTANICAL NAME	COMMON NAME	HT.	QTY.	SIZE
	TREES				
AR	ACER RUBRUM 'KARPICK'	KARPICK RED MAPLE	40'	6	2"–2.5" CAL.
AG	AMELANCHIER X GRANDIFLORA 'ROBIN HILL'	ROBIN HILL SERVICEBERRY	15'	3	1.5"–2" CAL. (SINGLE STEM)

SCALE: 1" = 20'

LITTLETON
RECONSTRUCTION OF FOSTER STREET

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	XXX-XXXX(XXX)X	66	127
	PROJECT FILE NO. 609054		

LANDSCAPING PLANS



LITTLETON
RECONSTRUCTION OF FOSTER STREET

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	XXX-XXXX(XXX)X	67	127
PROJECT FILE NO.	609054		

LANDSCAPING PLANS

PLANT LIST

KEY	BOTANICAL NAME	COMMON NAME	HT.	QTY.	SIZE
	TREES				
AR	ACER RUBRUM 'KARPICK'	KARPICK RED MAPLE	40'	5	2"–2.5" CAL.
AG	AMELANCHIER X GRANDIFLORA 'ROBIN HILL'	ROBIN HILL SERVICEBERRY	15'	5	1.5"–2" CAL. (SINGLE STEM)
NS	NYSSA SYLVATICA	BLACK GUM	30'	6	2"–2.5" CAL.
QB	QUERCUS BICOLOR 'BONNIE AND MIKE'	BEACON SWAMP WHITE OAK	35'	4	2"–2.5" CAL.

LEGEND:

PLANT QUANTITY AND SPECIES

Plotted on 1-Dec-2023 7:42 AM

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PLANT LIST

KEY	BOTANICAL NAME	COMMON NAME	HT.	QTY.	SIZE
	TREES				
AC	ACER RUBRUM 'KARPICK'	KARPICK RED MAPLE	40'	3	2"–2.5" CAL.
AG	AMELANCHIER X GRANDIFLORA 'ROBIN HILL'	ROBIN HILL SERVICEBERRY	15'	14	1.5"–2" CAL. (SINGLE STEM)
NS	NYSSA SYLVATICA	BLACK GUM	30'	4	2"–2.5" CAL.
QB	QUERCUS BICOLOR 'BONNIE AND MIKE'	BEACON SWAMP WHITE OAK	35'	14	2"–2.5" CAL.
	SHRUBS				
RC	RHODODENDRON CATAWBIENSE 'ALBUM'	WHITE CATAWBA RHODODENDRON		19	3 GAL.

LEGEND:

PLANT QUANTITY AND SPECIES (X / XX)

LITTLETON
RECONSTRUCTION OF FOSTER STREET

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	XXX-XXXX(XXX)X	68	127
PROJECT FILE NO.	609054		

LANDSCAPING PLANS

20170044A21_LSP01.DWG Plotted on 1-Dec-2023 7:42 AM

NAD 83

N

ASIJA PROPERTIES, LLC & SANDEEP ASIJA
BK/PG 70688/365
PLAN NO 1425 OF 1981
PARCEL #R10 2 2
295 FOSTER STREET

CONTINUED ON SHEET NO. 67

CONTINUED ON SHEET NO. 69

JORDAN S. MCCATHERIN
BK/PG 62917/52
PARCEL #R10 1 0
277 FOSTER STREET

FOSTER STREET (PUBLIC)

BULKELEY ROAD (PUBLIC)

Δ=9° 16' 42"
L=348.16' R=2150.00'

2018 TOWN LAYOUT

1950 TOWN LAYOUT SEE SHLO NO. 3786

50' BUFFER TO RESOURCE AREA (LITTLETON)

100' BUFFER TO RESOURCE AREA

ANTHONY J. RIZZOLO, JR. & JOSEPHINE RIZZOLO
BK/PG 17691/108
PLAN NO 831 OF 1973
PARCEL #R09 5 G
290 FOSTER STREET

BROCKTON KENYON & AINE COLLINS
BK/PG 72894/208
PLAN NO 831 OF 1973
PARCEL #R09 5 F
286 FOSTER STREET

GREGORY & SHERI BALZOTTI
BK/PG 50902/470
PLAN NO 831 OF 1973
PARCEL #R09 5 E
284 FOSTER ST

JOSEPH W. & AMANDA LENNON,
LIVING TRUSTEES OF THE
AMANDA+JOSEPH LENNON LIVING TRUST
BK/PG 64219/262
PLAN NO 1628 OF 1972
PARCEL #R09 5 A
3 BULKELEY ROAD

0 20 50 100
SCALE: 1" = 20'

PLANT LIST

KEY	BOTANICAL NAME	COMMON NAME	HT.	QTY.	SIZE
	TREES				
AG	AMELANCHIER X GRANDIFLORA 'ROBIN HILL'	ROBIN HILL SERVICEBERRY	15'	3	1.5"-2" CAL. (SINGLE STEM)

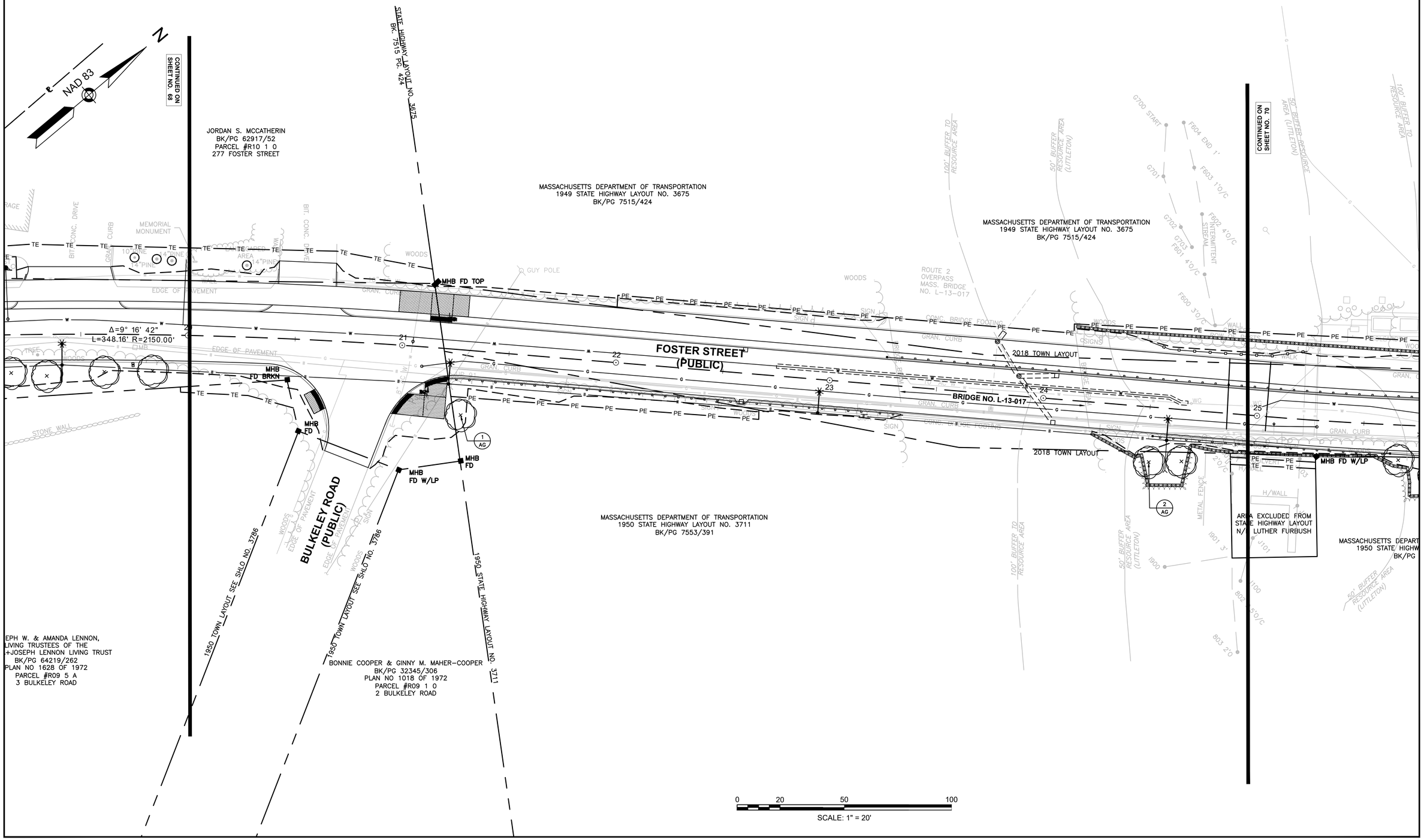
LEGEND:

PLANT QUANTITY AND SPECIES (X / XX)

LITTLETON
RECONSTRUCTION OF FOSTER STREET

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	XXX-XXXX(XXX)X	69	127
PROJECT FILE NO.	609054		

LANDSCAPING PLANS



PLANT LIST

KEY	BOTANICAL NAME	COMMON NAME	HT.	QTY.	SIZE
	TREES				
AG	AMELANCHIER X GRANDIFLORA 'ROBIN HILL'	ROBIN HILL SERVICEBERRY	15'	7	1.5"–2" CAL. (SINGLE STEM)
NS	NYSSA SYLVATICA	BLACK GUM	30'	2	2"–2.5" CAL.
QC	QUERCUS COCCINEA	SCARLET OAK	50'	1	2"–2.5" CAL.
AR	ACER RUBRUM 'KARPICK'	KARPICK RED MAPLE	40'	1	2"–2.5" CAL.

LEGEND:

PLANT QUANTITY AND SPECIES

LITTLETON
RECONSTRUCTION OF FOSTER STREET

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	XXX-XXXX(XXX)X	70	127
PROJECT FILE NO.	609054		

LANDSCAPING PLANS

NAD 83

265 FOSTER LLC
BK/PG 75845/36
PLAN NO 266 OF 1987
PARCEL #R11 1 0
265 FOSTER STREET

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
(PARCEL FBL 3–A)
BK/PG 57072/384
BK/PG 57072/376
PLAN NO 435 OF 2011
PARCEL #R11 3 5
263 FOSTER STREET

MASSACHUSETTS BAY TRANSPORTATI
(PARCEL FBL 3–B)
BK/PG 57072/384
BK/PG 57072/376
PLAN NO 435 OF 20
PARCEL #R11 3 5
263 FOSTER STREE

(MBTA)
BK/PG 13117/113
PARCEL #R11 2 0

JUNE 30, 1914 RAILROAD SIDELINE

1949 STATE HIGHWAY LAYOUT NO. 3675
BK. 7515 PG. 424

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY (f/ BOSTON & MAINE RAILROAD)

FOSTER STREET (PUBLIC)

GRIMES LANE (PUBLIC)

2018 TOWN LAYOUT

1950 SHLO NO. 3711

1951 SHLO NO. 3836

MASSACHUSETTS DEPARTMENT OF TRANSPORTATION
1950 STATE HIGHWAY LAYOUT NO. 3711
BK/PG 7553/391

AREA EXCLUDED FROM STATE HIGHWAY LAYOUT N/F LUTHER FURBUSH

(MBTA)
BK/PG 13117/113
PARCEL #R08 37 0

DURKEE FARM BUILDERS, INC.
BK/PG 67620/69
PARCEL #R08 15 0
260 FOSTER STREET

CONTINUED ON SHEET NO. 69

CONTINUED ON SHEET NO. 71

50' BUFFER RESOURCE AREA (LITTLETON)

100' BUFFER TO RESOURCE AREA

CATV (COMCAST)

0 20 50 100

SCALE: 1" = 20'

20170044A21_LSP01.DWG Plotted on 1-Dec-2023 7:43 AM

PLANT LIST

KEY	BOTANICAL NAME	COMMON NAME	HT.	QTY.	SIZE
	TREES				
AR	ACER RUBRUM 'KARPICK'	KARPICK RED MAPLE	40'	4	2"–2.5" CAL.
NS	NYSSA SYLVATICA	BLACK GUM	30'	3	2"–2.5" CAL.
QC	QUERCUS COCCINEA	SCARLET OAK	50'	1	2"–2.5" CAL.

LEGEND:

PLANT QUANTITY AND SPECIES (X / XX)

LITTLETON
RECONSTRUCTION OF FOSTER STREET

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	XXX-XXXX(XXX)X	71	127
PROJECT FILE NO.	609054		

LANDSCAPING PLANS

NAD 83 N

ETTS BAY TRANSORTATION AUTHORITY
(PARCEL FBL 3–A)
BK/PG 57072/384
BK/PG 57072/376
PLAN NO 435 OF 2011
PARCEL #R11 3 5
263 FOSTER STREET

MASSACHUSETTS BAY TRANSORTATION AUTHORITY
(PARCEL FBL 3–B)
BK/PG 57072/384
BK/PG 57072/376
PLAN NO 435 OF 2011
PARCEL #R11 3 5
263 FOSTER STREET

SNS FOSTER, LLC & C/O ROBERT LONG
BK/PG 72045/170
PLAN NO 435 OF 2011
PARCEL #R11 3 0
245 FOSTER STREET

CONTINUED ON SHEET NO. 70

CONTINUED ON SHEET NO. 72

FOSTER STREET (PUBLIC)

2018 TOWN LAYOUT

MHB FD

100' BUFFER TO RESOURCE AREA

50' BUFFER RESOURCE AREA (LITTLETON)

NOTE:
NO RECORD OF WATER LINE NORTHEAST OF THIS HYDRANT. WATER LINE IS BELIEVED TO CONTINUE AND IS SHOWN SCHEMATICALLY, FOR ILLUSTRATIVE PURPOSES ONLY.

RICHARD B. VIGNON
BK/PG 13250/70
PLAN NO 847 OF 1969
PARCEL #R08 13
242 FOSTER STREET

DURKEE FARM BUILDERS, INC.
BK/PG 67620/69
PARCEL #R08 15 0
260 FOSTER STREET

DERS, INC.
/69
15 0
TREET

0 20 50 100
SCALE: 1" = 20'

LITTLETON
RECONSTRUCTION OF FOSTER STREET

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	XXX-XXXX(XXX)X	72	127
	PROJECT FILE NO.	609054	

LANDSCAPING PLANS

Plotted on 1-Dec-2023 7:43 AM
20170044A21_LSP01.DWG