## PLANNED DEVELOPMENT (PD) SUBMITTAL TABLE

| | |
|---|---|
| TOTAL LAND AREA | 55,820 SF |
| DEVELOPABLE SITE AREA | 55,820 SF |
| COMMON OR USABLE OPEN SPACE | 28,840 SF |
| SITE COVERAGE OF BUILDINGS | 10,000 SF |
| IMPERVIOUS SURFACE AREA | 23,700 SF |
| IMPERVIOUS SURFACE RATIO | 0.428 (42.8%) |
| GROSS FLOOR AREA OF ALL NON RESIDENTIAL BUILDINGS | 0 SF |
| FLOOR AREA RATIO | 0.101 (10.1%) |
| DENSITY OF DWELLING UNITS | 3,072± SF/UNIT |
| NUMBER OF OFF-STREET PARKING SPACES | 28 SPACES |

## BUILDING HEIGHTS

| BUILDING | (A) AVERAGE FINISHED GRADE ELEVATION BASED ON BUILDING CORNERS (FT) | (B) GARAGE ENTRANCE ELEVATION (FT) | (C) MEAN ROOF HEIGHT ABOVE GARAGE ENTRANCE ELEVATION (FT) | (D) ELEVATION OF MEAN ROOF HEIGHT (FT) (B+C) | PROPOSED BUILDING HEIGHT (FT) (D−A) |
|---|---|---|---|---|---|
| 1 | 110.10 | 110.7 | 28.10 | 138.80 | 28.70 |
| 2 | 113.90 | 113.0 | 28.10 | 141.10 | 27.20 |
| 3 | 115.60 | 115.3 | 25.75 | 141.05 | 25.45 |
| 4 | 117.10 | 116.2 | 28.10 | 144.30 | 27.20 |
| 5 | 115.10 | 114.7 | 28.10 | 142.80 | 27.70 |
| 6 | 115.30 | 115.3 | 25.75 | 141.05 | 25.75 |
| 7 | 114.00 | 113.0 | 28.10 | 141.10 | 27.10 |
| 8 | 110.00 | 108.0 | 28.10 | 137.10 | 27.10 |

### BUILDING HEIGHT NOTE:

BUILDING HEIGHT IS CALCULATED AS THE VERTICAL DISTANCE FROM THE AVERAGE FINISHED GRADE (AVERAGE OF FINISHED GROUND ELEVATION AT THE MAIN CORNERS OF THE STRUCTURE) TO THE HIGHEST POINT OF THE ROOF: TOP OF THE HIGHEST ROOF BEAM (FLAT ROOF), DECK OF A MANSARD ROOF, OR MEAN LEVEL BETWEEN EAVES AND RIDGE (GABLE, HIP, SHED, GAMBREL, PYRAMID, OR SIMILAR ROOFS). MAXIMUM ALLOWABLE HEIGHTS ARE ESTABLISHED IN TABLE 2 (DIMENSIONAL REGULATIONS) BY ZONING DISTRICT. DEFINITION PER HAVERHILL ZONING ORDINANCE § 11.0 (DEFINITIONS).

### SNOW STORAGE NOTE:

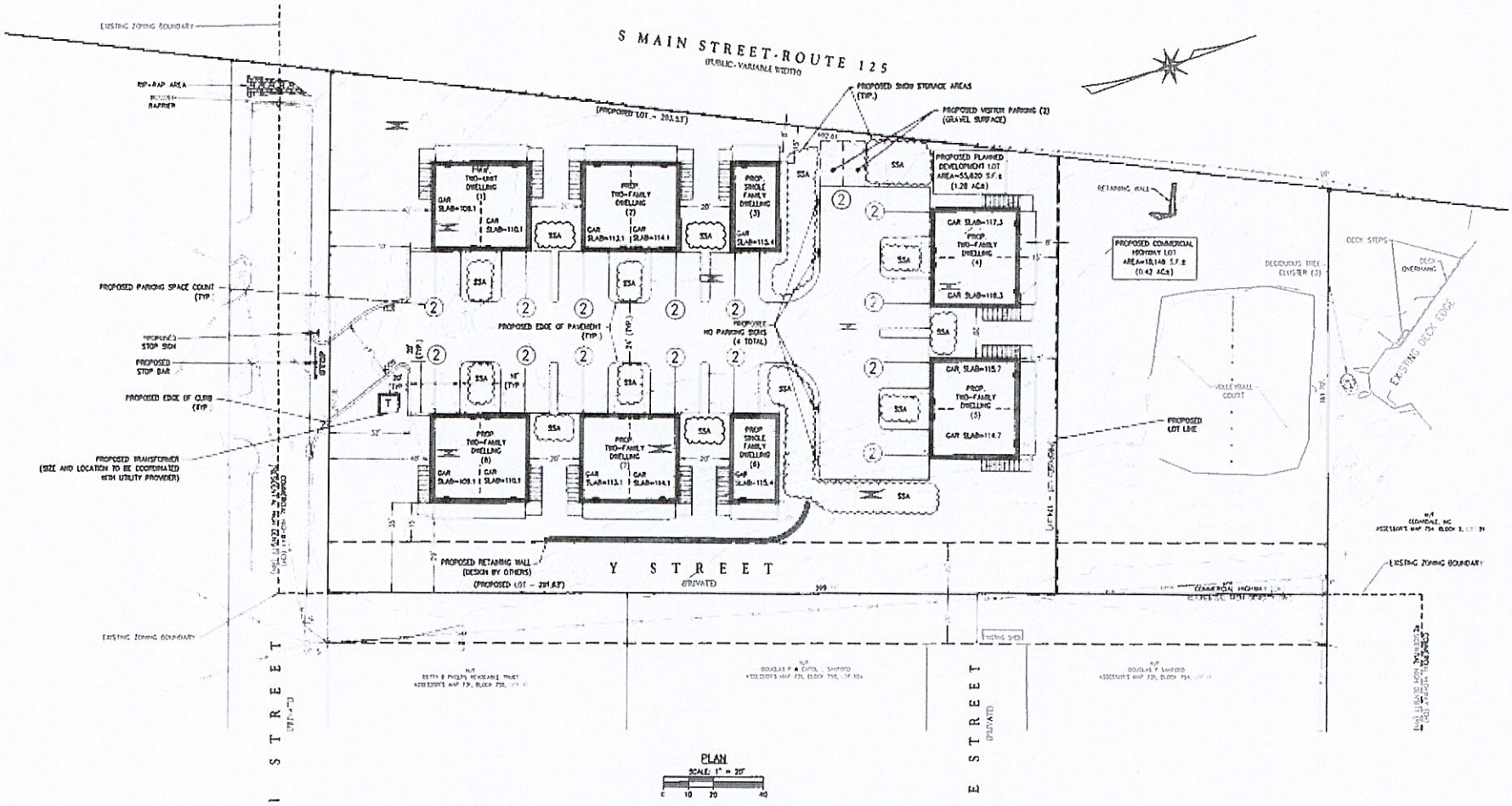
EXCESS SNOW TO BE REMOVED FROM THE SITE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE AND LOCAL REGULATIONS.

### PARKING SPACE COUNT SUMMARY

| | NUMBER OF SPACES |
|---|---|
| SURFACE (RESIDENTS) | 28 |
| SURFACE (VISITORS) | 2 |
| GARAGE | 14 |
| RATIO (14 UNITS) | 3.14 SPACES/ UNIT |

## ZONING TABLE – PLANNED DEVELOPMENT (PD)

| SETBACK | RESIDENTIAL HIGH DENSITY (RH) 1-FAM | RESIDENTIAL HIGH DENSITY (RH) 2-FAM | COMMERCIAL HIGHWAY (CH) | PROPOSED PD LOT |
|---|---|---|---|---|
| LOT AREA (MIN.) | 7,500 SF | 9,000 SF | 22,500 SF | 55,820 SF± |
| LOT AREA REQUIRED PER DWELLING UNIT (MIN.) | N/A | N/A | N/A | 3,072 SF± |
| LOT FRONTAGE (MIN.) | 75' | 80' | 175' | 207.39' |
| LOT DEPTH (MIN.) | 100' | 100' | 100' | 291' |
| FRONT SETBACK (MIN.) | 20' | 20' | 30' | 40' |
| SIDE SETBACK (MIN.) | 10' | 10' | 15' | 15' |
| REAR SETBACK (MIN.) | 30' | 30' | 15' | 15' |
| BUILDING HEIGHT (MAX.) | 35' | 35' | 40' | <40' |
| BUILDING HEIGHT – STORIES (MAX.) | 2.5 | 2.5 | 3.5 | <3.5 |
| BUILDING COVERAGE (% MAX.) | 25% | 25% | NONE | 18.1% |
| FLOOR AREA RATIO (FAR, MAX.) | N/A | N/A | 0.50 | <0.50 |
| OPEN SPACE (% MIN.) | 45% | 45% | 25% | 51% |




The Morin-Cameron GROUP, INC.
CIVIL ENGINEERS | ENVIRONMENTAL CONSULTANTS
LAND SURVEYORS | LAND USE PLANNERS
18 ELM STREET, HAVERHILL, MASSACHUSETTS 01832
P: 978.373.9666 F: 978.373.9693

SURVEY BY: MCC
DRAFTED BY: DTS
CHECKED BY: TLS
APPROVED BY: SPC
SCALE: AS NOTED
DATE: APRIL 28, 2023

| REVISIONS | | |
|---|---|---|
| NO. | DESCRIPTION | DATE |
| 1 | PER REVIEW & CITY COMMENTS | 9/29/2023 |

SITE DEVELOPMENT PLANS
IN
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(PORTION OF ASSESSOR'S MAP 734, BLOCK 2, LOT 21)
PREPARED FOR:
DENTINUET NORTH DEVELOPMENT LLC

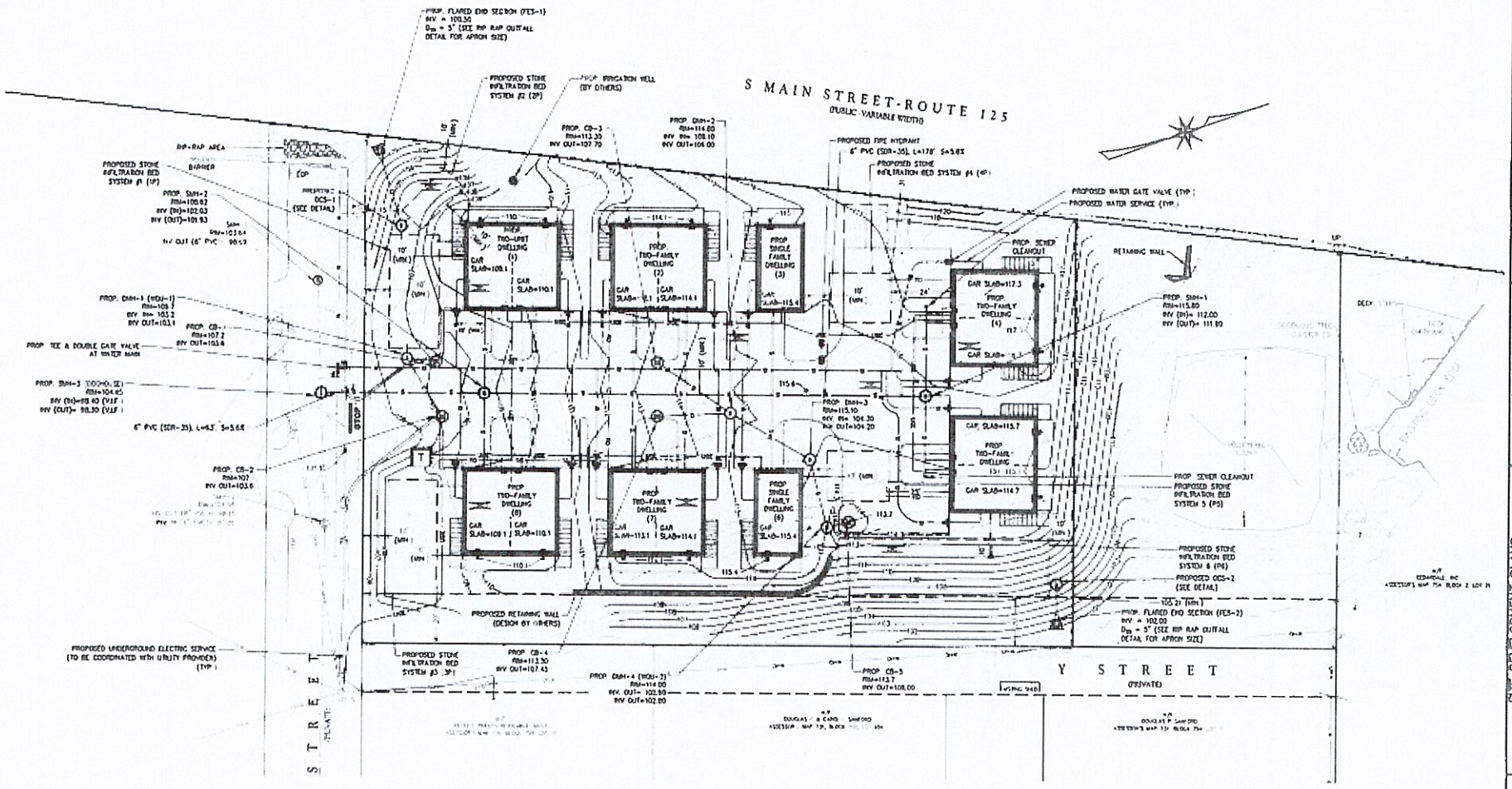
SITE LAYOUT PLAN

DRAWING NO. 5 OF 11

PROJ. #43
DRAWING: 4316_MAP.dwg

NOTES:

1. FINAL HYDRANT LOCATIONS TO BE COORDINATED WITH HAVERHILL FIRE DEPARTMENT
2. FINAL ELECTRIC LOCATIONS TO BE COORDINATED WITH UTILITY PROVIDER
2. FINAL WATER CONNECTION TO BE COORDINATED WITH HAVERHILL WATER DEPARTMENT
3. ALL ROOF STORMWATER TO BE DIRECTED TO STORMWATER SYSTEMS. FINAL CONNECTIONS TO BE COORDINATED WITH ARCHITECTURAL PLANS.




PLAN
SCALE: 1" = 20'
0 10 20 40

The Morin-Cameron GROUP, INC.
CIVIL ENGINEERS | ENVIRONMENTAL CONSULTANTS
LAND SURVEYORS | LANDSCAPE ARCHITECTS
14 GIN STREET, HAVERHILL, MASSACHUSETTS 01832
P. 978-373-0848, F. 978-373-0849, WWW.MORINCAMERON.COM

| REVISIONS | | |
|---|---|---|
| NO. | DESCRIPTION | DATE |
| 1 | PLAN REVIEW & CITY COMMENTS | 9/30/2008 |

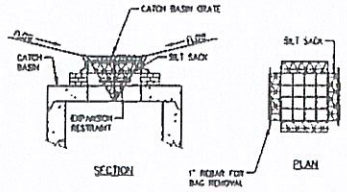
SURVEY BY: MCG
DRAFTED BY: CM
CHECKED BY: TMS
APPROVED BY: SPC
SCALE: AS NOTED
DATE: APRIL 28, 2008

SITE DEVELOPMENT PLANS
IN
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(PORTION OF ASSESSOR'S MAP 734, BLOCK 2, LOT 21)
PREPARED FOR:
PENTUCKET NORTH DEVELOPMENT LLC

GRADING, DRAINAGE & UTILITIES

DRAWING NO. 6 OF 11

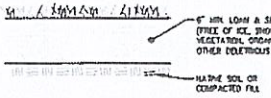
PROJ. #431
DRAWING 4319_MAIN.dwg



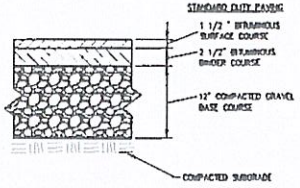

SILT SACK NOTES:

1. INSTALL SILT SACKS IN EXISTING CATCH BASINS. INSTALL SILT SACKS IN NEW CATCH BASINS AFTER INSTALLATION.
2. GRATES TO BE PLACED OVER SILT SACKS.
3. SILTSACK SHALL BE INSPECTED PERIODICALLY AND AFTER ALL STORM EVENTS AND CLEANING OR REPLACEMENT SHALL BE PERFORMED WHEN DEPTH OF SEDIMENT IS WITHIN 6" OF GRATE.

SILT SACK
(NOT TO SCALE)



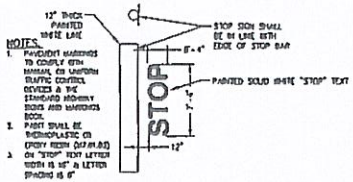

LOAM & SEED
(NOT TO SCALE)




NOTES:

1. PAVEMENT SHALL BE TYPE I, CLASS 1, BITUMINOUS CONCRETE.
2. PAVEMENT THICKNESS AFTER ROLLING.
3. SUBGRADE TO BE INSPECTED PRIOR TO INSTALLATION OF PAVEMENT SUBBASE. IF UNCOMPACTED FILL OR UNSUITABLE SOIL IS PRESENT, IT SHALL BE REMOVED TO UNDISTURBED NATIVE SOIL AND REPLACED WITH STRUCTURAL FILL COMPACTED TO 95% R.C.

TYPICAL PAVEMENT SECTION
(NOT TO SCALE)

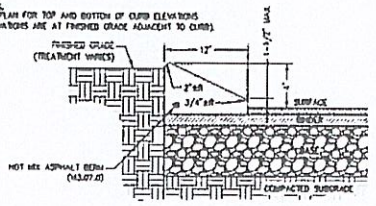



NOTES:

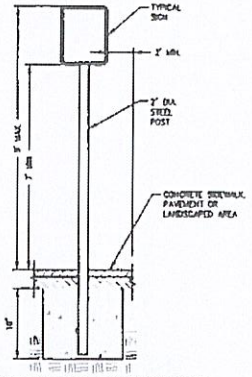
1. PAVEMENT MARKINGS TO COMPLY WITH MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES & THE STANDARD HIGHWAY SIGNS AND MARKINGS BOOK.
2. PAINT SHALL BE THERMOPLASTIC OR EPOXY RESIN (M7.01.02)
3. ON "STOP" TEXT LETTER WIDTH IS 48" & LETTER SPACING IS 6"

STOP BAR
(NOT TO SCALE)

NOTE:
SEE PLAN FOR TOP AND BOTTOM OF CURB ELEVATIONS (ELEVATIONS ARE AT FINISHED GRADE ADJACENT TO CURB).



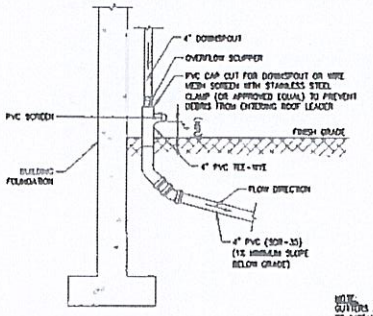

CAPE COD BERM
(NOT TO SCALE)




SIGN POST FOR SIGNS IN PARKING AREAS
(NOT TO SCALE)

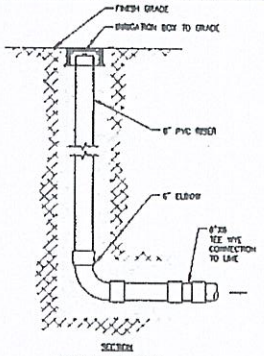
| M.U.T.C.D. LEGEND | WIDTH | HEIGHT | SYMBOL |
|---|---|---|---|
| R1-1 | 30" | 30" | STOP |

SIGN KEY
(NOT TO SCALE)

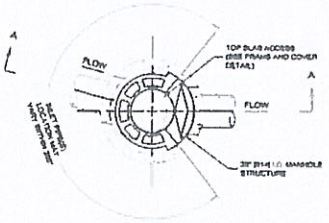



DOWN SPOUT ROOF LEADER
NOT TO SCALE

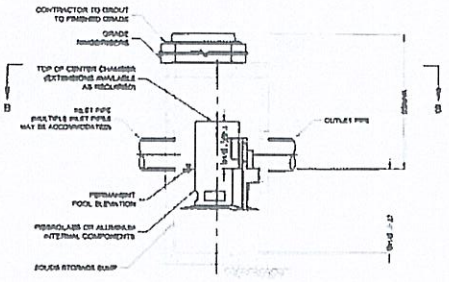
NOTE:
GUTTERS AND DOWNSPOUTS SHALL BE INSTALLED TO COLLECT ALL ROOF RUNOFF FROM THE HOUSE & CONVEY IT TO THE INFILTRATION AREAS.




SEWER CLEANOUT
(NOT TO SCALE)




PLAN VIEW B-B
NOT TO SCALE




ELEVATION A-A
NOT TO SCALE

CONTECH CS-3 (WQU-1 & WQU-2)
(NOT TO SCALE)

The Morin-Cameron GROUP, INC.
CIVIL ENGINEERS ENVIRONMENTAL CONSULTANTS

| REVISIONS | | |
|---|---|---|
| | DESCRIPTION | DATE |
| 1 | PER REVIEW & CITY COMMENTS | 9/20/2023 |

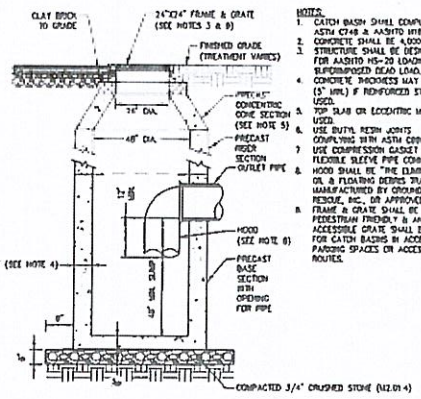
SURVEY BY: MCG
DRAFTED BY: DTS
CHECKED BY: BLS
APPROVED BY: SPC
SCALE: AS NOTED

SITE DEVELOPMENT PLANS
IN
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(PORTION OF ASSESSORS MAP 734, BLOCK 2, LOT 21)

DETAILS

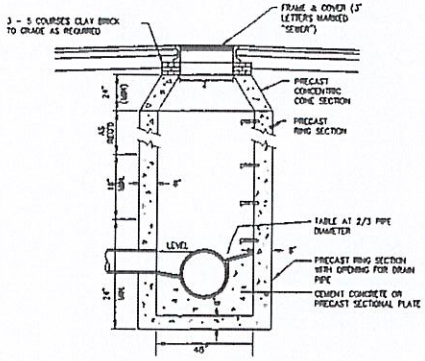
DRAWING NO.

PROJ#
DRAWING: 4316_MA



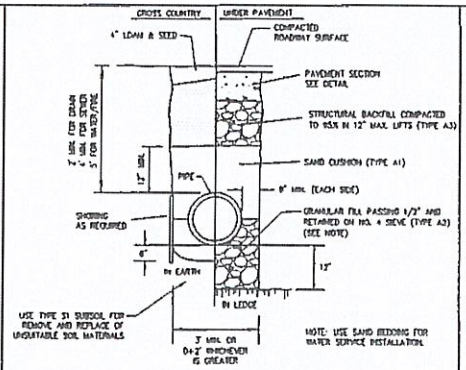

NOTES:
1. CATCH BASIN SHALL COMPLY WITH ASTM C748 & AASHTO M199.
2. CONCRETE SHALL BE 4,000 PSI MIN.
3. STRUCTURE SHALL BE DESIGNED FOR AASHTO HS-20 LOADING & SUPERIMPOSED DEAD LOAD.
4. CONCRETE THICKNESS MAY BE LESS (5" MIN.) IF REINFORCED STEEL IS USED.
5. TOP SLAB OR ECCENTRIC MAY BE USED.
6. USE BUTYL RESIN JOINTS COMPLYING WITH ASTM C990.
7. USE COMPRESSION GASKET OR FLEXIBLE SLEEVE PIPE CONNECTION.
8. HOOD SHALL BE "PIPE ELIMINATOR" OIL & FLOATING DEBRIS TRAP AS MANUFACTURED BY GROUND WATER RESCUE, INC., OR APPROVED EQUAL. FRAME & GRATE SHALL BE PEDESTRIAN FRIENDLY & AN ACCESSIBLE GRATE SHALL BE USED FOR CATCH BASINS IN ACCESSIBLE PARKING SPACES OR ACCESSIBLE ROUTES.

CATCH BASIN
(NOT TO SCALE)




NOTE: OUTLET INVERT IS A MINIMUM 0.10' LOWER THAN INLET INVERT.

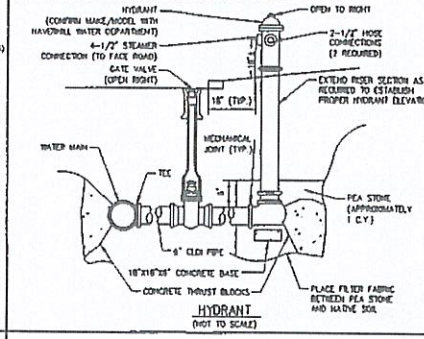
SEWER MANHOLE DETAIL
(NOT TO SCALE)



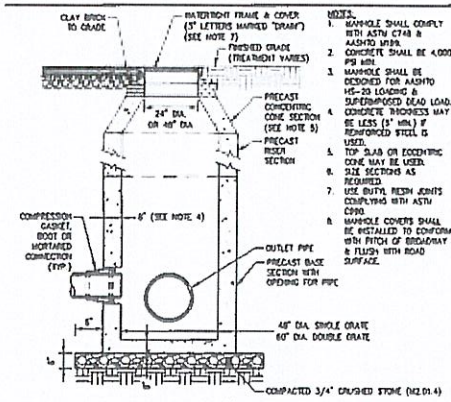

NOTE: USE SAND BEDDING FOR WATER SERVICE INSTALLATION

UTILITY TRENCH DETAIL
(NOT TO SCALE)

NOTES:
1. CONCRETE THRUST BLOCKS TO BE USED ONLY WHERE THEY CAN BEAR ON UNDISTURBED EARTH AS SHOWN. USE CLAMPS AND TIE RODS OR OTHER ACCEPTABLE METHOD OF JOINT RESTRAINT WHERE SOIL CONDITIONS PROHIBIT THE USE OF THRUST BLOCKS.
2. HYDRANT IN SIDEWALK AREAS TO BE LOCATED TO PROVIDE MINIMUM CLEAR SIDEWALK PASSAGE WIDTH OF 3 FEET AT HYDRANT.
3. COORDINATE FINAL LOCATIONS OF HYDRANT WITH HAVERHILL FIRE DEPARTMENT

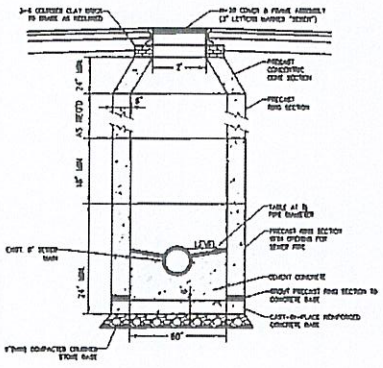



HYDRANT
(NOT TO SCALE)



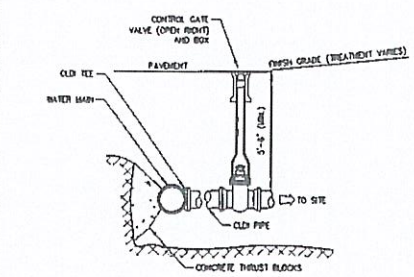

NOTES:
1. MANHOLE SHALL COMPLY WITH ASTM C748 & AASHTO M199.
2. CONCRETE SHALL BE 4,000 PSI MIN.
3. MANHOLE SHALL BE DESIGNED FOR AASHTO HS-20 LOADING & SUPERIMPOSED DEAD LOAD.
4. CONCRETE THICKNESS MAY BE LESS (5" MIN.) IF REINFORCED STEEL IS USED.
5. TOP SLAB OR ECCENTRIC CONE MAY BE USED.
6. SIZE SECTIONS AS REQUIRED.
7. USE BUTYL RESIN JOINTS COMPLYING WITH ASTM C990.
8. MANHOLE COVERS SHALL BE INSTALLED TO CONFORM WITH PITCH OF BROADWAY & FLUSH WITH ROAD SURFACE.

DRAIN MANHOLE
(NOT TO SCALE)

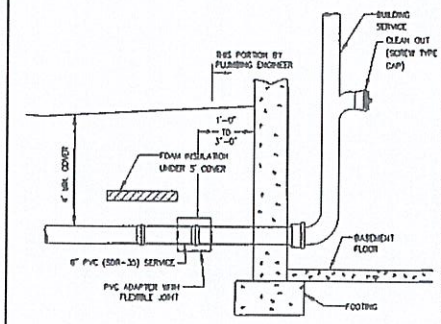



NOTES:
1. EXISTING SEWER MAIN LOCATION, SIZE, AND MATERIAL SHALL BE VERIFIED IN FIELD.
2. IF LEDGE ENCOUNTERED BELOW EXISTING SEWER MAIN, REINFORCING DOWELS SHALL BE SET A MIN. OF 6" INTO EXISTING LEDGE PRIOR TO CASTING BASE OF DOG HOUSE MANHOLE.

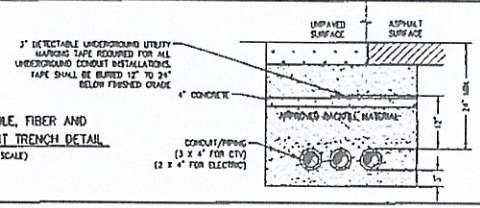
SEWER MANHOLE DETAIL (DOGHOUSE)
(NOT TO SCALE)




WATER MAIN GATE VALVE CONNECTION
(NOT TO SCALE)

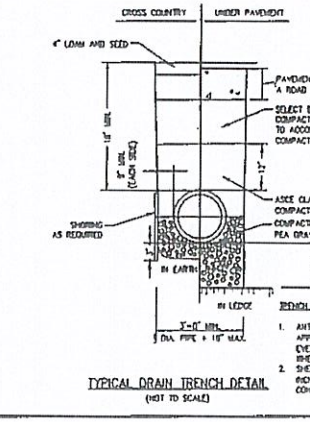



TYPICAL BUILDING SEWER SERVICE
(NOT TO SCALE)



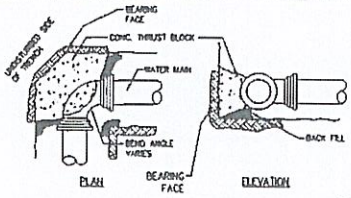

TELEPHONE, CABLE, FIBER AND ELECTRICAL CONDUIT TRENCH DETAIL
(NOT TO SCALE)

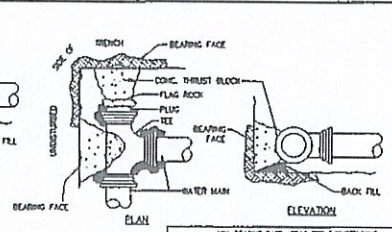
ELECTRICAL CONDUIT TRENCH DETAIL
NOTES:
1. ADJUST FOR ANY LOCAL MODIFICATIONS TO NFPA 70/NEC.
2. COORDINATE CONDUITS WITH APPLICABLE SERVICE PROVIDERS.




TRENCH NOTES:
1. ANTI-SEEPAGE COLLAR (ACTN-DRAIN OR APPROVED EQUAL) SHALL BE INSTALLED EVERY 50' ALONG A TRENCH EXCAVATION WHEN THE SLOPE EXCEEDS 4%.
2. SHEETING, IF USED, SHALL BE CUT OFF 12 INCHES (12") ABOVE TOP OF PIPE OR CONDUIT.

TYPICAL DRAIN TRENCH DETAIL
(NOT TO SCALE)




NOTES:
1. ALL WATER MAIN FITTINGS, BENDS, TEES, PLUGS ETC. SHALL BE RESTRAINED W/ THRUST BLOCKS EXCEPT WHERE NOTED.
2. ALL THRUST BLOCKS & COLLARS SHALL BE INSTALLED SO THAT THEY BEAR AGAINST UNDISTURBED EARTH.
3. MINIMUM COMPRESSIVE STRENGTH OF THRUST BLOCK CONCRETE SHALL BE 3,000 P.S.I.
4. KEEP CONCRETE CLEAR OF MECHANICAL JOINTS.

THRUST BLOCK DETAIL
(NOT TO SCALE)

| MIN. BEARING FACE AREAS FOR THRUSTBLOCKS | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 90° | 45° | 22.5° | 11.25 | PLUGS | CAPS | HYDRANTS |
| 8"-6" | 8 | 5 | 8 | 6 | 4 | 4 | 4 |
| 8"-12" | 12 | 8 | 5 | 6 | 8 | 8 | 6 |

The Morin-Cameron GROUP, INC.
CIVIL ENGINEERS / ENVIRONMENTAL CONSULTANTS
LAND SURVEYORS / LAND USE PLANNERS
2001 MAIN STREET, STRATHAM, NEW HAMPSHIRE 03885
P: 603-772-4746 F: 603-772-1851

| REV. | DESCRIPTION | DATE |
|---|---|---|
| 1 | PEER REVIEW & CITY COMMENTS | 9/30/2025 |

SURVEY BY: MCG
DRAFTED BY: DTS
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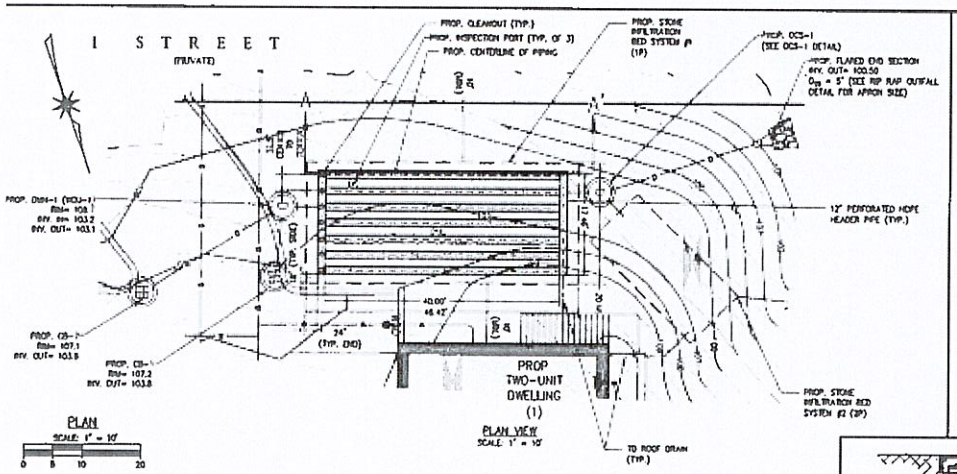
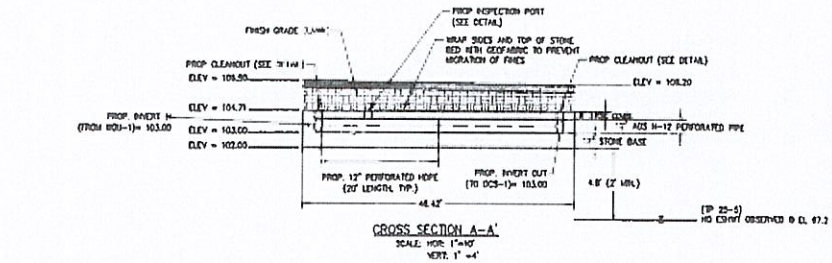
IN
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(PORTION OF ASSESSOR'S MAP 754, BLOCK 2, LOT 21)
PREPARED FOR:
CENTURY 21 NORTHEAST REALTY TRUST

DETAILS

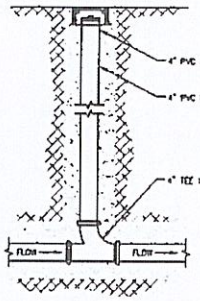
DRAWING NO. 8 OF 11

FROM A43
DRAWING 4318_MAP.dwg

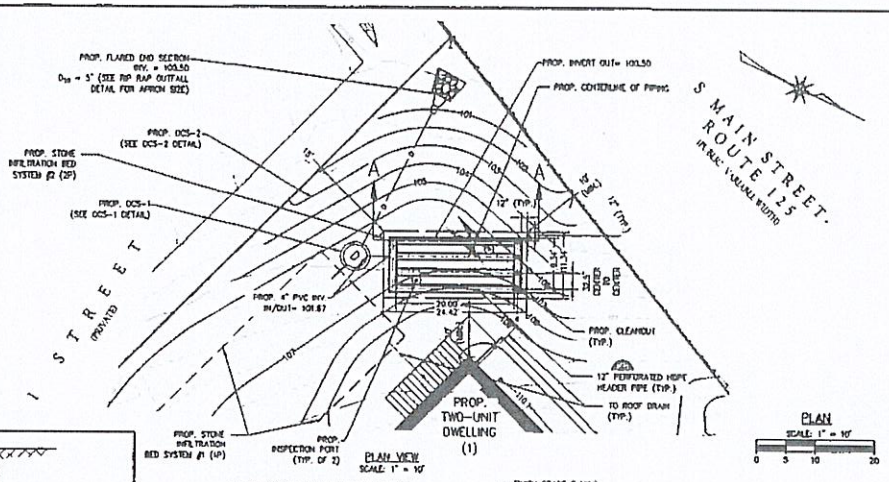


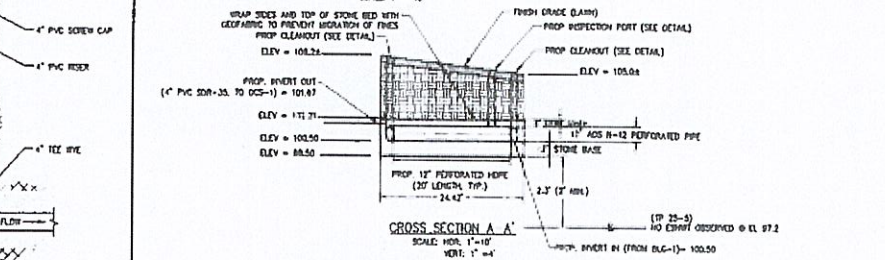




STONE INFILTRATION BED SYSTEM #1 DETAIL (1P)
(46.42 LENGTH X 20.46' WIDTH)
SCALE: AS NOTED

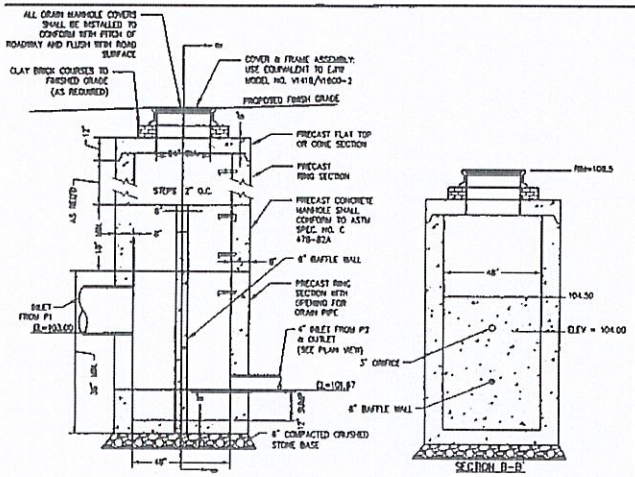



CLEANOUT
(NOT TO SCALE)

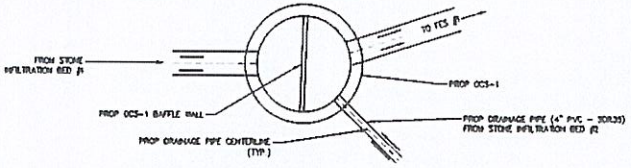


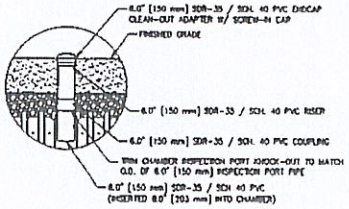

STONE INFILTRATION BED SYSTEM #2 DETAIL (SIS2)(2P)
(24.42' LENGTH X 11.34' WIDTH)
SCALE: AS NOTED




OUTLET CONTROL STRUCTURE (OCS-1)
(NOT TO SCALE)



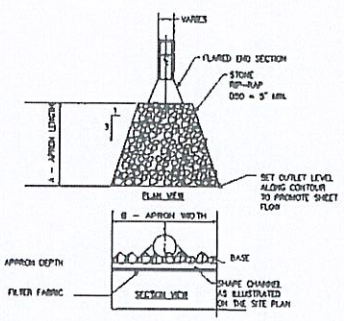

OUTLET CONTROL STRUCTURE (OCS-1, PLAN VIEW)
(NOT TO SCALE)




INSPECTION PORT
NOT TO SCALE

RIP RAP/OUTLET SIZING

| OUTLET | PIPE DIAMETER (in) | DESIGN 100-YR DISCHARGE (CFS) | $D_{50}$ MIN. (in) | SELECTED $D_{50}$ (in) | DESIGN APRON LENGTH "A" (FT) | DESIGN APRON LENGTH "B" (FT) | DESIGN APRON DEPTH "D" (FT) |
|---|---|---|---|---|---|---|---|
| FES-1 | 12 | 0.3 | 1 | 3 | 4 | 5.5 | 1.5 |
| FES-2 | 12 | 0.8 | 1 | 3 | 4 | 5.5 | 1.5 |




6 RIP RAP OUTFALL
(NOT TO SCALE)

The Morin-Cameron GROUP, INC.
CIVIL ENGINEERS | ENVIRONMENTAL CONSULTANTS
LAND SURVEYORS | LAND USE PLANNERS
10 DUPUIS DRIVE, WILMINGTON, MA 01887
P. 978-777-3050, F. 978-658-0018
WWW.MORINCAMERON.COM

| NO. | REVISIONS DESCRIPTION | DATE |
|---|---|---|
| 1 | PER REVIEW & CITY COMMENTS | 6/20/2008 |

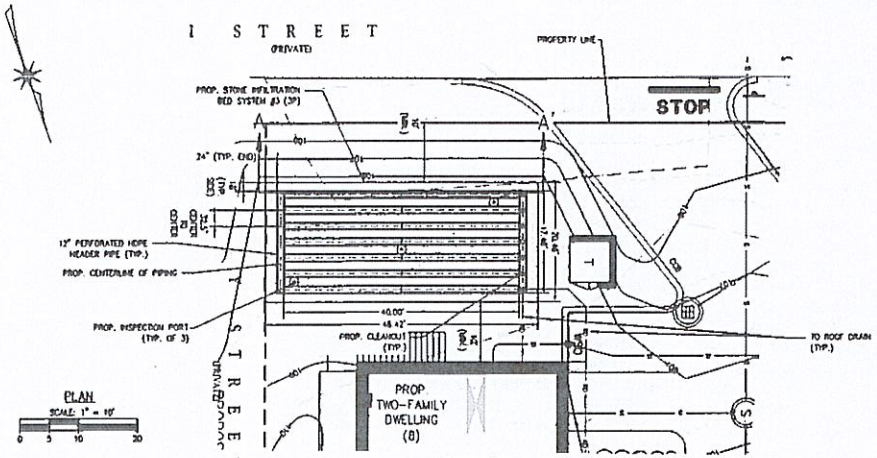
SURVEY BY: MCG
DRAFTED BY: DTS
CHECKED BY: RAS
APPROVED BY: SPC
SCALE: AS NOTED
DATE: APRIL 28, 2008

SITE DEVELOPMENT PLANS
IN
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(PORTION OF ASSESSORS MAP 734, BLOCK 2, LOT 21)
PREPARED FOR:
PENTUCKET NORTH DEVELOPMENT LLC

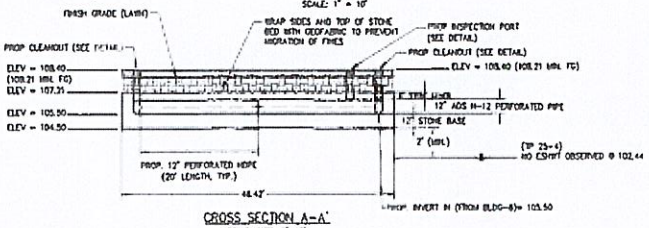
STORMWATER DETAILS

DRAWING NO. 9 OF 11

FILE NO. 04316
DRAWING: 4316_MAIN.dwg

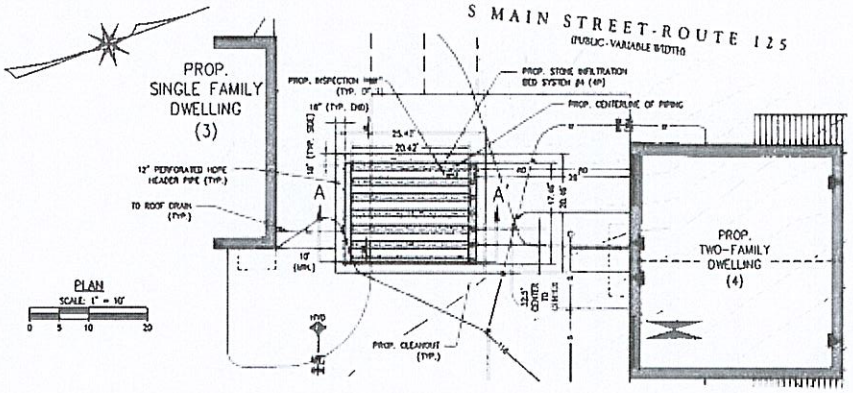



PLAN VIEW
SCALE: 1" = 10'

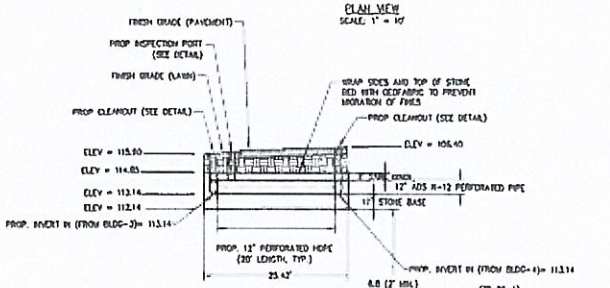



CROSS SECTION A-A'
SCALE: HOR: 1"=10'
VERT: 1" =4'

STONE INFILTRATION BED SYSTEM #3 DETAIL (3P)
(46.42' LENGTH X 20.46' WIDTH)
SCALE: AS NOTED

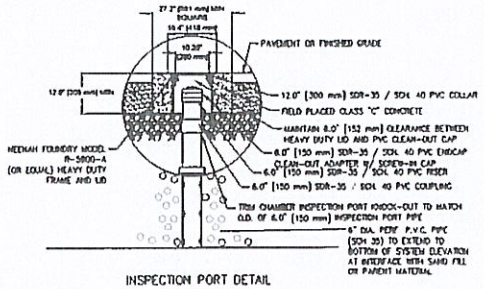



PLAN VIEW
SCALE: 1" = 10'




CROSS SECTION A-A'
SCALE: HOR: 1"=10'
VERT: 1" =4'

STONE INFILTRATION BED SYSTEM #4 DETAIL (4P)
(25.42' LENGTH X 20.46' WIDTH)
SCALE: AS NOTED




INSPECTION PORT DETAIL
(NOT TO SCALE)

The Morin-Cameron GROUP, INC.
CIVIL ENGINEERS ENVIRONMENTAL CONSULTANTS

| NO. | REVISIONS DESCRIPTION | DATE |
|---|---|---|
| 1 | PER REVIEW & CITY COMMENTS | 9/20/2006 |

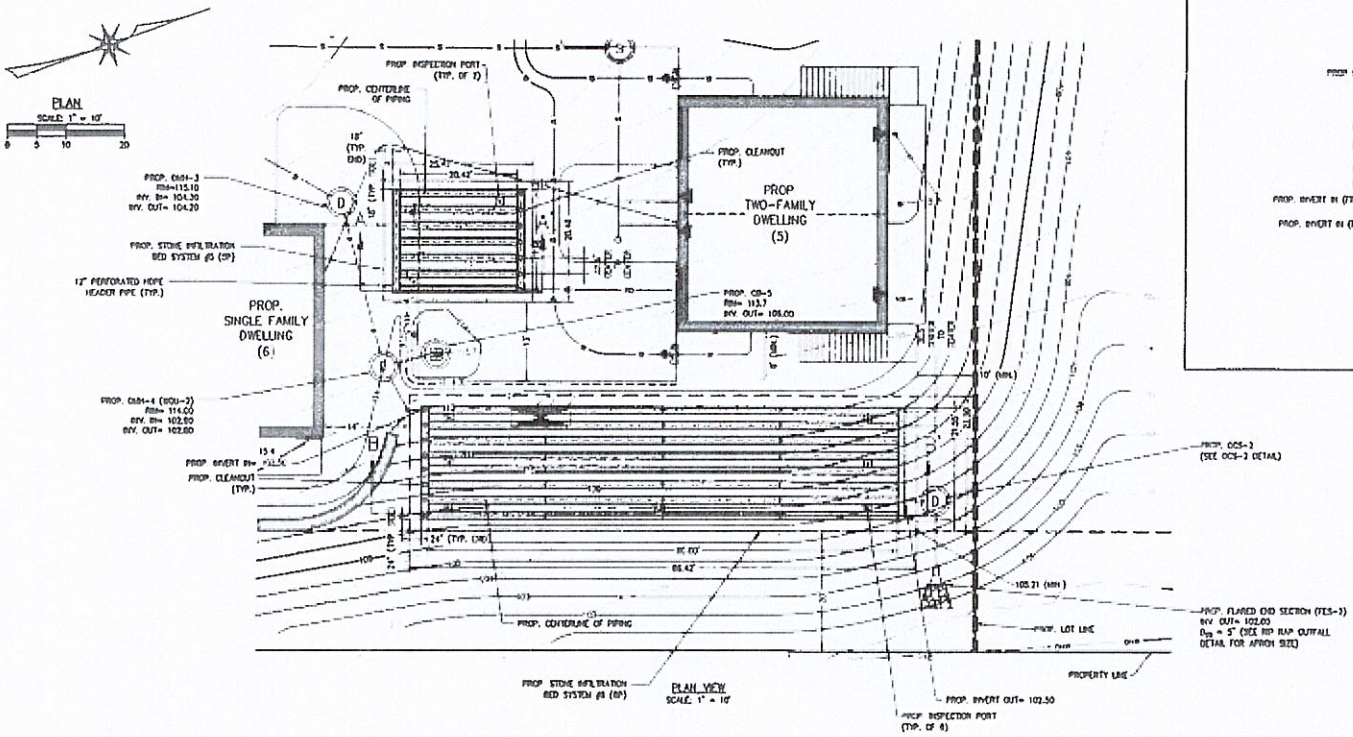
SURVEY BY: MCG
DRAWN BY: DTS
CHECKED BY: TMS
APPROVED BY: SPC
SCALE: AS NOTED

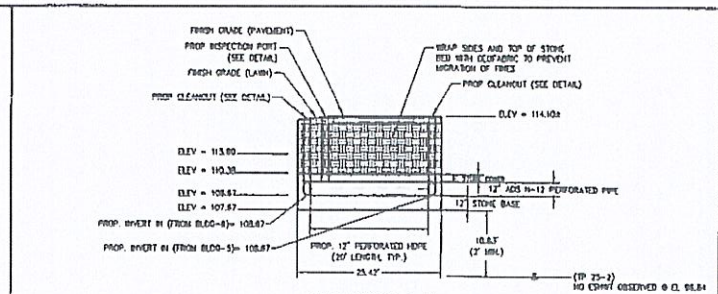
SITE DEVELOPMENT PLANS
IN
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(PORTION OF ASSESSOR'S MAP 754, BLOCK 2, LOT 21)

STORMWATER DETAILS

DRAWING NO.

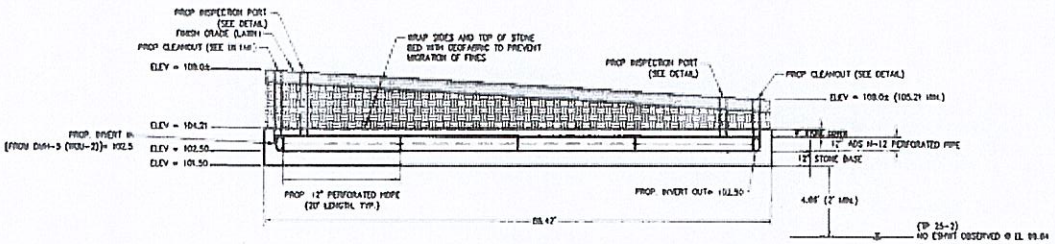
PROJ.
DRAWING: 4316_M



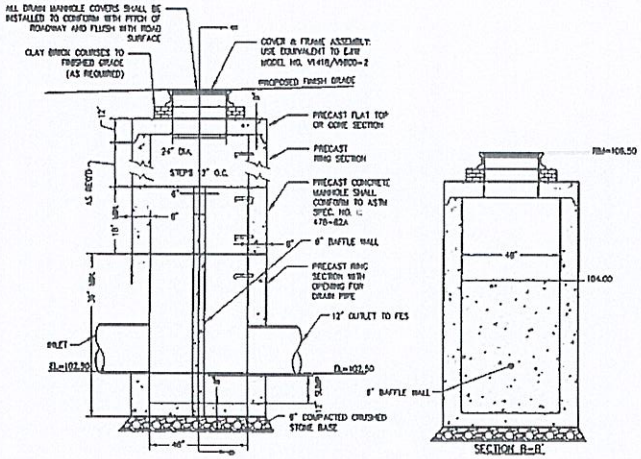

CROSS SECTION A-A'
SCALE: HOR: 1"=10'
VERT: 1"=4'

STONE INFILTRATION BED SYSTEM #5 DETAIL (5P)
(25.42' LENGTH X 20.46' WIDTH)
SCALE: AS NOTED




CROSS SECTION B-B'
SCALE: HOR: 1"=10'
VERT: 1"=4'

STONE INFILTRATION BED SYSTEM #6 DETAIL (6P)
(86.42' LENGTH X 23.00' WIDTH)
SCALE: AS NOTED




OUTLET CONTROL STRUCTURE (OCS-2)
(NOT TO SCALE)

The Morin-Cameron GROUP, INC.
CIVIL ENGINEERS | ENVIRONMENTAL CONSULTANTS
LAND SURVEYORS | LAND USE PLANNERS
18 ELM STREET, HAVERHILL, MASSACHUSETTS 01830
T: 978-373-9564 F: 978-373-9568

| NO. | REVISIONS DESCRIPTION | DATE |
|---|---|---|
| 1 | PER REVIEW & CITY COMMENTS | 9/20/2018 |

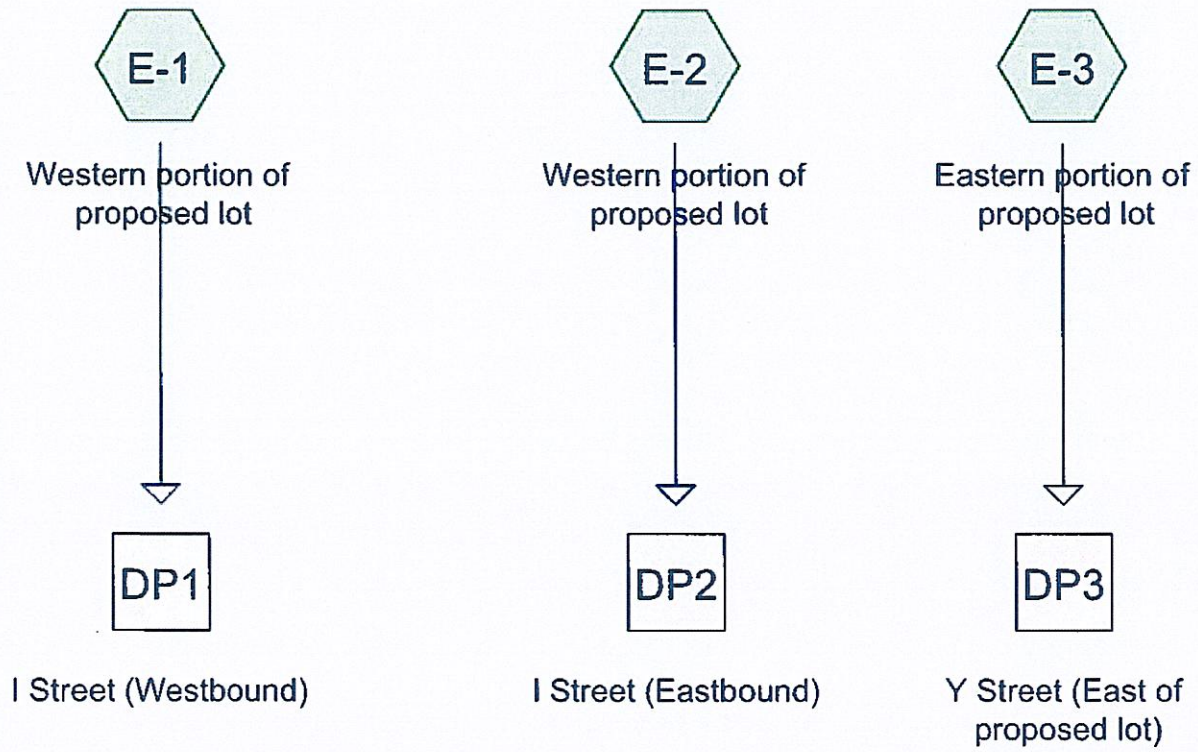
SURVEY BY: MCG
DRAFTED BY: DTS
CHECKED BY: MAS
APPROVED BY: JPC
SCALE: AS NOTED
DATE: APRIL 26, 2018

SITE DEVELOPMENT PLANS
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(PORTION OF ASSESSOR'S MAP 754, BLOCK 2, LOT 21)
PREPARED FOR:
PENTUCKET NORTH DEVELOPMENT LLC

STORMWATER DETAILS

DRAWING NO. 11 OF 11

PROJ. #4318
DRAWING 4318_MAP.dwg




Subcat Reach Pond Link

**Routing Diagram for 4316 Existing Conditions**
Prepared by The Morin-Cameron Group, Inc, Printed 9/17/2026
HydroCAD® 10.20-9a s/n 00401 © 2026 HydroCAD Software Solutions LLC

## Rainfall Events Listing

| Event# | Event Name | Storm Type | Curve | Mode | Duration (hours) | B/B | Depth (inches) | AMC |
|---|---|---|---|---|---|---|---|---|
| 1 | 2-Year | NOAA10 24-hr | D | Default | 24.00 | 1 | 3.17 | 2 |
| 2 | 10-Year | NOAA10 24-hr | D | Default | 24.00 | 1 | 5.02 | 2 |
| 3 | 25-Year | NOAA10 24-hr | D | Default | 24.00 | 1 | 6.18 | 2 |
| 4 | 100-Year | NOAA10 24-hr | D | Default | 24.00 | 1 | 7.96 | 2 |

## Area Listing (all nodes)

| Area (sq-ft) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 36,279 | 39 | >75% Grass cover, Good, HSG A (E-1, E-2, E-3) |
| 691 | 96 | Gravel surface, HSG A (E-1, E-2) |
| 36,826 | 30 | Woods, Good, HSG A (E-1, E-2, E-3) |
| **73,796** | **35** | **TOTAL AREA** |

## Ground Covers (all nodes)

| HSG-A (sq-ft) | HSG-B (sq-ft) | HSG-C (sq-ft) | HSG-D (sq-ft) | Other (sq-ft) | Total (sq-ft) | Ground Cover |
|---|---|---|---|---|---|---|
| 36,279 | 0 | 0 | 0 | 0 | 36,279 | >75% Grass cover, Good |
| 691 | 0 | 0 | 0 | 0 | 691 | Gravel surface |
| 36,826 | 0 | 0 | 0 | 0 | 36,826 | Woods, Good |
| **73,796** | **0** | **0** | **0** | **0** | **73,796** | **TOTAL AREA** |

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**SubcatchmentE-1: Western portion of** Runoff Area=14,004 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=180' Tc=6.4 min CN=32 Runoff=0.0 cfs 0 cf

**SubcatchmentE-2: Western portion of** Runoff Area=8,274 sf 0.00% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=34 Runoff=0.0 cfs 0 cf

**SubcatchmentE-3: Eastern portion of** Runoff Area=51,518 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=208' Tc=9.5 min CN=36 Runoff=0.0 cfs 0 cf

**Reach DP1: I Street (Westbound)** Inflow=0.0 cfs 0 cf
Outflow=0.0 cfs 0 cf

**Reach DP2: I Street (Eastbound)** Inflow=0.0 cfs 0 cf
Outflow=0.0 cfs 0 cf

**Reach DP3: Y Street (East of proposed lot)** Inflow=0.0 cfs 0 cf
Outflow=0.0 cfs 0 cf

**Total Runoff Area = 73,796 sf Runoff Volume = 0 cf Average Runoff Depth = 0.00"**
**100.00% Pervious = 73,796 sf 0.00% Impervious = 0 sf**

## Summary for Subcatchment E-1: Western portion of proposed lot

Runoff = 0.0 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"
Routed to Reach DP1 : I Street (Westbound)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 12,377 | 30 | Woods, Good, HSG A |
| 171 | 96 | Gravel surface, HSG A |
| 1,456 | 39 | >75% Grass cover, Good, HSG A |
| 14,004 | 32 | Weighted Average |
| 14,004 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | 50 | 0.0180 | 0.14 | | **Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.10" |
| 0.4 | 130 | 0.1270 | 5.74 | | **Shallow Concentrated Flow, Woodland** Unpaved Kv= 16.1 fps |
| 6.4 | 180 | Total | | | |

## Summary for Subcatchment E-2: Western portion of proposed lot

Runoff = 0.0 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"
Routed to Reach DP2 : I Street (Eastbound)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 7,667 | 30 | Woods, Good, HSG A |
| 520 | 96 | Gravel surface, HSG A |
| 87 | 39 | >75% Grass cover, Good, HSG A |
| 8,274 | 34 | Weighted Average |
| 8,274 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry,** |

## Summary for Subcatchment E-3: Eastern portion of proposed lot

Runoff = 0.0 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"
Routed to Reach DP3 : Y Street (East of proposed lot)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 16,782 | 30 | Woods, Good, HSG A |
| 34,736 | 39 | >75% Grass cover, Good, HSG A |
| 51,518 | 36 | Weighted Average |
| 51,518 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | 23 | 0.0430 | 0.08 | | **Sheet Flow, Sheet- Woods**<br>Woods: Light underbrush n= 0.400 P2= 3.10" |
| 4.0 | 27 | 0.0370 | 0.11 | | **Sheet Flow, Sheet - Lawn**<br>Grass: Dense n= 0.240 P2= 3.10" |
| 0.5 | 158 | 0.1010 | 5.12 | | **Shallow Concentrated Flow, Lawn**<br>Unpaved Kv= 16.1 fps |
| 9.5 | 208 | Total | | | |

## Summary for Reach DP1: I Street (Westbound)

Inflow Area = 14,004 sf, 0.00% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.0 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.0 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

## Summary for Reach DP2: I Street (Eastbound)

Inflow Area = 8,274 sf, 0.00% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.0 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.0 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

## Summary for Reach DP3: Y Street (East of proposed lot)

Inflow Area = 51,518 sf, 0.00% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.0 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.0 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment E-1: Western portion of** Runoff Area=14,004 sf 0.00% Impervious Runoff Depth=0.03"
Flow Length=180' Tc=6.4 min CN=32 Runoff=0.0 cfs 31 cf

**Subcatchment E-2: Western portion of** Runoff Area=8,274 sf 0.00% Impervious Runoff Depth=0.06"
Tc=6.0 min CN=34 Runoff=0.0 cfs 43 cf

**Subcatchment E-3: Eastern portion of** Runoff Area=51,518 sf 0.00% Impervious Runoff Depth=0.11"
Flow Length=208' Tc=9.5 min CN=36 Runoff=0.0 cfs 478 cf

**Reach DP1: I Street (Westbound)** Inflow=0.0 cfs 31 cf
Outflow=0.0 cfs 31 cf

**Reach DP2: I Street (Eastbound)** Inflow=0.0 cfs 43 cf
Outflow=0.0 cfs 43 cf

**Reach DP3: Y Street (East of proposed lot)** Inflow=0.0 cfs 478 cf
Outflow=0.0 cfs 478 cf

**Total Runoff Area = 73,796 sf Runoff Volume = 553 cf Average Runoff Depth = 0.09"**
**100.00% Pervious = 73,796 sf 0.00% Impervious = 0 sf**

**4316 Existing Conditions**
Prepared by The Morin-Cameron Group, Inc
HydroCAD® 10.20-9a s/n 00401 © 2026 HydroCAD Software Solutions LLC

## Summary for Subcatchment E-1: Western portion of proposed lot

Runoff = 0.0 cfs @ 21.85 hrs, Volume= 31 cf, Depth= 0.03"
Routed to Reach DP1 : I Street (Westbound)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 12,377 | 30 | Woods, Good, HSG A |
| 171 | 96 | Gravel surface, HSG A |
| 1,456 | 39 | >75% Grass cover, Good, HSG A |
| 14,004 | 32 | Weighted Average |
| 14,004 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | 50 | 0.0180 | 0.14 | | **Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.10" |
| 0.4 | 130 | 0.1270 | 5.74 | | **Shallow Concentrated Flow, Woodland** Unpaved Kv= 16.1 fps |
| 6.4 | 180 | Total | | | |

## Summary for Subcatchment E-2: Western portion of proposed lot

Runoff = 0.0 cfs @ 20.25 hrs, Volume= 43 cf, Depth= 0.06"
Routed to Reach DP2 : I Street (Eastbound)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 7,667 | 30 | Woods, Good, HSG A |
| 520 | 96 | Gravel surface, HSG A |
| 87 | 39 | >75% Grass cover, Good, HSG A |
| 8,274 | 34 | Weighted Average |
| 8,274 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry,** |

## Summary for Subcatchment E-3: Eastern portion of proposed lot

Runoff = 0.0 cfs @ 19.26 hrs, Volume= 478 cf, Depth= 0.11"
Routed to Reach DP3 : Y Street (East of proposed lot)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 16,782 | 30 | Woods, Good, HSG A |
| 34,736 | 39 | >75% Grass cover, Good, HSG A |
| 51,518 | 36 | Weighted Average |
| 51,518 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | 23 | 0.0430 | 0.08 | | **Sheet Flow, Sheet- Woods**<br>Woods: Light underbrush n= 0.400 P2= 3.10" |
| 4.0 | 27 | 0.0370 | 0.11 | | **Sheet Flow, Sheet - Lawn**<br>Grass: Dense n= 0.240 P2= 3.10" |
| 0.5 | 158 | 0.1010 | 5.12 | | **Shallow Concentrated Flow, Lawn**<br>Unpaved Kv= 16.1 fps |
| 9.5 | 208 | Total | | | |

## Summary for Reach DP1: I Street (Westbound)

Inflow Area = 14,004 sf, 0.00% Impervious, Inflow Depth = 0.03" for 10-Year event
Inflow = 0.0 cfs @ 21.85 hrs, Volume= 31 cf
Outflow = 0.0 cfs @ 21.85 hrs, Volume= 31 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

## Summary for Reach DP2: I Street (Eastbound)

Inflow Area = 8,274 sf, 0.00% Impervious, Inflow Depth = 0.06" for 10-Year event
Inflow = 0.0 cfs @ 20.25 hrs, Volume= 43 cf
Outflow = 0.0 cfs @ 20.25 hrs, Volume= 43 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

## Summary for Reach DP3: Y Street (East of proposed lot)

Inflow Area = 51,518 sf, 0.00% Impervious, Inflow Depth = 0.11" for 10-Year event
Inflow = 0.0 cfs @ 19.26 hrs, Volume= 478 cf
Outflow = 0.0 cfs @ 19.26 hrs, Volume= 478 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**SubcatchmentE-1: Western portion of** Runoff Area=14,004 sf 0.00% Impervious Runoff Depth=0.16"
Flow Length=180' Tc=6.4 min CN=32 Runoff=0.0 cfs 188 cf

**SubcatchmentE-2: Western portion of** Runoff Area=8,274 sf 0.00% Impervious Runoff Depth=0.24"
Tc=6.0 min CN=34 Runoff=0.0 cfs 168 cf

**SubcatchmentE-3: Eastern portion of** Runoff Area=51,518 sf 0.00% Impervious Runoff Depth=0.34"
Flow Length=208' Tc=9.5 min CN=36 Runoff=0.0 cfs 1,449 cf

**Reach DP1: I Street (Westbound)** Inflow=0.0 cfs 188 cf
Outflow=0.0 cfs 188 cf

**Reach DP2: I Street (Eastbound)** Inflow=0.0 cfs 168 cf
Outflow=0.0 cfs 168 cf

**Reach DP3: Y Street (East of proposed lot)** Inflow=0.0 cfs 1,449 cf
Outflow=0.0 cfs 1,449 cf

**Total Runoff Area = 73,796 sf Runoff Volume = 1,805 cf Average Runoff Depth = 0.29"**
**100.00% Pervious = 73,796 sf 0.00% Impervious = 0 sf**

## Summary for Subcatchment E-1: Western portion of proposed lot

Runoff = 0.0 cfs @ 18.95 hrs, Volume= 188 cf, Depth= 0.16"
Routed to Reach DP1 : I Street (Westbound)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.18"

| Area (sf) | CN | Description |
|---|---|---|
| 12,377 | 30 | Woods, Good, HSG A |
| 171 | 96 | Gravel surface, HSG A |
| 1,456 | 39 | >75% Grass cover, Good, HSG A |
| 14,004 | 32 | Weighted Average |
| 14,004 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | 50 | 0.0180 | 0.14 | | **Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.10" |
| 0.4 | 130 | 0.1270 | 5.74 | | **Shallow Concentrated Flow, Woodland** Unpaved Kv= 16.1 fps |
| 6.4 | 180 | Total | | | |

## Summary for Subcatchment E-2: Western portion of proposed lot

Runoff = 0.0 cfs @ 15.02 hrs, Volume= 168 cf, Depth= 0.24"
Routed to Reach DP2 : I Street (Eastbound)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.18"

| Area (sf) | CN | Description |
|---|---|---|
| 7,667 | 30 | Woods, Good, HSG A |
| 520 | 96 | Gravel surface, HSG A |
| 87 | 39 | >75% Grass cover, Good, HSG A |
| 8,274 | 34 | Weighted Average |
| 8,274 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry,** |

## Summary for Subcatchment E-3: Eastern portion of proposed lot

Runoff = 0.0 cfs @ 13.25 hrs, Volume= 1,449 cf, Depth= 0.34"
Routed to Reach DP3 : Y Street (East of proposed lot)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.18"

| Area (sf) | CN | Description |
|---|---|---|
| 16,782 | 30 | Woods, Good, HSG A |
| 34,736 | 39 | >75% Grass cover, Good, HSG A |
| 51,518 | 36 | Weighted Average |
| 51,518 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | 23 | 0.0430 | 0.08 | | **Sheet Flow, Sheet- Woods**<br>Woods: Light underbrush n= 0.400 P2= 3.10" |
| 4.0 | 27 | 0.0370 | 0.11 | | **Sheet Flow, Sheet - Lawn**<br>Grass: Dense n= 0.240 P2= 3.10" |
| 0.5 | 158 | 0.1010 | 5.12 | | **Shallow Concentrated Flow, Lawn**<br>Unpaved Kv= 16.1 fps |
| 9.5 | 208 | Total | | | |

## Summary for Reach DP1: I Street (Westbound)

Inflow Area = 14,004 sf, 0.00% Impervious, Inflow Depth = 0.16" for 25-Year event
Inflow = 0.0 cfs @ 18.95 hrs, Volume= 188 cf
Outflow = 0.0 cfs @ 18.95 hrs, Volume= 188 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

## Summary for Reach DP2: I Street (Eastbound)

Inflow Area = 8,274 sf, 0.00% Impervious, Inflow Depth = 0.24" for 25-Year event
Inflow = 0.0 cfs @ 15.02 hrs, Volume= 168 cf
Outflow = 0.0 cfs @ 15.02 hrs, Volume= 168 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

## Summary for Reach DP3: Y Street (East of proposed lot)

Inflow Area = 51,518 sf, 0.00% Impervious, Inflow Depth = 0.34" for 25-Year event
Inflow = 0.0 cfs @ 13.25 hrs, Volume= 1,449 cf
Outflow = 0.0 cfs @ 13.25 hrs, Volume= 1,449 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**SubcatchmentE-1: Western portion of** Runoff Area=14,004 sf 0.00% Impervious Runoff Depth=0.55"
Flow Length=180' Tc=6.4 min CN=32 Runoff=0.0 cfs 644 cf

**SubcatchmentE-2: Western portion of** Runoff Area=8,274 sf 0.00% Impervious Runoff Depth=0.71"
Tc=6.0 min CN=34 Runoff=0.1 cfs 488 cf

**SubcatchmentE-3: Eastern portion of** Runoff Area=51,518 sf 0.00% Impervious Runoff Depth=0.87"
Flow Length=208' Tc=9.5 min CN=36 Runoff=0.5 cfs 3,755 cf

**Reach DP1: I Street (Westbound)** Inflow=0.0 cfs 644 cf
Outflow=0.0 cfs 644 cf

**Reach DP2: I Street (Eastbound)** Inflow=0.1 cfs 488 cf
Outflow=0.1 cfs 488 cf

**Reach DP3: Y Street (East of proposed lot)** Inflow=0.5 cfs 3,755 cf
Outflow=0.5 cfs 3,755 cf

**Total Runoff Area = 73,796 sf Runoff Volume = 4,886 cf Average Runoff Depth = 0.79"**
**100.00% Pervious = 73,796 sf 0.00% Impervious = 0 sf**

## Summary for Subcatchment E-1: Western portion of proposed lot

Runoff = 0.0 cfs @ 12.25 hrs, Volume= 644 cf, Depth= 0.55"
Routed to Reach DP1 : I Street (Westbound)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 12,377 | 30 | Woods, Good, HSG A |
| 171 | 96 | Gravel surface, HSG A |
| 1,456 | 39 | >75% Grass cover, Good, HSG A |
| 14,004 | 32 | Weighted Average |
| 14,004 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | 50 | 0.0180 | 0.14 | | **Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.10" |
| 0.4 | 130 | 0.1270 | 5.74 | | **Shallow Concentrated Flow, Woodland** Unpaved Kv= 16.1 fps |
| 6.4 | 180 | Total | | | |

## Summary for Subcatchment E-2: Western portion of proposed lot

Runoff = 0.1 cfs @ 12.16 hrs, Volume= 488 cf, Depth= 0.71"
Routed to Reach DP2 : I Street (Eastbound)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 7,667 | 30 | Woods, Good, HSG A |
| 520 | 96 | Gravel surface, HSG A |
| 87 | 39 | >75% Grass cover, Good, HSG A |
| 8,274 | 34 | Weighted Average |
| 8,274 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry,** |

## Summary for Subcatchment E-3: Eastern portion of proposed lot

Runoff = 0.5 cfs @ 12.20 hrs, Volume= 3,755 cf, Depth= 0.87"
Routed to Reach DP3 : Y Street (East of proposed lot)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 16,782 | 30 | Woods, Good, HSG A |
| 34,736 | 39 | >75% Grass cover, Good, HSG A |
| 51,518 | 36 | Weighted Average |
| 51,518 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | 23 | 0.0430 | 0.08 | | **Sheet Flow, Sheet- Woods**<br>Woods: Light underbrush n= 0.400 P2= 3.10" |
| 4.0 | 27 | 0.0370 | 0.11 | | **Sheet Flow, Sheet - Lawn**<br>Grass: Dense n= 0.240 P2= 3.10" |
| 0.5 | 158 | 0.1010 | 5.12 | | **Shallow Concentrated Flow, Lawn**<br>Unpaved Kv= 16.1 fps |
| 9.5 | 208 | Total | | | |

## Summary for Reach DP1: I Street (Westbound)

Inflow Area = 14,004 sf, 0.00% Impervious, Inflow Depth = 0.55" for 100-Year event
Inflow = 0.0 cfs @ 12.25 hrs, Volume= 644 cf
Outflow = 0.0 cfs @ 12.25 hrs, Volume= 644 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

## Summary for Reach DP2: I Street (Eastbound)

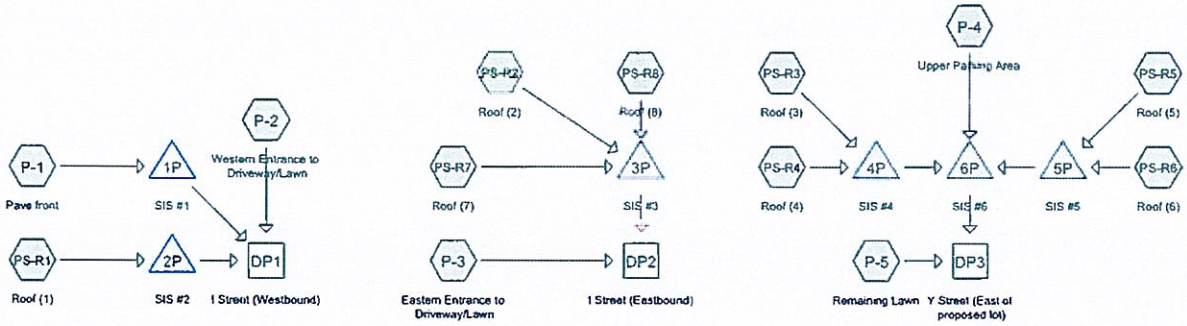
Inflow Area = 8,274 sf, 0.00% Impervious, Inflow Depth = 0.71" for 100-Year event
Inflow = 0.1 cfs @ 12.16 hrs, Volume= 488 cf
Outflow = 0.1 cfs @ 12.16 hrs, Volume= 488 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

## Summary for Reach DP3: Y Street (East of proposed lot)

Inflow Area = 51,518 sf, 0.00% Impervious, Inflow Depth = 0.87" for 100-Year event
Inflow = 0.5 cfs @ 12.20 hrs, Volume= 3,755 cf
Outflow = 0.5 cfs @ 12.20 hrs, Volume= 3,755 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2




Subcat Reach Pond Link

**Routing Diagram for 4316 Proposed Conditions**
Prepared by The Morin-Cameron Group, Inc, Printed 9/17/2026
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## Rainfall Events Listing

| Event# | Event Name | Storm Type | Curve | Mode | Duration (hours) | B/B | Depth (inches) | AMC |
|---|---|---|---|---|---|---|---|---|
| 1 | 2-Year | NOAA10 24-hr | D | Default | 24.00 | 1 | 3.17 | 2 |
| 2 | 10-Year | NOAA10 24-hr | D | Default | 24.00 | 1 | 5.02 | 2 |
| 3 | 100-Year | NOAA10 24-hr | D | Default | 24.00 | 1 | 7.96 | 2 |

## Area Listing (all nodes)

| Area (sq-ft) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 50,008 | 39 | >75% Grass cover, Good, HSG A (P-1, P-2, P-3, P-4, P-5) |
| 13,708 | 98 | Paved parking, HSG A (P-1, P-2, P-3, P-4) |
| 10,080 | 98 | Roofs, HSG A (PS-R1, PS-R2, PS-R3, PS-R4, PS-R5, PS-R6, PS-R7, PS-R8) |
| **73,796** | **58** | **TOTAL AREA** |

## Ground Covers (all nodes)

| HSG-A (sq-ft) | HSG-B (sq-ft) | HSG-C (sq-ft) | HSG-D (sq-ft) | Other (sq-ft) | Total (sq-ft) | Ground Cover |
|---|---|---|---|---|---|---|
| 50,008 | 0 | 0 | 0 | 0 | 50,008 | >75% Grass cover, Good |
| 13,708 | 0 | 0 | 0 | 0 | 13,708 | Paved parking |
| 10,080 | 0 | 0 | 0 | 0 | 10,080 | Roofs |
| **73,796** | **0** | **0** | **0** | **0** | **73,796** | **TOTAL AREA** |

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**SubcatchmentP-1: Pave front** Runoff Area=5,775 sf 80.45% Impervious Runoff Depth=1.81"
Tc=6.0 min CN=86 Runoff=0.3 cfs 871 cf

**SubcatchmentP-2: Western Entrance to** Runoff Area=8,985 sf 6.84% Impervious Runoff Depth=0.02"
Tc=6.0 min CN=43 Runoff=0.0 cfs 15 cf

**SubcatchmentP-3: Eastern Entrance to** Runoff Area=5,037 sf 12.63% Impervious Runoff Depth=0.05"
Tc=6.0 min CN=46 Runoff=0.0 cfs 23 cf

**SubcatchmentP-4: Upper Parking Area** Runoff Area=11,423 sf 68.38% Impervious Runoff Depth=1.31"
Tc=6.0 min CN=79 Runoff=0.4 cfs 1,251 cf

**SubcatchmentP-5: Remaining Lawn** Runoff Area=32,496 sf 0.00% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=39 Runoff=0.0 cfs 0 cf

**SubcatchmentPS-R1: Roof (1)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=2.94"
Tc=6.0 min CN=98 Runoff=0.1 cfs 353 cf

**SubcatchmentPS-R2: Roof (2)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=2.94"
Tc=6.0 min CN=98 Runoff=0.1 cfs 353 cf

**SubcatchmentPS-R3: Roof (3)** Runoff Area=720 sf 100.00% Impervious Runoff Depth=2.94"
Tc=6.0 min CN=98 Runoff=0.1 cfs 176 cf

**SubcatchmentPS-R4: Roof (4)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=2.94"
Tc=6.0 min CN=98 Runoff=0.1 cfs 353 cf

**SubcatchmentPS-R5: Roof (5)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=2.94"
Tc=6.0 min CN=98 Runoff=0.1 cfs 353 cf

**SubcatchmentPS-R6: Roof (6)** Runoff Area=720 sf 100.00% Impervious Runoff Depth=2.94"
Tc=6.0 min CN=98 Runoff=0.1 cfs 176 cf

**SubcatchmentPS-R7: Roof (7)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=2.94"
Tc=6.0 min CN=98 Runoff=0.1 cfs 353 cf

**SubcatchmentPS-R8: Roof (8)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=2.94"
Tc=6.0 min CN=98 Runoff=0.1 cfs 353 cf

**Reach DP1: I Street (Westbound)** Inflow=0.0 cfs 15 cf
Outflow=0.0 cfs 15 cf

**Reach DP2: I Street (Eastbound)** Inflow=0.0 cfs 23 cf
Outflow=0.0 cfs 23 cf

**Reach DP3: Y Street (East of proposed lot)** Inflow=0.0 cfs 0 cf
Outflow=0.0 cfs 0 cf

**Pond 1P: SIS #1** Peak Elev=102.70' Storage=265 cf Inflow=0.3 cfs 871 cf
Discarded=0.0 cfs 871 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 871 cf

**Pond 2P: SIS #2** Peak Elev=100.48' Storage=109 cf Inflow=0.1 cfs 353 cf
Discarded=0.0 cfs 353 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 353 cf

**Pond 3P: SIS #3** Peak Elev=105.33' Storage=315 cf Inflow=0.3 cfs 1,058 cf
Discarded=0.0 cfs 1,058 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 1,058 cf

**Pond 4P: SIS #4** Peak Elev=112.83' Storage=143 cf Inflow=0.2 cfs 529 cf
Discarded=0.0 cfs 529 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 529 cf

**Pond 5P: SIS #5** Peak Elev=108.35' Storage=141 cf Inflow=0.2 cfs 529 cf
Discarded=0.0 cfs 529 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 529 cf

**Pond 6P: SIS #6** Peak Elev=101.89' Storage=310 cf Inflow=0.4 cfs 1,251 cf
Discarded=0.0 cfs 1,251 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 1,251 cf

**Total Runoff Area = 73,796 sf Runoff Volume = 4,627 cf Average Runoff Depth = 0.75"**
**67.77% Pervious = 50,008 sf 32.23% Impervious = 23,788 sf**

## Summary for Subcatchment P-1: Pave front

Runoff = 0.3 cfs @ 12.13 hrs, Volume= 871 cf, Depth= 1.81"
Routed to Pond 1P : SIS #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 4,646 | 98 | Paved parking, HSG A |
| 1,129 | 39 | >75% Grass cover, Good, HSG A |
| 5,775 | 86 | Weighted Average |
| 1,129 | | 19.55% Pervious Area |
| 4,646 | | 80.45% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment P-2: Western Entrance to Driveway/Lawn

Runoff = 0.0 cfs @ 21.85 hrs, Volume= 15 cf, Depth= 0.02"
Routed to Reach DP1 : I Street (Westbound)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 8,370 | 39 | >75% Grass cover, Good, HSG A |
| 615 | 98 | Paved parking, HSG A |
| 8,985 | 43 | Weighted Average |
| 8,370 | | 93.16% Pervious Area |
| 615 | | 6.84% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment P-3: Eastern Entrance to Driveway/Lawn

Runoff = 0.0 cfs @ 19.94 hrs, Volume= 23 cf, Depth= 0.05"
Routed to Reach DP2 : I Street (Eastbound)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 4,401 | 39 | >75% Grass cover, Good, HSG A |
| 636 | 98 | Paved parking, HSG A |
| 5,037 | 46 | Weighted Average |
| 4,401 | | 87.37% Pervious Area |
| 636 | | 12.63% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment P-4: Upper Parking Area

Runoff = 0.4 cfs @ 12.13 hrs, Volume= 1,251 cf, Depth= 1.31"
Routed to Pond 6P : SIS #6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 7,811 | 98 | Paved parking, HSG A |
| 3,612 | 39 | >75% Grass cover, Good, HSG A |
| 11,423 | 79 | Weighted Average |
| 3,612 | | 31.62% Pervious Area |
| 7,811 | | 68.38% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment P-5: Remaining Lawn

Runoff = 0.0 cfs @ 24.02 hrs, Volume= 0 cf, Depth= 0.00"
Routed to Reach DP3 : Y Street (East of proposed lot)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 32,496 | 39 | >75% Grass cover, Good, HSG A |
| 32,496 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R1: Roof (1)

Runoff = 0.1 cfs @ 12.13 hrs, Volume= 353 cf, Depth= 2.94"
Routed to Pond 2P : SIS #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R2: Roof (2)

Runoff = 0.1 cfs @ 12.13 hrs, Volume= 353 cf, Depth= 2.94"
Routed to Pond 3P : SIS #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R3: Roof (3)

Runoff = 0.1 cfs @ 12.13 hrs, Volume= 176 cf, Depth= 2.94"
Routed to Pond 4P : SIS #4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 720 | 98 | Roofs, HSG A |
| 720 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R4: Roof (4)

Runoff = 0.1 cfs @ 12.13 hrs, Volume= 353 cf, Depth= 2.94"
Routed to Pond 4P : SIS #4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R5: Roof (5)

Runoff = 0.1 cfs @ 12.13 hrs, Volume= 353 cf, Depth= 2.94"
Routed to Pond 5P : SIS #5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R6: Roof (6)

Runoff = 0.1 cfs @ 12.13 hrs, Volume= 176 cf, Depth= 2.94"
Routed to Pond 5P : SIS #5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 720 | 98 | Roofs, HSG A |
| 720 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R7: Roof (7)

Runoff = 0.1 cfs @ 12.13 hrs, Volume= 353 cf, Depth= 2.94"
Routed to Pond 3P : SIS #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R8: Roof (8)

Runoff = 0.1 cfs @ 12.13 hrs, Volume= 353 cf, Depth= 2.94"
Routed to Pond 3P : SIS #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Reach DP1: I Street (Westbound)

Inflow Area = 16,200 sf, 41.36% Impervious, Inflow Depth = 0.01" for 2-Year event
Inflow = 0.0 cfs @ 21.85 hrs, Volume= 15 cf
Outflow = 0.0 cfs @ 21.85 hrs, Volume= 15 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

## Summary for Reach DP2: I Street (Eastbound)

Inflow Area = 5,037 sf, 12.63% Impervious, Inflow Depth = 0.05" for 2-Year event
Inflow = 0.0 cfs @ 19.94 hrs, Volume= 23 cf
Outflow = 0.0 cfs @ 19.94 hrs, Volume= 23 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

## Summary for Reach DP3: Y Street (East of proposed lot)

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 48,239 sf, | 25.15% Impervious, | Inflow Depth = | 0.00" | for 2-Year event |
| Inflow = | 0.0 cfs @ | 24.02 hrs, Volume= | 0 cf | | |
| Outflow = | 0.0 cfs @ | 24.02 hrs, Volume= | 0 cf, Atten= 0%, Lag= 0.0 min | | |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

## Summary for Pond 1P: SIS #1

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 5,775 sf, | 80.45% Impervious, | Inflow Depth = | 1.81" | for 2-Year event |
| Inflow = | 0.3 cfs @ | 12.13 hrs, Volume= | 871 cf | | |
| Outflow = | 0.0 cfs @ | 11.81 hrs, Volume= | 871 cf, Atten= 93%, Lag= 0.0 min | | |
| Discarded = | 0.0 cfs @ | 11.81 hrs, Volume= | 871 cf | | |
| Primary = | 0.0 cfs @ | 0.00 hrs, Volume= | 0 cf | | |

Routed to Reach DP1 : I Street (Westbound)

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 102.70' @ 13.36 hrs Surf.Area= 950 sf Storage= 265 cf

Plug-Flow detention time= 90.6 min calculated for 871 cf (100% of inflow)
Center-of-Mass det. time= 90.6 min ( 940.3 - 849.7 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 102.00' | 897 cf | **20.46'W x 46.42'L x 2.71'H Field A**<br>2,573 cf Overall - 330 cf Embedded = 2,243 cf x 40.0% Voids |
| #2A | 103.00' | 255 cf | **ADS N-12 12"** x 14 Inside #1<br>Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf<br>Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf<br>14 Chambers in 7 Rows<br>17.46' Header x 0.81 sf x 2 = 28.3 cf Inside |
| | | 1,152 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 102.00' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 103.00' | **12.0" Round Culvert**<br>L= 35.0' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 103.00' / 100.00' S= 0.0857 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.79 sf |
| #3 | Device 2 | 104.00' | **3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads |
| #4 | Device 2 | 104.50' | **4.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

**Discarded OutFlow** Max=0.0 cfs @ 11.81 hrs HW=102.03' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=102.00' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** ( Controls 0.0 cfs)
  ├─**3=Orifice/Grate** ( Controls 0.0 cfs)
  └─**4=Broad-Crested Rectangular Weir**( Controls 0.0 cfs)

## Summary for Pond 2P: SIS #2

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 1,440 sf,100.00% Impervious, | Inflow Depth = | 2.94" | for 2-Year event | |
| Inflow = | 0.1 cfs @ | 12.13 hrs, | Volume= | 353 cf | |
| Outflow = | 0.0 cfs @ | 11.29 hrs, | Volume= | 353 cf, | Atten= 94%, Lag= 0.0 min |
| Discarded = | 0.0 cfs @ | 11.29 hrs, | Volume= | 353 cf | |
| Primary = | 0.0 cfs @ | 0.00 hrs, | Volume= | 0 cf | |

Routed to Reach DP1 : I Street (Westbound)

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 100.48' @ 13.47 hrs Surf.Area= 277 sf Storage= 109 cf

Plug-Flow detention time= 115.5 min calculated for 352 cf (100% of inflow)
Center-of-Mass det. time= 115.4 min ( 876.4 - 761.0 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 99.50' | 259 cf | **11.34'W x 24.42'L x 2.71'H Field A**<br>750 cf Overall - 103 cf Embedded = 646 cf x 40.0% Voids |
| #2A | 100.50' | 80 cf | **ADS N-12 12"** x 4 Inside #1<br>Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf<br>Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf<br>4 Chambers in 4 Rows<br>9.34' Header x 0.81 sf x 2 = 15.1 cf Inside |
| | | 339 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 99.50' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 101.67' | **4.0" Round Culvert**<br>L= 5.0' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 101.67' / 101.67' S= 0.0000 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.09 sf |

**Discarded OutFlow** Max=0.0 cfs @ 11.29 hrs HW=99.53' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=99.50' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** ( Controls 0.0 cfs)

## Summary for Pond 3P: SIS #3

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 4,320 sf,100.00% Impervious, Inflow Depth = 2.94" for 2-Year event | | | | |
| Inflow = | 0.3 cfs @ | 12.13 hrs, | Volume= | 1,058 cf | |
| Outflow = | 0.0 cfs @ | 11.86 hrs, | Volume= | 1,058 cf, | Atten= 93%, Lag= 0.0 min |
| Discarded = | 0.0 cfs @ | 11.86 hrs, | Volume= | 1,058 cf | |
| Primary = | 0.0 cfs @ | 0.00 hrs, | Volume= | 0 cf | |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 105.33' @ 13.24 hrs Surf.Area= 950 sf Storage= 315 cf

Plug-Flow detention time= 97.4 min calculated for 1,057 cf (100% of inflow)
Center-of-Mass det. time= 97.4 min ( 858.3 - 761.0 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 104.50' | 897 cf | **20.46'W x 46.42'L x 2.71'H Field A**<br>2,573 cf Overall - 330 cf Embedded = 2,243 cf x 40.0% Voids |
| #2A | 105.50' | 255 cf | **ADS N-12 12"** x 14 Inside #1<br>Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf<br>Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf<br>14 Chambers in 7 Rows<br>17.46' Header x 0.81 sf x 2 = 28.3 cf Inside |
| #3 | 106.50' | 2 cf | **0.50'D x 10.00'H Vertical Cone/Cylinder**Impervious |
| | | 1,154 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 104.50' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.05' |
| #2 | Primary | 110.70' | **4.0" Vert. Roof Leader outlet @ tee-wye X 4.00** C= 0.600<br>Limited to weir flow at low heads |

**Discarded OutFlow** Max=0.0 cfs @ 11.86 hrs HW=104.62' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=104.50' (Free Discharge)
└**2=Roof Leader outlet @ tee-wye** ( Controls 0.0 cfs)

## Summary for Pond 4P: SIS #4

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 2,160 sf,100.00% Impervious, Inflow Depth = 2.94" for 2-Year event | | | | |
| Inflow = | 0.2 cfs @ | 12.13 hrs, | Volume= | 529 cf | |
| Outflow = | 0.0 cfs @ | 12.02 hrs, | Volume= | 529 cf, | Atten= 92%, Lag= 0.0 min |
| Discarded = | 0.0 cfs @ | 12.02 hrs, | Volume= | 529 cf | |
| Primary = | 0.0 cfs @ | 0.00 hrs, | Volume= | 0 cf | |
| Routed to Pond 6P : SIS #6 | | | | | |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 112.83' @ 13.06 hrs Surf.Area= 520 sf Storage= 143 cf

Plug-Flow detention time= 71.6 min calculated for 529 cf (100% of inflow)

Center-of-Mass det. time= 71.6 min ( 832.5 - 761.0 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 112.14' | 490 cf | **20.46'W x 25.42'L x 2.71'H Field A**<br>1,409 cf Overall - 183 cf Embedded = 1,226 cf x 40.0% Voids |
| #2A | 113.14' | 142 cf | **ADS N-12 12"** x 7 Inside #1<br>Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf<br>Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf<br>7 Chambers in 7 Rows<br>17.46' Header x 0.81 sf x 2 = 28.3 cf Inside |
| #3 | 114.14' | 3 cf | **0.50'D x 15.00'H Vertical Cone/Cylinder**Impervious |
| | | 635 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 112.14' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 117.80' | **4.0" Vert. Orifice/Grate X 4.00** C= 0.600<br>Limited to weir flow at low heads |

**Discarded OutFlow** Max=0.0 cfs @ 12.02 hrs HW=112.32' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=112.14' TW=101.50' (Dynamic Tailwater)
└**2=Orifice/Grate** ( Controls 0.0 cfs)

## Summary for Pond 5P: SIS #5

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 2,160 sf,100.00% Impervious, Inflow Depth = 2.94" for 2-Year event | | | | |
| Inflow = | 0.2 cfs @ | 12.13 hrs, | Volume= | 529 cf | |
| Outflow = | 0.0 cfs @ | 11.19 hrs, | Volume= | 529 cf, | Atten= 92%, Lag= 0.0 min |
| Discarded = | 0.0 cfs @ | 11.19 hrs, | Volume= | 529 cf | |
| Primary = | 0.0 cfs @ | 0.00 hrs, | Volume= | 0 cf | |

Routed to Pond 6P : SIS #6

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 108.35' @ 13.06 hrs Surf.Area= 520 sf Storage= 141 cf

Plug-Flow detention time= 68.8 min calculated for 529 cf (100% of inflow)
Center-of-Mass det. time= 68.8 min ( 829.8 - 761.0 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 107.67' | 490 cf | **20.46'W x 25.42'L x 2.71'H Field A**<br>1,409 cf Overall - 183 cf Embedded = 1,226 cf x 40.0% Voids |
| #2A | 108.67' | 142 cf | **ADS N-12 12"** x 7 Inside #1<br>Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf<br>Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf<br>7 Chambers in 7 Rows<br>17.46' Header x 0.81 sf x 2 = 28.3 cf Inside |
| #3 | 107.57' | 3 cf | **0.50'D x 15.00'H Vertical Cone/Cylinder**Impervious |
| | | 635 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 107.67' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 116.00' | **4.0" Vert. Orifice/Grate X 4.00** C= 0.600<br>Limited to weir flow at low heads |

**Discarded OutFlow** Max=0.0 cfs @ 11.19 hrs HW=107.67' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=107.57' TW=101.50' (Dynamic Tailwater)
└─**2=Orifice/Grate** ( Controls 0.0 cfs)

## Summary for Pond 6P: SIS #6

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 15,743 sf, | 77.06% Impervious, | Inflow Depth = | 0.95" | for 2-Year event |
| Inflow = | 0.4 cfs @ | 12.13 hrs, Volume= | 1,251 cf | | |
| Outflow = | 0.0 cfs @ | 11.95 hrs, Volume= | 1,251 cf, | Atten= 89%, | Lag= 0.0 min |
| Discarded = | 0.0 cfs @ | 11.95 hrs, Volume= | 1,251 cf | | |
| Primary = | 0.0 cfs @ | 0.00 hrs, Volume= | 0 cf | | |

Routed to Reach DP3 : Y Street (East of proposed lot)

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 101.89' @ 12.70 hrs Surf.Area= 1,988 sf Storage= 310 cf

Plug-Flow detention time= 44.4 min calculated for 1,251 cf (100% of inflow)
Center-of-Mass det. time= 44.4 min ( 926.3 - 881.9 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 101.50' | 1,870 cf | **23.00'W x 86.42'L x 2.71'H Field A**<br>5,385 cf Overall - 710 cf Embedded = 4,675 cf x 40.0% Voids |
| #2A | 102.50' | 549 cf | **ADS N-12 12"** x 32 Inside #1<br>Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf<br>Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf<br>32 Chambers in 8 Rows<br>19.00' Header x 0.81 sf x 2 = 30.8 cf Inside |
| | | 2,419 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 101.50' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 102.50' | **12.0" Round Culvert**<br>L= 50.0' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 102.50' / 102.00' S= 0.0100 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.79 sf |
| #3 | Device 2 | 104.00' | **4.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

**Discarded OutFlow** Max=0.0 cfs @ 11.95 hrs HW=101.53' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=101.50' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** ( Controls 0.0 cfs)
  └─**3=Broad-Crested Rectangular Weir**( Controls 0.0 cfs)

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**SubcatchmentP-1: Pave front** Runoff Area=5,775 sf 80.45% Impervious Runoff Depth=3.49"
Tc=6.0 min CN=86 Runoff=0.6 cfs 1,677 cf

**SubcatchmentP-2: Western Entrance to** Runoff Area=8,985 sf 6.84% Impervious Runoff Depth=0.36"
Tc=6.0 min CN=43 Runoff=0.0 cfs 269 cf

**SubcatchmentP-3: Eastern Entrance to** Runoff Area=5,037 sf 12.63% Impervious Runoff Depth=0.50"
Tc=6.0 min CN=46 Runoff=0.0 cfs 208 cf

**SubcatchmentP-4: Upper Parking Area** Runoff Area=11,423 sf 68.38% Impervious Runoff Depth=2.82"
Tc=6.0 min CN=79 Runoff=0.9 cfs 2,683 cf

**SubcatchmentP-5: Remaining Lawn** Runoff Area=32,496 sf 0.00% Impervious Runoff Depth=0.20"
Tc=6.0 min CN=39 Runoff=0.0 cfs 553 cf

**SubcatchmentPS-R1: Roof (1)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=4.78"
Tc=6.0 min CN=98 Runoff=0.2 cfs 574 cf

**SubcatchmentPS-R2: Roof (2)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=4.78"
Tc=6.0 min CN=98 Runoff=0.2 cfs 574 cf

**SubcatchmentPS-R3: Roof (3)** Runoff Area=720 sf 100.00% Impervious Runoff Depth=4.78"
Tc=6.0 min CN=98 Runoff=0.1 cfs 287 cf

**SubcatchmentPS-R4: Roof (4)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=4.78"
Tc=6.0 min CN=98 Runoff=0.2 cfs 574 cf

**SubcatchmentPS-R5: Roof (5)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=4.78"
Tc=6.0 min CN=98 Runoff=0.2 cfs 574 cf

**SubcatchmentPS-R6: Roof (6)** Runoff Area=720 sf 100.00% Impervious Runoff Depth=4.78"
Tc=6.0 min CN=98 Runoff=0.1 cfs 287 cf

**SubcatchmentPS-R7: Roof (7)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=4.78"
Tc=6.0 min CN=98 Runoff=0.2 cfs 574 cf

**SubcatchmentPS-R8: Roof (8)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=4.78"
Tc=6.0 min CN=98 Runoff=0.2 cfs 574 cf

**Reach DP1: I Street (Westbound)** Inflow=0.0 cfs 269 cf
Outflow=0.0 cfs 269 cf

**Reach DP2: I Street (Eastbound)** Inflow=0.0 cfs 208 cf
Outflow=0.0 cfs 208 cf

**Reach DP3: Y Street (East of proposed lot)** Inflow=0.0 cfs 553 cf
Outflow=0.0 cfs 553 cf

**Pond 1P: SIS #1** Peak Elev=103.65' Storage=698 cf Inflow=0.6 cfs 1,677 cf
Discarded=0.0 cfs 1,677 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 1,677 cf

**Pond 2P: SIS #2** Peak Elev=101.25' Storage=222 cf Inflow=0.2 cfs 574 cf
Discarded=0.0 cfs 574 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 574 cf

**Pond 3P: SIS #3** Peak Elev=106.03' Storage=630 cf Inflow=0.5 cfs 1,722 cf
Discarded=0.0 cfs 1,722 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 1,722 cf

**Pond 4P: SIS #4** Peak Elev=113.51' Storage=295 cf Inflow=0.3 cfs 861 cf
Discarded=0.0 cfs 861 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 861 cf

**Pond 5P: SIS #5** Peak Elev=109.03' Storage=293 cf Inflow=0.3 cfs 861 cf
Discarded=0.0 cfs 861 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 861 cf

**Pond 6P: SIS #6** Peak Elev=102.74' Storage=990 cf Inflow=0.9 cfs 2,683 cf
Discarded=0.0 cfs 2,683 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 2,683 cf

**Total Runoff Area = 73,796 sf Runoff Volume = 9,408 cf Average Runoff Depth = 1.53"**
**67.77% Pervious = 50,008 sf 32.23% Impervious = 23,788 sf**

## Summary for Subcatchment P-1: Pave front

Runoff = 0.6 cfs @ 12.13 hrs, Volume= 1,677 cf, Depth= 3.49"
Routed to Pond 1P : SIS #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 4,646 | 98 | Paved parking, HSG A |
| 1,129 | 39 | >75% Grass cover, Good, HSG A |
| 5,775 | 86 | Weighted Average |
| 1,129 | | 19.55% Pervious Area |
| 4,646 | | 80.45% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment P-2: Western Entrance to Driveway/Lawn

Runoff = 0.0 cfs @ 12.18 hrs, Volume= 269 cf, Depth= 0.36"
Routed to Reach DP1 : I Street (Westbound)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 8,370 | 39 | >75% Grass cover, Good, HSG A |
| 615 | 98 | Paved parking, HSG A |
| 8,985 | 43 | Weighted Average |
| 8,370 | | 93.16% Pervious Area |
| 615 | | 6.84% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment P-3: Eastern Entrance to Driveway/Lawn

Runoff = 0.0 cfs @ 12.16 hrs, Volume= 208 cf, Depth= 0.50"
Routed to Reach DP2 : I Street (Eastbound)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 4,401 | 39 | >75% Grass cover, Good, HSG A |
| 636 | 98 | Paved parking, HSG A |
| 5,037 | 46 | Weighted Average |
| 4,401 | | 87.37% Pervious Area |
| 636 | | 12.63% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment P-4: Upper Parking Area

Runoff = 0.9 cfs @ 12.13 hrs, Volume= 2,683 cf, Depth= 2.82"
Routed to Pond 6P : SIS #6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 7,811 | 98 | Paved parking, HSG A |
| 3,612 | 39 | >75% Grass cover, Good, HSG A |
| 11,423 | 79 | Weighted Average |
| 3,612 | | 31.62% Pervious Area |
| 7,811 | | 68.38% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment P-5: Remaining Lawn

Runoff = 0.0 cfs @ 15.02 hrs, Volume= 553 cf, Depth= 0.20"
Routed to Reach DP3 : Y Street (East of proposed lot)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 32,496 | 39 | >75% Grass cover, Good, HSG A |
| 32,496 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R1: Roof (1)

Runoff = 0.2 cfs @ 12.13 hrs, Volume= 574 cf, Depth= 4.78"
Routed to Pond 2P : SIS #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R2: Roof (2)

Runoff = 0.2 cfs @ 12.13 hrs, Volume= 574 cf, Depth= 4.78"
Routed to Pond 3P : SIS #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R3: Roof (3)

Runoff = 0.1 cfs @ 12.13 hrs, Volume= 287 cf, Depth= 4.78"
Routed to Pond 4P : SIS #4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 720 | 98 | Roofs, HSG A |
| 720 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R4: Roof (4)

Runoff = 0.2 cfs @ 12.13 hrs, Volume= 574 cf, Depth= 4.78"
Routed to Pond 4P : SIS #4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R5: Roof (5)

Runoff = 0.2 cfs @ 12.13 hrs, Volume= 574 cf, Depth= 4.78"
Routed to Pond 5P : SIS #5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R6: Roof (6)

Runoff = 0.1 cfs @ 12.13 hrs, Volume= 287 cf, Depth= 4.78"
Routed to Pond 5P : SIS #5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 720 | 98 | Roofs, HSG A |
| 720 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R7: Roof (7)

Runoff = 0.2 cfs @ 12.13 hrs, Volume= 574 cf, Depth= 4.78"
Routed to Pond 3P : SIS #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R8: Roof (8)

Runoff = 0.2 cfs @ 12.13 hrs, Volume= 574 cf, Depth= 4.78"
Routed to Pond 3P : SIS #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Reach DP1: I Street (Westbound)

Inflow Area = 16,200 sf, 41.36% Impervious, Inflow Depth = 0.20" for 10-Year event
Inflow = 0.0 cfs @ 12.18 hrs, Volume= 269 cf
Outflow = 0.0 cfs @ 12.18 hrs, Volume= 269 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

## Summary for Reach DP2: I Street (Eastbound)

Inflow Area = 5,037 sf, 12.63% Impervious, Inflow Depth = 0.50" for 10-Year event
Inflow = 0.0 cfs @ 12.16 hrs, Volume= 208 cf
Outflow = 0.0 cfs @ 12.16 hrs, Volume= 208 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

## Summary for Reach DP3: Y Street (East of proposed lot)

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 48,239 sf, | 25.15% Impervious, | Inflow Depth = | 0.14" | for 10-Year event |
| Inflow = | 0.0 cfs @ | 15.02 hrs, Volume= | 553 cf | | |
| Outflow = | 0.0 cfs @ | 15.02 hrs, Volume= | 553 cf, | Atten= 0%, | Lag= 0.0 min |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

## Summary for Pond 1P: SIS #1

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 5,775 sf, | 80.45% Impervious, | Inflow Depth = | 3.49" | for 10-Year event |
| Inflow = | 0.6 cfs @ | 12.13 hrs, Volume= | 1,677 cf | | |
| Outflow = | 0.0 cfs @ | 10.98 hrs, Volume= | 1,677 cf, | Atten= 96%, | Lag= 0.0 min |
| Discarded = | 0.0 cfs @ | 10.98 hrs, Volume= | 1,677 cf | | |
| Primary = | 0.0 cfs @ | 0.00 hrs, Volume= | 0 cf | | |

Routed to Reach DP1 : I Street (Westbound)

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 103.65' @ 15.08 hrs Surf.Area= 950 sf Storage= 698 cf

Plug-Flow detention time= 297.8 min calculated for 1,677 cf (100% of inflow)
Center-of-Mass det. time= 297.9 min ( 1,121.7 - 823.9 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 102.00' | 897 cf | **20.46'W x 46.42'L x 2.71'H Field A**<br>2,573 cf Overall - 330 cf Embedded = 2,243 cf x 40.0% Voids |
| #2A | 103.00' | 255 cf | **ADS N-12 12"** x 14 Inside #1<br>Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf<br>Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf<br>14 Chambers in 7 Rows<br>17.46' Header x 0.81 sf x 2 = 28.3 cf Inside |
| | | 1,152 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 102.00' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 103.00' | **12.0" Round Culvert**<br>L= 35.0' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 103.00' / 100.00' S= 0.0857 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.79 sf |
| #3 | Device 2 | 104.00' | **3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads |
| #4 | Device 2 | 104.50' | **4.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

**Discarded OutFlow** Max=0.0 cfs @ 10.98 hrs HW=102.03' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=102.00' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** ( Controls 0.0 cfs)
  ├─**3=Orifice/Grate** ( Controls 0.0 cfs)
  └─**4=Broad-Crested Rectangular Weir**( Controls 0.0 cfs)

## Summary for Pond 2P: SIS #2

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 1,440 sf,100.00% Impervious, | Inflow Depth = | 4.78" | for | 10-Year event |
| Inflow = | 0.2 cfs @ | 12.13 hrs, Volume= | 574 cf | | |
| Outflow = | 0.0 cfs @ | 10.25 hrs, Volume= | 574 cf, | Atten= 96%, | Lag= 0.0 min |
| Discarded = | 0.0 cfs @ | 10.25 hrs, Volume= | 574 cf | | |
| Primary = | 0.0 cfs @ | 0.00 hrs, Volume= | 0 cf | | |

Routed to Reach DP1 : I Street (Westbound)

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 101.25' @ 15.06 hrs Surf.Area= 277 sf Storage= 222 cf

Plug-Flow detention time= 279.9 min calculated for 574 cf (100% of inflow)
Center-of-Mass det. time= 279.9 min ( 1,030.4 - 750.5 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 99.50' | 259 cf | **11.34'W x 24.42'L x 2.71'H Field A**<br>750 cf Overall - 103 cf Embedded = 646 cf x 40.0% Voids |
| #2A | 100.50' | 80 cf | **ADS N-12 12"** x 4 Inside #1<br>Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf<br>Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf<br>4 Chambers in 4 Rows<br>9.34' Header x 0.81 sf x 2 = 15.1 cf Inside |
| | | 339 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 99.50' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 101.67' | **4.0" Round Culvert**<br>L= 5.0' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 101.67' / 101.67' S= 0.0000 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.09 sf |

**Discarded OutFlow** Max=0.0 cfs @ 10.25 hrs HW=99.53' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=99.50' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** ( Controls 0.0 cfs)

## Summary for Pond 3P: SIS #3

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 4,320 sf,100.00% Impervious, | Inflow Depth = | 4.78" | for | 10-Year event |
| Inflow = | 0.5 cfs @ | 12.13 hrs, Volume= | 1,722 cf | | |
| Outflow = | 0.0 cfs @ | 11.22 hrs, Volume= | 1,722 cf, | Atten= 96%, | Lag= 0.0 min |
| Discarded = | 0.0 cfs @ | 11.22 hrs, Volume= | 1,722 cf | | |
| Primary = | 0.0 cfs @ | 0.00 hrs, Volume= | 0 cf | | |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 106.03' @ 14.08 hrs Surf.Area= 950 sf Storage= 630 cf

Plug-Flow detention time= 230.2 min calculated for 1,721 cf (100% of inflow)
Center-of-Mass det. time= 230.2 min ( 980.8 - 750.5 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 104.50' | 897 cf | **20.46'W x 46.42'L x 2.71'H Field A**<br>2,573 cf Overall - 330 cf Embedded = 2,243 cf x 40.0% Voids |
| #2A | 105.50' | 255 cf | **ADS N-12 12"** x 14 Inside #1<br>Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf<br>Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf<br>14 Chambers in 7 Rows<br>17.46' Header x 0.81 sf x 2 = 28.3 cf Inside |
| #3 | 106.50' | 2 cf | **0.50'D x 10.00'H Vertical Cone/Cylinder**Impervious |
| | | 1,154 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 104.50' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.05' |
| #2 | Primary | 110.70' | **4.0" Vert. Roof Leader outlet @ tee-wye X 4.00** C= 0.600<br>Limited to weir flow at low heads |

**Discarded OutFlow** Max=0.0 cfs @ 11.22 hrs HW=104.62' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=104.50' (Free Discharge)
└─**2=Roof Leader outlet @ tee-wye** ( Controls 0.0 cfs)

## Summary for Pond 4P: SIS #4

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 2,160 sf,100.00% Impervious, | Inflow Depth = | 4.78" | for | 10-Year event |
| Inflow = | 0.3 cfs @ | 12.13 hrs, Volume= | 861 cf | | |
| Outflow = | 0.0 cfs @ | 11.74 hrs, Volume= | 861 cf, | Atten= 95%, | Lag= 0.0 min |
| Discarded = | 0.0 cfs @ | 11.74 hrs, Volume= | 861 cf | | |
| Primary = | 0.0 cfs @ | 0.00 hrs, Volume= | 0 cf | | |
| Routed to Pond 6P : SIS #6 | | | | | |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 113.51' @ 13.63 hrs Surf.Area= 520 sf Storage= 295 cf

Plug-Flow detention time= 185.8 min calculated for 861 cf (100% of inflow)

Center-of-Mass det. time= 185.7 min ( 936.3 - 750.5 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 112.14' | 490 cf | **20.46'W x 25.42'L x 2.71'H Field A** |
| | | | 1,409 cf Overall - 183 cf Embedded = 1,226 cf x 40.0% Voids |
| #2A | 113.14' | 142 cf | **ADS N-12 12"** x 7 Inside #1 |
| | | | Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf |
| | | | Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf |
| | | | 7 Chambers in 7 Rows |
| | | | 17.46' Header x 0.81 sf x 2 = 28.3 cf Inside |
| #3 | 114.14' | 3 cf | **0.50'D x 15.00'H Vertical Cone/Cylinder**Impervious |
| | | 635 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 112.14' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 117.80' | **4.0" Vert. Orifice/Grate X 4.00** C= 0.600 |
| | | | Limited to weir flow at low heads |

**Discarded OutFlow** Max=0.0 cfs @ 11.74 hrs HW=112.31' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=112.14' TW=101.50' (Dynamic Tailwater)
└**2=Orifice/Grate** ( Controls 0.0 cfs)

## Summary for Pond 5P: SIS #5

Inflow Area = 2,160 sf,100.00% Impervious, Inflow Depth = 4.78" for 10-Year event
Inflow = 0.3 cfs @ 12.13 hrs, Volume= 861 cf
Outflow = 0.0 cfs @ 10.57 hrs, Volume= 861 cf, Atten= 95%, Lag= 0.0 min
Discarded = 0.0 cfs @ 10.57 hrs, Volume= 861 cf
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Pond 6P : SIS #6

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 109.03' @ 13.63 hrs Surf.Area= 520 sf Storage= 293 cf

Plug-Flow detention time= 183.0 min calculated for 861 cf (100% of inflow)
Center-of-Mass det. time= 183.1 min ( 933.6 - 750.5 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 107.67' | 490 cf | **20.46'W x 25.42'L x 2.71'H Field A** |
| | | | 1,409 cf Overall - 183 cf Embedded = 1,226 cf x 40.0% Voids |
| #2A | 108.67' | 142 cf | **ADS N-12 12"** x 7 Inside #1 |
| | | | Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf |
| | | | Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf |
| | | | 7 Chambers in 7 Rows |
| | | | 17.46' Header x 0.81 sf x 2 = 28.3 cf Inside |
| #3 | 107.57' | 3 cf | **0.50'D x 15.00'H Vertical Cone/Cylinder**Impervious |
| | | 635 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 107.67' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 116.00' | **4.0" Vert. Orifice/Grate X 4.00** C= 0.600<br>Limited to weir flow at low heads |

**Discarded OutFlow** Max=0.0 cfs @ 10.57 hrs HW=107.67' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=107.57' TW=101.50' (Dynamic Tailwater)
└─**2=Orifice/Grate** ( Controls 0.0 cfs)

## Summary for Pond 6P: SIS #6

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 15,743 sf, | 77.06% Impervious, | Inflow Depth = | 2.05" | for 10-Year event |
| Inflow = | 0.9 cfs @ | 12.13 hrs, Volume= | 2,683 cf | | |
| Outflow = | 0.0 cfs @ | 11.56 hrs, Volume= | 2,683 cf, | Atten= 95%, | Lag= 0.0 min |
| Discarded = | 0.0 cfs @ | 11.56 hrs, Volume= | 2,683 cf | | |
| Primary = | 0.0 cfs @ | 0.00 hrs, Volume= | 0 cf | | |

Routed to Reach DP3 : Y Street (East of proposed lot)

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 102.74' @ 14.23 hrs Surf.Area= 1,988 sf Storage= 990 cf

Plug-Flow detention time= 204.2 min calculated for 2,683 cf (100% of inflow)
Center-of-Mass det. time= 204.2 min ( 1,055.8 - 851.6 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 101.50' | 1,870 cf | **23.00'W x 86.42'L x 2.71'H Field A**<br>5,385 cf Overall - 710 cf Embedded = 4,675 cf x 40.0% Voids |
| #2A | 102.50' | 549 cf | **ADS N-12 12"** x 32 Inside #1<br>Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf<br>Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf<br>32 Chambers in 8 Rows<br>19.00' Header x 0.81 sf x 2 = 30.8 cf Inside |
| | | 2,419 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 101.50' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 102.50' | **12.0" Round Culvert**<br>L= 50.0' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 102.50' / 102.00' S= 0.0100 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.79 sf |
| #3 | Device 2 | 104.00' | **4.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

**Discarded OutFlow** Max=0.0 cfs @ 11.56 hrs HW=101.53' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=101.50' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** ( Controls 0.0 cfs)
  └─**3=Broad-Crested Rectangular Weir**( Controls 0.0 cfs)

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**SubcatchmentP-1: Pave front** Runoff Area=5,775 sf 80.45% Impervious Runoff Depth=6.29"
Tc=6.0 min CN=86 Runoff=1.0 cfs 3,028 cf

**SubcatchmentP-2: Western Entrance to** Runoff Area=8,985 sf 6.84% Impervious Runoff Depth=1.52"
Tc=6.0 min CN=43 Runoff=0.3 cfs 1,137 cf

**SubcatchmentP-3: Eastern Entrance to** Runoff Area=5,037 sf 12.63% Impervious Runoff Depth=1.82"
Tc=6.0 min CN=46 Runoff=0.2 cfs 762 cf

**SubcatchmentP-4: Upper Parking Area** Runoff Area=11,423 sf 68.38% Impervious Runoff Depth=5.47"
Tc=6.0 min CN=79 Runoff=1.7 cfs 5,208 cf

**SubcatchmentP-5: Remaining Lawn** Runoff Area=32,496 sf 0.00% Impervious Runoff Depth=1.14"
Tc=6.0 min CN=39 Runoff=0.8 cfs 3,088 cf

**SubcatchmentPS-R1: Roof (1)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=7.72"
Tc=6.0 min CN=98 Runoff=0.3 cfs 926 cf

**SubcatchmentPS-R2: Roof (2)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=7.72"
Tc=6.0 min CN=98 Runoff=0.3 cfs 926 cf

**SubcatchmentPS-R3: Roof (3)** Runoff Area=720 sf 100.00% Impervious Runoff Depth=7.72"
Tc=6.0 min CN=98 Runoff=0.1 cfs 463 cf

**SubcatchmentPS-R4: Roof (4)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=7.72"
Tc=6.0 min CN=98 Runoff=0.3 cfs 926 cf

**SubcatchmentPS-R5: Roof (5)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=7.72"
Tc=6.0 min CN=98 Runoff=0.3 cfs 926 cf

**SubcatchmentPS-R6: Roof (6)** Runoff Area=720 sf 100.00% Impervious Runoff Depth=7.72"
Tc=6.0 min CN=98 Runoff=0.1 cfs 463 cf

**SubcatchmentPS-R7: Roof (7)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=7.72"
Tc=6.0 min CN=98 Runoff=0.3 cfs 926 cf

**SubcatchmentPS-R8: Roof (8)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=7.72"
Tc=6.0 min CN=98 Runoff=0.3 cfs 926 cf

**Reach DP1: I Street (Westbound)** Inflow=0.3 cfs 2,064 cf
Outflow=0.3 cfs 2,064 cf

**Reach DP2: I Street (Eastbound)** Inflow=0.2 cfs 762 cf
Outflow=0.2 cfs 762 cf

**Reach DP3: Y Street (East of proposed lot)** Inflow=0.8 cfs 3,477 cf
Outflow=0.8 cfs 3,477 cf

**Pond 1P: SIS #1** Peak Elev=104.50' Storage=1,074 cf Inflow=1.0 cfs 3,028 cf
Discarded=0.0 cfs 2,277 cf Primary=0.1 cfs 751 cf Outflow=0.2 cfs 3,028 cf

**Pond 2P: SIS #2** Peak Elev=101.94' Storage=309 cf Inflow=0.3 cfs 926 cf
Discarded=0.0 cfs 750 cf Primary=0.1 cfs 176 cf Outflow=0.1 cfs 926 cf

**Pond 3P: SIS #3** Peak Elev=110.77' Storage=1,153 cf Inflow=0.8 cfs 2,779 cf
Discarded=0.0 cfs 2,633 cf Primary=0.0 cfs 126 cf Outflow=0.1 cfs 2,759 cf

**Pond 4P: SIS #4** Peak Elev=114.71' Storage=602 cf Inflow=0.4 cfs 1,390 cf
Discarded=0.0 cfs 1,390 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 1,390 cf

**Pond 5P: SIS #5** Peak Elev=110.22' Storage=600 cf Inflow=0.4 cfs 1,390 cf
Discarded=0.0 cfs 1,390 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 1,390 cf

**Pond 6P: SIS #6** Peak Elev=104.03' Storage=2,281 cf Inflow=1.7 cfs 5,208 cf
Discarded=0.0 cfs 4,811 cf Primary=0.1 cfs 389 cf Outflow=0.1 cfs 5,201 cf

**Total Runoff Area = 73,796 sf Runoff Volume = 19,708 cf Average Runoff Depth = 3.20"**
**67.77% Pervious = 50,008 sf 32.23% Impervious = 23,788 sf**

## Summary for Subcatchment P-1: Pave front

Runoff = 1.0 cfs @ 12.13 hrs, Volume= 3,028 cf, Depth= 6.29"
Routed to Pond 1P : SIS #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 4,646 | 98 | Paved parking, HSG A |
| 1,129 | 39 | >75% Grass cover, Good, HSG A |
| 5,775 | 86 | Weighted Average |
| 1,129 | | 19.55% Pervious Area |
| 4,646 | | 80.45% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment P-2: Western Entrance to Driveway/Lawn

Runoff = 0.3 cfs @ 12.14 hrs, Volume= 1,137 cf, Depth= 1.52"
Routed to Reach DP1 : I Street (Westbound)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 8,370 | 39 | >75% Grass cover, Good, HSG A |
| 615 | 98 | Paved parking, HSG A |
| 8,985 | 43 | Weighted Average |
| 8,370 | | 93.16% Pervious Area |
| 615 | | 6.84% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment P-3: Eastern Entrance to Driveway/Lawn

Runoff = 0.2 cfs @ 12.14 hrs, Volume= 762 cf, Depth= 1.82"
Routed to Reach DP2 : I Street (Eastbound)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 4,401 | 39 | >75% Grass cover, Good, HSG A |
| 636 | 98 | Paved parking, HSG A |
| 5,037 | 46 | Weighted Average |
| 4,401 | | 87.37% Pervious Area |
| 636 | | 12.63% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment P-4: Upper Parking Area

Runoff = 1.7 cfs @ 12.13 hrs, Volume= 5,208 cf, Depth= 5.47"
Routed to Pond 6P : SIS #6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 7,811 | 98 | Paved parking, HSG A |
| 3,612 | 39 | >75% Grass cover, Good, HSG A |
| 11,423 | 79 | Weighted Average |
| 3,612 | | 31.62% Pervious Area |
| 7,811 | | 68.38% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment P-5: Remaining Lawn

Runoff = 0.8 cfs @ 12.15 hrs, Volume= 3,088 cf, Depth= 1.14"
Routed to Reach DP3 : Y Street (East of proposed lot)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 32,496 | 39 | >75% Grass cover, Good, HSG A |
| 32,496 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R1: Roof (1)

Runoff = 0.3 cfs @ 12.13 hrs, Volume= 926 cf, Depth= 7.72"
Routed to Pond 2P : SIS #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R2: Roof (2)

Runoff = 0.3 cfs @ 12.13 hrs, Volume= 926 cf, Depth= 7.72"
Routed to Pond 3P : SIS #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R3: Roof (3)

Runoff = 0.1 cfs @ 12.13 hrs, Volume= 463 cf, Depth= 7.72"
Routed to Pond 4P : SIS #4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 720 | 98 | Roofs, HSG A |
| 720 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R4: Roof (4)

Runoff = 0.3 cfs @ 12.13 hrs, Volume= 926 cf, Depth= 7.72"
Routed to Pond 4P : SIS #4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R5: Roof (5)

Runoff = 0.3 cfs @ 12.13 hrs, Volume= 926 cf, Depth= 7.72"
Routed to Pond 5P : SIS #5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R6: Roof (6)

Runoff = 0.1 cfs @ 12.13 hrs, Volume= 463 cf, Depth= 7.72"
Routed to Pond 5P : SIS #5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 720 | 98 | Roofs, HSG A |
| 720 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R7: Roof (7)

Runoff = 0.3 cfs @ 12.13 hrs, Volume= 926 cf, Depth= 7.72"
Routed to Pond 3P : SIS #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R8: Roof (8)

Runoff = 0.3 cfs @ 12.13 hrs, Volume= 926 cf, Depth= 7.72"
Routed to Pond 3P : SIS #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Reach DP1: I Street (Westbound)

Inflow Area = 16,200 sf, 41.36% Impervious, Inflow Depth = 1.53" for 100-Year event
Inflow = 0.3 cfs @ 12.24 hrs, Volume= 2,064 cf
Outflow = 0.3 cfs @ 12.24 hrs, Volume= 2,064 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

## Summary for Reach DP2: I Street (Eastbound)

Inflow Area = 5,037 sf, 12.63% Impervious, Inflow Depth = 1.82" for 100-Year event
Inflow = 0.2 cfs @ 12.14 hrs, Volume= 762 cf
Outflow = 0.2 cfs @ 12.14 hrs, Volume= 762 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

## Summary for Reach DP3: Y Street (East of proposed lot)

| | | | | |
|---|---|---|---|---|
| Inflow Area = | 48,239 sf, | 25.15% Impervious, | Inflow Depth = | 0.87" for 100-Year event |
| Inflow = | 0.8 cfs @ | 12.15 hrs, Volume= | 3,477 cf | |
| Outflow = | 0.8 cfs @ | 12.15 hrs, Volume= | 3,477 cf, | Atten= 0%, Lag= 0.0 min |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

## Summary for Pond 1P: SIS #1

| | | | | |
|---|---|---|---|---|
| Inflow Area = | 5,775 sf, | 80.45% Impervious, | Inflow Depth = | 6.29" for 100-Year event |
| Inflow = | 1.0 cfs @ | 12.13 hrs, Volume= | 3,028 cf | |
| Outflow = | 0.2 cfs @ | 12.39 hrs, Volume= | 3,028 cf, | Atten= 83%, Lag= 15.6 min |
| Discarded = | 0.0 cfs @ | 9.33 hrs, Volume= | 2,277 cf | |
| Primary = | 0.1 cfs @ | 12.39 hrs, Volume= | 751 cf | |

Routed to Reach DP1 : I Street (Westbound)

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 104.50' @ 12.39 hrs Surf.Area= 950 sf Storage= 1,074 cf

Plug-Flow detention time= 303.3 min calculated for 3,027 cf (100% of inflow)
Center-of-Mass det. time= 303.3 min ( 1,104.9 - 801.5 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 102.00' | 897 cf | **20.46'W x 46.42'L x 2.71'H Field A**<br>2,573 cf Overall - 330 cf Embedded = 2,243 cf x 40.0% Voids |
| #2A | 103.00' | 255 cf | **ADS N-12 12"** x 14 Inside #1<br>Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf<br>Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf<br>14 Chambers in 7 Rows<br>17.46' Header x 0.81 sf x 2 = 28.3 cf Inside |
| | | 1,152 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 102.00' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 103.00' | **12.0" Round Culvert**<br>L= 35.0' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 103.00' / 100.00' S= 0.0857 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.79 sf |
| #3 | Device 2 | 104.00' | **3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads |
| #4 | Device 2 | 104.50' | **4.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

**Discarded OutFlow** Max=0.0 cfs @ 9.33 hrs HW=102.03' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.1 cfs @ 12.39 hrs HW=104.50' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** (Passes 0.1 cfs of 3.0 cfs potential flow)
  ├─**3=Orifice/Grate** (Orifice Controls 0.1 cfs @ 2.96 fps)
  └─**4=Broad-Crested Rectangular Weir**(Weir Controls 0.0 cfs @ 0.15 fps)

## Summary for Pond 2P: SIS #2

| | | | | |
|---|---|---|---|---|
| Inflow Area = | 1,440 sf,100.00% Impervious, Inflow Depth = 7.72" for 100-Year event | | | |
| Inflow = | 0.3 cfs @ 12.13 hrs, Volume= | 926 cf | | |
| Outflow = | 0.1 cfs @ 12.27 hrs, Volume= | 926 cf, Atten= 70%, Lag= 8.7 min | | |
| Discarded = | 0.0 cfs @ 7.54 hrs, Volume= | 750 cf | | |
| Primary = | 0.1 cfs @ 12.27 hrs, Volume= | 176 cf | | |

Routed to Reach DP1 : I Street (Westbound)

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 101.94' @ 12.27 hrs Surf.Area= 277 sf Storage= 309 cf

Plug-Flow detention time= 310.7 min calculated for 926 cf (100% of inflow)
Center-of-Mass det. time= 310.8 min ( 1,053.6 - 742.8 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 99.50' | 259 cf | **11.34'W x 24.42'L x 2.71'H Field A**<br>750 cf Overall - 103 cf Embedded = 646 cf x 40.0% Voids |
| #2A | 100.50' | 80 cf | **ADS N-12 12"** x 4 Inside #1<br>Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf<br>Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf<br>4 Chambers in 4 Rows<br>9.34' Header x 0.81 sf x 2 = 15.1 cf Inside |
| | | 339 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 99.50' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 101.67' | **4.0" Round Culvert**<br>L= 5.0' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 101.67' / 101.67' S= 0.0000 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.09 sf |

**Discarded OutFlow** Max=0.0 cfs @ 7.54 hrs HW=99.53' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.1 cfs @ 12.27 hrs HW=101.94' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** (Barrel Controls 0.1 cfs @ 1.34 fps)

## Summary for Pond 3P: SIS #3

| | | | | |
|---|---|---|---|---|
| Inflow Area = | 4,320 sf,100.00% Impervious, | Inflow Depth = | 7.72" | for 100-Year event |
| Inflow = | 0.8 cfs @ 12.13 hrs, | Volume= | 2,779 cf | |
| Outflow = | 0.1 cfs @ 13.13 hrs, | Volume= | 2,759 cf, | Atten= 92%, Lag= 60.1 min |
| Discarded = | 0.0 cfs @ 9.65 hrs, | Volume= | 2,633 cf | |
| Primary = | 0.0 cfs @ 13.13 hrs, | Volume= | 126 cf | |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 110.77' @ 13.13 hrs Surf.Area= 950 sf Storage= 1,153 cf

Plug-Flow detention time= 424.5 min calculated for 2,758 cf (99% of inflow)
Center-of-Mass det. time= 419.5 min ( 1,162.3 - 742.8 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 104.50' | 897 cf | **20.46'W x 46.42'L x 2.71'H Field A**<br>2,573 cf Overall - 330 cf Embedded = 2,243 cf x 40.0% Voids |
| #2A | 105.50' | 255 cf | **ADS N-12 12"** x 14 Inside #1<br>Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf<br>Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf<br>14 Chambers in 7 Rows<br>17.46' Header x 0.81 sf x 2 = 28.3 cf Inside |
| #3 | 106.50' | 2 cf | **0.50'D x 10.00'H Vertical Cone/Cylinder**-Impervious |
| | | 1,154 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 104.50' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.05' |
| #2 | Primary | 110.70' | **4.0" Vert. Roof Leader outlet @ tee-wye X 4.00** C= 0.600<br>Limited to weir flow at low heads |

**Discarded OutFlow** Max=0.0 cfs @ 9.65 hrs HW=104.62' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 13.13 hrs HW=110.77' (Free Discharge)
└**2=Roof Leader outlet @ tee-wye** (Orifice Controls 0.0 cfs @ 0.88 fps)

## Summary for Pond 4P: SIS #4

| | | | | |
|---|---|---|---|---|
| Inflow Area = | 2,160 sf,100.00% Impervious, | Inflow Depth = | 7.72" | for 100-Year event |
| Inflow = | 0.4 cfs @ 12.13 hrs, | Volume= | 1,390 cf | |
| Outflow = | 0.0 cfs @ 10.76 hrs, | Volume= | 1,390 cf, | Atten= 97%, Lag= 0.0 min |
| Discarded = | 0.0 cfs @ 10.76 hrs, | Volume= | 1,390 cf | |
| Primary = | 0.0 cfs @ 0.00 hrs, | Volume= | 0 cf | |

Routed to Pond 6P : SIS #6

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 114.71' @ 15.47 hrs Surf.Area= 520 sf Storage= 602 cf

Plug-Flow detention time= 413.6 min calculated for 1,389 cf (100% of inflow)

Center-of-Mass det. time= 413.7 min ( 1,156.5 - 742.8 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 112.14' | 490 cf | **20.46'W x 25.42'L x 2.71'H Field A** |
| | | | 1,409 cf Overall - 183 cf Embedded = 1,226 cf x 40.0% Voids |
| #2A | 113.14' | 142 cf | **ADS N-12 12"** x 7 Inside #1 |
| | | | Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf |
| | | | Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf |
| | | | 7 Chambers in 7 Rows |
| | | | 17.46' Header x 0.81 sf x 2 = 28.3 cf Inside |
| #3 | 114.14' | 3 cf | **0.50'D x 15.00'H Vertical Cone/Cylinder**Impervious |
| | | 635 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 112.14' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 117.80' | **4.0" Vert. Orifice/Grate X 4.00** C= 0.600 |
| | | | Limited to weir flow at low heads |

**Discarded OutFlow** Max=0.0 cfs @ 10.76 hrs HW=112.31' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=112.14' TW=101.50' (Dynamic Tailwater)
└**2=Orifice/Grate** ( Controls 0.0 cfs)

## Summary for Pond 5P: SIS #5

Inflow Area = 2,160 sf,100.00% Impervious, Inflow Depth = 7.72" for 100-Year event
Inflow = 0.4 cfs @ 12.13 hrs, Volume= 1,390 cf
Outflow = 0.0 cfs @ 8.88 hrs, Volume= 1,390 cf, Atten= 97%, Lag= 0.0 min
Discarded = 0.0 cfs @ 8.88 hrs, Volume= 1,390 cf
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Pond 6P : SIS #6

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 110.22' @ 15.47 hrs Surf.Area= 520 sf Storage= 600 cf

Plug-Flow detention time= 410.8 min calculated for 1,389 cf (100% of inflow)
Center-of-Mass det. time= 410.9 min ( 1,153.7 - 742.8 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 107.67' | 490 cf | **20.46'W x 25.42'L x 2.71'H Field A** |
| | | | 1,409 cf Overall - 183 cf Embedded = 1,226 cf x 40.0% Voids |
| #2A | 108.67' | 142 cf | **ADS N-12 12"** x 7 Inside #1 |
| | | | Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf |
| | | | Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf |
| | | | 7 Chambers in 7 Rows |
| | | | 17.46' Header x 0.81 sf x 2 = 28.3 cf Inside |
| #3 | 107.57' | 3 cf | **0.50'D x 15.00'H Vertical Cone/Cylinder**Impervious |
| | | 635 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 107.67' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 116.00' | **4.0" Vert. Orifice/Grate X 4.00** C= 0.600<br>Limited to weir flow at low heads |

**Discarded OutFlow** Max=0.0 cfs @ 8.88 hrs HW=107.67' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=107.57' TW=101.50' (Dynamic Tailwater)
└─**2=Orifice/Grate** ( Controls 0.0 cfs)

## Summary for Pond 6P: SIS #6

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 15,743 sf, | 77.06% Impervious, | Inflow Depth = | 3.97" | for 100-Year event |
| Inflow = | 1.7 cfs @ | 12.13 hrs, | Volume= | 5,208 cf | |
| Outflow = | 0.1 cfs @ | 13.41 hrs, | Volume= | 5,201 cf, | Atten= 93%, Lag= 76.8 min |
| Discarded = | 0.0 cfs @ | 10.37 hrs, | Volume= | 4,811 cf | |
| Primary = | 0.1 cfs @ | 13.41 hrs, | Volume= | 389 cf | |

Routed to Reach DP3 : Y Street (East of proposed lot)

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 104.03' @ 13.41 hrs Surf.Area= 1,988 sf Storage= 2,281 cf

Plug-Flow detention time= 446.6 min calculated for 5,201 cf (100% of inflow)
Center-of-Mass det. time= 445.8 min ( 1,271.2 - 825.4 )

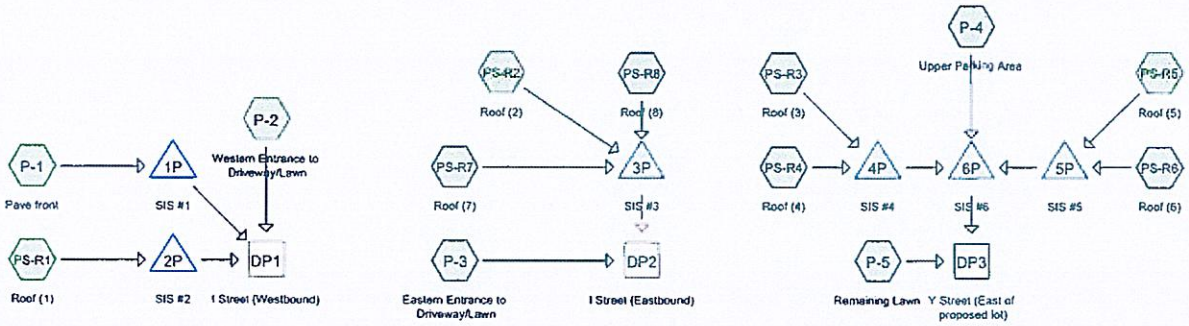
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 101.50' | 1,870 cf | **23.00'W x 86.42'L x 2.71'H Field A**<br>5,385 cf Overall - 710 cf Embedded = 4,675 cf x 40.0% Voids |
| #2A | 102.50' | 549 cf | **ADS N-12 12"** x 32 Inside #1<br>Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf<br>Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf<br>32 Chambers in 8 Rows<br>19.00' Header x 0.81 sf x 2 = 30.8 cf Inside |
| | | 2,419 cf | Total Available Storage |

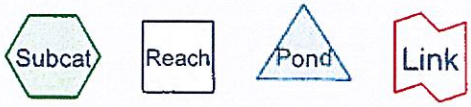
Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 101.50' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 102.50' | **12.0" Round Culvert**<br>L= 50.0' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 102.50' / 102.00' S= 0.0100 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.79 sf |
| #3 | Device 2 | 104.00' | **4.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

**Discarded OutFlow** Max=0.0 cfs @ 10.37 hrs HW=101.53' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.1 cfs @ 13.41 hrs HW=104.03' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** (Passes 0.1 cfs of 3.0 cfs potential flow)
  └─**3=Broad-Crested Rectangular Weir** (Weir Controls 0.1 cfs @ 0.52 fps)




**Routing Diagram for 4316 Proposed Conditions**
Prepared by The Morin-Cameron Group, Inc, Printed 9/17/2026
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## Rainfall Events Listing

| Event# | Event Name | Storm Type | Curve | Mode | Duration (hours) | B/B | Depth (inches) | AMC |
|---|---|---|---|---|---|---|---|---|
| 1 | 2-Year | NOAA10 24-hr | D | Default | 24.00 | 1 | 3.17 | 2 |
| 2 | 10-Year | NOAA10 24-hr | D | Default | 24.00 | 1 | 5.02 | 2 |
| 3 | 100-Year | NOAA10 24-hr | D | Default | 24.00 | 1 | 7.96 | 2 |

## Area Listing (all nodes)

| Area (sq-ft) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 50,008 | 39 | >75% Grass cover, Good, HSG A (P-1, P-2, P-3, P-4, P-5) |
| 13,708 | 98 | Paved parking, HSG A (P-1, P-2, P-3, P-4) |
| 10,080 | 98 | Roofs, HSG A (PS-R1, PS-R2, PS-R3, PS-R4, PS-R5, PS-R6, PS-R7, PS-R8) |
| **73,796** | **58** | **TOTAL AREA** |

## Ground Covers (all nodes)

| HSG-A (sq-ft) | HSG-B (sq-ft) | HSG-C (sq-ft) | HSG-D (sq-ft) | Other (sq-ft) | Total (sq-ft) | Ground Cover |
|---|---|---|---|---|---|---|
| 50,008 | 0 | 0 | 0 | 0 | 50,008 | >75% Grass cover, Good |
| 13,708 | 0 | 0 | 0 | 0 | 13,708 | Paved parking |
| 10,080 | 0 | 0 | 0 | 0 | 10,080 | Roofs |
| **73,796** | **0** | **0** | **0** | **0** | **73,796** | **TOTAL AREA** |

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**SubcatchmentP-1: Pave front** Runoff Area=5,775 sf 80.45% Impervious Runoff Depth=1.81"
Tc=6.0 min CN=86 Runoff=0.3 cfs 871 cf

**SubcatchmentP-2: Western Entrance to** Runoff Area=8,985 sf 6.84% Impervious Runoff Depth=0.02"
Tc=6.0 min CN=43 Runoff=0.0 cfs 15 cf

**SubcatchmentP-3: Eastern Entrance to** Runoff Area=5,037 sf 12.63% Impervious Runoff Depth=0.05"
Tc=6.0 min CN=46 Runoff=0.0 cfs 23 cf

**SubcatchmentP-4: Upper Parking Area** Runoff Area=11,423 sf 68.38% Impervious Runoff Depth=1.31"
Tc=6.0 min CN=79 Runoff=0.4 cfs 1,251 cf

**SubcatchmentP-5: Remaining Lawn** Runoff Area=32,496 sf 0.00% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=39 Runoff=0.0 cfs 0 cf

**SubcatchmentPS-R1: Roof (1)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=2.94"
Tc=6.0 min CN=98 Runoff=0.1 cfs 353 cf

**SubcatchmentPS-R2: Roof (2)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=2.94"
Tc=6.0 min CN=98 Runoff=0.1 cfs 353 cf

**SubcatchmentPS-R3: Roof (3)** Runoff Area=720 sf 100.00% Impervious Runoff Depth=2.94"
Tc=6.0 min CN=98 Runoff=0.1 cfs 176 cf

**SubcatchmentPS-R4: Roof (4)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=2.94"
Tc=6.0 min CN=98 Runoff=0.1 cfs 353 cf

**SubcatchmentPS-R5: Roof (5)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=2.94"
Tc=6.0 min CN=98 Runoff=0.1 cfs 353 cf

**SubcatchmentPS-R6: Roof (6)** Runoff Area=720 sf 100.00% Impervious Runoff Depth=2.94"
Tc=6.0 min CN=98 Runoff=0.1 cfs 176 cf

**SubcatchmentPS-R7: Roof (7)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=2.94"
Tc=6.0 min CN=98 Runoff=0.1 cfs 353 cf

**SubcatchmentPS-R8: Roof (8)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=2.94"
Tc=6.0 min CN=98 Runoff=0.1 cfs 353 cf

**Reach DP1: I Street (Westbound)** Inflow=0.0 cfs 15 cf
Outflow=0.0 cfs 15 cf

**Reach DP2: I Street (Eastbound)** Inflow=0.0 cfs 23 cf
Outflow=0.0 cfs 23 cf

**Reach DP3: Y Street (East of proposed lot)** Inflow=0.0 cfs 0 cf
Outflow=0.0 cfs 0 cf

**Pond 1P: SIS #1**
Peak Elev=102.70' Storage=265 cf Inflow=0.3 cfs 871 cf
Discarded=0.0 cfs 871 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 871 cf

**Pond 2P: SIS #2**
Peak Elev=100.48' Storage=109 cf Inflow=0.1 cfs 353 cf
Discarded=0.0 cfs 353 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 353 cf

**Pond 3P: SIS #3**
Peak Elev=105.33' Storage=315 cf Inflow=0.3 cfs 1,058 cf
Discarded=0.0 cfs 1,058 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 1,058 cf

**Pond 4P: SIS #4**
Peak Elev=112.83' Storage=143 cf Inflow=0.2 cfs 529 cf
Discarded=0.0 cfs 529 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 529 cf

**Pond 5P: SIS #5**
Peak Elev=108.35' Storage=141 cf Inflow=0.2 cfs 529 cf
Discarded=0.0 cfs 529 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 529 cf

**Pond 6P: SIS #6**
Peak Elev=101.89' Storage=310 cf Inflow=0.4 cfs 1,251 cf
Discarded=0.0 cfs 1,251 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 1,251 cf

**Total Runoff Area = 73,796 sf Runoff Volume = 4,627 cf Average Runoff Depth = 0.75"**
**67.77% Pervious = 50,008 sf 32.23% Impervious = 23,788 sf**

## Summary for Subcatchment P-1: Pave front

Runoff = 0.3 cfs @ 12.13 hrs, Volume= 871 cf, Depth= 1.81"
Routed to Pond 1P : SIS #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 4,646 | 98 | Paved parking, HSG A |
| 1,129 | 39 | >75% Grass cover, Good, HSG A |
| 5,775 | 86 | Weighted Average |
| 1,129 | | 19.55% Pervious Area |
| 4,646 | | 80.45% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment P-2: Western Entrance to Driveway/Lawn

Runoff = 0.0 cfs @ 21.85 hrs, Volume= 15 cf, Depth= 0.02"
Routed to Reach DP1 : I Street (Westbound)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 8,370 | 39 | >75% Grass cover, Good, HSG A |
| 615 | 98 | Paved parking, HSG A |
| 8,985 | 43 | Weighted Average |
| 8,370 | | 93.16% Pervious Area |
| 615 | | 6.84% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment P-3: Eastern Entrance to Driveway/Lawn

Runoff = 0.0 cfs @ 19.94 hrs, Volume= 23 cf, Depth= 0.05"
Routed to Reach DP2 : I Street (Eastbound)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 4,401 | 39 | >75% Grass cover, Good, HSG A |
| 636 | 98 | Paved parking, HSG A |
| 5,037 | 46 | Weighted Average |
| 4,401 | | 87.37% Pervious Area |
| 636 | | 12.63% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment P-4: Upper Parking Area

Runoff = 0.4 cfs @ 12.13 hrs, Volume= 1,251 cf, Depth= 1.31"
Routed to Pond 6P : SIS #6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 7,811 | 98 | Paved parking, HSG A |
| 3,612 | 39 | >75% Grass cover, Good, HSG A |
| 11,423 | 79 | Weighted Average |
| 3,612 | | 31.62% Pervious Area |
| 7,811 | | 68.38% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment P-5: Remaining Lawn

Runoff = 0.0 cfs @ 24.02 hrs, Volume= 0 cf, Depth= 0.00"
Routed to Reach DP3 : Y Street (East of proposed lot)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 32,496 | 39 | >75% Grass cover, Good, HSG A |
| 32,496 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R1: Roof (1)

Runoff = 0.1 cfs @ 12.13 hrs, Volume= 353 cf, Depth= 2.94"
Routed to Pond 2P : SIS #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R2: Roof (2)

Runoff = 0.1 cfs @ 12.13 hrs, Volume= 353 cf, Depth= 2.94"
Routed to Pond 3P : SIS #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R3: Roof (3)

Runoff = 0.1 cfs @ 12.13 hrs, Volume= 176 cf, Depth= 2.94"
Routed to Pond 4P : SIS #4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 720 | 98 | Roofs, HSG A |
| 720 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R4: Roof (4)

Runoff = 0.1 cfs @ 12.13 hrs, Volume= 353 cf, Depth= 2.94"
Routed to Pond 4P : SIS #4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R5: Roof (5)

Runoff = 0.1 cfs @ 12.13 hrs, Volume= 353 cf, Depth= 2.94"
Routed to Pond 5P : SIS #5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R6: Roof (6)

Runoff = 0.1 cfs @ 12.13 hrs, Volume= 176 cf, Depth= 2.94"
Routed to Pond 5P : SIS #5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 720 | 98 | Roofs, HSG A |
| 720 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R7: Roof (7)

Runoff = 0.1 cfs @ 12.13 hrs, Volume= 353 cf, Depth= 2.94"
Routed to Pond 3P : SIS #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R8: Roof (8)

Runoff = 0.1 cfs @ 12.13 hrs, Volume= 353 cf, Depth= 2.94"
Routed to Pond 3P : SIS #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.17"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Reach DP1: I Street (Westbound)

Inflow Area = 16,200 sf, 41.36% Impervious, Inflow Depth = 0.01" for 2-Year event
Inflow = 0.0 cfs @ 21.85 hrs, Volume= 15 cf
Outflow = 0.0 cfs @ 21.85 hrs, Volume= 15 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

## Summary for Reach DP2: I Street (Eastbound)

Inflow Area = 5,037 sf, 12.63% Impervious, Inflow Depth = 0.05" for 2-Year event
Inflow = 0.0 cfs @ 19.94 hrs, Volume= 23 cf
Outflow = 0.0 cfs @ 19.94 hrs, Volume= 23 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

## Summary for Reach DP3: Y Street (East of proposed lot)

| | | | | |
|---|---|---|---|---|
| Inflow Area = | 48,239 sf, | 25.15% Impervious, | Inflow Depth = 0.00" | for 2-Year event |
| Inflow = | 0.0 cfs @ | 24.02 hrs, Volume= | 0 cf | |
| Outflow = | 0.0 cfs @ | 24.02 hrs, Volume= | 0 cf, Atten= 0%, Lag= 0.0 min | |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

## Summary for Pond 1P: SIS #1

| | | | | |
|---|---|---|---|---|
| Inflow Area = | 5,775 sf, | 80.45% Impervious, | Inflow Depth = 1.81" | for 2-Year event |
| Inflow = | 0.3 cfs @ | 12.13 hrs, Volume= | 871 cf | |
| Outflow = | 0.0 cfs @ | 11.81 hrs, Volume= | 871 cf, Atten= 93%, Lag= 0.0 min | |
| Discarded = | 0.0 cfs @ | 11.81 hrs, Volume= | 871 cf | |
| Primary = | 0.0 cfs @ | 0.00 hrs, Volume= | 0 cf | |

Routed to Reach DP1 : I Street (Westbound)

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 102.70' @ 13.36 hrs Surf.Area= 950 sf Storage= 265 cf

Plug-Flow detention time= 90.6 min calculated for 871 cf (100% of inflow)
Center-of-Mass det. time= 90.6 min ( 940.3 - 849.7 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 102.00' | 897 cf | **20.46'W x 46.42'L x 2.71'H Field A**<br>2,573 cf Overall - 330 cf Embedded = 2,243 cf x 40.0% Voids |
| #2A | 103.00' | 255 cf | **ADS N-12 12"** x 14 Inside #1<br>Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf<br>Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf<br>14 Chambers in 7 Rows<br>17.46' Header x 0.81 sf x 2 = 28.3 cf Inside |
| | | 1,152 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 102.00' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 103.00' | **12.0" Round Culvert**<br>L= 35.0' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 103.00' / 100.00' S= 0.0857 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.79 sf |
| #3 | Device 2 | 104.00' | **3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads |
| #4 | Device 2 | 104.50' | **4.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

**Discarded OutFlow** Max=0.0 cfs @ 11.81 hrs HW=102.03' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=102.00' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** ( Controls 0.0 cfs)
  ├─**3=Orifice/Grate** ( Controls 0.0 cfs)
  └─**4=Broad-Crested Rectangular Weir**( Controls 0.0 cfs)

## Summary for Pond 2P: SIS #2

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 1,440 sf,100.00% Impervious, | Inflow Depth = | 2.94" | for 2-Year event | |
| Inflow = | 0.1 cfs @ | 12.13 hrs, | Volume= | 353 cf | |
| Outflow = | 0.0 cfs @ | 11.29 hrs, | Volume= | 353 cf, | Atten= 94%, Lag= 0.0 min |
| Discarded = | 0.0 cfs @ | 11.29 hrs, | Volume= | 353 cf | |
| Primary = | 0.0 cfs @ | 0.00 hrs, | Volume= | 0 cf | |

Routed to Reach DP1 : I Street (Westbound)

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 100.48' @ 13.47 hrs Surf.Area= 277 sf Storage= 109 cf

Plug-Flow detention time= 115.5 min calculated for 352 cf (100% of inflow)
Center-of-Mass det. time= 115.4 min ( 876.4 - 761.0 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 99.50' | 259 cf | **11.34'W x 24.42'L x 2.71'H Field A**<br>750 cf Overall - 103 cf Embedded = 646 cf x 40.0% Voids |
| #2A | 100.50' | 80 cf | **ADS N-12 12"** x 4 Inside #1<br>Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf<br>Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf<br>4 Chambers in 4 Rows<br>9.34' Header x 0.81 sf x 2 = 15.1 cf Inside |
| | | 339 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 99.50' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 101.67' | **4.0" Round Culvert**<br>L= 5.0' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 101.67' / 101.67' S= 0.0000 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.09 sf |

**Discarded OutFlow** Max=0.0 cfs @ 11.29 hrs HW=99.53' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=99.50' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** ( Controls 0.0 cfs)

## Summary for Pond 3P: SIS #3

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 4,320 sf,100.00% Impervious, Inflow Depth = 2.94" for 2-Year event | | | | |
| Inflow = | 0.3 cfs @ | 12.13 hrs, | Volume= | 1,058 cf | |
| Outflow = | 0.0 cfs @ | 11.86 hrs, | Volume= | 1,058 cf, | Atten= 93%, Lag= 0.0 min |
| Discarded = | 0.0 cfs @ | 11.86 hrs, | Volume= | 1,058 cf | |
| Primary = | 0.0 cfs @ | 0.00 hrs, | Volume= | 0 cf | |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 105.33' @ 13.24 hrs Surf.Area= 950 sf Storage= 315 cf

Plug-Flow detention time= 97.4 min calculated for 1,057 cf (100% of inflow)
Center-of-Mass det. time= 97.4 min ( 858.3 - 761.0 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 104.50' | 897 cf | **20.46'W x 46.42'L x 2.71'H Field A**<br>2,573 cf Overall - 330 cf Embedded = 2,243 cf x 40.0% Voids |
| #2A | 105.50' | 255 cf | **ADS N-12 12"** x 14 Inside #1<br>Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf<br>Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf<br>14 Chambers in 7 Rows<br>17.46' Header x 0.81 sf x 2 = 28.3 cf Inside |
| #3 | 106.50' | 2 cf | **0.50'D x 10.00'H Vertical Cone/Cylinder**-Impervious |
| | | 1,154 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 104.50' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.05' |
| #2 | Primary | 110.70' | **4.0" Vert. Roof Leader outlet @ tee-wye X 4.00** C= 0.600<br>Limited to weir flow at low heads |

**Discarded OutFlow** Max=0.0 cfs @ 11.86 hrs HW=104.62' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=104.50' (Free Discharge)
└**2=Roof Leader outlet @ tee-wye** ( Controls 0.0 cfs)

## Summary for Pond 4P: SIS #4

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 2,160 sf,100.00% Impervious, Inflow Depth = 2.94" for 2-Year event | | | | |
| Inflow = | 0.2 cfs @ | 12.13 hrs, | Volume= | 529 cf | |
| Outflow = | 0.0 cfs @ | 12.02 hrs, | Volume= | 529 cf, | Atten= 92%, Lag= 0.0 min |
| Discarded = | 0.0 cfs @ | 12.02 hrs, | Volume= | 529 cf | |
| Primary = | 0.0 cfs @ | 0.00 hrs, | Volume= | 0 cf | |
| Routed to Pond 6P : SIS #6 | | | | | |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 112.83' @ 13.06 hrs Surf.Area= 520 sf Storage= 143 cf

Plug-Flow detention time= 71.6 min calculated for 529 cf (100% of inflow)

Center-of-Mass det. time= 71.6 min ( 832.5 - 761.0 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 112.14' | 490 cf | **20.46'W x 25.42'L x 2.71'H Field A** |
| | | | 1,409 cf Overall - 183 cf Embedded = 1,226 cf x 40.0% Voids |
| #2A | 113.14' | 142 cf | **ADS N-12 12"** x 7 Inside #1 |
| | | | Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf |
| | | | Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf |
| | | | 7 Chambers in 7 Rows |
| | | | 17.46' Header x 0.81 sf x 2 = 28.3 cf Inside |
| #3 | 114.14' | 3 cf | **0.50'D x 15.00'H Vertical Cone/Cylinder**Impervious |
| | | 635 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 112.14' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 117.80' | **4.0" Vert. Orifice/Grate X 4.00** C= 0.600 |
| | | | Limited to weir flow at low heads |

**Discarded OutFlow** Max=0.0 cfs @ 12.02 hrs HW=112.32' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=112.14' TW=101.50' (Dynamic Tailwater)
└**2=Orifice/Grate** ( Controls 0.0 cfs)

## Summary for Pond 5P: SIS #5

| | | | | |
|---|---|---|---|---|
| Inflow Area = | 2,160 sf,100.00% Impervious, | Inflow Depth = 2.94" | for 2-Year event | |
| Inflow = | 0.2 cfs @ | 12.13 hrs, Volume= | 529 cf | |
| Outflow = | 0.0 cfs @ | 11.19 hrs, Volume= | 529 cf, | Atten= 92%, Lag= 0.0 min |
| Discarded = | 0.0 cfs @ | 11.19 hrs, Volume= | 529 cf | |
| Primary = | 0.0 cfs @ | 0.00 hrs, Volume= | 0 cf | |

Routed to Pond 6P : SIS #6

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 108.35' @ 13.06 hrs Surf.Area= 520 sf Storage= 141 cf

Plug-Flow detention time= 68.8 min calculated for 529 cf (100% of inflow)
Center-of-Mass det. time= 68.8 min ( 829.8 - 761.0 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 107.67' | 490 cf | **20.46'W x 25.42'L x 2.71'H Field A** |
| | | | 1,409 cf Overall - 183 cf Embedded = 1,226 cf x 40.0% Voids |
| #2A | 108.67' | 142 cf | **ADS N-12 12"** x 7 Inside #1 |
| | | | Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf |
| | | | Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf |
| | | | 7 Chambers in 7 Rows |
| | | | 17.46' Header x 0.81 sf x 2 = 28.3 cf Inside |
| #3 | 107.57' | 3 cf | **0.50'D x 15.00'H Vertical Cone/Cylinder**Impervious |
| | | 635 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 107.67' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 116.00' | **4.0" Vert. Orifice/Grate X 4.00** C= 0.600<br>Limited to weir flow at low heads |

**Discarded OutFlow** Max=0.0 cfs @ 11.19 hrs HW=107.67' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=107.57' TW=101.50' (Dynamic Tailwater)
└**2=Orifice/Grate** ( Controls 0.0 cfs)

## Summary for Pond 6P: SIS #6

| | | | | |
|---|---|---|---|---|
| Inflow Area = | 15,743 sf, 77.06% Impervious, | Inflow Depth = 0.95" | for 2-Year event | |
| Inflow = | 0.4 cfs @ 12.13 hrs, | Volume= | 1,251 cf | |
| Outflow = | 0.0 cfs @ 11.95 hrs, | Volume= | 1,251 cf, | Atten= 89%, Lag= 0.0 min |
| Discarded = | 0.0 cfs @ 11.95 hrs, | Volume= | 1,251 cf | |
| Primary = | 0.0 cfs @ 0.00 hrs, | Volume= | 0 cf | |

Routed to Reach DP3 : Y Street (East of proposed lot)

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 101.89' @ 12.70 hrs Surf.Area= 1,988 sf Storage= 310 cf

Plug-Flow detention time= 44.4 min calculated for 1,251 cf (100% of inflow)
Center-of-Mass det. time= 44.4 min ( 926.3 - 881.9 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 101.50' | 1,870 cf | **23.00'W x 86.42'L x 2.71'H Field A**<br>5,385 cf Overall - 710 cf Embedded = 4,675 cf x 40.0% Voids |
| #2A | 102.50' | 549 cf | **ADS N-12 12"** x 32 Inside #1<br>Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf<br>Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf<br>32 Chambers in 8 Rows<br>19.00' Header x 0.81 sf x 2 = 30.8 cf Inside |
| | | 2,419 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 101.50' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 102.50' | **12.0" Round Culvert**<br>L= 50.0' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 102.50' / 102.00' S= 0.0100 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.79 sf |
| #3 | Device 2 | 104.00' | **4.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

**Discarded OutFlow** Max=0.0 cfs @ 11.95 hrs HW=101.53' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=101.50' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** ( Controls 0.0 cfs)
  └─**3=Broad-Crested Rectangular Weir**( Controls 0.0 cfs)

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**SubcatchmentP-1: Pave front** Runoff Area=5,775 sf 80.45% Impervious Runoff Depth=3.49"
Tc=6.0 min CN=86 Runoff=0.6 cfs 1,677 cf

**SubcatchmentP-2: Western Entrance to** Runoff Area=8,985 sf 6.84% Impervious Runoff Depth=0.36"
Tc=6.0 min CN=43 Runoff=0.0 cfs 269 cf

**SubcatchmentP-3: Eastern Entrance to** Runoff Area=5,037 sf 12.63% Impervious Runoff Depth=0.50"
Tc=6.0 min CN=46 Runoff=0.0 cfs 208 cf

**SubcatchmentP-4: Upper Parking Area** Runoff Area=11,423 sf 68.38% Impervious Runoff Depth=2.82"
Tc=6.0 min CN=79 Runoff=0.9 cfs 2,683 cf

**SubcatchmentP-5: Remaining Lawn** Runoff Area=32,496 sf 0.00% Impervious Runoff Depth=0.20"
Tc=6.0 min CN=39 Runoff=0.0 cfs 553 cf

**SubcatchmentPS-R1: Roof (1)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=4.78"
Tc=6.0 min CN=98 Runoff=0.2 cfs 574 cf

**SubcatchmentPS-R2: Roof (2)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=4.78"
Tc=6.0 min CN=98 Runoff=0.2 cfs 574 cf

**SubcatchmentPS-R3: Roof (3)** Runoff Area=720 sf 100.00% Impervious Runoff Depth=4.78"
Tc=6.0 min CN=98 Runoff=0.1 cfs 287 cf

**SubcatchmentPS-R4: Roof (4)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=4.78"
Tc=6.0 min CN=98 Runoff=0.2 cfs 574 cf

**SubcatchmentPS-R5: Roof (5)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=4.78"
Tc=6.0 min CN=98 Runoff=0.2 cfs 574 cf

**SubcatchmentPS-R6: Roof (6)** Runoff Area=720 sf 100.00% Impervious Runoff Depth=4.78"
Tc=6.0 min CN=98 Runoff=0.1 cfs 287 cf

**SubcatchmentPS-R7: Roof (7)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=4.78"
Tc=6.0 min CN=98 Runoff=0.2 cfs 574 cf

**SubcatchmentPS-R8: Roof (8)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=4.78"
Tc=6.0 min CN=98 Runoff=0.2 cfs 574 cf

**Reach DP1: I Street (Westbound)** Inflow=0.0 cfs 269 cf
Outflow=0.0 cfs 269 cf

**Reach DP2: I Street (Eastbound)** Inflow=0.0 cfs 208 cf
Outflow=0.0 cfs 208 cf

**Reach DP3: Y Street (East of proposed lot)** Inflow=0.0 cfs 553 cf
Outflow=0.0 cfs 553 cf

**Pond 1P: SIS #1** Peak Elev=103.65' Storage=698 cf Inflow=0.6 cfs 1,677 cf
Discarded=0.0 cfs 1,677 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 1,677 cf

**Pond 2P: SIS #2** Peak Elev=101.25' Storage=222 cf Inflow=0.2 cfs 574 cf
Discarded=0.0 cfs 574 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 574 cf

**Pond 3P: SIS #3** Peak Elev=106.03' Storage=630 cf Inflow=0.5 cfs 1,722 cf
Discarded=0.0 cfs 1,722 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 1,722 cf

**Pond 4P: SIS #4** Peak Elev=113.51' Storage=295 cf Inflow=0.3 cfs 861 cf
Discarded=0.0 cfs 861 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 861 cf

**Pond 5P: SIS #5** Peak Elev=109.03' Storage=293 cf Inflow=0.3 cfs 861 cf
Discarded=0.0 cfs 861 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 861 cf

**Pond 6P: SIS #6** Peak Elev=102.74' Storage=990 cf Inflow=0.9 cfs 2,683 cf
Discarded=0.0 cfs 2,683 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 2,683 cf

**Total Runoff Area = 73,796 sf Runoff Volume = 9,408 cf Average Runoff Depth = 1.53"**
**67.77% Pervious = 50,008 sf 32.23% Impervious = 23,788 sf**

## Summary for Subcatchment P-1: Pave front

Runoff = 0.6 cfs @ 12.13 hrs, Volume= 1,677 cf, Depth= 3.49"
Routed to Pond 1P : SIS #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 4,646 | 98 | Paved parking, HSG A |
| 1,129 | 39 | >75% Grass cover, Good, HSG A |
| 5,775 | 86 | Weighted Average |
| 1,129 | | 19.55% Pervious Area |
| 4,646 | | 80.45% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment P-2: Western Entrance to Driveway/Lawn

Runoff = 0.0 cfs @ 12.18 hrs, Volume= 269 cf, Depth= 0.36"
Routed to Reach DP1 : I Street (Westbound)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 8,370 | 39 | >75% Grass cover, Good, HSG A |
| 615 | 98 | Paved parking, HSG A |
| 8,985 | 43 | Weighted Average |
| 8,370 | | 93.16% Pervious Area |
| 615 | | 6.84% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment P-3: Eastern Entrance to Driveway/Lawn

Runoff = 0.0 cfs @ 12.16 hrs, Volume= 208 cf, Depth= 0.50"
Routed to Reach DP2 : I Street (Eastbound)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 4,401 | 39 | >75% Grass cover, Good, HSG A |
| 636 | 98 | Paved parking, HSG A |
| 5,037 | 46 | Weighted Average |
| 4,401 | | 87.37% Pervious Area |
| 636 | | 12.63% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment P-4: Upper Parking Area

Runoff = 0.9 cfs @ 12.13 hrs, Volume= 2,683 cf, Depth= 2.82"
Routed to Pond 6P : SIS #6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 7,811 | 98 | Paved parking, HSG A |
| 3,612 | 39 | >75% Grass cover, Good, HSG A |
| 11,423 | 79 | Weighted Average |
| 3,612 | | 31.62% Pervious Area |
| 7,811 | | 68.38% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment P-5: Remaining Lawn

Runoff = 0.0 cfs @ 15.02 hrs, Volume= 553 cf, Depth= 0.20"
Routed to Reach DP3 : Y Street (East of proposed lot)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 32,496 | 39 | >75% Grass cover, Good, HSG A |
| 32,496 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R1: Roof (1)

Runoff = 0.2 cfs @ 12.13 hrs, Volume= 574 cf, Depth= 4.78"
Routed to Pond 2P : SIS #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R2: Roof (2)

Runoff = 0.2 cfs @ 12.13 hrs, Volume= 574 cf, Depth= 4.78"
Routed to Pond 3P : SIS #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R3: Roof (3)

Runoff = 0.1 cfs @ 12.13 hrs, Volume= 287 cf, Depth= 4.78"
Routed to Pond 4P : SIS #4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 720 | 98 | Roofs, HSG A |
| 720 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R4: Roof (4)

Runoff = 0.2 cfs @ 12.13 hrs, Volume= 574 cf, Depth= 4.78"
Routed to Pond 4P : SIS #4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R5: Roof (5)

Runoff = 0.2 cfs @ 12.13 hrs, Volume= 574 cf, Depth= 4.78"
Routed to Pond 5P : SIS #5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R6: Roof (6)

Runoff = 0.1 cfs @ 12.13 hrs, Volume= 287 cf, Depth= 4.78"
Routed to Pond 5P : SIS #5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 720 | 98 | Roofs, HSG A |
| 720 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R7: Roof (7)

Runoff = 0.2 cfs @ 12.13 hrs, Volume= 574 cf, Depth= 4.78"
Routed to Pond 3P : SIS #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R8: Roof (8)

Runoff = 0.2 cfs @ 12.13 hrs, Volume= 574 cf, Depth= 4.78"
Routed to Pond 3P : SIS #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.02"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Reach DP1: I Street (Westbound)

Inflow Area = 16,200 sf, 41.36% Impervious, Inflow Depth = 0.20" for 10-Year event
Inflow = 0.0 cfs @ 12.18 hrs, Volume= 269 cf
Outflow = 0.0 cfs @ 12.18 hrs, Volume= 269 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

## Summary for Reach DP2: I Street (Eastbound)

Inflow Area = 5,037 sf, 12.63% Impervious, Inflow Depth = 0.50" for 10-Year event
Inflow = 0.0 cfs @ 12.16 hrs, Volume= 208 cf
Outflow = 0.0 cfs @ 12.16 hrs, Volume= 208 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

## Summary for Reach DP3: Y Street (East of proposed lot)

| | | | | |
|---|---|---|---|---|
| Inflow Area = | 48,239 sf, | 25.15% Impervious, | Inflow Depth = 0.14" | for 10-Year event |
| Inflow = | 0.0 cfs @ | 15.02 hrs, Volume= | 553 cf | |
| Outflow = | 0.0 cfs @ | 15.02 hrs, Volume= | 553 cf, Atten= 0%, Lag= 0.0 min | |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

## Summary for Pond 1P: SIS #1

| | | | | |
|---|---|---|---|---|
| Inflow Area = | 5,775 sf, | 80.45% Impervious, | Inflow Depth = 3.49" | for 10-Year event |
| Inflow = | 0.6 cfs @ | 12.13 hrs, Volume= | 1,677 cf | |
| Outflow = | 0.0 cfs @ | 10.98 hrs, Volume= | 1,677 cf, Atten= 96%, Lag= 0.0 min | |
| Discarded = | 0.0 cfs @ | 10.98 hrs, Volume= | 1,677 cf | |
| Primary = | 0.0 cfs @ | 0.00 hrs, Volume= | 0 cf | |

Routed to Reach DP1 : I Street (Westbound)

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 103.65' @ 15.08 hrs Surf.Area= 950 sf Storage= 698 cf

Plug-Flow detention time= 297.8 min calculated for 1,677 cf (100% of inflow)
Center-of-Mass det. time= 297.9 min ( 1,121.7 - 823.9 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 102.00' | 897 cf | **20.46'W x 46.42'L x 2.71'H Field A**<br>2,573 cf Overall - 330 cf Embedded = 2,243 cf x 40.0% Voids |
| #2A | 103.00' | 255 cf | **ADS N-12 12"** x 14 Inside #1<br>Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf<br>Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf<br>14 Chambers in 7 Rows<br>17.46' Header x 0.81 sf x 2 = 28.3 cf Inside |
| | | 1,152 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 102.00' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 103.00' | **12.0" Round Culvert**<br>L= 35.0' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 103.00' / 100.00' S= 0.0857 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.79 sf |
| #3 | Device 2 | 104.00' | **3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads |
| #4 | Device 2 | 104.50' | **4.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

**Discarded OutFlow** Max=0.0 cfs @ 10.98 hrs HW=102.03' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=102.00' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** ( Controls 0.0 cfs)
  ├─**3=Orifice/Grate** ( Controls 0.0 cfs)
  └─**4=Broad-Crested Rectangular Weir**( Controls 0.0 cfs)

## Summary for Pond 2P: SIS #2

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 1,440 sf,100.00% Impervious, | Inflow Depth = | 4.78" | for | 10-Year event |
| Inflow = | 0.2 cfs @ | 12.13 hrs, Volume= | 574 cf | | |
| Outflow = | 0.0 cfs @ | 10.25 hrs, Volume= | 574 cf, | Atten= 96%, | Lag= 0.0 min |
| Discarded = | 0.0 cfs @ | 10.25 hrs, Volume= | 574 cf | | |
| Primary = | 0.0 cfs @ | 0.00 hrs, Volume= | 0 cf | | |

Routed to Reach DP1 : I Street (Westbound)

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 101.25' @ 15.06 hrs Surf.Area= 277 sf Storage= 222 cf

Plug-Flow detention time= 279.9 min calculated for 574 cf (100% of inflow)
Center-of-Mass det. time= 279.9 min ( 1,030.4 - 750.5 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 99.50' | 259 cf | **11.34'W x 24.42'L x 2.71'H Field A**<br>750 cf Overall - 103 cf Embedded = 646 cf x 40.0% Voids |
| #2A | 100.50' | 80 cf | **ADS N-12 12"** x 4 Inside #1<br>Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf<br>Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf<br>4 Chambers in 4 Rows<br>9.34' Header x 0.81 sf x 2 = 15.1 cf Inside |
| | | 339 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 99.50' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 101.67' | **4.0" Round Culvert**<br>L= 5.0' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 101.67' / 101.67' S= 0.0000 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.09 sf |

**Discarded OutFlow** Max=0.0 cfs @ 10.25 hrs HW=99.53' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=99.50' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** ( Controls 0.0 cfs)

## Summary for Pond 3P: SIS #3

| | | | | |
|---|---|---|---|---|
| Inflow Area = | 4,320 sf,100.00% Impervious, Inflow Depth = 4.78" for 10-Year event | | | |
| Inflow = | 0.5 cfs @ | 12.13 hrs, Volume= | 1,722 cf | |
| Outflow = | 0.0 cfs @ | 11.22 hrs, Volume= | 1,722 cf, Atten= 96%, Lag= 0.0 min | |
| Discarded = | 0.0 cfs @ | 11.22 hrs, Volume= | 1,722 cf | |
| Primary = | 0.0 cfs @ | 0.00 hrs, Volume= | 0 cf | |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 106.03' @ 14.08 hrs Surf.Area= 950 sf Storage= 630 cf

Plug-Flow detention time= 230.2 min calculated for 1,721 cf (100% of inflow)
Center-of-Mass det. time= 230.2 min ( 980.8 - 750.5 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 104.50' | 897 cf | **20.46'W x 46.42'L x 2.71'H Field A**<br>2,573 cf Overall - 330 cf Embedded = 2,243 cf x 40.0% Voids |
| #2A | 105.50' | 255 cf | **ADS N-12 12"** x 14 Inside #1<br>Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf<br>Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf<br>14 Chambers in 7 Rows<br>17.46' Header x 0.81 sf x 2 = 28.3 cf Inside |
| #3 | 106.50' | 2 cf | **0.50'D x 10.00'H Vertical Cone/Cylinder**Impervious |
| | | 1,154 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 104.50' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.05' |
| #2 | Primary | 110.70' | **4.0" Vert. Roof Leader outlet @ tee-wye X 4.00** C= 0.600<br>Limited to weir flow at low heads |

**Discarded OutFlow** Max=0.0 cfs @ 11.22 hrs HW=104.62' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=104.50' (Free Discharge)
└**2=Roof Leader outlet @ tee-wye** ( Controls 0.0 cfs)

## Summary for Pond 4P: SIS #4

| | | | | |
|---|---|---|---|---|
| Inflow Area = | 2,160 sf,100.00% Impervious, Inflow Depth = 4.78" for 10-Year event | | | |
| Inflow = | 0.3 cfs @ | 12.13 hrs, Volume= | 861 cf | |
| Outflow = | 0.0 cfs @ | 11.74 hrs, Volume= | 861 cf, Atten= 95%, Lag= 0.0 min | |
| Discarded = | 0.0 cfs @ | 11.74 hrs, Volume= | 861 cf | |
| Primary = | 0.0 cfs @ | 0.00 hrs, Volume= | 0 cf | |
| Routed to Pond 6P : SIS #6 | | | | |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 113.51' @ 13.63 hrs Surf.Area= 520 sf Storage= 295 cf

Plug-Flow detention time= 185.8 min calculated for 861 cf (100% of inflow)

Center-of-Mass det. time= 185.7 min ( 936.3 - 750.5 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 112.14' | 490 cf | **20.46'W x 25.42'L x 2.71'H Field A** |
| | | | 1,409 cf Overall - 183 cf Embedded = 1,226 cf x 40.0% Voids |
| #2A | 113.14' | 142 cf | **ADS N-12 12"** x 7 Inside #1 |
| | | | Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf |
| | | | Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf |
| | | | 7 Chambers in 7 Rows |
| | | | 17.46' Header x 0.81 sf x 2 = 28.3 cf Inside |
| #3 | 114.14' | 3 cf | **0.50'D x 15.00'H Vertical Cone/Cylinder**-Impervious |
| | | 635 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 112.14' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 117.80' | **4.0" Vert. Orifice/Grate X 4.00** C= 0.600 |
| | | | Limited to weir flow at low heads |

**Discarded OutFlow** Max=0.0 cfs @ 11.74 hrs HW=112.31' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=112.14' TW=101.50' (Dynamic Tailwater)
└**2=Orifice/Grate** ( Controls 0.0 cfs)

## Summary for Pond 5P: SIS #5

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 2,160 sf,100.00% Impervious, | Inflow Depth = | 4.78" | for | 10-Year event |
| Inflow = | 0.3 cfs @ | 12.13 hrs, Volume= | 861 cf | | |
| Outflow = | 0.0 cfs @ | 10.57 hrs, Volume= | 861 cf, | Atten= 95%, | Lag= 0.0 min |
| Discarded = | 0.0 cfs @ | 10.57 hrs, Volume= | 861 cf | | |
| Primary = | 0.0 cfs @ | 0.00 hrs, Volume= | 0 cf | | |

Routed to Pond 6P : SIS #6

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 109.03' @ 13.63 hrs Surf.Area= 520 sf Storage= 293 cf

Plug-Flow detention time= 183.0 min calculated for 861 cf (100% of inflow)
Center-of-Mass det. time= 183.1 min ( 933.6 - 750.5 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 107.67' | 490 cf | **20.46'W x 25.42'L x 2.71'H Field A** |
| | | | 1,409 cf Overall - 183 cf Embedded = 1,226 cf x 40.0% Voids |
| #2A | 108.67' | 142 cf | **ADS N-12 12"** x 7 Inside #1 |
| | | | Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf |
| | | | Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf |
| | | | 7 Chambers in 7 Rows |
| | | | 17.46' Header x 0.81 sf x 2 = 28.3 cf Inside |
| #3 | 107.57' | 3 cf | **0.50'D x 15.00'H Vertical Cone/Cylinder**-Impervious |
| | | 635 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 107.67' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 116.00' | **4.0" Vert. Orifice/Grate X 4.00** C= 0.600<br>Limited to weir flow at low heads |

**Discarded OutFlow** Max=0.0 cfs @ 10.57 hrs HW=107.67' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=107.57' TW=101.50' (Dynamic Tailwater)
└─**2=Orifice/Grate** ( Controls 0.0 cfs)

## Summary for Pond 6P: SIS #6

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 15,743 sf, | 77.06% Impervious, | Inflow Depth = | 2.05" | for 10-Year event |
| Inflow = | 0.9 cfs @ | 12.13 hrs, | Volume= | 2,683 cf | |
| Outflow = | 0.0 cfs @ | 11.56 hrs, | Volume= | 2,683 cf, | Atten= 95%, Lag= 0.0 min |
| Discarded = | 0.0 cfs @ | 11.56 hrs, | Volume= | 2,683 cf | |
| Primary = | 0.0 cfs @ | 0.00 hrs, | Volume= | 0 cf | |

Routed to Reach DP3 : Y Street (East of proposed lot)

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 102.74' @ 14.23 hrs Surf.Area= 1,988 sf Storage= 990 cf

Plug-Flow detention time= 204.2 min calculated for 2,683 cf (100% of inflow)
Center-of-Mass det. time= 204.2 min ( 1,055.8 - 851.6 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 101.50' | 1,870 cf | **23.00'W x 86.42'L x 2.71'H Field A**<br>5,385 cf Overall - 710 cf Embedded = 4,675 cf x 40.0% Voids |
| #2A | 102.50' | 549 cf | **ADS N-12 12"** x 32 Inside #1<br>Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf<br>Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf<br>32 Chambers in 8 Rows<br>19.00' Header x 0.81 sf x 2 = 30.8 cf Inside |
| | | 2,419 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 101.50' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 102.50' | **12.0" Round Culvert**<br>L= 50.0' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 102.50' / 102.00' S= 0.0100 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.79 sf |
| #3 | Device 2 | 104.00' | **4.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

**Discarded OutFlow** Max=0.0 cfs @ 11.56 hrs HW=101.53' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=101.50' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** ( Controls 0.0 cfs)
  └─**3=Broad-Crested Rectangular Weir**( Controls 0.0 cfs)

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**SubcatchmentP-1: Pave front** Runoff Area=5,775 sf 80.45% Impervious Runoff Depth=6.29"
Tc=6.0 min CN=86 Runoff=1.0 cfs 3,028 cf

**SubcatchmentP-2: Western Entrance to** Runoff Area=8,985 sf 6.84% Impervious Runoff Depth=1.52"
Tc=6.0 min CN=43 Runoff=0.3 cfs 1,137 cf

**SubcatchmentP-3: Eastern Entrance to** Runoff Area=5,037 sf 12.63% Impervious Runoff Depth=1.82"
Tc=6.0 min CN=46 Runoff=0.2 cfs 762 cf

**SubcatchmentP-4: Upper Parking Area** Runoff Area=11,423 sf 68.38% Impervious Runoff Depth=5.47"
Tc=6.0 min CN=79 Runoff=1.7 cfs 5,208 cf

**SubcatchmentP-5: Remaining Lawn** Runoff Area=32,496 sf 0.00% Impervious Runoff Depth=1.14"
Tc=6.0 min CN=39 Runoff=0.8 cfs 3,088 cf

**SubcatchmentPS-R1: Roof (1)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=7.72"
Tc=6.0 min CN=98 Runoff=0.3 cfs 926 cf

**SubcatchmentPS-R2: Roof (2)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=7.72"
Tc=6.0 min CN=98 Runoff=0.3 cfs 926 cf

**SubcatchmentPS-R3: Roof (3)** Runoff Area=720 sf 100.00% Impervious Runoff Depth=7.72"
Tc=6.0 min CN=98 Runoff=0.1 cfs 463 cf

**SubcatchmentPS-R4: Roof (4)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=7.72"
Tc=6.0 min CN=98 Runoff=0.3 cfs 926 cf

**SubcatchmentPS-R5: Roof (5)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=7.72"
Tc=6.0 min CN=98 Runoff=0.3 cfs 926 cf

**SubcatchmentPS-R6: Roof (6)** Runoff Area=720 sf 100.00% Impervious Runoff Depth=7.72"
Tc=6.0 min CN=98 Runoff=0.1 cfs 463 cf

**SubcatchmentPS-R7: Roof (7)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=7.72"
Tc=6.0 min CN=98 Runoff=0.3 cfs 926 cf

**SubcatchmentPS-R8: Roof (8)** Runoff Area=1,440 sf 100.00% Impervious Runoff Depth=7.72"
Tc=6.0 min CN=98 Runoff=0.3 cfs 926 cf

**Reach DP1: I Street (Westbound)** Inflow=0.3 cfs 2,064 cf
Outflow=0.3 cfs 2,064 cf

**Reach DP2: I Street (Eastbound)** Inflow=0.2 cfs 762 cf
Outflow=0.2 cfs 762 cf

**Reach DP3: Y Street (East of proposed lot)** Inflow=0.8 cfs 3,477 cf
Outflow=0.8 cfs 3,477 cf

**Pond 1P: SIS #1** Peak Elev=104.50' Storage=1,074 cf Inflow=1.0 cfs 3,028 cf
Discarded=0.0 cfs 2,277 cf Primary=0.1 cfs 751 cf Outflow=0.2 cfs 3,028 cf

**Pond 2P: SIS #2** Peak Elev=101.94' Storage=309 cf Inflow=0.3 cfs 926 cf
Discarded=0.0 cfs 750 cf Primary=0.1 cfs 176 cf Outflow=0.1 cfs 926 cf

**Pond 3P: SIS #3** Peak Elev=110.77' Storage=1,153 cf Inflow=0.8 cfs 2,779 cf
Discarded=0.0 cfs 2,633 cf Primary=0.0 cfs 126 cf Outflow=0.1 cfs 2,759 cf

**Pond 4P: SIS #4** Peak Elev=114.71' Storage=602 cf Inflow=0.4 cfs 1,390 cf
Discarded=0.0 cfs 1,390 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 1,390 cf

**Pond 5P: SIS #5** Peak Elev=110.22' Storage=600 cf Inflow=0.4 cfs 1,390 cf
Discarded=0.0 cfs 1,390 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 1,390 cf

**Pond 6P: SIS #6** Peak Elev=104.03' Storage=2,281 cf Inflow=1.7 cfs 5,208 cf
Discarded=0.0 cfs 4,811 cf Primary=0.1 cfs 389 cf Outflow=0.1 cfs 5,201 cf

**Total Runoff Area = 73,796 sf Runoff Volume = 19,708 cf Average Runoff Depth = 3.20"**
**67.77% Pervious = 50,008 sf 32.23% Impervious = 23,788 sf**

## Summary for Subcatchment P-1: Pave front

Runoff = 1.0 cfs @ 12.13 hrs, Volume= 3,028 cf, Depth= 6.29"
Routed to Pond 1P : SIS #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 4,646 | 98 | Paved parking, HSG A |
| 1,129 | 39 | >75% Grass cover, Good, HSG A |
| 5,775 | 86 | Weighted Average |
| 1,129 | | 19.55% Pervious Area |
| 4,646 | | 80.45% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment P-2: Western Entrance to Driveway/Lawn

Runoff = 0.3 cfs @ 12.14 hrs, Volume= 1,137 cf, Depth= 1.52"
Routed to Reach DP1 : I Street (Westbound)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 8,370 | 39 | >75% Grass cover, Good, HSG A |
| 615 | 98 | Paved parking, HSG A |
| 8,985 | 43 | Weighted Average |
| 8,370 | | 93.16% Pervious Area |
| 615 | | 6.84% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment P-3: Eastern Entrance to Driveway/Lawn

Runoff = 0.2 cfs @ 12.14 hrs, Volume= 762 cf, Depth= 1.82"
Routed to Reach DP2 : I Street (Eastbound)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 4,401 | 39 | >75% Grass cover, Good, HSG A |
| 636 | 98 | Paved parking, HSG A |
| 5,037 | 46 | Weighted Average |
| 4,401 | | 87.37% Pervious Area |
| 636 | | 12.63% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | Direct Entry, Min Tc=6min |

## Summary for Subcatchment P-4: Upper Parking Area

Runoff = 1.7 cfs @ 12.13 hrs, Volume= 5,208 cf, Depth= 5.47"
Routed to Pond 6P : SIS #6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 7,811 | 98 | Paved parking, HSG A |
| 3,612 | 39 | >75% Grass cover, Good, HSG A |
| 11,423 | 79 | Weighted Average |
| 3,612 | | 31.62% Pervious Area |
| 7,811 | | 68.38% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | Direct Entry, Min Tc=6min |

## Summary for Subcatchment P-5: Remaining Lawn

Runoff = 0.8 cfs @ 12.15 hrs, Volume= 3,088 cf, Depth= 1.14"
Routed to Reach DP3 : Y Street (East of proposed lot)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 32,496 | 39 | >75% Grass cover, Good, HSG A |
| 32,496 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | Direct Entry, Min Tc=6min |

## Summary for Subcatchment PS-R1: Roof (1)

Runoff = 0.3 cfs @ 12.13 hrs, Volume= 926 cf, Depth= 7.72"
Routed to Pond 2P : SIS #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | |

**Direct Entry, Min Tc=6min**

## Summary for Subcatchment PS-R2: Roof (2)

Runoff = 0.3 cfs @ 12.13 hrs, Volume= 926 cf, Depth= 7.72"
Routed to Pond 3P : SIS #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | |

**Direct Entry, Min Tc=6min**

## Summary for Subcatchment PS-R3: Roof (3)

Runoff = 0.1 cfs @ 12.13 hrs, Volume= 463 cf, Depth= 7.72"
Routed to Pond 4P : SIS #4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 720 | 98 | Roofs, HSG A |
| 720 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | |

**Direct Entry, Min Tc=6min**

## Summary for Subcatchment PS-R4: Roof (4)

Runoff = 0.3 cfs @ 12.13 hrs, Volume= 926 cf, Depth= 7.72"
Routed to Pond 4P : SIS #4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R5: Roof (5)

Runoff = 0.3 cfs @ 12.13 hrs, Volume= 926 cf, Depth= 7.72"
Routed to Pond 5P : SIS #5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R6: Roof (6)

Runoff = 0.1 cfs @ 12.13 hrs, Volume= 463 cf, Depth= 7.72"
Routed to Pond 5P : SIS #5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 720 | 98 | Roofs, HSG A |
| 720 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R7: Roof (7)

Runoff = 0.3 cfs @ 12.13 hrs, Volume= 926 cf, Depth= 7.72"
Routed to Pond 3P : SIS #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Subcatchment PS-R8: Roof (8)

Runoff = 0.3 cfs @ 12.13 hrs, Volume= 926 cf, Depth= 7.72"
Routed to Pond 3P : SIS #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=7.96"

| Area (sf) | CN | Description |
|---|---|---|
| 1,440 | 98 | Roofs, HSG A |
| 1,440 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Min Tc=6min** |

## Summary for Reach DP1: I Street (Westbound)

Inflow Area = 16,200 sf, 41.36% Impervious, Inflow Depth = 1.53" for 100-Year event
Inflow = 0.3 cfs @ 12.24 hrs, Volume= 2,064 cf
Outflow = 0.3 cfs @ 12.24 hrs, Volume= 2,064 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

## Summary for Reach DP2: I Street (Eastbound)

Inflow Area = 5,037 sf, 12.63% Impervious, Inflow Depth = 1.82" for 100-Year event
Inflow = 0.2 cfs @ 12.14 hrs, Volume= 762 cf
Outflow = 0.2 cfs @ 12.14 hrs, Volume= 762 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

## Summary for Reach DP3: Y Street (East of proposed lot)

| | | | | |
|---|---|---|---|---|
| Inflow Area = | 48,239 sf, | 25.15% Impervious, | Inflow Depth = 0.87" | for 100-Year event |
| Inflow = | 0.8 cfs @ | 12.15 hrs, Volume= | 3,477 cf | |
| Outflow = | 0.8 cfs @ | 12.15 hrs, Volume= | 3,477 cf, Atten= 0%, Lag= 0.0 min | |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

## Summary for Pond 1P: SIS #1

| | | | | |
|---|---|---|---|---|
| Inflow Area = | 5,775 sf, | 80.45% Impervious, | Inflow Depth = 6.29" | for 100-Year event |
| Inflow = | 1.0 cfs @ | 12.13 hrs, Volume= | 3,028 cf | |
| Outflow = | 0.2 cfs @ | 12.39 hrs, Volume= | 3,028 cf, Atten= 83%, Lag= 15.6 min | |
| Discarded = | 0.0 cfs @ | 9.33 hrs, Volume= | 2,277 cf | |
| Primary = | 0.1 cfs @ | 12.39 hrs, Volume= | 751 cf | |

Routed to Reach DP1 : I Street (Westbound)

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 104.50' @ 12.39 hrs Surf.Area= 950 sf Storage= 1,074 cf

Plug-Flow detention time= 303.3 min calculated for 3,027 cf (100% of inflow)
Center-of-Mass det. time= 303.3 min ( 1,104.9 - 801.5 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 102.00' | 897 cf | **20.46'W x 46.42'L x 2.71'H Field A**<br>2,573 cf Overall - 330 cf Embedded = 2,243 cf x 40.0% Voids |
| #2A | 103.00' | 255 cf | **ADS N-12 12"** x 14 Inside #1<br>Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf<br>Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf<br>14 Chambers in 7 Rows<br>17.46' Header x 0.81 sf x 2 = 28.3 cf Inside |
| | | 1,152 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 102.00' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 103.00' | **12.0" Round Culvert**<br>L= 35.0' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 103.00' / 100.00' S= 0.0857 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.79 sf |
| #3 | Device 2 | 104.00' | **3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads |
| #4 | Device 2 | 104.50' | **4.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

**Discarded OutFlow** Max=0.0 cfs @ 9.33 hrs HW=102.03' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.1 cfs @ 12.39 hrs HW=104.50' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** (Passes 0.1 cfs of 3.0 cfs potential flow)
  ├─**3=Orifice/Grate** (Orifice Controls 0.1 cfs @ 2.96 fps)
  └─**4=Broad-Crested Rectangular Weir** (Weir Controls 0.0 cfs @ 0.15 fps)

## Summary for Pond 2P: SIS #2

| | | | | |
|---|---|---|---|---|
| Inflow Area = | 1,440 sf, 100.00% Impervious, Inflow Depth = 7.72" for 100-Year event | | | |
| Inflow = | 0.3 cfs @ | 12.13 hrs, Volume= | 926 cf | |
| Outflow = | 0.1 cfs @ | 12.27 hrs, Volume= | 926 cf, Atten= 70%, Lag= 8.7 min | |
| Discarded = | 0.0 cfs @ | 7.54 hrs, Volume= | 750 cf | |
| Primary = | 0.1 cfs @ | 12.27 hrs, Volume= | 176 cf | |

Routed to Reach DP1 : I Street (Westbound)

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 101.94' @ 12.27 hrs Surf.Area= 277 sf Storage= 309 cf

Plug-Flow detention time= 310.7 min calculated for 926 cf (100% of inflow)
Center-of-Mass det. time= 310.8 min ( 1,053.6 - 742.8 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 99.50' | 259 cf | **11.34'W x 24.42'L x 2.71'H Field A**<br>750 cf Overall - 103 cf Embedded = 646 cf x 40.0% Voids |
| #2A | 100.50' | 80 cf | **ADS N-12 12"** x 4 Inside #1<br>Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf<br>Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf<br>4 Chambers in 4 Rows<br>9.34' Header x 0.81 sf x 2 = 15.1 cf Inside |
| | | 339 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 99.50' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 101.67' | **4.0" Round Culvert**<br>L= 5.0' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 101.67' / 101.67' S= 0.0000 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.09 sf |

**Discarded OutFlow** Max=0.0 cfs @ 7.54 hrs HW=99.53' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.1 cfs @ 12.27 hrs HW=101.94' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** (Barrel Controls 0.1 cfs @ 1.34 fps)

## Summary for Pond 3P: SIS #3

| | | | | |
|---|---|---|---|---|
| Inflow Area = | 4,320 sf,100.00% Impervious, Inflow Depth = 7.72" for 100-Year event | | | |
| Inflow = | 0.8 cfs @ | 12.13 hrs, Volume= | 2,779 cf | |
| Outflow = | 0.1 cfs @ | 13.13 hrs, Volume= | 2,759 cf, Atten= 92%, Lag= 60.1 min | |
| Discarded = | 0.0 cfs @ | 9.65 hrs, Volume= | 2,633 cf | |
| Primary = | 0.0 cfs @ | 13.13 hrs, Volume= | 126 cf | |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 110.77' @ 13.13 hrs Surf.Area= 950 sf Storage= 1,153 cf

Plug-Flow detention time= 424.5 min calculated for 2,758 cf (99% of inflow)
Center-of-Mass det. time= 419.5 min ( 1,162.3 - 742.8 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 104.50' | 897 cf | **20.46'W x 46.42'L x 2.71'H Field A**<br>2,573 cf Overall - 330 cf Embedded = 2,243 cf x 40.0% Voids |
| #2A | 105.50' | 255 cf | **ADS N-12 12"** x 14 Inside #1<br>Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf<br>Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf<br>14 Chambers in 7 Rows<br>17.46' Header x 0.81 sf x 2 = 28.3 cf Inside |
| #3 | 106.50' | 2 cf | **0.50'D x 10.00'H Vertical Cone/Cylinder**Impervious |
| | | 1,154 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 104.50' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.05' |
| #2 | Primary | 110.70' | **4.0" Vert. Roof Leader outlet @ tee-wye X 4.00** C= 0.600<br>Limited to weir flow at low heads |

**Discarded OutFlow** Max=0.0 cfs @ 9.65 hrs HW=104.62' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 13.13 hrs HW=110.77' (Free Discharge)
└**2=Roof Leader outlet @ tee-wye** (Orifice Controls 0.0 cfs @ 0.88 fps)

## Summary for Pond 4P: SIS #4

| | | | | |
|---|---|---|---|---|
| Inflow Area = | 2,160 sf,100.00% Impervious, Inflow Depth = 7.72" for 100-Year event | | | |
| Inflow = | 0.4 cfs @ | 12.13 hrs, Volume= | 1,390 cf | |
| Outflow = | 0.0 cfs @ | 10.76 hrs, Volume= | 1,390 cf, Atten= 97%, Lag= 0.0 min | |
| Discarded = | 0.0 cfs @ | 10.76 hrs, Volume= | 1,390 cf | |
| Primary = | 0.0 cfs @ | 0.00 hrs, Volume= | 0 cf | |
| Routed to Pond 6P : SIS #6 | | | | |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 114.71' @ 15.47 hrs Surf.Area= 520 sf Storage= 602 cf

Plug-Flow detention time= 413.6 min calculated for 1,389 cf (100% of inflow)

Center-of-Mass det. time= 413.7 min ( 1,156.5 - 742.8 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 112.14' | 490 cf | **20.46'W x 25.42'L x 2.71'H Field A** |
| | | | 1,409 cf Overall - 183 cf Embedded = 1,226 cf x 40.0% Voids |
| #2A | 113.14' | 142 cf | **ADS N-12 12"** x 7 Inside #1 |
| | | | Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf |
| | | | Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf |
| | | | 7 Chambers in 7 Rows |
| | | | 17.46' Header x 0.81 sf x 2 = 28.3 cf Inside |
| #3 | 114.14' | 3 cf | **0.50'D x 15.00'H Vertical Cone/Cylinder**-Impervious |
| | | 635 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 112.14' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 117.80' | **4.0" Vert. Orifice/Grate X 4.00** C= 0.600 |
| | | | Limited to weir flow at low heads |

**Discarded OutFlow** Max=0.0 cfs @ 10.76 hrs HW=112.31' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=112.14' TW=101.50' (Dynamic Tailwater)
└**2=Orifice/Grate** ( Controls 0.0 cfs)

## Summary for Pond 5P: SIS #5

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 2,160 sf, | 100.00% Impervious, | Inflow Depth = | 7.72" | for 100-Year event |
| Inflow = | 0.4 cfs @ | 12.13 hrs, Volume= | 1,390 cf | | |
| Outflow = | 0.0 cfs @ | 8.88 hrs, Volume= | 1,390 cf, | Atten= 97%, | Lag= 0.0 min |
| Discarded = | 0.0 cfs @ | 8.88 hrs, Volume= | 1,390 cf | | |
| Primary = | 0.0 cfs @ | 0.00 hrs, Volume= | 0 cf | | |

Routed to Pond 6P : SIS #6

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 110.22' @ 15.47 hrs Surf.Area= 520 sf Storage= 600 cf

Plug-Flow detention time= 410.8 min calculated for 1,389 cf (100% of inflow)
Center-of-Mass det. time= 410.9 min ( 1,153.7 - 742.8 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 107.67' | 490 cf | **20.46'W x 25.42'L x 2.71'H Field A** |
| | | | 1,409 cf Overall - 183 cf Embedded = 1,226 cf x 40.0% Voids |
| #2A | 108.67' | 142 cf | **ADS N-12 12"** x 7 Inside #1 |
| | | | Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf |
| | | | Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf |
| | | | 7 Chambers in 7 Rows |
| | | | 17.46' Header x 0.81 sf x 2 = 28.3 cf Inside |
| #3 | 107.57' | 3 cf | **0.50'D x 15.00'H Vertical Cone/Cylinder**-Impervious |
| | | 635 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 107.67' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 116.00' | **4.0" Vert. Orifice/Grate X 4.00** C= 0.600<br>Limited to weir flow at low heads |

**Discarded OutFlow** Max=0.0 cfs @ 8.88 hrs HW=107.67' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=107.57' TW=101.50' (Dynamic Tailwater)
└─**2=Orifice/Grate** ( Controls 0.0 cfs)

## Summary for Pond 6P: SIS #6

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 15,743 sf, | 77.06% Impervious, | Inflow Depth = | 3.97" | for 100-Year event |
| Inflow = | 1.7 cfs @ | 12.13 hrs, Volume= | 5,208 cf | | |
| Outflow = | 0.1 cfs @ | 13.41 hrs, Volume= | 5,201 cf, | Atten= 93%, | Lag= 76.8 min |
| Discarded = | 0.0 cfs @ | 10.37 hrs, Volume= | 4,811 cf | | |
| Primary = | 0.1 cfs @ | 13.41 hrs, Volume= | 389 cf | | |

Routed to Reach DP3 : Y Street (East of proposed lot)

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 104.03' @ 13.41 hrs Surf.Area= 1,988 sf Storage= 2,281 cf

Plug-Flow detention time= 446.6 min calculated for 5,201 cf (100% of inflow)
Center-of-Mass det. time= 445.8 min ( 1,271.2 - 825.4 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 101.50' | 1,870 cf | **23.00'W x 86.42'L x 2.71'H Field A**<br>5,385 cf Overall - 710 cf Embedded = 4,675 cf x 40.0% Voids |
| #2A | 102.50' | 549 cf | **ADS N-12 12"** x 32 Inside #1<br>Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf<br>Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf<br>32 Chambers in 8 Rows<br>19.00' Header x 0.81 sf x 2 = 30.8 cf Inside |
| | | 2,419 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 101.50' | **1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01' |
| #2 | Primary | 102.50' | **12.0" Round Culvert**<br>L= 50.0' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 102.50' / 102.00' S= 0.0100 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.79 sf |
| #3 | Device 2 | 104.00' | **4.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

**Discarded OutFlow** Max=0.0 cfs @ 10.37 hrs HW=101.53' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.1 cfs @ 13.41 hrs HW=104.03' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** (Passes 0.1 cfs of 3.0 cfs potential flow)
  └─**3=Broad-Crested Rectangular Weir** (Weir Controls 0.1 cfs @ 0.52 fps)

## Construction Phase Best Management Practices (BMP's)

Erosion and Sedimentation will be controlled at the site by utilizing structural practices, stabilization practices, and dust control. These practices correspond with the site development plans entitled "Site Development Plans In Haverhill, Massachusetts, 931 Boston Road" prepared by The Morin-Cameron Group, Inc. dated April 28, 2026 as revised and approved by the Haverhill City Council, hereinafter referred to as the Site Plans.

Responsible Party Contact Information:

| | |
|---|---|
| Stormwater Management System Owner: | Pentucket North Development LLC<br>c/o Ronald J. Mailloux Sr.<br>55 Chase Street<br>Methuen, MA 01844<br>P: (978) 808-0722 |
| General Contractor: | TBD |
| Site Contractor: | TBD |

City Contact Information:

| | |
|---|---|
| Haverhill Public Works: | Haverhill Public Works Department<br>500 Primrose Street<br>Haverhill, MA 01830<br>P: (978) 374-2360 |
| Haverhill City Council: | Haverhill City Council<br>Haverhill City Hall<br>4 Summer Street, Room 204<br>Haverhill, MA 01830<br>P: (978) 374-2328 |
| Site Design Engineer Information: | The Morin-Cameron Group, Inc.<br>66 Elm St<br>Danvers, MA 01923<br>Phone: (978) 777-8586 |

**General:**

**a.** Proposed perimeter erosion & sediment controls shall manage all stormwater leaving the site during construction, including sheet flow onto adjacent private and public properties.
**b.** Erosion and sediment control measures shall be installed prior to any soil disturbance, the area of disturbance shall be kept to a minimum, and any sediment in runoff shall be retained within the project area.
**c.** In areas where final grading has not occurred, implement temporary stabilization measures within 7 days after initial disturbance for exposed soil areas within 100 feet of a surface water body or wetland and no more than 14 days after initial disturbance for all other areas.
**d.** Permanent stabilization must be in place no more than 3 days (72 hours) following the completion of final grading of exposed soil areas.
**e.** Runoff must be directed to temporary practices until stormwater BMPs are stabilized. Basins, ditches, and swales must be stabilized prior to directing runoff to them.
**f.** Permanent or temporary basins shall be installed prior to installation of any connected drainage systems.
**g.** All temporary erosion control measures are to be removed after final site stabilization. Trapped sediment and other disturbed soil areas shall be permanently stabilized prior to removal of temporary control measures.
**h.** Construction BMPs must be maintained while construction or land disturbance activities continue
**i.** The inspections of temporary erosion control measures following rain events shall verify that the construction BMPs shown and described on the plans are in good condition and are minimizing erosion. A maintenance and inspection report shall be made with each inspection. All site inspection reports shall be submitted to DPW on no longer than a monthly basis in a format approved by the DPW.
**j.** Off-site surface water and runoff from undisturbed areas shall be diverted away from disturbed areas and stockpiles where feasible or carried non erosively through the project area. Integrity of downstream drainage systems shall be maintained.
**k.** All proposed infiltration systems must be staked out and protected for the duration of construction activities from compaction, siltation, and erosion or will be restored or replaced such that the BMP will be capable of functioning as designed.
**l.** Waste disposal, sanitary sewer or septic system regulations, and air quality requirements, including dust control will be handled in compliance with applicable federal, state and local laws and regulations.

**Structural Practices:**

1) **Silt Fence** (proposed as part of the stockpiling protection)– Siltation fence shall be installed in accordance with the approved plans.
   a) Installation Schedule: Prior to stockpiling.

   b) Maintenance and Inspection: The site supervisor shall inspect the silt fence at least once per week and shall repair any damaged or affected areas of the fence at the time they are noted.

2) **Mulch Sock** – Mulch sock shall be installed in accordance with the approved plans where high rates of stormwater runoff are anticipated.
   c) Installation Schedule: Prior to Start of land disturbance.

d) Maintenance and Inspection: The site supervisor shall inspect the mulch sock at least once per week and shall repair any damaged or affected areas of the sock at the time they are noted.

3) **Inlet Protection** – Inlet Protection will be utilized around the catch basin grates installed on site. The inlet protection will allow the storm drain inlets to be used before final stabilization. This structural practice will allow early use of the drainage system. Siltsack or equivalent will be utilized for the inlet protection. Siltsack is manufactured by ACF Environmental. The telephone number is 800-448-3636. Regular flow siltsack will be utilized, and if it does not allow enough storm water flow, hi-flow siltsack will be utilized.

Silt Sack (or equivalent) Inlet Protection Inspection/Maintenance Requirements *

a) The silt sack trapping device and the catch basin should be inspected after every rain storm and repairs made as necessary.

b) Sediment should be removed from the silt sack after the sediment has reached a maximum depth of one-half the depth of the trap.

c) Sediment should be disposed of in a suitable area and protected from erosion by either structural or vegetative means. Sediment material removed shall be disposed of in accordance with all applicable local, state, and federal regulations.

d) The silt sack must be replaced if it is ripped or torn in any way.

e) Temporary traps should be removed and the area repaired as soon as the contributing drainage area to the inlet has been completely stabilized.

4) **Sediment Track-Out:** Stabilized Construction Exit: Prior to the commencement of site work, crushed stone anti-tracking pads will be installed at the entrance to the site. This will prevent trucks from tracking material onto the road from the construction site. If, at any point during the project, the tracking pad becomes ineffective due to accumulation of soil, the crushed stone shall be replaced. Details for construction of the stabilized entrance can be found in the Erosion Control Details sheet that is part of the comprehensive permit plan set associated with the project. The site supervisor will inspect the tracking pads weekly to ensure that they are properly limiting the tracking of soil onto the road. If tracking onto the roadway is noted, it shall be removed immediately via a mechanical street sweeper.

**Stabilization Practices:**

Stabilization measures shall be implemented as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased, but in no case more than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased, with the following exceptions.

- Where the initiation of stabilization measures by the 14th day after construction activity temporary or permanently cease is precluded by snow cover, stabilization measures shall be initiated as soon as practicable.

- Where construction activity will resume on a portion of the site within 21 days from when activities ceased, (e.g. the total time period that construction activity is temporarily ceased is less than 21 days) then stabilization measures do not have to be initiated on that portion of the site by the 14th day after construction activity temporarily ceased.

1) **Temporary Seeding** – Temporary seeding will allow a short-term vegetative cover on disturbed site areas that may be in danger of erosion. Temporary seeding will be done at stock piles and disturbed portions of the site where construction activity will temporarily cease for at least 21 days. The temporary seeding will stabilize cleared and unvegetated areas that will not be brought into final grade for several weeks or months.

Temporary Seeding Planting Procedures *

a) Planting should preferably be done between April 1st and June 30th, and September 1st through September 31st. If planting is done in the months of July and August, irrigation may be required. If planting is done between October 1st and March 31st, mulching should be applied immediately after planting. If seeding is done during the summer months, irrigation of some sort will probably be necessary.

b) Before seeding, install structural practice controls. Utilize Amoco supergro or equivalent.

c) Select the appropriate seed species for temporary cover from the following table.

| Species | Seeding Rate (lbs./1,000 sq.) | Seeding Rate (lbs./acre) | Recommended Seeding Dates | Seed Cover required |
|---|---|---|---|---|
| Annual Ryegrass | 1 | 40 | April 1st to June 1st<br>August 15th to Sept. 15th | ¼ inch |
| Foxtail Millet | 0.7 | 30 | May 1st to June 30th | ½ to ¾ inch |
| Oats | 2 | 80 | April 1st to July 1st<br>August 15th to Sept. 15th | 1 to 1-½ inch |
| Winter Rye | 3 | 120 | August 15th to Oct. 15th | 1 to 1-½ inch |

Apply the seed uniformly by hydroseeding, broadcasting, or by hand.

d) Use effective mulch, such as clean grain straw; tacked and/or tied with netting to protect seedbed and encourage plant growth.

Temporary Seeding Inspection/Maintenance *

a) Inspect within 6 weeks of planting to see if stands are adequate. Check for damage within 24 hours of the end to a heavy rainfall, defined as a 2-year storm event (i.e., 3.2 inches of rainfall within a twenty-four-hour period). Stands should be uniform and dense. Reseed and mulch damaged and sparse areas immediately. Tack or tie down mulch as necessary.

b) Seeds should be supplied with adequate moisture. Furnish water as needed, especially in abnormally hot or dry weather. Water application rates should be controlled to prevent runoff.

2) **Geotextiles** - Geotextiles such as jute netting will be used in combination with other practices such as mulching to stabilize slopes. The following geotextile materials or equivalent are to be utilized for structural and nonstructural controls as shown in the following table.

| Practice | Manufacturer | Product | Remarks |
|---|---|---|---|
| Sediment Fence | Amoco | Woven polypropylene 1198 or equivalent | 0.425 mm opening |
| Construction Entrance | Amoco | Woven polypropylene 2002 or equivalent | 0.300 mm opening |
| Outlet Protection | Amoco | Nonwoven polypropylene 4551 or equivalent | 0.150 mm opening |
| Erosion Control (slope stability) | Amoco | Supergro or equivalent | Erosion control revegetation mix, open polypropylene fiber on degradable polypropylene net scrim |

Amoco may be reached at (800) 445 7732

Geotextile Installation

a) Netting and matting require firm, continuous contact between the materials and the soil. If there is no contact, the material will not hold the soil and erosion will occur underneath the material.

Geotextile Inspection/Maintenance *

a) In the field, regular inspections should be made to check for cracks, tears, or breaches in the fabric. The appropriate repairs should be made.

3) **Mulching and Netting** – Mulching will provide immediate protection to exposed soils during the period of short construction delays, or over winter months through the application of plant residues, or other suitable materials, to exposed soil areas. In areas, which have been seeded either for temporary or permanent cover, mulching should immediately follow seeding. On steep slopes, mulch must be supplemented with netting. The preferred mulching material is straw.

Mulch (Hay or Straw) Materials and Installation

a) Straw has been found to be one of the most effective organic mulch materials. The specifications for straw are described below, but other material may be appropriate. The straw should be air-dried; free of undesirable seeds & coarse materials. The application rate per 1,000 sq. is 90-100 lbs. (2-3 bales) and the application rate per acre is 2 tons (100-120 bales). The application should cover about 90% of the surface. The use of straw mulch is appropriate where mulch is maintained for more than three months. Straw mulch is subject to wind blowing unless anchored, is the most commonly used mulching material, and has the best microenvironment for germinating seeds.

Mulch Maintenance *

a) Inspect after rainstorms to check for movement of mulch or erosion. If washout, breakage, or erosion occurs, repair surface, reseed, remulch, and install new netting.

b) Straw or grass mulches that blow or wash away should be repaired promptly.

c) If plastic netting is used to anchor mulch, care should be taken during initial mowing to keep the mower height high. Otherwise, the netting can wrap up on the mower blade shafts. After a period of time, the netting degrades and becomes less of a problem.

d) Continue inspections until vegetation is well established.

4) **Land Grading** – Grading on fill slopes, cut slopes, and stockpile areas will be done with full siltation controls in place.

Land Grading Design/Installation Requirements

a) Areas to be graded should be cleared and grubbed of all timber, logs, brush, rubbish, and vegetated matter that will interfere with the grading operation. Topsoil should be stripped and stockpiled for use on critical disturbed areas for establishment of vegetation. Cut slopes to be topsoiled should be thoroughly scarified to a minimum depth of 3-inches prior to placement of topsoil.

b) Fill materials should be generally free of brush, rubbish, rocks, and stumps. Frozen materials or soft and easily compressible materials should not be used in fills intended to support buildings, parking lots, roads, conduits, or other structures.

c) Earth fill intended to support structural measures should be compacted to a minimum of 90 percent of Standard Proctor Test density with proper moisture control, or as otherwise specified by the engineer responsible for the design. Compaction of other fills should be to the density required to control sloughing, erosion or excessive moisture content. Maximum thickness of fill layers prior to compaction should not exceed 9 inches.

d) The uppermost one foot of fill slopes should be compacted to at least 85 percent of the maximum unit weight (based on the modified AASHTO compaction test). This is usually accomplished by running heavy equipment over the fill.

e) Fill should consist of material from borrow areas and excess cut will be stockpiled in areas shown on the Site Plans. All disturbed areas should be free draining, left with a neat and finished appearance, and should be protected from erosion.

Land Grading Stabilization Inspection/Maintenance *

a) All slopes should be checked periodically to see that vegetation is in good condition. Any rills or damage from erosion and animal burrowing should be repaired immediately to avoid further damage.

b) If seeps develop on the slopes, the area should be evaluated to determine if the seep will cause an unstable condition. Subsurface drains or a gravel mulch may be required to solve seep problems. However, no seeps are anticipated.

c) Areas requiring revegetation should be repaired immediately. Control undesirable vegetation such as weeds and woody growth to avoid bank stability problems in the future.

5) **Topsoiling** * – Topsoiling will help establish vegetation on all disturbed areas throughout the site during the seeding process. The soil texture of the topsoil to be used will be a sandy loam to a silt loam texture with 15% to 20% organic content.

Topsoiling Placement

a) Topsoil should not be placed while in a frozen or muddy condition, when the subgrade is excessively wet, or when conditions exist that may otherwise be detrimental to proper grading or proposed seeding.

b) Do not place topsoil on slopes steeper than 2.5:1, as it will tend to erode.

c) If topsoil and subsoil are not properly bonded, water will not infiltrate the soil profile evenly and it will be difficult to establish vegetation. The best method is to actually work the topsoil into the layer below for a depth of at least 6 inches.

6) **Permanent Seeding** – Permanent Seeding should be done immediately after the final design grades are achieved. Native species of plants should be used to establish perennial vegetative cover on disturbed areas. The revegetation should be done early enough in the fall so that a good cover is established before cold weather comes and growth stops until the spring. A good cover is defined as vegetation covering 75 percent or more of the ground surface.

Permanent Seeding Seedbed Preparation

a) In infertile or coarse-textured subsoil, it is best to stockpile topsoil and re-spread it over the finished slope at a minimum 2 to 6-inch depth and roll it to provide a

firm seedbed. The topsoil must have a sandy loam to silt loam texture with 15% to 20% organic content. If construction fill operations have left soil exposed with a loose, rough, or irregular surface, smooth with blade and roll.

b) Loosen the soil to a depth of 3-5 inches with suitable agricultural or construction equipment.

c) Areas not to receive topsoil shall be treated to firm the seedbed after incorporation of the lime and fertilizer so that it is depressed no more than ½ - 1 inch when stepped on with a shoe. Areas to receive topsoil shall not be firmed until after topsoiling and lime and fertilizer is applied and incorporated, at which time it shall be treated to firm the seedbed as described above.

Permanent Seeding Grass Selection/Application

a) Select an appropriate cool or warm season grass based on site conditions and seeding date. Apply the seed uniformly by hydro-seeding, broadcasting, or by hand. Uniform seed distribution is essential. On steep slopes, hydroseeding may be the most effective seeding method. Surface roughening is particularly important when preparing slopes for hydroseeding.

b) Lime and fertilize. Organic fertilizer shall be utilized in areas within the 100-foot buffer zone to a wetland resource area.

c) Mulch the seedings with straw applied at the rate of ½ tons per acre. Anchor the mulch with erosion control netting or fabric on sloping areas. Amoco supergro or equivalent should be utilized.

Permanent Seeding Inspection/Maintenance *

a) Frequently inspect seeded areas for failure and make necessary repairs and reseed immediately. Conduct or follow-up survey after one year and replace failed plants where necessary.

b) If vegetative cover is inadequate to prevent rill erosion, overseed and fertilize in accordance with soil test results.

c) If a stand has less than 40% cover, reevaluate choice of plant materials and quantities of lime and fertilizer. Re-establish the stand following seedbed preparation and seeding recommendations, omitting lime and fertilizer in the absence of soil test results. If the season prevents resowing, mulch or jute netting is an effective temporary cover.

d) Seeded areas should be fertilized during the second growing season. Lime and fertilize thereafter at periodic intervals, as needed. Organic fertilizer shall be utilized in areas within the 100-foot buffer zone to a wetland resource area.

**Dust Control:**

Dust control will be utilized throughout the entire construction process of the site. For example, keeping disturbed surfaces moist during windy periods will be an effective control measure, especially for construction access roads. The use of dust control will prevent the movement of soil to offsite areas. However, care must be taken to not create runoff from excessive use of water to control dust. The following are methods of Dust Control that may be used on-site:

- Vegetative Cover – The most practical method for disturbed areas not subject to traffic.
- Calcium Chloride – Calcium chloride may be applied by mechanical spreader as loose, dry granules or flakes at a rate that keeps the surface moist but not so high as to cause water pollution or plant damage.
- Sprinkling – The site may be sprinkled until the surface is wet. Sprinkling will be effective for dust control on haul roads and other traffic routes.
- Stone – Stone will be used to stabilize construction roads; will also be effective for dust control.

The general contractor shall employ an on-site water vehicle for the control of dust as necessary.

**Non-Stormwater Discharges:**

The construction de-watering and all non-stormwater discharges will be directed into a sediment dirt bag (or equivalent inlet protection) or a sediment basin. Sediment material removed shall be disposed of in accordance with all applicable local, state, and federal regulations.

The developer and site general contractor will comply with the E.P.A.'s Final General Permit for Construction De-watering Discharges, (N.P.D.E.S., Section 402 and 40 C.F.R. 122.26(b) (14) (x).

**Inspection/Maintenance:**

Operator personnel must inspect the construction site at least once every 14 calendar days and within 24 hours of a storm event of 1/4-inch or greater. The applicant shall be responsible to secure the services of a design professional or similar professional (inspector) on an on-going basis throughout all phases of the project. Refer to the Inspection/Maintenance Requirements presented earlier in the "Structural and Stabilization Practices." The inspector should review the erosion and sediment controls with respect to the following:

- Whether or not the measure was installed/performed correctly.
- Whether or not there has been damage to the measure since it was installed or performed.
- What should be done to correct any problems with the measure.

The inspector should complete a Stormwater Management Construction Phase BMP Inspection Schedule and Evaluation Checklist for documenting the findings and should request the required maintenance or repair for the pollution prevention measures when the inspector finds that it is necessary for the measure to be effective. The inspector

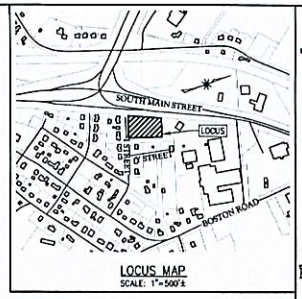
should notify the appropriate person to make the changes and submit copies of the form to the Haverhill Department of Public Works.

It is essential that the inspector document the inspection of the pollution prevention measures. These records will be used to request maintenance and repair and to prove that the inspection and maintenance were performed. The forms list each of the measures to be inspected on the site, the inspector's name, the date of the inspection, the condition of the measure/area inspected, maintenance or repair performed and any changes which should be made to the Operation and Maintenance Plan to control or eliminate unforeseen pollution of storm water.

# SITE DEVELOPMENT PLANS

## FOR A
## MULTI-FAMILY DEVELOPMENT
## LOCATED AT
## 931 BOSTON ROAD
## HAVERHILL, MASSACHUSETTS

(PORTION OF ASSESSOR'S MAP 754, BLOCK 2, LOT 21)

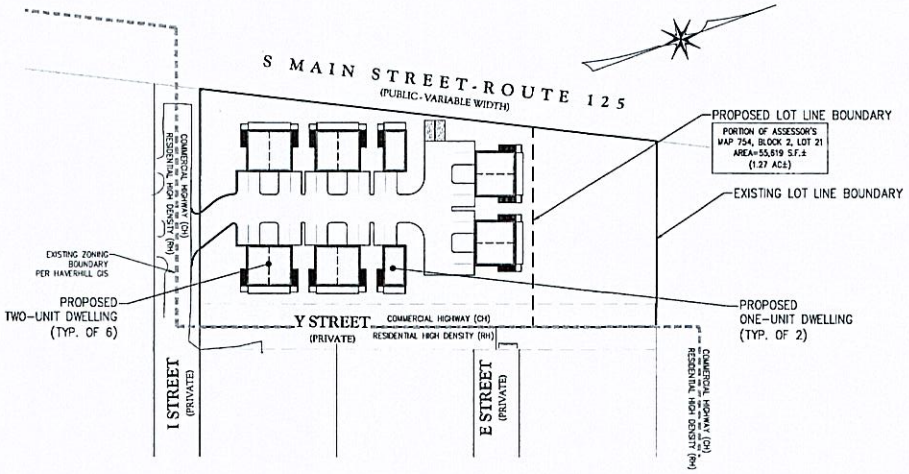



LOCUS MAP
SCALE: 1"=500'±

SCHEDULE OF PLAN SET DRAWINGS:

| | |
|---|---|
| SHEET 1 OF 11 | COVER SHEET |
| SHEET 2 OF 11 | SITE CONTEXT PLAN |
| SHEET 3 OF 11 | EXISTING CONDITIONS PLAN |
| SHEET 4 OF 11 | SITE PREPARATION & EROSION CONTROL |
| SHEET 5 OF 11 | SITE LAYOUT PLAN |
| SHEET 6 OF 11 | GRADING, DRAINAGE & UTILITY PLAN |
| SHEET 7 OF 11 | DETAILS |
| SHEET 8 OF 11 | DETAILS |
| SHEET 9 OF 11 | STORMWATER DETAILS |
| SHEET 10 OF 11 | STORMWATER DETAILS |
| SHEET 11 OF 11 | STORMWATER DETAILS |
| SHEET A0.0 | SITE PLAN |
| SHEET A1.1 | 1ST FLOOR PLAN DUPLEX BUILDING |
| SHEET A1.2 | 2ND FLOOR PLAN DUPLEX BUILDING |
| SHEET A1.3 | 3RD FLOOR PLAN DUPLEX BUILDING |
| SHEET A1.4 | ROOF PLAN DUPLEX BUILDING |
| SHEET A2.1 | ELEVATIONS DUPLEX BUILDING |
| SHEET A2.2 | ELEVATIONS DUPLEX BUILDING |
| SHEET A2.3 | STREET ELEVATIONS |
| SHEET A1.1B | 1ST & 2ND FLOOR PLAN SINGLE BUILDING |
| SHEET A1.2B | 3RD FLOOR & ROOF PLAN SINGLE BUILDING |
| SHEET A2.1B | ELEVATIONS SINGLE BUILDING |
| SHEET L-100 | LANDSCAPE PLAN |

ZONING DISTRICT: COMMERCIAL HIGHWAY (CH)
PROPOSED ZONING DISTRICT: PLANNED RESIDENTIAL DEVELOPMENT DISTRICT (PDD)
(PENDING CITY COUNCIL APPROVAL)




PLAN
SCALE: 1" = 50'
0 25 50 100


APPLICANT:
PENTUCKET NORTH DEVELOPMENT LLC
C/O RONALD J MAILLOUX SR.
55 CHASE STREET
METHUEN, MA 01844

OWNER:
CEDARDALE, INC
931 BOSTON ROAD
HAVERHILL, MA 01835
BOOK 6023, PAGE 614

CIVIL ENGINEER/SURVEYOR:
THE MORIN-CAMERON GROUP, INC.
66 ELM STREET
DANVERS, MA 01923
PHONE: 978-777-8586

ARCHITECT:
SCOTT BROWN ARCHITECTS
48 MARKET STREET
NEWBURYPORT, MA 01950
PHONE: 978-465-3535

LANDSCAPE DESIGNER:
CORLISS LANDSCAPE & IRRIGATION
31 ESSEX ROAD
IPSWICH, MA 01938
PHONE: 978-356-4224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MA-RI-ME-NH-VT
CALL UTILITIES UNDERGROUND PLANT DAMAGE PREVENTION SYSTEM
TOLL FREE 1-888-344-7233

NOTE:
UNDERGROUND UTILITIES SHOWN ON THIS PLAN ARE BASED UPON VISIBLE ABOVE GROUND UTILITIES AND RECORD INFORMATION OF BELOW GROUND UTILITIES AND ARE APPROXIMATE ONLY. CONTRACTOR IS RESPONSIBLE FOR TAKING ALL NECESSARY PRECAUTIONS BEFORE BEGINNING ANY EXCAVATION.


The Morin-Cameron GROUP, INC.
CIVIL ENGINEERS | ENVIRONMENTAL CONSULTANTS
LAND SURVEYORS | LAND USE PLANNERS
66 ELM STREET, DANVERS, MASSACHUSETTS 01923
P: 978-777-8586, W: WWW.MORINCAMERON.COM


| REVISIONS | | |
|---|---|---|
| NO. | DESCRIPTION | DATE |
| 1. | PEER REVIEW & CITY COMMENTS | 9/30/2025 |

SURVEY BY: MCG
DRAFTED BY: DTS
CHECKED BY: WAS
APPROVED BY: SPC
SCALE: AS NOTED
DATE: APRIL 28, 2025

SITE DEVELOPMENT PLANS
IN
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(PORTION OF ASSESSOR'S MAP 754, BLOCK 2, LOT 21)
PREPARED FOR:
PENTUCKET NORTH DEVELOPMENT LLC

COVER SHEET

DRAWING NO. 1 OF 11

PROJ. #4316
DRAWING: 4316_MAIN.dwg

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| NO. | REVISIONS DESCRIPTION | DATE |
|---|---|---|
| 1 | PEER REVIEW & CITY COMMENTS | 9/26/2025 |

SURVEY BY: MCG
DRAFTED BY: DTS
CHECKED BY: MAS
APPROVED BY: SPC
SCALE: AS NOTED
DATE: APRIL 28, 2025

# SITE DEVELOPMENT PLANS
IN
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(PORTION OF ASSESSOR'S MAP 754, BLOCK 2, LOT 21)
PREPARED FOR:
PENTUCKET NORTH DEVELOPMENT LLC

SITE CONTEXT PLAN

DRAWING NO. 2 OF 11

PROJ. #4316
DRAWING: 4316_MAIN.dwg

## LEGEND

CONTOURS
- MAJOR
- MINOR
- CHAIN LINK FENCE
- FIRE HYDRANT
- GUY WIRE
- IRRIGATION CONTROL VALVE
- LIGHT POLE
- OVERHEAD WIRE
- PROPERTY LINE
- SANITARY SEWER MANHOLE
- SANITARY SEWER MAIN/SERVICE
- SQUARE CATCH BASIN
- STORM SEWER/DRAINAGE
- TREE LINE
- UTILITY POLE
- WATER GATE
- WATER SPICKET MANHOLE

## GENERAL NOTE:

1. THESE PLANS ARE PREPARED FOR OUR CLIENTS USE FOR THE SPECIFIC PURPOSE OF OBTAINING PERMITS AND LOCAL APPROVALS, AND ARE NOT TO BE USED OR RELIED UPON AS A CONSTRUCTION DOCUMENT OR ANY OTHER USE BY OTHER WITHOUT THE WRITTEN CONSENT OF THE MORIN-CAMERON GROUP, INC.

## PLAN NOTES:

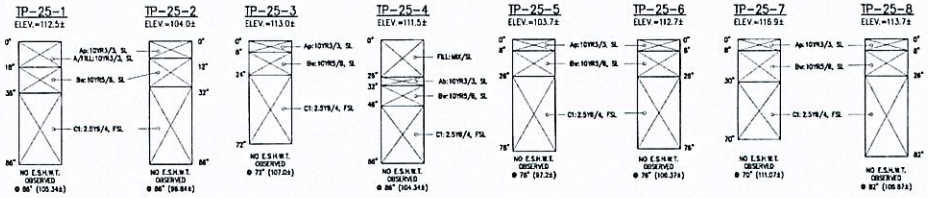
1. THE EXISTING CONDITIONS DEPICTED HEREON ARE BASED ON INFORMATION PROVIDED BY ON THE GROUND SURVEY BY THE MORIN-CAMERON GROUP, INC., ON AUGUST 19, 2025.
2. ABUTTER INFORMATION SHOWN HEREON WAS TAKEN FROM THE HAVERHILL GIS DATABASE.
3. THE PROPERTY BOUNDARY IS BASED ON A PLAN ENTITLED "PLAN OF LAND, LOCATED IN HAVERHILL, MA" PREPARED BY CHRISTIANSEN & SERGI, DATED JANUARY 6, 1998 AND RECORDED AT THE SOUTH ESSEX DISTRICT REGISTRY OF DEEDS IN BOOK 16530, PAGE 429.
4. ELEVATIONS HEREON REFER TO VERTICAL DATUM NAVD88.
5. PROJECT SITE LOCATED WITHIN ZONING AREA COMMERCIAL HIGHWAY (CH).
6. PROJECT SITE IS NOT LOCATED WITHIN A WETLANDS AREA.
7. PROJECT SITE IS NOT LOCATED WITHIN A FEMA FLOOD ZONE.

## FLOOD NOTE:

THE SUBJECT PROPERTY IS LOCATED IN A ZONE X: AREA OF MINIMAL FLOOD HAZARD ABOVE 500-YEAR FLOOD LEVEL, AS ILLUSTRATED ON THE FLOOD INSURANCE RATE MAP COMMUNITY PANEL NO. 25009C0085G, WHICH HAS AN EFFECTIVE DATE OF JULY 8, 2013.

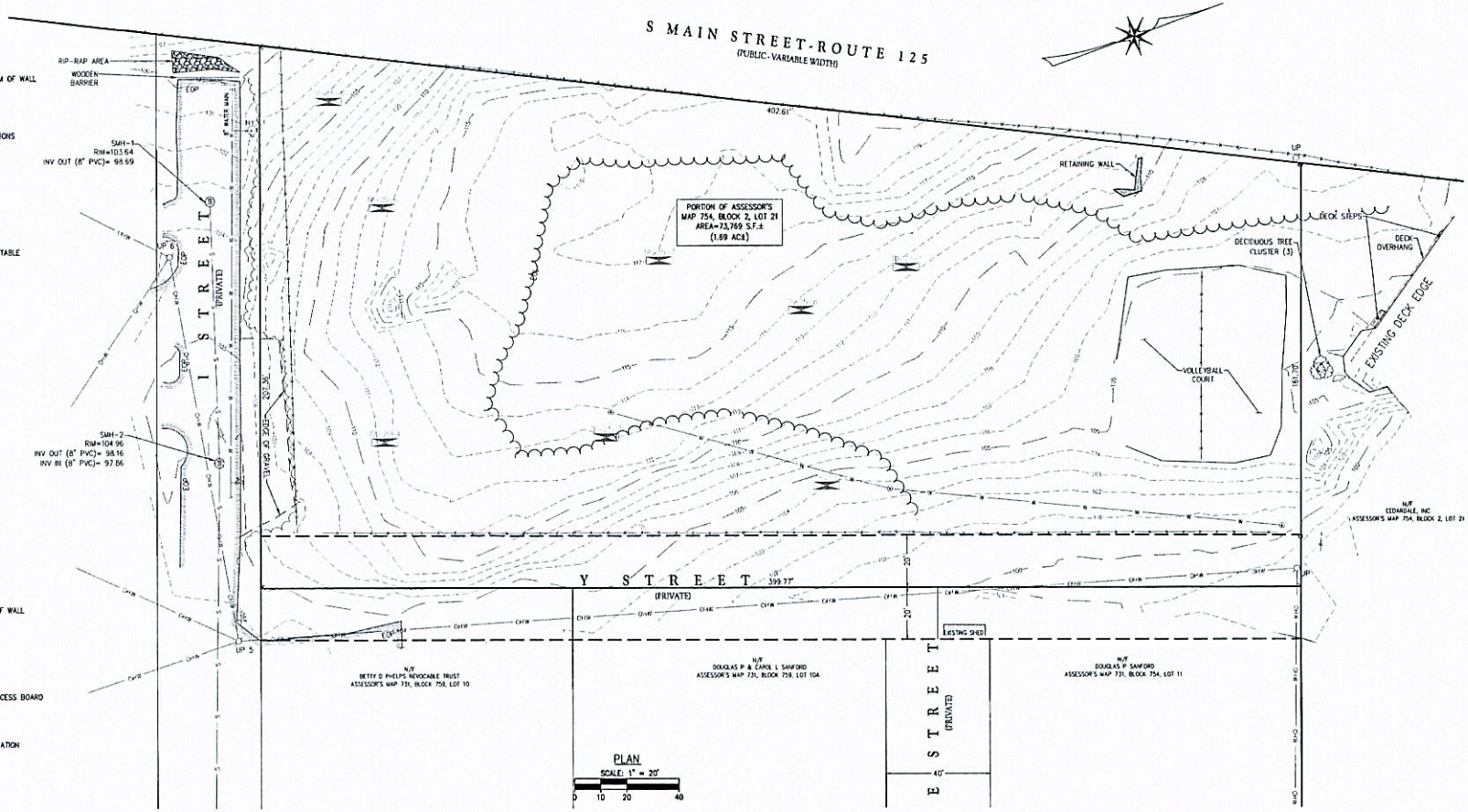
## SOIL LOGS

DATE PERFORMED: NOVEMBER 13, 2025
PERFORMED BY: WILL SCHKUTA, SE #14030




## ABBREVIATIONS:

| | |
|---|---|
| AC | ACRES |
| APPROX | APPROXIMATE |
| BIT | BITUMINOUS |
| BLDG | BUILDING |
| BVW | BORDERING VEGETATED WETLAND |
| BW | FINISH GRADE ADJACENT TO BOTTOM OF WALL |
| CCB | CAPE COD BERM |
| CB | CATCH BASIN |
| CF | CUBIC FEET |
| CI | CAST IRON |
| CLDI | CEMENT LINED DUCTILE IRON |
| CMR | CODE OF MASSACHUSETTS REGULATIONS |
| CONC | CONCRETE |
| CY | CUBIC YARD |
| DI | DUCTILE IRON |
| DIA | DIAMETER |
| DMH | DRAIN MANHOLE |
| DS | DOWNSTREAM |
| DYL | DOUBLE YELLOW LINE |
| ELEC | ELECTRIC |
| EL/ELEV | ELEVATION |
| EDG | EDGE OF GRAVEL |
| EOP | EDGE OF PAVEMENT |
| ESHWT | ESTIMATED SEASONAL HIGH WATER TABLE |
| EXIST | EXISTING |
| FG | FINAL GRADE |
| FT | FEET |
| GAR | GARAGE |
| GG | GAS GATE |
| HDPE | HIGH DENSITY POLYETHYLENEL |
| ID | INNER DIAMETER |
| IN | INCH |
| INV | INVERT |
| L | LENGTH |
| LB | POUNDS |
| MAX | MAXIMUM |
| MCC | MONOLITHIC CONCRETE CURB |
| MIN | MINIMUM |
| N/F | NOW OR FORMERLY |
| OC | ON CENTER |
| OHW | OVERHEAD WIRES |
| PE | POLYETHYLENE |
| ± | PLUS OR MINUS |
| PCC | PRECAST CONCRETE CURB |
| RCP | RCD CONCRETE PIPE |
| REC | RECORD |
| PROP | PROPOSED |
| PSI | POUNDS PER SQUARE INCH |
| PVC | POLYVINYL CHLORIDE |
| R | RADIUS |
| RC | RELATIVE COMPACTION |
| REQ'D | REQUIRED |
| ROW | RIGHT OF WAY |
| S | SLOPE |
| SF | SQUARE FEET |
| SGO | SAND, GAS AND OIL SEPARATOR |
| SMH | SEWER MANHOLE |
| SQ | SQUARE |
| TBD | TO BE DETERMINED |
| TC | TOP OF CURB/TRANSITION CURB |
| TW | FINISH GRADE ADJACENT TO TOP OF WALL |
| TYP | TYPICAL |
| UGE | UNDERGROUND ELECTRIC |
| UNK | UNKNOWN |
| VAR | VARIANCE |
| VCC | VERTICAL GRANITE CURB |
| VIF | VERIFY IN FIELD |
| LSA | LANDSCAPE AREA |
| LF | LINEAR FEET |
| MAAB | MASSACHUSETTS ARCHITECTURE ACCESS BOARD |
| MEP | MECHANICAL ELECTRICAL PLUMBING |
| MCC | MONOLITHIC CONCRETE CURB |
| ML | MILLIMETER |
| NF | NOT FOUND |
| NFPA | NATIONAL FIRE PROTECTION ASSOCIATION |
| US | UPSTREAM |
| WF | WETLAND FLAG |
| WG | WATER GATE |
| WQU | WATER QUALITY UNIT |
| WSO | WATER SHUTOFF |
| W/ | WITH |

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|---|---|---|
| NO. | DESCRIPTION | DATE |
| 1 | PEER REVIEW & CITY COMMENTS | 9/30/2026 |

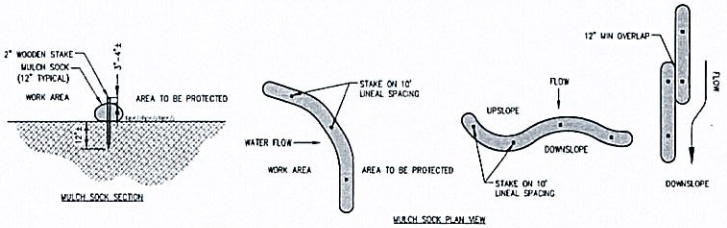
SURVEY BY: MCG
DRAFTED BY: DTS
CHECKED BY: WAS
APPROVED BY: SPC
SCALE: AS NOTED
DATE: APRIL 28, 2026

# SITE DEVELOPMENT PLANS
IN
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(PORTION OF ASSESSOR'S MAP 754, BLOCK 2, LOT 21)
PREPARED FOR
PENTUCKET NORTH DEVELOPMENT LLC

EXISTING CONDITIONS PLAN

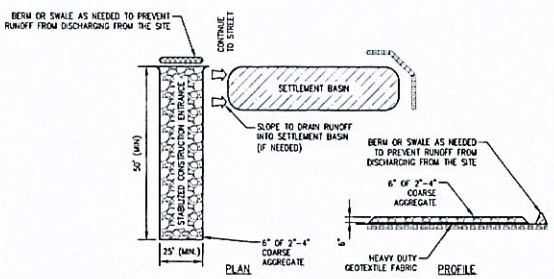
DRAWING NO. 3 OF 11

PROJ. #4316
DRAWING: 4316_MAIN.dwg



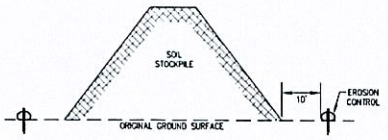

NOTES:
1. MULCH CAN BE SUBSTITUTED WITH COMPOST.
2. WRAP SHALL BE CUT & REMOVED AFTER STABILIZATION IS ESTABLISHED. MULCH TO REMAIN.

## MULCH SOCK
(NOT TO SCALE)



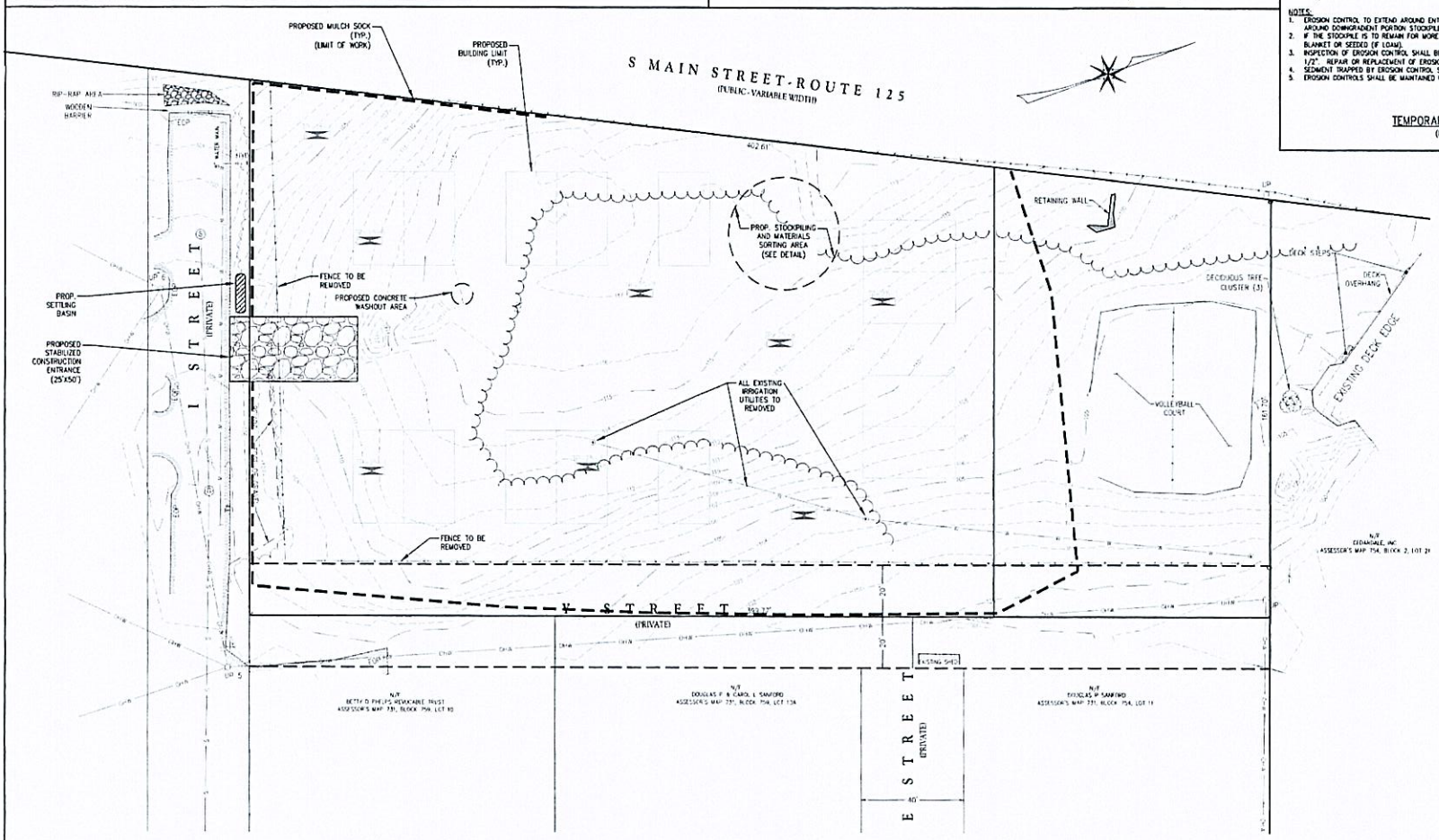

SITE CONSTRUCTION EXIT SPECIFICATIONS:
1. STONE FOR STABILIZATION CONSTRUCTION ENTRANCE SHALL BE 2"-4" STONE.
2. THE LENGTH OF THE STABILIZED ENTRANCE SHALL NOT BE LESS THAN 40 FEET.
3. THE WIDTH OF THE ENTRANCE SHALL BE NO LESS THAN THE WIDTH OF THE INGRESS OR EGRESS DRIVE, OR 16 FEET, WHICHEVER IS GREATER.
4. GEOTEXTILE FILTER FABRIC SHALL BE PLACED OVER THE ENTIRE AREA PRIOR TO PLACING STONE.
5. ALL SURFACE WATER THAT IS FLOWING TO OR DIVERTED TOWARDS THE CONSTRUCTION ENTRANCE SHALL BE PIPED BENEATH THE ENTRANCE. IF PIPING IS IMPRACTICAL, A BERM WITH MINIMUM 1 TO 5 SLOPES THAT CAN BE CROSSED BY VEHICLES CAN BE SUBSTITUTED.
6. THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO RIGHTS OF WAY. THIS MAY REQUIRE PERIODIC TOPDRESSING WITH ADDITIONAL STONE AS CONDITIONS DEMAND AND REPAIR AND/OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT. SEDIMENT SPILLED, WASHED OR TRACKED ONTO THE RIGHT OF WAY MUST BE REMOVED IMMEDIATELY.

## STABILIZED CONSTRUCTION ENTRANCE DETAIL
(NOT TO SCALE)




NOTES:
1. EROSION CONTROL TO EXTEND AROUND ENTIRE PERIMETER OF STOCKPILE IF ON LEVEL GROUND OR TO EXTEND AROUND DOWNGRADIENT PORTION STOCKPILE IS ON SLOPE.
2. IF THE STOCKPILE IS TO REMAIN FOR MORE THAN 14 DAYS IT SHALL BE STABILIZED WITH AN EROSION CONTROL BLANKET OR SEEDED (IF LOAM).
3. INSPECTION OF EROSION CONTROL SHALL BE AT LEAST ONCE PER WEEK AND AFTER RAIN EVENTS IN EXCESS OF 1/2". REPAIR OR REPLACEMENT OF EROSION CONTROL SHALL BE MADE PROMPTLY AS NEEDED.
4. SEDIMENT TRAPPED BY EROSION CONTROL SHALL BE REMOVED AND PROPERLY DISPOSED OF.
5. EROSION CONTROLS SHALL BE MAINTAINED UNTIL STOCKPILE IS ELIMINATED.

## TEMPORARY SOIL STOCKPILE
(NOT TO SCALE)




PLAN
SCALE: 1" = 20'
0 10 20 40

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| NO. | REVISIONS DESCRIPTION | DATE |
|---|---|---|
| 1 | PEER REVIEW & CITY COMMENTS | 5/22/2026 |

SURVEY BY: MCC
DRAFTED BY: DTS
CHECKED BY: MAS
APPROVED BY: SPC
SCALE: AS NOTED
DATE: APRIL 28, 2026

SITE DEVELOPMENT PLANS
IN
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(PORTION OF ASSESSOR'S MAP 754, BLOCK 2, LOT 21)
PREPARED FOR:
PENTUCKET NORTH DEVELOPMENT LLC

SITE PREPARATION & EROSION CONTROL

DRAWING NO. 4 OF 11

PROJ. #4316
DRAWING: 4316_MAIN.dwg

## PLANNED DEVELOPMENT (PD) SUBMITTAL TABLE

| | |
|---|---|
| TOTAL LAND AREA | 55,620 SF |
| DEVELOPABLE SITE AREA | 55,620 SF |
| COMMON OR USABLE OPEN SPACE | 28,640 SF |
| SITE COVERAGE OF BUILDINGS | 10,080 SF |
| IMPERVIOUS SURFACE AREA | 23,788 SF |
| IMPERVIOUS SURFACE RATIO | 0.428 (42.8%) |
| GROSS FLOOR AREA OF ALL NON RESIDENTIAL BUILDINGS | 0 SF |
| FLOOR AREA RATIO | 0.181 (18.1%) |
| DENSITY OF DWELLING UNITS | 3,972± SF/UNIT |
| NUMBER OF OFF-STREET PARKING SPACES | 28 SPACES |

## BUILDING HEIGHTS

| BUILDING | (A) AVERAGE FINISHED GRADE ELEVATION BASED ON BUILDING CORNERS (FT) | (B) GARAGE ENTRANCE ELEVATION (FT) | (C) MEAN ROOF HEIGHT ABOVE GARAGE ENTRANCE ELEVATION (FT) | (D) ELEVATION OF MEAN ROOF HEIGHT (FT) (B+C) | PROPOSED BUILDING HEIGHT (FT) (D-A) |
|---|---|---|---|---|---|
| 1 | 110.10 | 110.7 | 28.10 | 138.80 | 28.70 |
| 2 | 113.90 | 113.0 | 28.10 | 141.10 | 27.20 |
| 3 | 115.60 | 115.3 | 25.75 | 141.05 | 25.45 |
| 4 | 117.10 | 116.2 | 28.10 | 144.30 | 27.20 |
| 5 | 115.10 | 114.7 | 28.10 | 142.80 | 27.70 |
| 6 | 115.30 | 115.3 | 25.75 | 141.05 | 25.75 |
| 7 | 114.00 | 113.0 | 28.10 | 141.10 | 27.10 |
| 8 | 110.00 | 109.0 | 28.10 | 137.10 | 27.10 |

### BUILDING HEIGHT NOTE:

BUILDING HEIGHT IS CALCULATED AS THE VERTICAL DISTANCE FROM THE AVERAGE FINISHED GRADE (AVERAGE OF FINISHED GROUND ELEVATION AT THE MAIN CORNERS OF THE STRUCTURE) TO THE HIGHEST POINT OF THE ROOF: TOP OF THE HIGHEST ROOF BEAM (FLAT ROOF), DECK OF A MANSARD ROOF, OR MEAN LEVEL BETWEEN EAVES AND RIDGE (GABLE, HIP, SHED, GAMBREL, PYRAMID, OR SIMILAR ROOFS). MAXIMUM ALLOWABLE HEIGHTS ARE ESTABLISHED IN TABLE 2 (DIMENSIONAL REGULATIONS) BY ZONING DISTRICT. DEFINITION PER HAVERHILL ZONING ORDINANCE § 11.0 (DEFINITIONS).

### SNOW STORAGE NOTE:

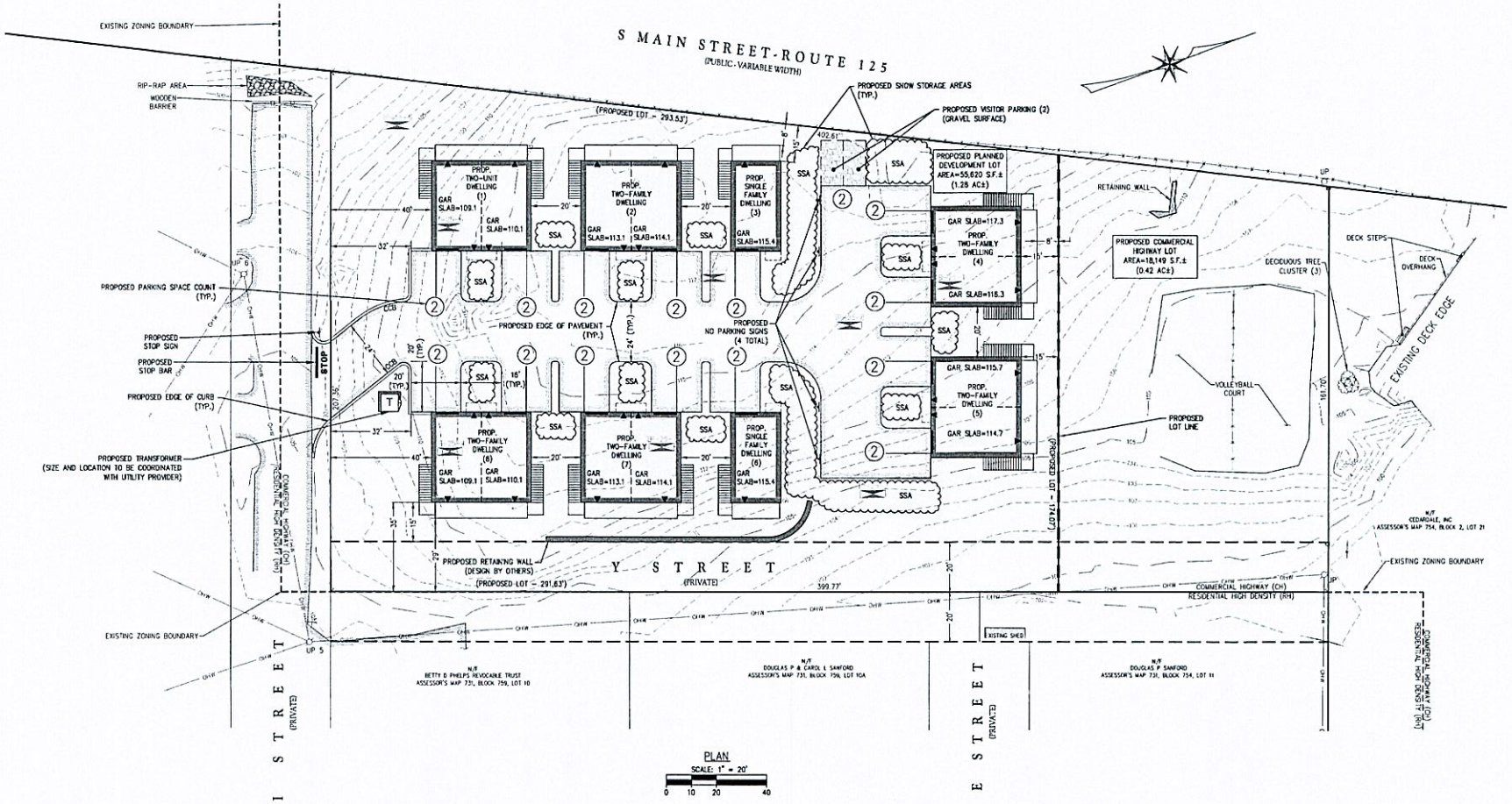
EXCESS SNOW TO BE REMOVED FROM THE SITE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE AND LOCAL REGULATIONS.

### PARKING SPACE COUNT SUMMARY

| | NUMBER OF SPACES |
|---|---|
| SURFACE (RESIDENTS) | 28 |
| SURFACE (VISITORS) | 2 |
| GARAGE | 14 |
| RATIO (14 UNITS) | 3.14 SPACES/ UNIT |

## ZONING TABLE – PLANNED DEVELOPMENT (PD)

| SETBACK | RESIDENTIAL HIGH DENSITY (RH) 1-FAM | RESIDENTIAL HIGH DENSITY (RH) 2-FAM | COMMERCIAL HIGHWAY (CH) | PROPOSED PD LOT |
|---|---|---|---|---|
| LOT AREA (MIN.) | 7,500 SF | 9,600 SF | 22,500 SF | 55,620 SF± |
| LOT AREA REQUIRED PER DWELLING UNIT (MIN.) | N/A | N/A | N/A | 3,972 SF± |
| LOT FRONTAGE (MIN.) | 75' | 80' | 175' | 207.36' |
| LOT DEPTH (MIN.) | 100' | 100' | 100' | 291' |
| FRONT SETBACK (MIN.) | 20' | 20' | 30' | 40' |
| SIDE SETBACK (MIN.) | 10' | 10' | 15' | 15' |
| REAR SETBACK (MIN.) | 30' | 30' | 15' | 15' |
| BUILDING HEIGHT (MAX.) | 35' | 35' | 40' | <40' |
| BUILDING HEIGHT – STORIES (MAX.) | 2.5 | 2.5 | 3.5 | <3.5 |
| BUILDING COVERAGE (%, MAX.) | 25% | 25% | NONE | 18.1% |
| FLOOR AREA RATIO (FAR, MAX.) | N/A | N/A | 0.50 | <0.50 |
| OPEN SPACE, (%, MIN.) | 45% | 45% | 25% | 51% |

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LAND SURVEYORS | LANDSCAPE ARCHITECTS
10 DU STREET, DANVERS, MASSACHUSETTS 01923
P: 978-777-8388 W: WWW.MORINCAMERON.COM

SURVEY BY: MCG
DRAFTED BY: DTS
CHECKED BY: MAS
APPROVED BY: SPC
SCALE: AS NOTED
DATE: APRIL 28, 2026

| NO. | REVISIONS DESCRIPTION | DATE |
|---|---|---|
| 1 | PEER REVIEW & CITY COMMENTS | 9/30/2026 |

# SITE DEVELOPMENT PLANS
IN
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(PORTION OF ASSESSOR'S MAP 754, BLOCK 2, LOT 21)
PREPARED FOR:
PENTUCKET NORTH DEVELOPMENT LLC

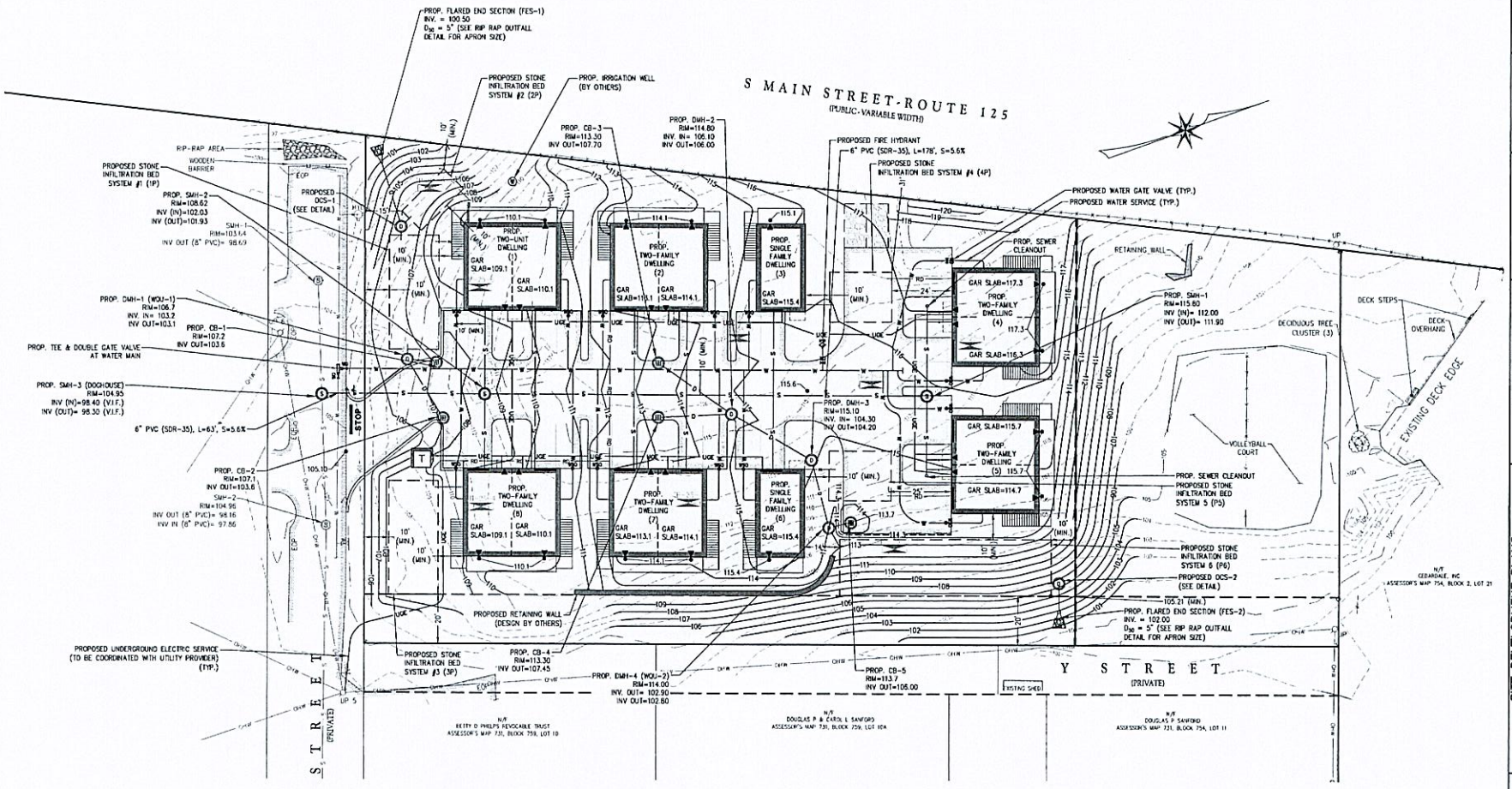
SITE LAYOUT PLAN

DRAWING NO. 5 OF 11

PROJ. #4316
DRAWING: 4316_MAIN.dwg

NOTES:

1. FINAL HYDRANT LOCATIONS TO BE COORDINATED WITH HAVERHILL FIRE DEPARTMENT.
2. FINAL ELECTRIC LOCATIONS TO BE COORDINATED WITH UTILITY PROVIDER.
2. FINAL WATER CONNECTION TO BE COORDINATED WITH HAVERHILL WATER DEPARTMENT.
3. ALL ROOF STORMWATER TO BE DIRECTED TO STORMWATER SYSTEMS. FINAL CONNECTIONS TO BE COORDINATED WITH ARCHITECTURAL PLANS.




PLAN
SCALE: 1" = 20'
0 10 20 40

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APPROVED BY: SPC
SCALE: AS NOTED
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| REVISIONS | | |
|---|---|---|
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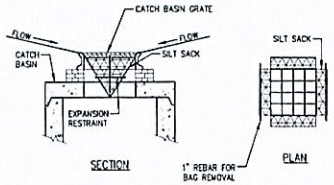
# SITE DEVELOPMENT PLANS
IN
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(PORTION OF ASSESSOR'S MAP 754, BLOCK 2, LOT 21)
PREPARED FOR:
PENTUCKET NORTH DEVELOPMENT LLC

GRADING, DRAINAGE & UTILITIES

DRAWING NO. 6 OF 11

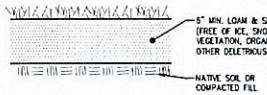
PROJ. #4316
DRAWING: 4316_MAIN.dwg



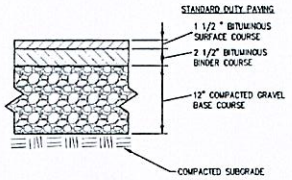

SILT SACK NOTES:

1. INSTALL SILT SACKS IN EXISTING CATCH BASINS. INSTALL SILT SACKS IN NEW CATCH BASINS AFTER INSTALLATION.
2. GRATES TO BE PLACED OVER SILT SACKS.
3. SILTSACK SHALL BE INSPECTED PERIODICALLY AND AFTER ALL STORM EVENTS AND CLEANING OR REPLACEMENT SHALL BE PERFORMED WHEN DEPTH OF SEDIMENT IS WITHIN 8" OF GRATE.

SILT SACK
(NOT TO SCALE)



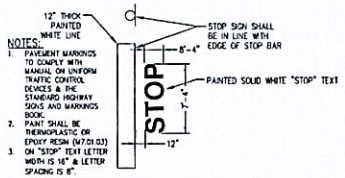

LOAM & SEED
(NOT TO SCALE)




NOTES:

1. PAVEMENT SHALL BE TYPE 1, CLASS 1, BITUMINOUS CONCRETE
2. PAVEMENT THICKNESS AFTER ROLLING.
3. SUBSOILS TO BE INSPECTED PRIOR TO INSTALLATION OF PAVEMENT SUBBASE. IF UNCOMPACTED FILL OR UNSUITABLE SOIL IS PRESENT, IT SHALL BE REMOVED TO UNDISTURBED NATIVE SOIL AND REPLACED WITH STRUCTURAL FILL COMPACTED TO 95% R.C.

TYPICAL PAVEMENT SECTION
(NOT TO SCALE)

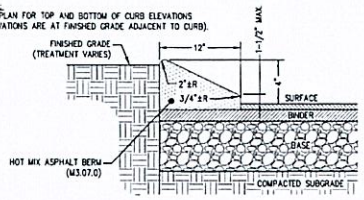



NOTES:

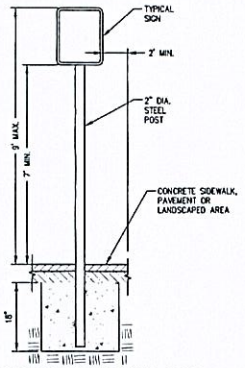
1. PAVEMENT MARKINGS TO COMPLY WITH MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES & THE STANDARD HIGHWAY SIGNS AND MARKINGS BOOK.
2. PAINT SHALL BE THERMOPLASTIC OR EPOXY RESIN (M7.01.03)
3. ON "STOP" TEXT LETTER WIDTH IS 16" & LETTER SPACING IS 8".

STOP BAR
(NOT TO SCALE)

NOTE:
SEE PLAN FOR TOP AND BOTTOM OF CURB ELEVATIONS (ELEVATIONS ARE AT FINISHED GRADE ADJACENT TO CURB).



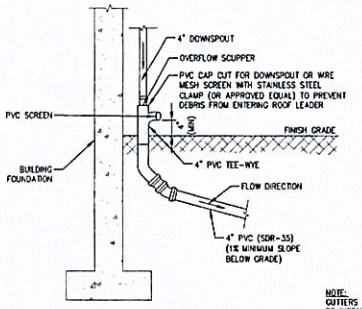

CAPE COD BERM
(NOT TO SCALE)




SIGN POST FOR SIGNS IN PARKING AREAS
(NOT TO SCALE)

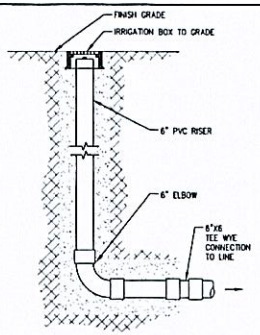
| M.U.T.C.D. LEGEND | WIDTH | HEIGHT | SYMBOL |
|---|---|---|---|
| R1-1 | 30" | 30" | STOP |

SIGN KEY
(NOT TO SCALE)

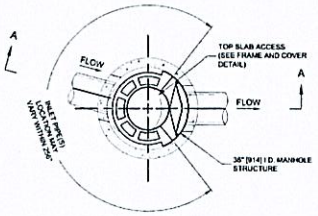



DOWN SPOUT ROOF LEADER
NOT TO SCALE

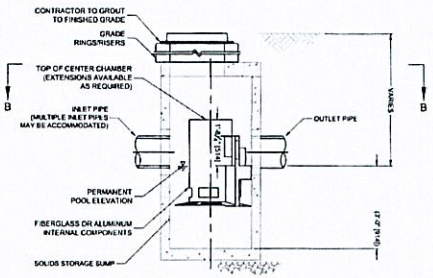
NOTE:
GUTTERS AND DOWNSPOUTS SHALL BE INSTALLED TO COLLECT ALL ROOF RUNOFF FROM THE HOUSE & CONVEY IT TO THE INFILTRATION AREAS.




SEWER CLEANOUT
(NOT TO SCALE)




PLAN VIEW B-B
NOT TO SCALE




ELEVATION A-A
NOT TO SCALE

CONTECH CS-3 (WQU-1 & WQU-2)
(NOT TO SCALE)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| NO. | REVISIONS DESCRIPTION | DATE |
|---|---|---|
| 1 | PEER REVIEW & CITY COMMENTS | 9/30/2025 |

SURVEY BY: MCG
DRAFTED BY: DTS
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SCALE: AS NOTED
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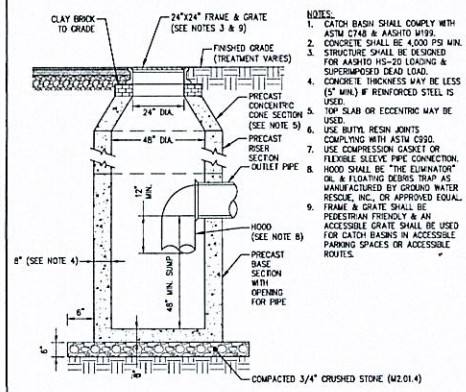
SITE DEVELOPMENT PLANS
IN
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(PORTION OF ASSESSOR'S MAP 754, BLOCK 2, LOT 21)
PREPARED FOR:
PENTUCKET NORTH DEVELOPMENT LLC

DETAILS

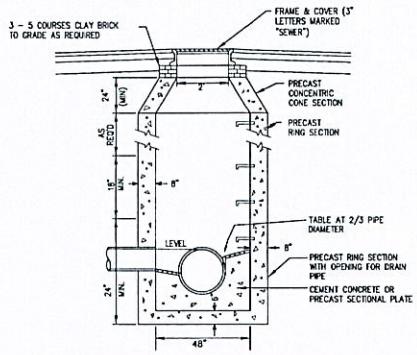
DRAWING NO. 7 OF 11

PROJ. #4316
DRAWING: 4316_MAIN.dwg



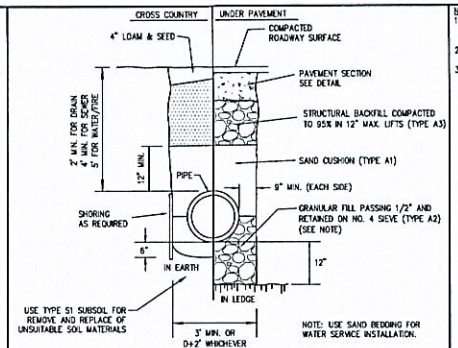

NOTES:
1. CATCH BASIN SHALL COMPLY WITH ASTM C748 & AASHTO M199.
2. CONCRETE SHALL BE 4,000 PSI MIN.
3. STRUCTURE SHALL BE DESIGNED FOR AASHTO HS-20 LOADING & SUPERIMPOSED DEAD LOAD.
4. CONCRETE THICKNESS MAY BE LESS (5" MIN.) IF REINFORCED STEEL IS USED.
5. TOP SLAB OR ECCENTRIC MAY BE USED.
6. USE BUTYL RESIN JOINTS COMPLYING WITH ASTM C990.
7. USE COMPRESSION GASKET OR FLEXIBLE SLEEVE PIPE CONNECTION.
8. HOOD SHALL BE "THE ELIMINATOR" OIL & FLOATING DEBRIS TRAP AS MANUFACTURED BY GROUND WATER RESCUE, INC., OR APPROVED EQUAL.
9. FRAME & GRATE SHALL BE PEDESTRIAN FRIENDLY & AN ACCESSIBLE GRATE SHALL BE USED FOR CATCH BASINS IN ACCESSIBLE PARKING SPACES OR ACCESSIBLE ROUTES.

CATCH BASIN
(NOT TO SCALE)




NOTE: OUTLET INVERT IS A MINIMUM 0.10' LOWER THAN INLET INVERT.

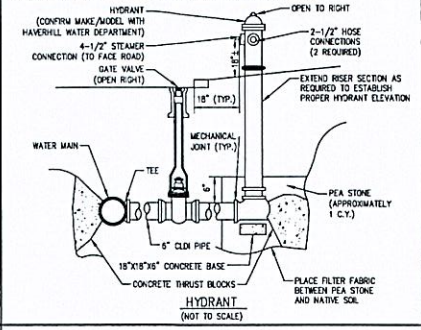
SEWER MANHOLE DETAIL
(NOT TO SCALE)



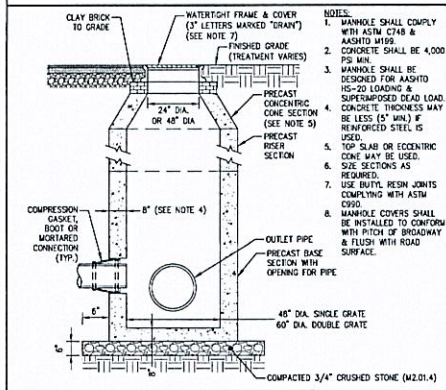

NOTE: USE SAND BEDDING FOR WATER SERVICE INSTALLATION.

UTILITY TRENCH DETAIL
(NOT TO SCALE)

NOTES:
1. CONCRETE THRUST BLOCKS TO BE USED ONLY WHERE THEY CAN BEAR ON UNDISTURBED EARTH AS SHOWN. USE CLAMPS AND TIE RODS OR OTHER ACCEPTABLE METHOD OF JOINT RESTRAINT WHERE SOIL CONDITIONS PROHIBIT THE USE OF THRUST BLOCKS.
2. HYDRANT IN SIDEWALK AREAS TO BE LOCATED TO PROVIDE MINIMUM CLEAR SIDEWALK PASSAGE WIDTH OF 3 FEET AT HYDRANT.
3. COORDINATE FINAL LOCATIONS OF HYDRANT WITH HAVERHILL FIRE DEPARTMENT.

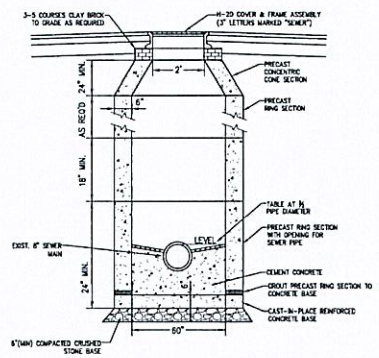



HYDRANT
(NOT TO SCALE)



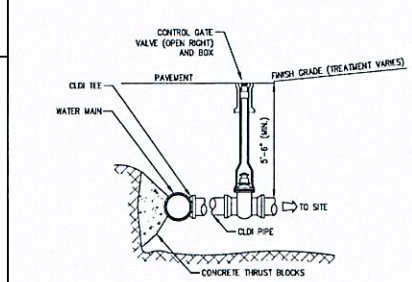

NOTES:
1. MANHOLE SHALL COMPLY WITH ASTM C748 & AASHTO M199.
2. CONCRETE SHALL BE 4,000 PSI MIN.
3. MANHOLE SHALL BE DESIGNED FOR AASHTO HS-20 LOADING & SUPERIMPOSED DEAD LOAD.
4. CONCRETE THICKNESS MAY BE LESS (5" MIN.) IF REINFORCED STEEL IS USED.
5. TOP SLAB OR ECCENTRIC CONE MAY BE USED.
6. SIZE SECTIONS AS REQUIRED.
7. USE BUTYL RESIN JOINTS COMPLYING WITH ASTM C990.
8. MANHOLE COVERS SHALL BE INSTALLED TO CONFORM WITH PITCH OF BROADWAY & FLUSH WITH ROAD SURFACE.

DRAIN MANHOLE
(NOT TO SCALE)

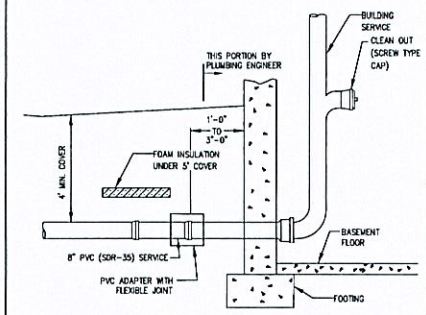



NOTES:
1. EXISTING SEWER MAIN LOCATION, SIZE AND MATERIAL SHALL BE VERIFIED IN FIELD.
2. IF LEDGE ENCOUNTERED BELOW EXISTING SEWER MAIN, REINFORCING DOWELS SHALL BE SET A MIN. OF 6" INTO EXISTING LEDGE PRIOR TO CASTING BASE OF DOG HOUSE MANHOLE.

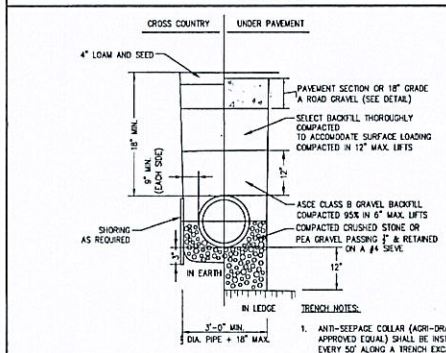
SEWER MANHOLE DETAIL (DOGHOUSE)
(NOT TO SCALE)




WATER MAIN GATE VALVE CONNECTION
(NOT TO SCALE)

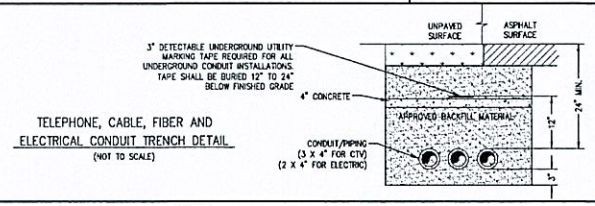



TYPICAL BUILDING SEWER SERVICE
(NOT TO SCALE)



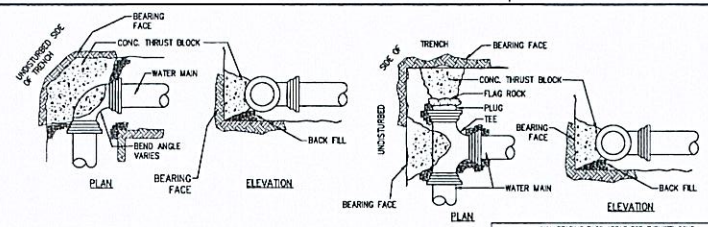

TRENCH NOTES:
1. ANTI-SEEPAGE COLLAR (AGRI-DRAIN OR APPROVED EQUAL) SHALL BE INSTALLED EVERY 50' ALONG A TRENCH EXCAVATION WHEN THE SLOPE EXCEEDS 4%.
2. SHEETING, IF USED, SHALL BE CUT OFF 12 INCHES (12") ABOVE TOP OF PIPE OR CONDUIT.

TYPICAL DRAIN TRENCH DETAIL
(NOT TO SCALE)




TELEPHONE, CABLE, FIBER AND ELECTRICAL CONDUIT TRENCH DETAIL
(NOT TO SCALE)

ELECTRICAL CONDUIT TRENCH DETAIL
NOTES:
1. ADJUST FOR ANY LOCAL MODIFICATIONS TO NFPA 70/NEC.
2. COORDINATE CONDUITS WITH APPLICABLE SERVICE PROVIDERS.




NOTES:
1. ALL WATER MAIN FITTINGS, BENDS, TEES, PLUGS ETC. SHALL BE RESTRAINED W/ THRUST BLOCKS EXCEPT WHERE NOTED.
2. ALL THRUST BLOCKS & COLLARS SHALL BE INSTALLED SO THAT THEY BEAR AGAINST UNDISTURBED EARTH.
3. MINIMUM COMPRESSIVE STRENGTH OF THRUST BLOCK CONCRETE SHALL BE 3,000 P.S.I.
4. KEEP CONCRETE CLEAR OF MECHANICAL JOINTS.

THRUST BLOCK DETAIL
(NOT TO SCALE)

| MIN. BEARING FACE AREAS FOR THRUSTBLOCKS | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 90° | 45° | 22.5° | TEES | PLUGS | CAPS | HYDRANTS |
| 0'-6" | 8 | 5 | 6 | 4 | 4 | 4 | 4 |
| 0'-8" | 12 | 8 | 5 | 6 | 8 | 8 | 8 |


The Morin-Cameron GROUP, INC.
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66 CUMMINGS PARK, WOBURN, MASSACHUSETTS 01801
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| NO. | REVISIONS DESCRIPTION | DATE |
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| 1 | PEER REVIEW & CITY COMMENTS | 9/30/2026 |

SURVEY BY: MCG
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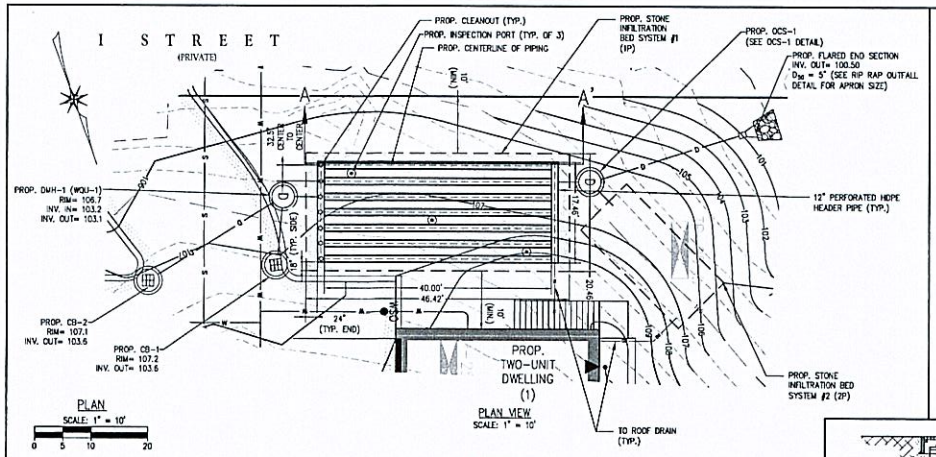
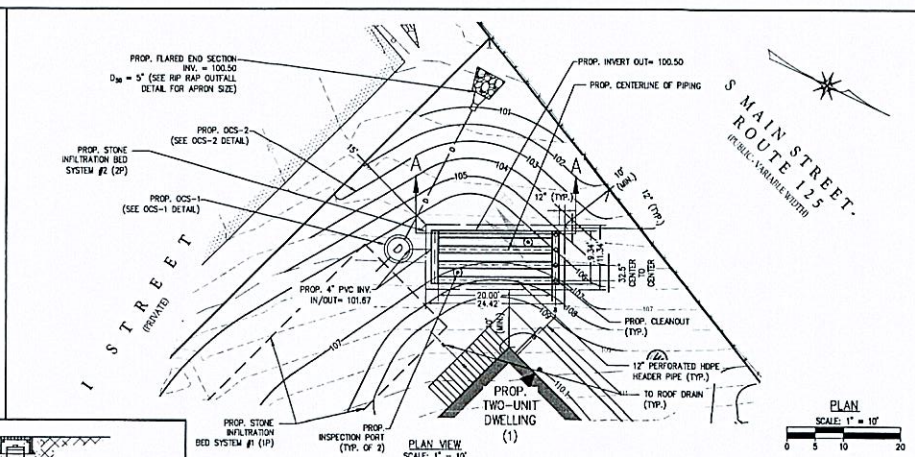
# SITE DEVELOPMENT PLANS
IN
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(PORTION OF ASSESSOR'S MAP 754, BLOCK 2, LOT 21)
PREPARED FOR:
PENTUCKET NORTH DEVELOPMENT LLC

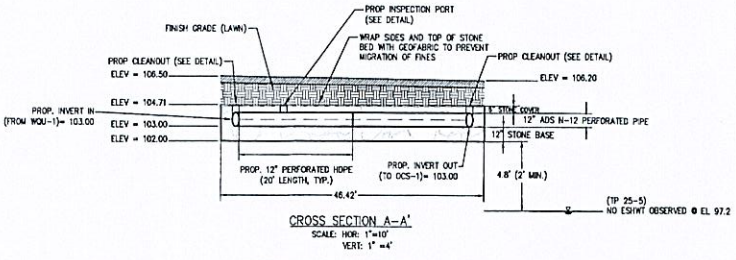
DETAILS

DRAWING NO. 8 OF 11

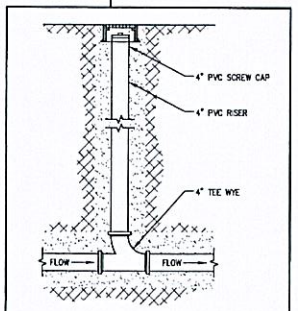
PROJ. #4316
DRAWING: 4316_MAIN.dwg



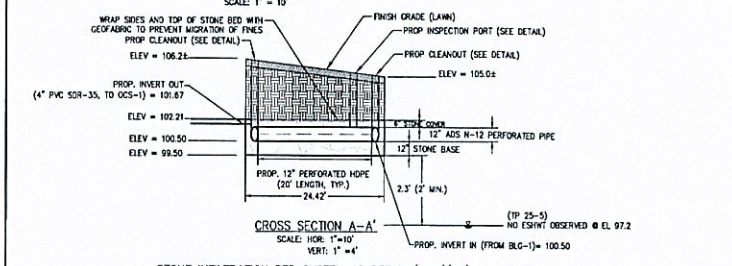



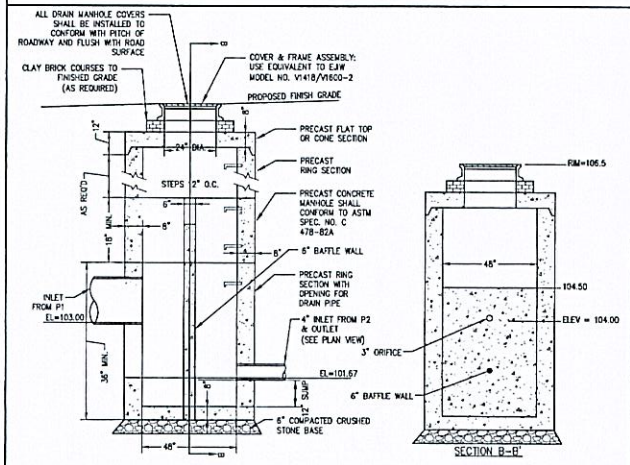

STONE INFILTRATION BED SYSTEM #1 DETAIL (1P)
(46.42 LENGTH X 20.46' WIDTH)
SCALE: AS NOTED



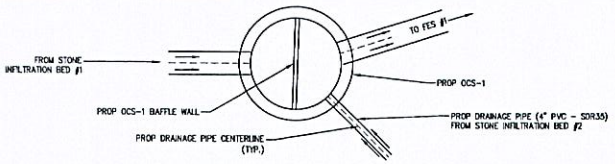

CLEANOUT
(NOT TO SCALE)



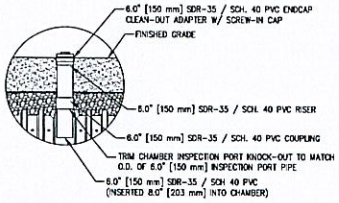

STONE INFILTRATION BED SYSTEM #2 DETAIL (SIS2)(2P)
(24.42' LENGTH X 11.34' WIDTH)
SCALE: AS NOTED




OUTLET CONTROL STRUCTURE (OCS-1)
(NOT TO SCALE)



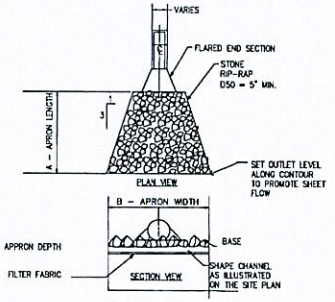

OUTLET CONTROL STRUCTURE (OCS-1, PLAN VIEW)
(NOT TO SCALE)




INSPECTION PORT
NOT TO SCALE

RIP RAP/OUTLET SIZING

| OUTLET | PIPE DIAMETER (IN) | DESIGN 100-YR DISCHARGE (CFS) | $D_{50}$ MIN. (IN) | SELECTED $D_{50}$ (IN) | DESIGN APRON LENGTH "A" (FT) | DESIGN APRON LENGTH "B" (FT) | DESIGN APRON DEPTH "D" (FT) |
|---|---|---|---|---|---|---|---|
| FES-1 | 12 | 0.3 | 1 | 5 | 4 | 5.5 | 1.5 |
| FES-2 | 12 | 0.8 | 1 | 5 | 4 | 5.5 | 1.5 |




6 RIP RAP OUTFALL
(NOT TO SCALE)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LAND SURVEYORS | LAND USE PLANNERS
18 CHESTNUT STREET, HAVERHILL, MASSACHUSETTS 01830
P. 978-777-5068 W. WWW.MORINCAMERON.COM


| REVISIONS | | |
|---|---|---|
| NO. | DESCRIPTION | DATE |
| 1 | PEER REVIEW & CITY COMMENTS | 9/30/2026 |

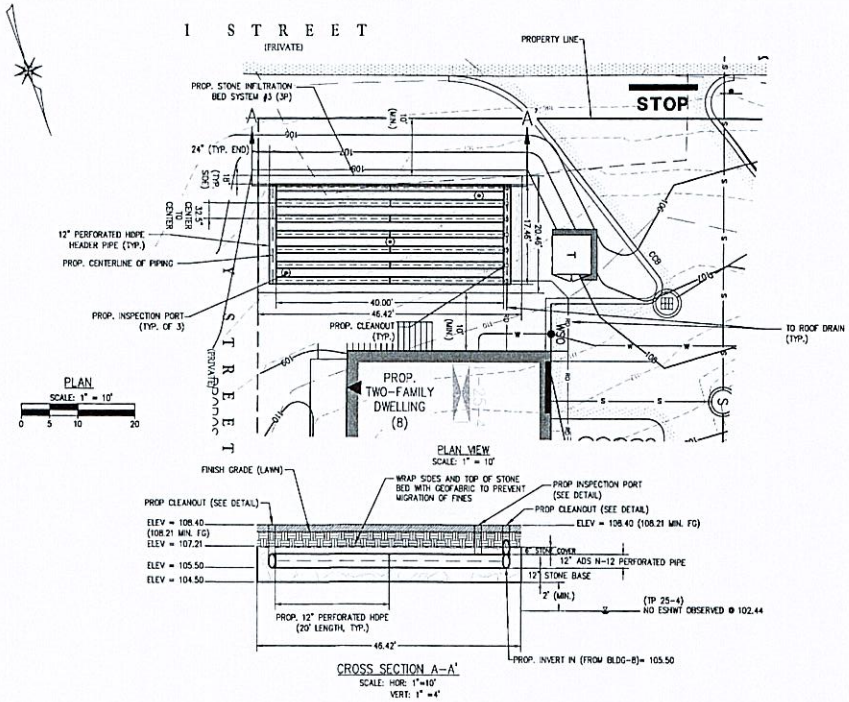
SURVEY BY: MCG
DRAFTED BY: DTS
CHECKED BY: WAS
APPROVED BY: SPC
SCALE: AS NOTED
DATE: APRIL 28, 2026

SITE DEVELOPMENT PLANS
IN
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(PORTION OF ASSESSOR'S MAP 754, BLOCK 2, LOT 21)
PREPARED FOR:
PENTUCKET NORTH DEVELOPMENT LLC

STORMWATER DETAILS

DRAWING NO. 9 OF 11

PROJ. #4316
DRAWING: 4316_MAIN.dwg




STONE INFILTRATION BED SYSTEM #3 DETAIL (3P)
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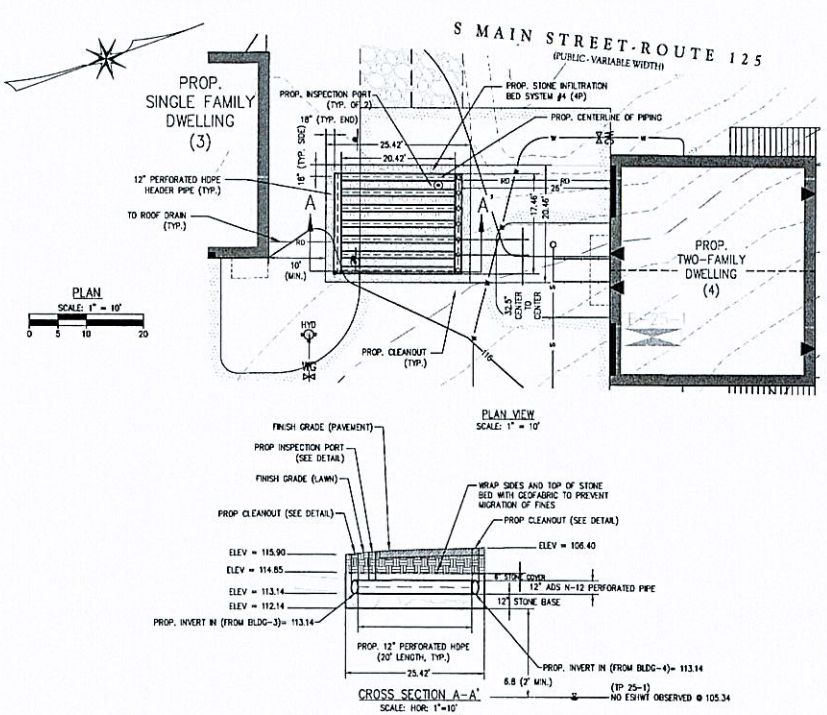


STONE INFILTRATION BED SYSTEM #4 DETAIL (4P)
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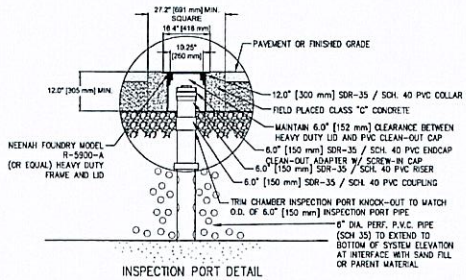


INSPECTION PORT DETAIL
(NOT TO SCALE)

The Morin-Cameron GROUP, INC.
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LAND SURVEYORS | LAND USE PLANNERS
56 EAST STREET, SALEM, MASSACHUSETTS 01970
P: 978.777.7400, F: 978.740.0404 | WWW.MORINCAMERON.COM

SURVEY BY: MCG
DRAFTED BY: DTS
CHECKED BY: MAS
APPROVED BY: SPC
SCALE: AS NOTED
DATE: APRIL 28, 2026

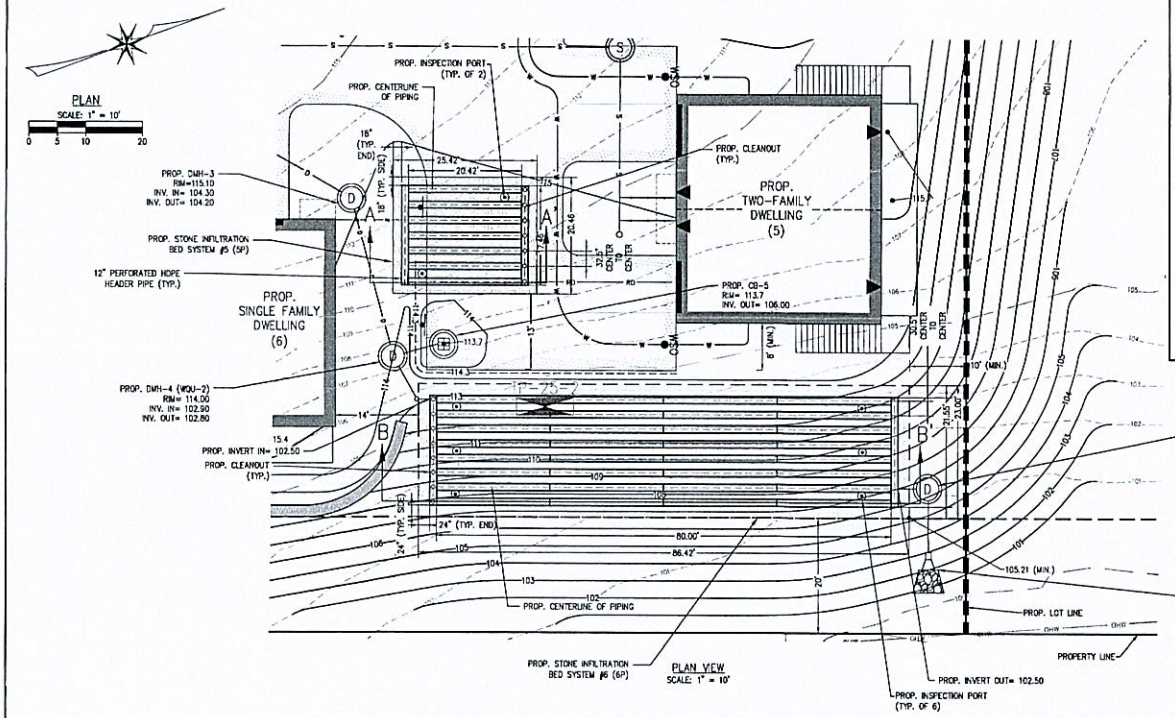
| NO. | REVISIONS DESCRIPTION | DATE |
|---|---|---|
| 1 | PEER REVIEW & CITY COMMENTS | 9/30/2026 |

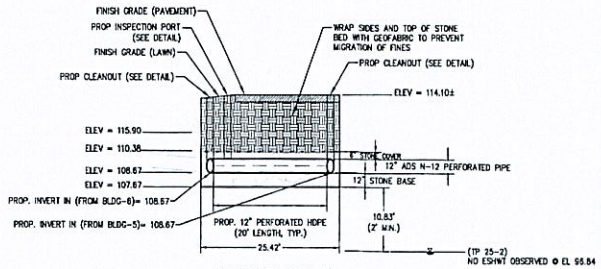
SITE DEVELOPMENT PLANS
IN
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(PORTION OF ASSESSOR'S MAP 754, BLOCK 2, LOT 21)
PREPARED FOR:
PENTUCKET NORTH DEVELOPMENT LLC

STORMWATER DETAILS

DRAWING NO. 10 OF 11

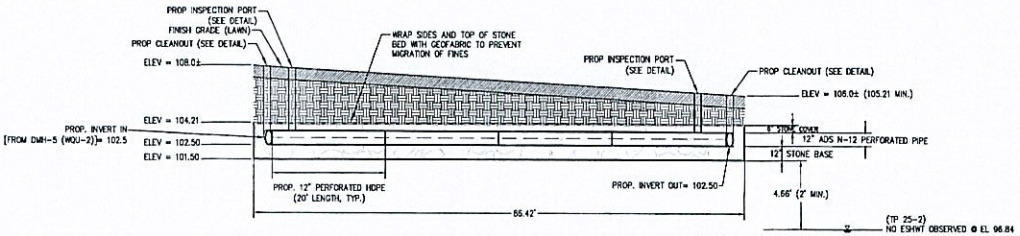
PROJ. #4316
DRAWING: 4316_MAIN.dwg




CROSS SECTION A-A'
SCALE: HOR: 1"=10'
VERT: 1" =4'

STONE INFILTRATION BED SYSTEM #5 DETAIL (5P)
(25.42' LENGTH X 20.46' WIDTH)
SCALE: AS NOTED




CROSS SECTION B-B'
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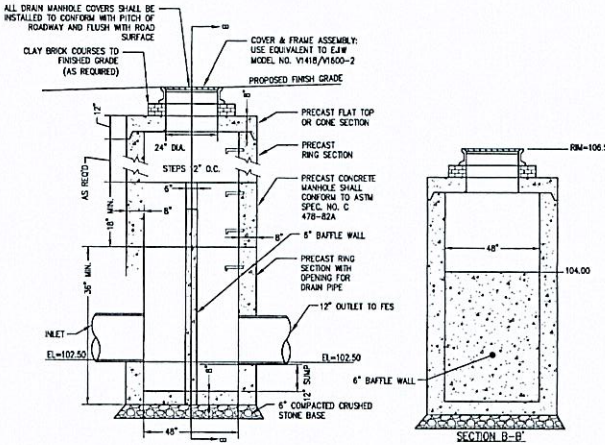
VERT: 1" =4'

STONE INFILTRATION BED SYSTEM #6 DETAIL (6P)
(86.42 LENGTH X 23.00' WIDTH)
SCALE: AS NOTED




OUTLET CONTROL STRUCTURE (OCS-2)
(NOT TO SCALE)

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94 ELM STREET, HAVERHILL, MASSACHUSETTS 01813
P: 978-777-3386 • WWW.MORINCAMERON.COM

| NO. | REVISIONS DESCRIPTION | DATE |
|---|---|---|
| 1 | PEER REVIEW & CITY COMMENTS | 9/30/2026 |

SURVEY BY: MCC
DRAFTED BY: DTS
CHECKED BY: MAS
APPROVED BY: SPC
SCALE: AS NOTED
DATE: APRIL 28, 2026

SITE DEVELOPMENT PLANS
IN
HAVERHILL, MASSACHUSETTS
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PREPARED FOR:
PENTUCKET NORTH DEVELOPMENT LLC

STORMWATER DETAILS

DRAWING NO. 11 OF 11

PROJ. #4316
DRAWING: 4316_MAIN.dwg

# MEMORANDUM

| | | | |
|---|---|---|---|
| **TO:** | Pentucket North Development LLC<br>c/o Ron Mailloux<br>55 Chase Street<br>Methuen, MA 01844 | **FROM:** | Scott W. Thornton, P.E. *and*<br>Thomas Hannon, E.I.T.<br>Vanasse & Associates, Inc.<br>35 New England Business Center Drive<br>Suite 140<br>Andover, MA 01810<br>(978) 474-8800 |
| **DATE:** | July 14, 2026 | **RE:** | 10758 |
| **SUBJECT:** | Transportation Impact Assessment<br>Proposed Residential Development – I Street<br>Haverhill, Massachusetts | | |

---

Vanasse & Associates, Inc. (VAI) has prepared this Transportation Impact Assessment (TIA) in order to identify traffic impacts associated with a proposed residential development to be located off of I Street in Haverhill, Massachusetts (hereafter referred to as the "Project"). The purpose of this memorandum is to review existing and future traffic conditions in the vicinity of the Project site, determine the traffic impact of the proposed Project at key intersections expected to experience increased traffic levels from the Project, and review the need for improvements to mitigate the Project's traffic impact.

## PROJECT DESCRIPTION

The Project entails construction of a 2 single family houses and 6 duplex houses. At present, the Project site contains areas of open and wooded space. The Project site is bordered by a health and fitness complex to the north, I Street to the south, a single-family house to the east, and Route 125 (South Main Street) to the west.

Vehicle access to and egress from the proposed residential development will be provided via a new full-access driveway that will intersect the north side of I Street.

## EXISTING CONDITIONS

A comprehensive field inventory of existing conditions within the study area was conducted in June 2026. The field investigation consisted of an inventory of existing roadway geometrics, traffic volumes, and operating characteristics, as well as posted speed limits, sight distance, and land use information within the study area. The study area for the Project is listed below and graphically depicted in Figure 1:

- Oxford Avenue at I Street
- Oxford Avenue at Boston Road

Figure 2 summarizes existing traffic control, lane use, travel lane widths, and pedestrian and bicycle accommodations at the study area intersections as observed in June 2026. No pedestrian or bicycle facilities were observed in the study area.

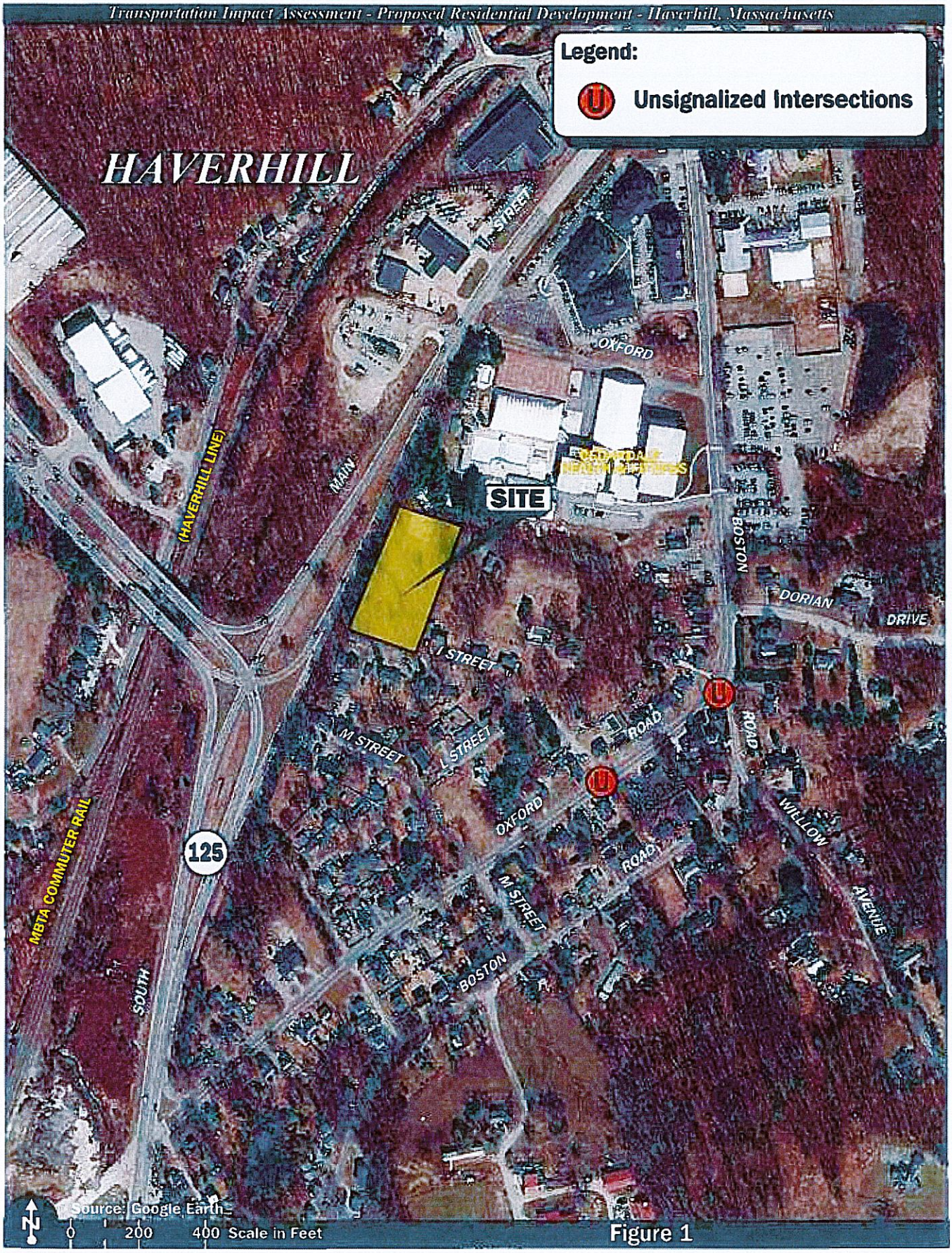


Figure 1

Study Area and Site Location Map

Vanasse & Associates inc

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**Legend:**

- Ⓤ Unsignalized Intersection
- xx' Lane Use and Travel Lane Width

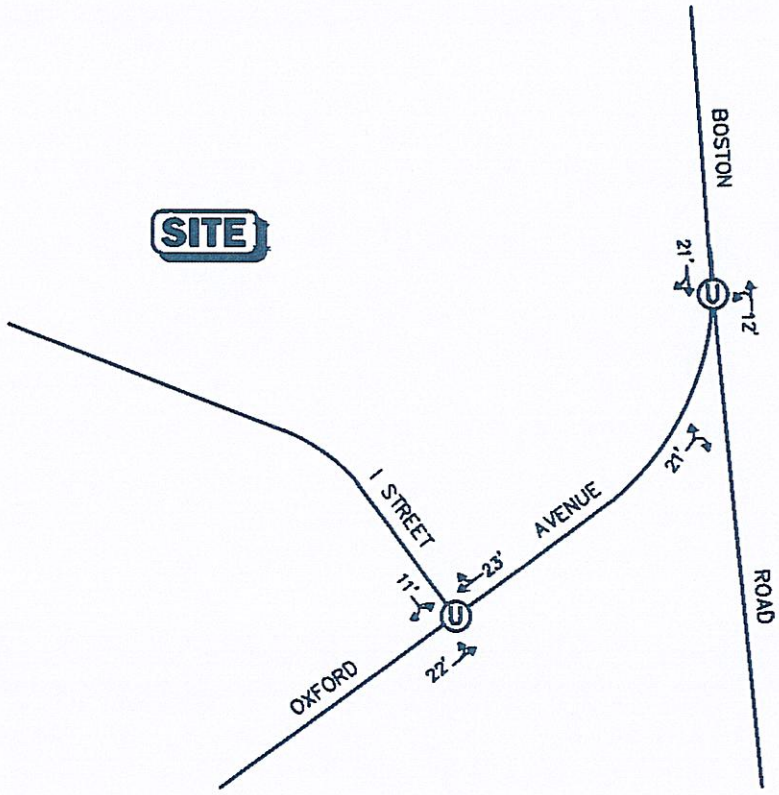


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**Figure 2**

**Existing Intersection Lane Use, Travel Lane Width, and Pedestrian Facilities**

Vanasse & Associates inc

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## Existing Traffic Volumes

In order to establish existing traffic-volume demands and flow patterns within the study area, manual turning movement counts (TMCs) were completed on June 23, 2026. The TMCs were conducted during the weekday morning (7:00 to 9:00 AM) and weekday evening (4:00 to 6:00 PM) peak periods. Bicycles and pedestrians were also counted.

### Traffic-Volume Adjustments

In order to develop 2026 Existing traffic-volume conditions, MassDOT weekday seasonal factors for Urban Group 7 (local road or street) were reviewed.[1] Based on a review of this data, it was determined that traffic volumes for the month of June are above average-month conditions. As such, the traffic volumes were not adjusted. The 2026 Existing traffic volumes are summarized in Table 1, with weekday morning and weekday evening peak-hour traffic volumes graphically depicted on Figure 3.

**Table 1**
**2026 EXISTING ROADWAY TRAFFIC-VOLUME SUMMARY**

| | Weekday Morning Peak Hour | | Weekday Evening Peak Hour | |
|---|---|---|---|---|
| Location | Volume (vph)[a] | Predominant Flow | Volume (vph) | Predominant Flow |
| I Street, north of Oxford Avenue | 7 | 57.1% NB | 18 | 55.6% NB |
| Oxford Avenue, west of I Street | 155 | 54.2% EB | 212 | 63.7% EB |

[a]Two-way peak-hour volume expressed in vehicles per hour.
NB = northbound.
EB = eastbound.

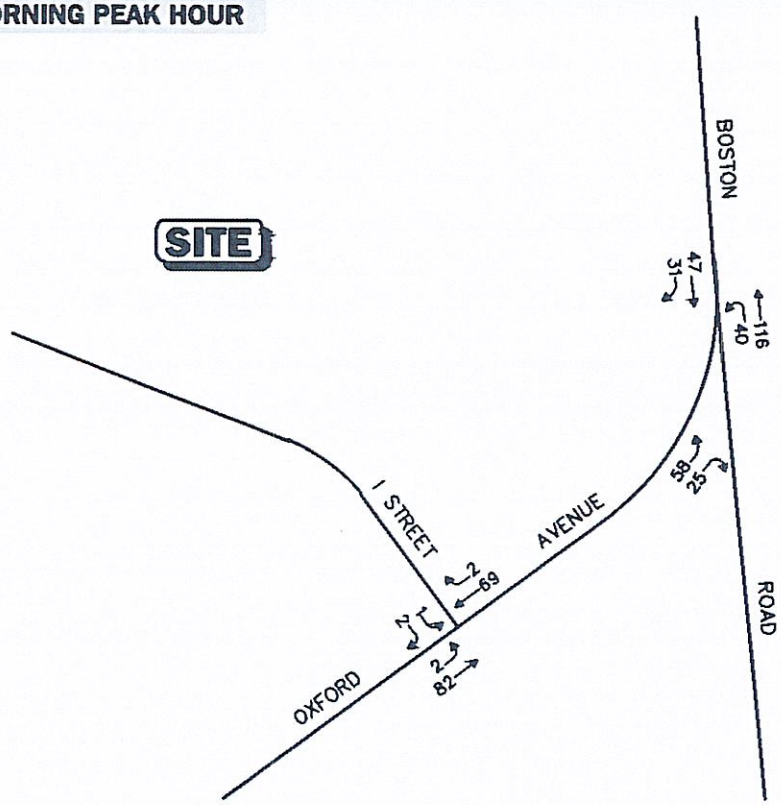
As can be seen in Table 1, I Street was observed to carry approximately 7 vehicles per hour (vph) during the weekday morning peak hour and 18 vph during the weekday evening peak hour. During the weekday morning peak hour, 57 percent of traffic is traveling northbound; and during the weekday evening peak hour, 56 percent of traffic is traveling northbound. Oxford Avenue was observed to carry approximately 155 vph during the weekday morning peak hour and 212 vph during the weekday evening peak hour. During the weekday morning peak hour, 54 percent of traffic is traveling eastbound; and during the weekday evening peak hour, 64 percent of traffic is traveling eastbound.

## Public Transportation

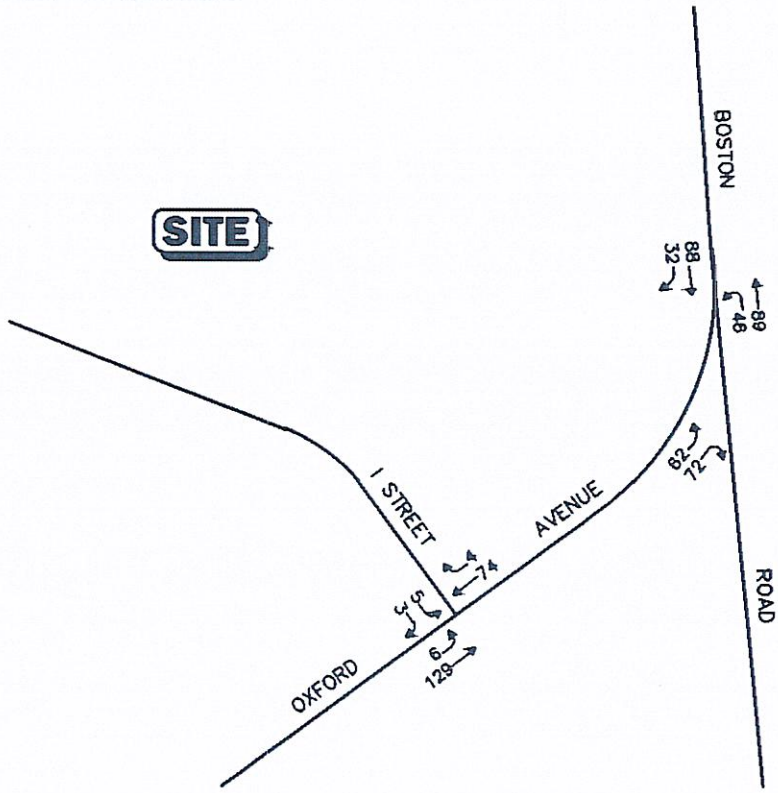
Public transportation services are provided in the study area along Oxford Avenue by Merrimack Valley Transit (MEVA), a fixed-route bus service traveled between the McGovern Transportation Center in Lawrence and the Washington Square Transit Center in Haverhill. The Oxford Avenue stop is located at 114 Oxford Avenue, approximately 0.4 miles (an 8-minute walk) west of the Project site. Schedule and fare information for the on-demand service are provided in the Appendix.

[1]MassDOT statewide Traffic Data Collection; 2025 Weekday Seasonal Factors, Groups U7.

**WEEKDAY MORNING PEAK HOUR**




**WEEKDAY EVENING PEAK HOUR**




Not To Scale

**Figure 3**

**2026 Existing Peak-Hour Traffic Volumes**

Vanasse & Associates inc

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## Motor Vehicle Crash Data

Motor vehicle crash information for the study area intersections was provided by the MassDOT Safety Management/Traffic Operations Unit for the most recent five-year period available (2019 through 2023) in order to examine motor vehicle crash trends occurring within the study area. The data is summarized in Table 2 by intersection, type, weather condition, lighting condition, pavement condition, and severity.

## Table 2
## MOTOR VEHICLE CRASH DATA SUMMARY

| Scenario | Oxford Avenue/ I Street | Oxford Avenue/ Boston Road |
|---|---|---|
| *Year:* | | |
| 2019 | 0 | 0 |
| 2020 | 0 | 1 |
| 2021 | 0 | 0 |
| 2022 | 0 | 0 |
| 2023 | 0 | 0 |
| Total | 0 | 1 |
| Average[a] | 0.0 | 0.2 |
| Crash Rate[b] | 0.00 | 0.13 |
| Significant[c] | No | No |
| *Type:* | | |
| Angle | 0 | 1 |
| Rear-End | 0 | 0 |
| Head-On | 0 | 0 |
| Sideswipe | 0 | 0 |
| Fixed Object | 0 | 0 |
| Pedestrian/Bike | 0 | 0 |
| Single Vehicle | 0 | 0 |
| Unknown/Other | 0 | 0 |
| Total | 0 | 1 |
| *Weather Conditions:* | | |
| Clear | 0 | 0 |
| Cloudy/Rain | 0 | 1 |
| Snow/Ice | 0 | 0 |
| Fog | 0 | 0 |
| Unknown/Other | 0 | 0 |
| Total | 0 | 1 |
| *Lighting Conditions:* | | |
| Daylight | 0 | 1 |
| Dawn/Dusk | 0 | 0 |
| Dark (lit) | 0 | 0 |
| Dark (unlit) | 0 | 0 |
| Unknown/Other | 0 | 0 |
| Total | 0 | 1 |
| *Pavement Conditions :* | | |
| Dry | 0 | 1 |
| Wet | 0 | 0 |
| Snow/Ice | 0 | 0 |
| Unknown/Other | 0 | 0 |
| Total | 0 | 1 |
| *Severity:* | | |
| Property Damage Only | 0 | 1 |
| Personal Injury | 0 | 0 |
| Fatality | 0 | 0 |
| Unknown/Other | 0 | 0 |
| Total | 0 | 1 |

[a]Average number of crashes over five-year period.
[b]Crash rate per million entering vehicles (mev).
[c]Significant if crash rate > 0.57 for unsignalized intersections (MassDOT District 4 rates).
Source: MassDOT Crash Data, 2019 through 2023.

## FUTURE CONDITIONS

To determine the impact of site-generated traffic volumes on the roadway network under future conditions, existing traffic volumes in the study area were projected to the year 2033. Traffic volumes on the roadway network at that time, in the absence of the Project (i.e., the No-Build condition), would include existing traffic, new traffic due to general background traffic growth, and traffic related to specific development by others expected to be completed by 2033. Inclusion of these factors resulted in the development of 2033 No-Build traffic volumes. Anticipated site-generated traffic volumes were then superimposed upon these No-Build traffic-flow networks to develop the 2033 Build traffic-volume conditions.

### Future Traffic Growth

Traffic growth on area roadways is a function of the expected land development impacting the study area. A procedure frequently employed estimates an annual percentage increase in traffic growth and applies that percentage to all existing traffic volumes under study. In addition, we research the location and type of planned development affecting the study area.

#### General Background Growth

To assess general traffic growth trends within the study area, MassDOT traffic-volume data from several permanent count stations in the surrounding area outside the study area were summarized and reviewed. Based on a review of this data, the traffic volume in the area is increasing by approximately 0.60 percent per year on average.

To provide a prudent planning condition for the Project, a slightly higher 1.0 percent annual compounded traffic growth rate was used to account for future traffic growth and presently unforeseen development within the study area.

#### Specific Development by Others

The City of Haverhill Planning Department was contacted to determine whether any projects are planned within the study area that would have an impact on future traffic volumes at the study intersections. Based on these discussions, the following projects were identified for possible inclusion in this assessment:

- ***Proposed Car Wash – 28 Ferry Road.*** This project entails the construction of a 3,908 square feet (sf) automatic car wash to be located at 28 Ferry Road in Haverhill, Massachusetts. Estimates of additional traffic expected to be generated by this development were calculated using data from the Institute of Transportation Engineers (ITE)[2] and have been incorporated into the analysis of future traffic conditions.

- ***Proposed Oxford Crossing Development – 145 Oxford Avenue.*** This project entails the construction of a six-story building with 230 residential units, 3,000 sf of retail space, and a 1,200 sf bakery, and a 200-seat restaurant to be located at 145 Oxford Avenue in Haverhill, Massachusetts. Estimates of additional traffic expected to be generated by this development were obtained from the technical memorandum[3] prepared for this project and have been incorporated into the analysis of future traffic conditions.

---

[2] *Trip Generation Manual*, 12th Edition; Institute of Transportation Engineers; Washington, DC; 2025.

[3] *Traffic Impact and Access Study*, Oxford Crossing; TEC; July 2022.

- ***Proposed Mixed-Use Development – 877 Boston Road.*** This project entails the construction of a 153-unit multifamily residential community, 2,400 sf of retail space, and a 2,700 sf bank to be located at 877 Boston Road in Haverhill, Massachusetts. The residential component of the mixed-use development has been constructed and occupied; the retail space and bank are proposed to be constructed in the future. Estimates of additional traffic expected to be generated by the retail space and bank were obtained from the technical memorandum[4] prepared for this project and have been incorporated into the analysis of future traffic conditions.

No other developments were identified at this time that are expected to result in a significant increase in traffic within the study area beyond the general background traffic growth rate.

**Planned Roadway Improvements**

The City of Haverhill engineering department was contacted to determine if there were any future roadway improvement projects within the study area. Based on these discussions it was confirmed that a Complete Streets project was being developed along Oxford Avenue/Boston Road corridor, but no plans have been completed. No alterations to the study area from this project were assumed, due to the lack of information.

No other roadway improvement projects, aside from routine maintenance activities, were identified as planned within the study area at this time.

**No-Build Traffic Volumes**

The 2033 No-Build peak-hour traffic-volume networks were developed by applying a compounded annual background traffic growth rate of 1.0 percent to the 2026 Existing peak-hour traffic volumes over a seven-year period, and including the traffic volumes from the background development projects noted above. The resulting 2033 No-Build weekday morning and weekday evening peak-hour traffic-volume networks are shown on Figure 4.

**Project-Generated Traffic**

In order to develop the traffic characteristics of the proposed Project, trip-generation statistics published by the ITE[5] for similar land uses as those proposed was used. ITE Land Use Code (LUC) 210, *Single-Family Detached Housing,* and LUC 215, *Single-Family Attached Housing*, were used to develop the anticipated traffic characteristics of the Project.

Trip-generation calculations were performed for a typical weekday, as well as the weekday morning and weekday evening peak hours, the critical time periods for Project-related traffic activity. A summary of the expected vehicle-trip generation is summarized in Table 3.

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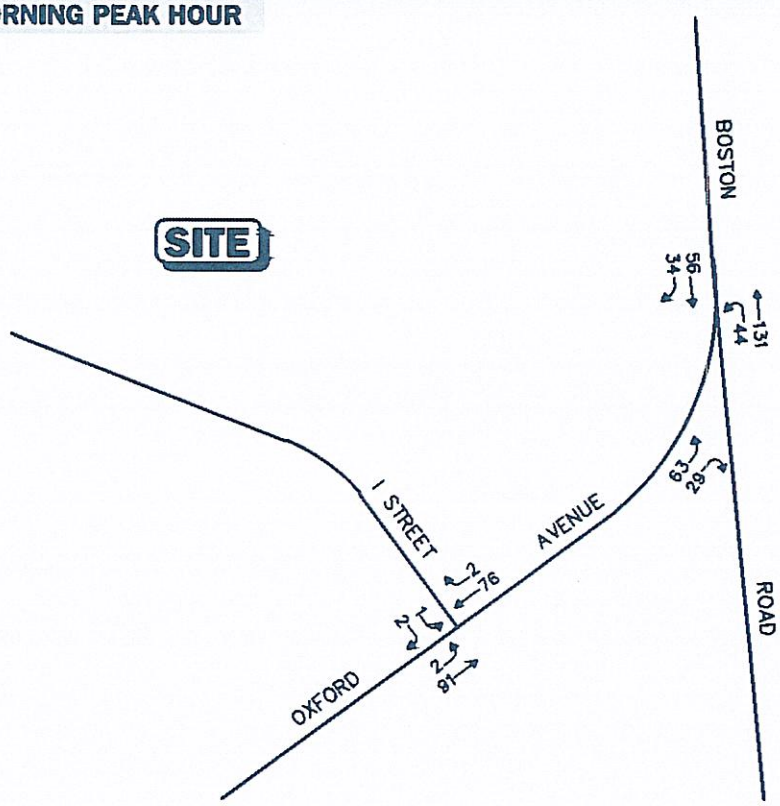
[4] *Transportation Impact Assessment*, Proposed Mixed-Use Development; VAI; June 2021.
[5] Ibid 2.

**WEEKDAY MORNING PEAK HOUR**




**WEEKDAY EVENING PEAK HOUR**

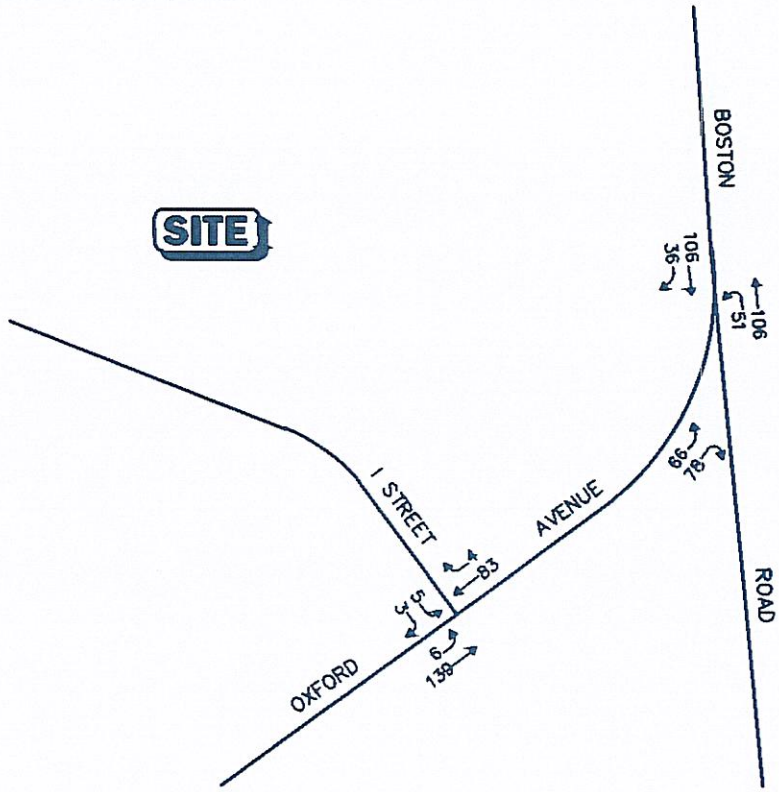



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**Figure 4**

**2033 No-Build**
**Peak-Hour Traffic Volumes**

Vanasse & Associates inc

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**Table 3**
**PROJECT TRIP-GENERATION SUMMARY**

| Time Period/ Directional Distribution | Single-Family Trips[a] | Duplex Trips[b] | Total Trips |
|---|---|---|---|
| *Weekday Morning Peak Hour:* | | | |
| Entering | 0 | 2 | 2 |
| Exiting | 1 | 4 | 5 |
| Total | 1 | 6 | 7 |
| *Weekday Evening Peak Hour:* | | | |
| Entering | 1 | 3 | 4 |
| Exiting | 1 | 3 | 4 |
| Total | 2 | 6 | 8 |
| *Weekday Daily:* | | | |
| Entering | 9 | 39 | 48 |
| Exiting | 9 | 39 | 48 |
| Total | 18 | 78 | 96 |

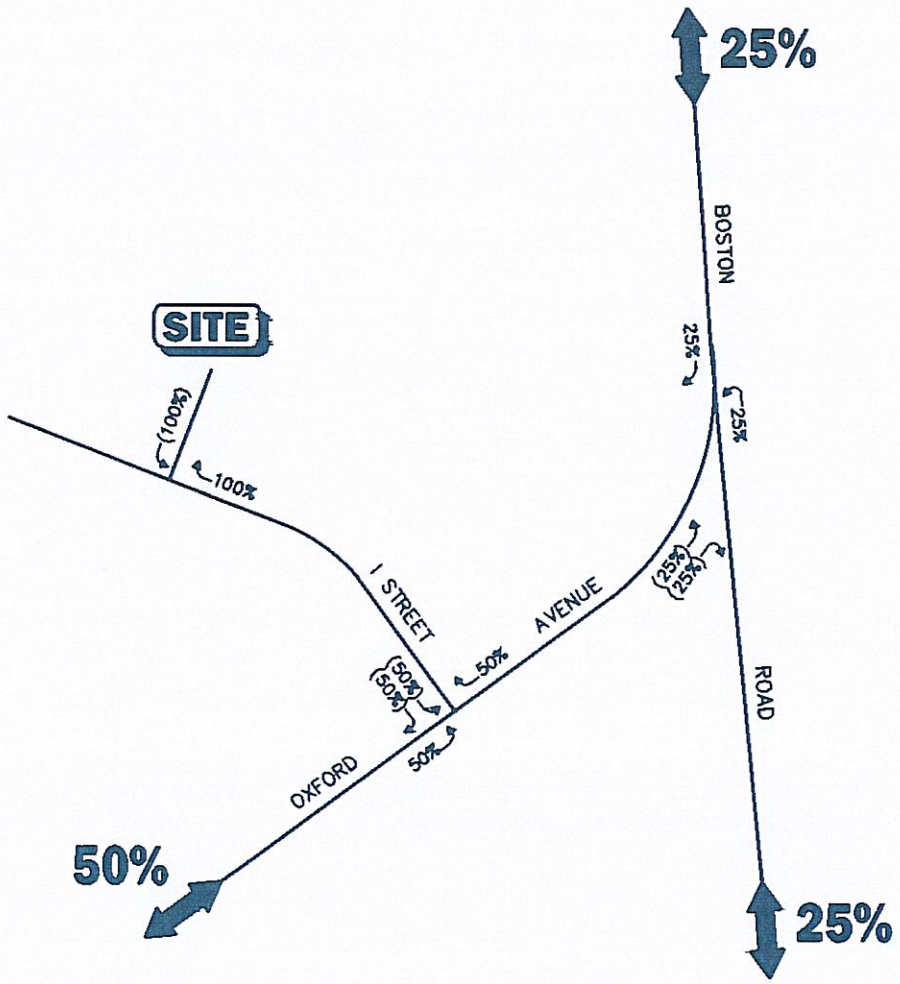
[a]Based on ITE LUC 210, *Single-Family Detached Housing*; 2 units.
[b]Based on ITE LUC 215, *Single-Family Attached Housing*; 12 units.

As shown in Table 3, the Project is expected to generate approximately 7 vehicle trips (2 entering and 5 exiting) during the weekday morning peak hour, and 8 vehicle trips (4 entering and 4 exiting) during the weekday evening peak hour. On an average weekday, the project would be expected to generate 48 entering trips and 48 exiting trips over a 24-hour period.

## Trip Distribution and Assignment

The directional distribution of the site-generated trips to and from the proposed residential development was developed based on a review of existing travel patterns within the study area.

The trip distribution for the Project is summarized in Table 4 and graphically depicted in Figure 5. The weekday morning and weekday evening peak-hour traffic volumes expected to be generated by the Project were assigned on the study area roadway network as shown on Figure 6.




**Legend:**

| | |
|---|---|
| XX | Entering Trips |
| (XX) | Exiting Trips |

Not To Scale

**Figure 5**

**Trip Distribution Map**

Vanasse & Associates inc

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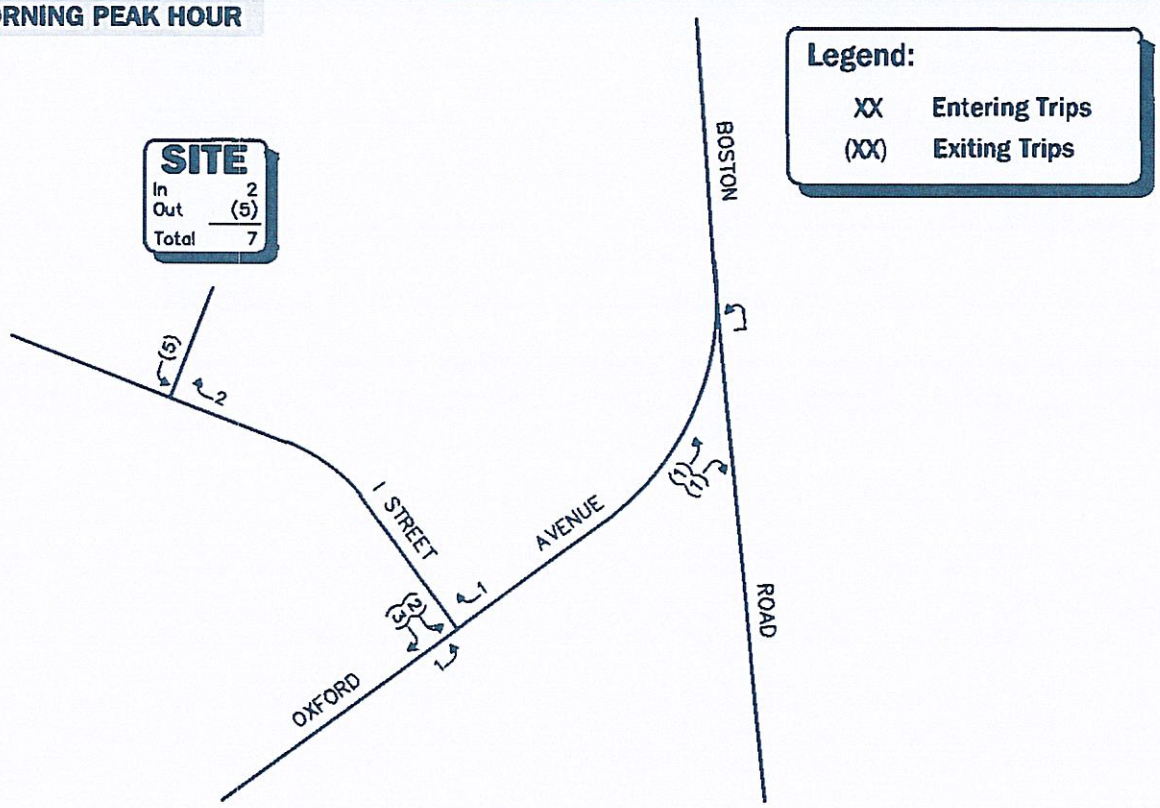
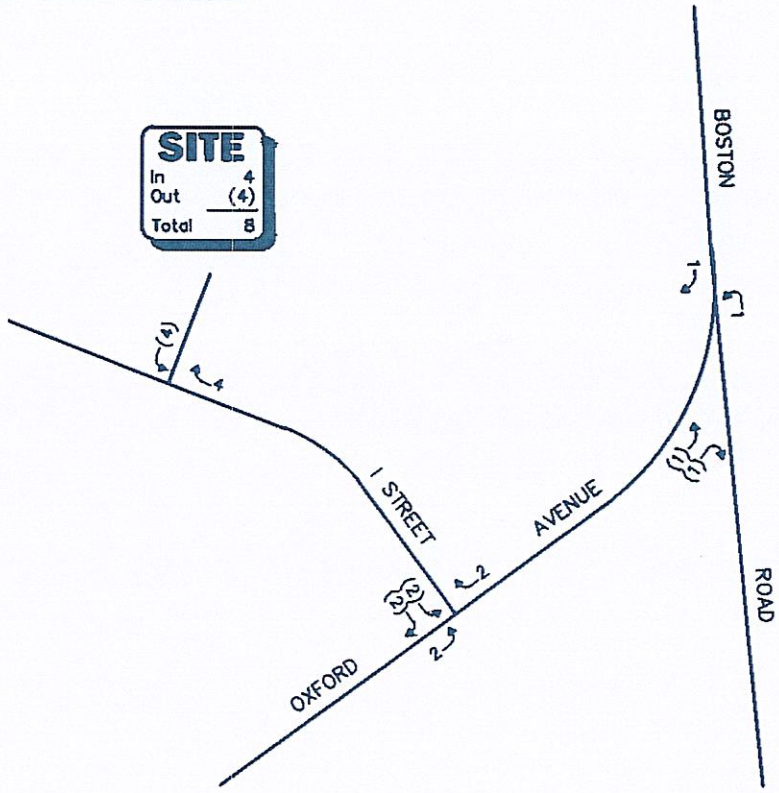
## WEEKDAY MORNING PEAK HOUR




## WEEKDAY EVENING PEAK HOUR




Not To Scale

**Figure 6**

**Project-Generated Peak-Hour Traffic Volumes**

Vanasse & Associates inc

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**Table 4**
**TRIP-DISTRIBUTION SUMMARY**

| Roadway | Direction (To/From) | Percent (To/From) |
|---|---|---|
| Boston Road | South | 25 |
| Boston Road | East | 25 |
| Oxford Avenue | West | 50 |
| TOTAL | | 100 |

## Future Traffic Volumes – Build Condition

The 2033 Build condition networks consist of the 2033 No-Build traffic volumes, with the anticipated Project-generated traffic added. The 2033 Build weekday morning and weekday evening peak-hour traffic-volume networks are graphically depicted on Figure 7.

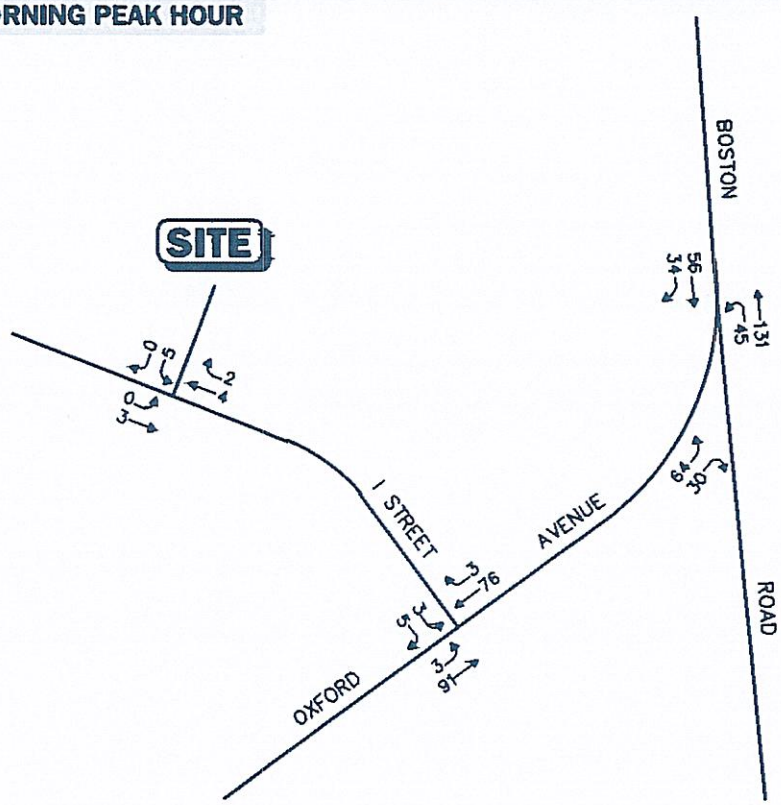
A summary of projected peak-hour traffic-volume increases external to the study area, the subject of this assessment, is shown in Table 5. These volumes are based on the expected increases from the Project.

**Table 5**
**PEAK-HOUR TRAFFIC-VOLUME INCREASES**

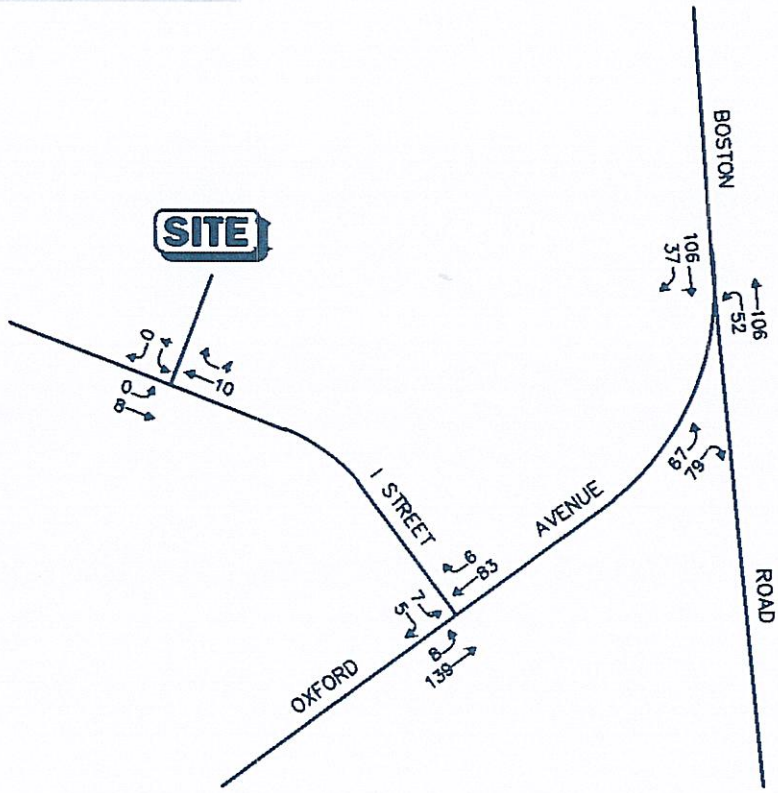
| Location/Peak Hour | 2033 No-Build | 2033 Build | Traffic-Volume Increase Over No-Build | Percent Increase Over No-Build |
|---|---|---|---|---|
| *Boston Road, south of Oxford Avenue:* | | | | |
| Weekday Morning | 260 | 262 | 2 | 0.8 |
| Weekday Evening | 341 | 343 | 2 | 0.6 |
| *Boston Road, east of Oxford Avenue:* | | | | |
| Weekday Morning | 284 | 285 | 1 | 0.4 |
| Weekday Evening | 314 | 316 | 2 | 0.6 |
| *Oxford Avenue, west of I Street:* | | | | |
| Weekday Morning | 171 | 175 | 4 | 2.3 |
| Weekday Evening | 231 | 235 | 4 | 1.7 |

As shown below in Table 5, Project-related traffic-volume increases external to the study area relative to 2033 No-Build conditions are anticipated to range from 1 to 4 vehicles or 0.4 to 2.3 percent during the peak periods.

## WEEKDAY MORNING PEAK HOUR




## WEEKDAY EVENING PEAK HOUR




Not To Scale

**Figure 7**

**2033 Build**
**Peak-Hour Traffic Volumes**

Vanasse & Associates inc

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## SIGHT DISTANCE EVALUATION

Sight distance measurements were performed at the Project site driveway intersection with I Street in accordance with MassDOT and American Association of State Highway and Transportation Officials (AASHTO)[6] recommendations. Both stopping sight distance (SSD) and intersection sight distance (ISD) measurements were performed. In brief, SSD is the distance recommended to be provided by a vehicle traveling at the design speed of a roadway, on wet pavement, to stop prior to striking an object in its travel path. ISD is the sight distance recommended to be provided by a driver entering or crossing an intersecting roadway to perceive an oncoming vehicle and safely complete a turning or crossing maneuver with oncoming traffic. In accordance with AASHTO standards, if the measured ISD is at least equal to the recommended SSD value for the major road, then drivers have sufficient sight distance to anticipate and avoid collisions. Table 6 presents the measured SSD and ISD at the study area intersection.

**Table 6**
**SIGHT DISTANCE ANALYSIS[a]**

| Intersection/Sight Distance Measurement | AASHTO[b] Minimum Recommended | AASHTO[b] Desirable | Field |
|---|---|---|---|
| ***Project Site Driveway at I Street*** | | | |
| *Stopping Sight Distance:* | | | |
| I Street approaching from the north | 200 | -- | 109[c] |
| I Street approaching from the south | 200 | -- | 500+ |
| *Intersection Sight Distance:* | | | |
| Left turn from Site driveway (looking north) | 200 | 335 | 109[c,d] |
| Left turn from Site driveway (looking south) | 200 | 335 | 500+[d] |

[a]Recommended values obtained from *A Policy on Geometric Design of Highways and Streets*, 7th Edition; American Association of State Highway and Transportation Officials (AASHTO); 2018.
[b]Based on MGL c. 90 § 17.
[c]Limited based on the length of roadway.
[d]Distance available if trees are removed within the sight triangle.

As can be seen in Table 6, the sight distance at the intersection of the site driveway with I Street to/from the south was found to exceed the minimum recommended values for SSD and the desirable values for ISD. The limit of sight distance for the site driveway to/from the north was based on the length of existing roadway. I Street terminates 109 feet from the driveway with driveways to one duplex unit and one garage between the end of the street and the proposed site driveway. Drivers will be provided with a clear and unobstructed view from the proposed site driveway to the end of the street.

[6] *A Policy on Geometric Design of Highway and Streets*, 7th Edition; American Association of State Highway and Transportation Officials (AASHTO); Washington D.C.; 2018.

## TRAFFIC OPERATIONS ANALYSIS

Level-of-service analyses were conducted for 2026 Existing, 2033 No-Build, and 2033 Build conditions for the study area intersections. The results of the intersection capacity analysis within the study area are described below, with a tabular summary provided in Table 7.

The Project does not have a significant effect on traffic delays at the study area intersections. The critical movements of the Project Site Driveway at the intersection with I Street operates at LOS A during the weekday morning and weekday evening peak hours under 2033 Build. There is no average vehicle queue under all peak hours.

**Table 7**
**UNSIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY**

| | 2026 Existing | | | | 2033 No-Build | | | | 2033 Build | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unsignalized Intersection/Peak Hour/Movement | Demand[a] | Delay[b] | LOS[c] | Queue[d] 95th | Demand | Delay | LOS | Queue 95th | Demand | Delay | LOS | Queue 95th |
| ***Oxford Avenue at I Street*** | | | | | | | | | | | | |
| *Weekday Morning:* | | | | | | | | | | | | |
| Oxford Avenue EB LT | 2 | 7.4 | A | 0 | 2 | 7.4 | A | 0 | 3 | 7.4 | A | 0 |
| I Street SB LT/RT | 3 | 9.1 | A | 0 | 3 | 8.9 | A | 0 | 8 | 9.0 | A | 0 |
| *Weekday Evening:* | | | | | | | | | | | | |
| Oxford Avenue EB LT | 6 | 7.4 | A | 0 | 6 | 7.4 | A | 0 | 8 | 7.4 | A | 0 |
| I Street SB LT/RT | 8 | 9.5 | A | 1 | 8 | 9.5 | A | 0 | 12 | 9.5 | A | 0 |
| ***Oxford Avenue at Boston Road*** | | | | | | | | | | | | |
| *Weekday Morning:* | | | | | | | | | | | | |
| Oxford Avenue EB TH/RT | 83 | 9.5 | A | 1 | 92 | 9.3 | A | 1 | 94 | 9.4 | A | 1 |
| Boston Road WB LT/TH | 78 | 0.0 | A | 0 | 90 | 0.0 | A | 0 | 90 | 0.0 | A | 0 |
| Boston Road NB LT/RT | 156 | 9.8 | A | 1 | 175 | 9.6 | A | 1 | 176 | 9.6 | A | 1 |
| *Weekday Evening:* | | | | | | | | | | | | |
| Oxford Avenue EB TH/RT | 134 | 9.8 | A | 1 | 144 | 9.9 | A | 1 | 146 | 9.9 | A | 1 |
| Boston Road WB LT/TH | 120 | 0.0 | A | 0 | 142 | 0.0 | A | 0 | 143 | 0.0 | A | 0 |
| Boston Road NB LT/RT | 135 | 9.7 | A | 1 | 157 | 9.8 | A | 1 | 158 | 9.8 | A | 1 |
| ***I Street at Project Site Driveway*** | | | | | | | | | | | | |
| *Weekday Morning:* | | | | | | | | | | | | |
| Project Site Driveway WB LT/RT | Intersection only exists under Build conditions. | | | | | | | | 5 | 8.6 | A | 0 |
| *Weekday Evening:* | | | | | | | | | | | | |
| Project Site Driveway WB LT/RT | | | | | | | | | 4 | 8.6 | A | 0 |

[a]Demand in vehicles per hour.
[b]Average control delay per vehicle (in seconds).
[c]Level of service.
[d]Queue length in vehicles.
EB = eastbound; WB = westbound; LT = left-turning movements; TH = through movements; RT = right-turning movements.

## RECOMMENDATIONS

### Project Access

Access to and egress from the proposed residential development will be provided via a new full-access driveway onto I Street. The following recommendations are offered with respect to the design and operation of the Project site driveway:

- The driveway should be placed under STOP-sign (*Manual on Uniform Traffic Control Devices* (MUTCD)[7] R1-1) control, with a painted STOP-bar included.
- All signs and other pavement markings to be installed within the Project site shall conform to the applicable standards of the current MUTCD.
- Signs and landscaping adjacent to the Project site driveway should be designed and maintained to remain below 24 inches above the driveway to avoid restricting lines of sight.
- Existing vegetation in the right-of-way on I Street should be trimmed and maintained so that it does not impede sight distance.

## CONCLUSIONS

VAI has prepared this TIA to identify traffic impacts associated with a proposed residential development to be located on I Street in Haverhill, Massachusetts. We have the following conclusions:

- No apparent safety deficiencies were noted in the motor vehicle crash history at the study area intersections.
- Traffic-volume increases related to the Project, external to the study, are anticipated to range from 1 to 4 vehicles or 0.4 to 2.3 percent, during peak periods.
- Lines of sight at the Project site driveway intersection with I Street were found to exceed the recommended values for SSD, and the desirable values for ISD if the existing vegetation in the right-of-way on I Street is trimmed and maintained.
- The Project will generally not have a significant impact on motorist delays or vehicle queuing at study area intersections compared to anticipated future conditions without the Project (No-Build conditions).
- Under 2033 Build conditions, all movements exiting the Project site driveway to I Street are expected to operate at LOS A during all peak hours, with no residual vehicle queue.

As documented in this study, Project-related traffic increases will generally not result in significant increases in overall traffic volumes or traffic delays within the study area. The site driveway is expected to operate with minimal delays during all peak hours. In general, Project-related traffic can be adequately accommodated with minimal impact on the traffic operations within the study area.

Attachments:
Technical Appendix

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[7] *Manual on Uniform Traffic Control Devices (MUTCD)*; Federal Highway Administration; Washington, D.C.; 2009.

# APPENDIX

TRAFFIC COUNT DATA
SEASONAL ADJUSTMENT DATA
PUBLIC TRANSPORTATION DATA
MASSDOT CRASH RATE WORKSHEETS
GROWTH RATE DATA
TRIP GENERATION DATA
CAPACITY ANALYSIS METHODOLOGY
CAPACITY ANALYSIS

# TRAFFIC COUNT DATA

S Street : I Street
/N Street : Oxford Avenue
y/State : Haverhill, MA
eather : Rain / Cloudy

File Name : 10758(
Site Code : 10758(
Start Date : 6/23/2(
Page No : 1

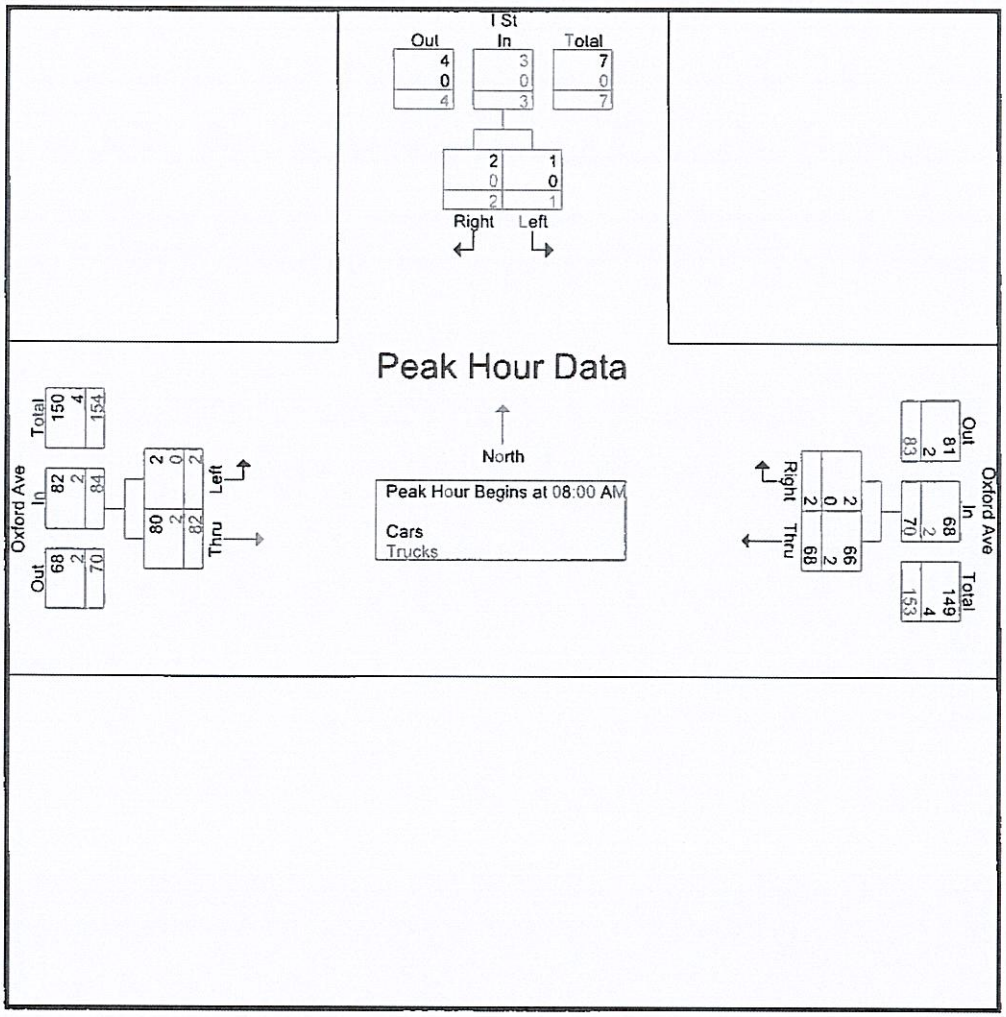
**Groups Printed- Cars - Trucks**

| | I St From North | | Oxford Ave From East | | Oxford Ave From West | | |
|---|---|---|---|---|---|---|---|
| Start Time | Left | Right | Thru | Right | Left | Thru | Int. Tot |
| 07:00 AM | 0 | 0 | 15 | 0 | 0 | 15 | 3 |
| 07:15 AM | 0 | 0 | 16 | 0 | 1 | 18 | 3 |
| 07:30 AM | 0 | 2 | 17 | 0 | 0 | 11 | 3 |
| 07:45 AM | 1 | 1 | 18 | 1 | 0 | 17 | 3 |
| Total | 1 | 3 | 66 | 1 | 1 | 61 | 13 |
| 08:00 AM | 0 | 2 | 6 | 0 | 0 | 9 | 1 |
| 08:15 AM | 0 | 0 | 23 | 0 | 1 | 14 | 3 |
| 08:30 AM | 1 | 0 | 23 | 0 | 1 | 26 | 5 |
| 08:45 AM | 0 | 0 | 16 | 2 | 0 | 33 | 5 |
| Total | 1 | 2 | 68 | 2 | 2 | 82 | 15 |
| Grand Total | 2 | 5 | 134 | 3 | 3 | 143 | 29 |
| Apprch % | 28.6 | 71.4 | 97.8 | 2.2 | 2.1 | 97.9 | |
| Total % | 0.7 | 1.7 | 46.2 | 1 | 1 | 49.3 | |
| Cars | 2 | 5 | 129 | 3 | 3 | 139 | 28 |
| % Cars | 100 | 100 | 96.3 | 100 | 100 | 97.2 | 96. |
| Trucks | 0 | 0 | 5 | 0 | 0 | 4 | |
| % Trucks | 0 | 0 | 3.7 | 0 | 0 | 2.8 | 3. |

| | I St From North | | | Oxford Ave From East | | | Oxford Ave From West | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Right | App. Total | Thru | Right | App. Total | Left | Thru | App. Total | Int. Tota |
| ak Hour Analysis From 07:00 AM to 08 45 AM - Peak 1 of 1 | | | | | | | | | | |
| ak Hour for Entire Intersection Begins at 08:00 AM | | | | | | | | | | |
| 08:00 AM | 0 | 2 | 2 | 6 | 0 | 6 | 0 | 9 | 9 | 1 |
| 08:15 AM | 0 | 0 | 0 | 23 | 0 | 23 | 1 | 14 | 15 | 3 |
| 08:30 AM | 1 | 0 | 1 | 23 | 0 | 23 | 1 | 26 | 27 | 5 |
| 08:45 AM | 0 | 0 | 0 | 16 | 2 | 18 | 0 | 33 | 33 | 5 |
| Total Volume | 1 | 2 | 3 | 68 | 2 | 70 | 2 | 82 | 84 | 15 |
| % App. Total | 33.3 | 66.7 | | 97.1 | 2.9 | | 2.4 | 97.6 | | |
| PHF | .250 | .250 | .375 | .739 | .250 | .761 | .500 | .621 | .636 | .77 |
| Cars | 1 | 2 | 3 | 66 | 2 | 68 | 2 | 80 | 82 | 15 |
| % Cars | 100 | 100 | 100 | 97.1 | 100 | 97.1 | 100 | 97.6 | 97.6 | 97. |
| Trucks | 0 | 0 | 0 | 2 | 0 | 2 | 0 | 2 | 2 | |
| % Trucks | 0 | 0 | 0 | 2.9 | 0 | 2.9 | 0 | 2.4 | 2.4 | 2. |

S Street : I Street
N Street : Oxford Avenue
y/State : Haverhill, MA
eather : Rain / Cloudy

File Name : 10758(
Site Code : 10758(
Start Date : 6/23/2(
Page No : 2

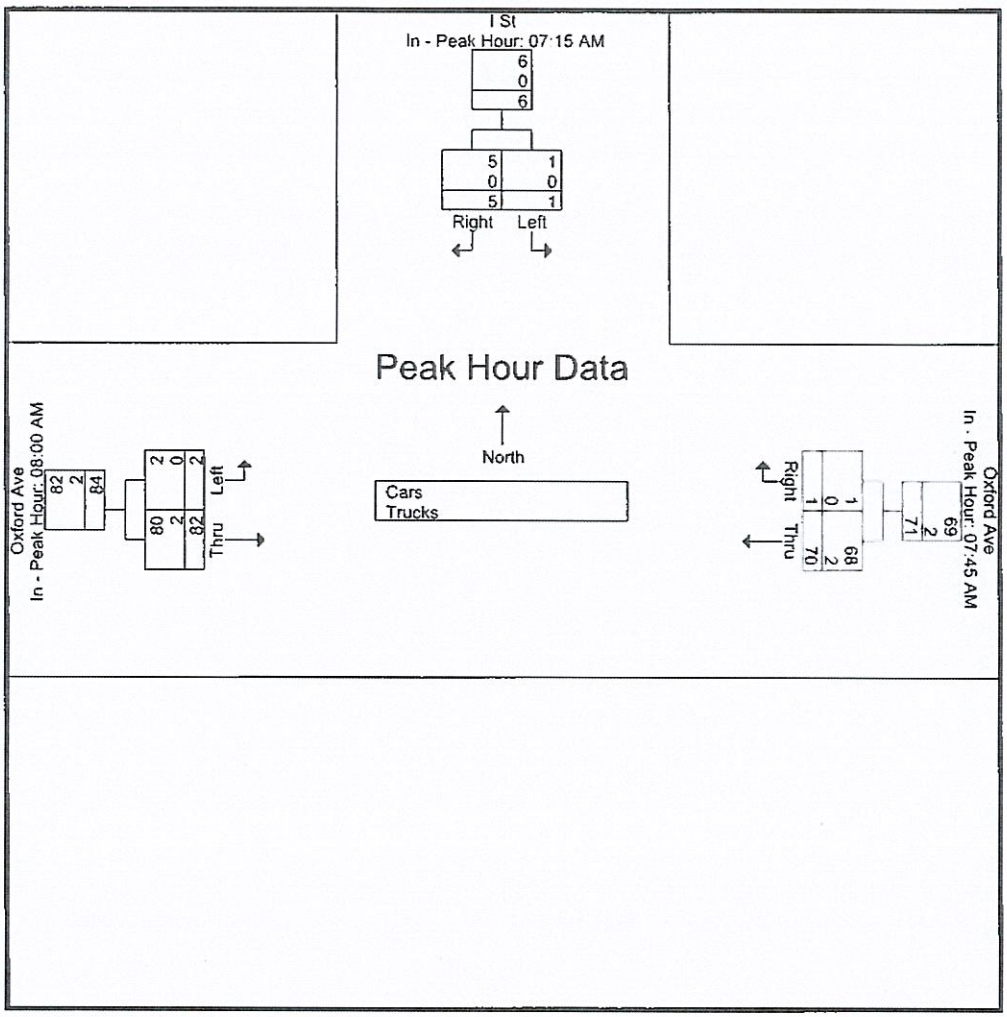



ak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1
ak Hour for Each Approach Begins at:

| | 07:15 AM | | | 07:45 AM | | | 08:00 AM | | |
|---|---|---|---|---|---|---|---|---|---|
| +0 mins. | 0 | 0 | 0 | 18 | 1 | 19 | 0 | 9 | 9 |
| +15 mins. | 0 | 2 | 2 | 6 | 0 | 6 | 1 | 14 | 15 |
| +30 mins. | 1 | 1 | 2 | 23 | 0 | 23 | 1 | 26 | 27 |
| +45 mins. | 0 | 2 | 2 | 23 | 0 | 23 | 0 | 33 | 33 |
| Total Volume | 1 | 5 | 6 | 70 | 1 | 71 | 2 | 82 | 84 |
| % App. Total | 16.7 | 83.3 | | 98.6 | 1.4 | | 2.4 | 97.6 | |
| PHF | .250 | .625 | .750 | .761 | .250 | .772 | .500 | .621 | .636 |
| Cars | 1 | 5 | 6 | 68 | 1 | 69 | 2 | 80 | 82 |
| % Cars | 100 | 100 | 100 | 97.1 | 100 | 97.2 | 100 | 97.6 | 97.6 |
| Trucks | 0 | 0 | 0 | 2 | 0 | 2 | 0 | 2 | 2 |
| % Trucks | 0 | 0 | 0 | 2.9 | 0 | 2.8 | 0 | 2.4 | 2.4 |

S Street : I Street
/N Street : Oxford Avenue
y/State : Haverhill, MA
eather : Rain / Cloudy

File Name : 10758(
Site Code : 10758(
Start Date : 6/23/2(
Page No : 3



S Street : I Street
N Street : Oxford Avenue
y/State : Haverhill MA
eather : Rain / Cloudy

File Name : 10758(
Site Code : 10758(
Start Date : 6/23/2(
Page No : 4

**Groups Printed- Cars**

| | I St From North | | Oxford Ave From East | | Oxford Ave From West | | |
|---|---|---|---|---|---|---|---|
| Start Time | Left | Right | Thru | Right | Left | Thru | Int. Tot |
| 07:00 AM | 0 | 0 | 14 | 0 | 0 | 14 | 2 |
| 07:15 AM | 0 | 0 | 16 | 0 | 1 | 18 | 3 |
| 07:30 AM | 0 | 2 | 15 | 0 | 0 | 11 | 2 |
| 07:45 AM | 1 | 1 | 18 | 1 | 0 | 16 | 3 |
| Total | 1 | 3 | 63 | 1 | 1 | 59 | 12 |
| 08:00 AM | 0 | 2 | 5 | 0 | 0 | 9 | 1 |
| 08:15 AM | 0 | 0 | 23 | 0 | 1 | 13 | 3 |
| 08:30 AM | 1 | 0 | 22 | 0 | 1 | 25 | 4 |
| 08:45 AM | 0 | 0 | 16 | 2 | 0 | 33 | 5 |
| Total | 1 | 2 | 66 | 2 | 2 | 80 | 15 |
| Grand Total | 2 | 5 | 129 | 3 | 3 | 139 | 28 |
| Apprch % | 28.6 | 71.4 | 97.7 | 2.3 | 2.1 | 97.9 | |
| Total % | 0.7 | 1.8 | 45.9 | 1.1 | 1.1 | 49.5 | |

| | I St From North | | | Oxford Ave From East | | | Oxford Ave From West | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Right | App. Total | Thru | Right | App. Total | Left | Thru | App. Total | Int. Tot |
| ak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1 | | | | | | | | | | |
| ak Hour for Entire Intersection Begins at 08:00 AM | | | | | | | | | | |
| 08:00 AM | 0 | 2 | 2 | 5 | 0 | 5 | 0 | 9 | 9 | 1 |
| 08:15 AM | 0 | 0 | 0 | 23 | 0 | 23 | 1 | 13 | 14 | 3 |
| 08:30 AM | 1 | 0 | 1 | 22 | 0 | 22 | 1 | 25 | 26 | 4 |
| 08:45 AM | 0 | 0 | 0 | 16 | 2 | 18 | 0 | 33 | 33 | 5 |
| Total Volume | 1 | 2 | 3 | 66 | 2 | 68 | 2 | 80 | 82 | 15 |
| % App. Total | 33.3 | 66.7 | | 97.1 | 2.9 | | 2.4 | 97.6 | | |
| PHF | .250 | .250 | .375 | .717 | .250 | .739 | .500 | .606 | .621 | .75 |

S Street : I Street
N Street : Oxford Avenue
y/State : Haverhill, MA
eather : Rain / Cloudy

File Name : 10758(
Site Code : 10758(
Start Date : 6/23/2(
Page No : 7

**Groups Printed- Trucks**

| | I St From North | | Oxford Ave From East | | Oxford Ave From West | | |
|---|---|---|---|---|---|---|---|
| Start Time | Left | Right | Thru | Right | Left | Thru | Int. Tot |
| 07:00 AM | 0 | 0 | 1 | 0 | 0 | 1 | |
| 07:15 AM | 0 | 0 | 0 | 0 | 0 | 0 | |
| 07:30 AM | 0 | 0 | 2 | 0 | 0 | 0 | |
| 07:45 AM | 0 | 0 | 0 | 0 | 0 | 1 | |
| Total | 0 | 0 | 3 | 0 | 0 | 2 | |
| 08:00 AM | 0 | 0 | 1 | 0 | 0 | 0 | |
| 08:15 AM | 0 | 0 | 0 | 0 | 0 | 1 | |
| 08:30 AM | 0 | 0 | 1 | 0 | 0 | 1 | |
| 08:45 AM | 0 | 0 | 0 | 0 | 0 | 0 | |
| Total | 0 | 0 | 2 | 0 | 0 | 2 | |
| Grand Total | 0 | 0 | 5 | 0 | 0 | 4 | |
| Apprch % | 0 | 0 | 100 | 0 | 0 | 100 | |
| Total % | 0 | 0 | 55.6 | 0 | 0 | 44.4 | |

| | I St From North | | | Oxford Ave From East | | | Oxford Ave From West | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Right | App. Total | Thru | Right | App. Total | Left | Thru | App. Total | Int. Tot |
| ak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1 | | | | | | | | | | |
| ak Hour for Entire Intersection Begins at 07:00 AM | | | | | | | | | | |
| 07:00 AM | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | |
| 07:15 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 07:30 AM | 0 | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | |
| 07:45 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | |
| Total Volume | 0 | 0 | 0 | 3 | 0 | 3 | 0 | 2 | 2 | |
| % App. Total | 0 | 0 | | 100 | 0 | | 0 | 100 | | |
| PHF | .000 | .000 | .000 | .375 | .000 | .375 | .000 | .500 | .500 | .62 |

S Street : I Street
N Street : Oxford Avenue
y/State : Haverhill, MA
eather : Rain / Cloudy

File Name : 10758(
Site Code : 10758(
Start Date : 6/23/2(
Page No : 10

**Groups Printed- Bikes Peds**

| | I St From North | | | Oxford Ave From East | | | Oxford Ave From West | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Right | Peds | Thru | Right | Peds | Left | Thru | Peds | Exclu. Total | Inclu. Total | Int. Tota |
| 07:00 AM | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | |
| 07:15 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 07:30 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 07:45 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Total | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | |
| 08:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 08:15 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 08:30 AM | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | |
| 08:45 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Total | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | |
| Grand Total | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | |
| Apprch % | 0 | 0 | | 0 | 0 | | 0 | 0 | | | | |
| Total % | | | | | | | | | | 100 | 0 | |

| | I St From North | | | Oxford Ave From East | | | Oxford Ave From West | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Right | App. Total | Thru | Right | App. Total | Left | Thru | App. Total | Int. Tota |
| ak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1 | | | | | | | | | | |
| ak Hour for Entire Intersection Begins at 07:00 AM | | | | | | | | | | |
| 07:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 07:15 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 07:30 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 07:45 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Total Volume | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| % App. Total | 0 | 0 | | 0 | 0 | | 0 | 0 | | |
| PHF | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .00 |

S Street : I Street
N Street : Oxford Avenue
y/State : Haverhill, MA
eather : Rain / Cloudy

File Name : 10758(
Site Code : 10758(
Start Date : 6/23/2(
Page No : 1

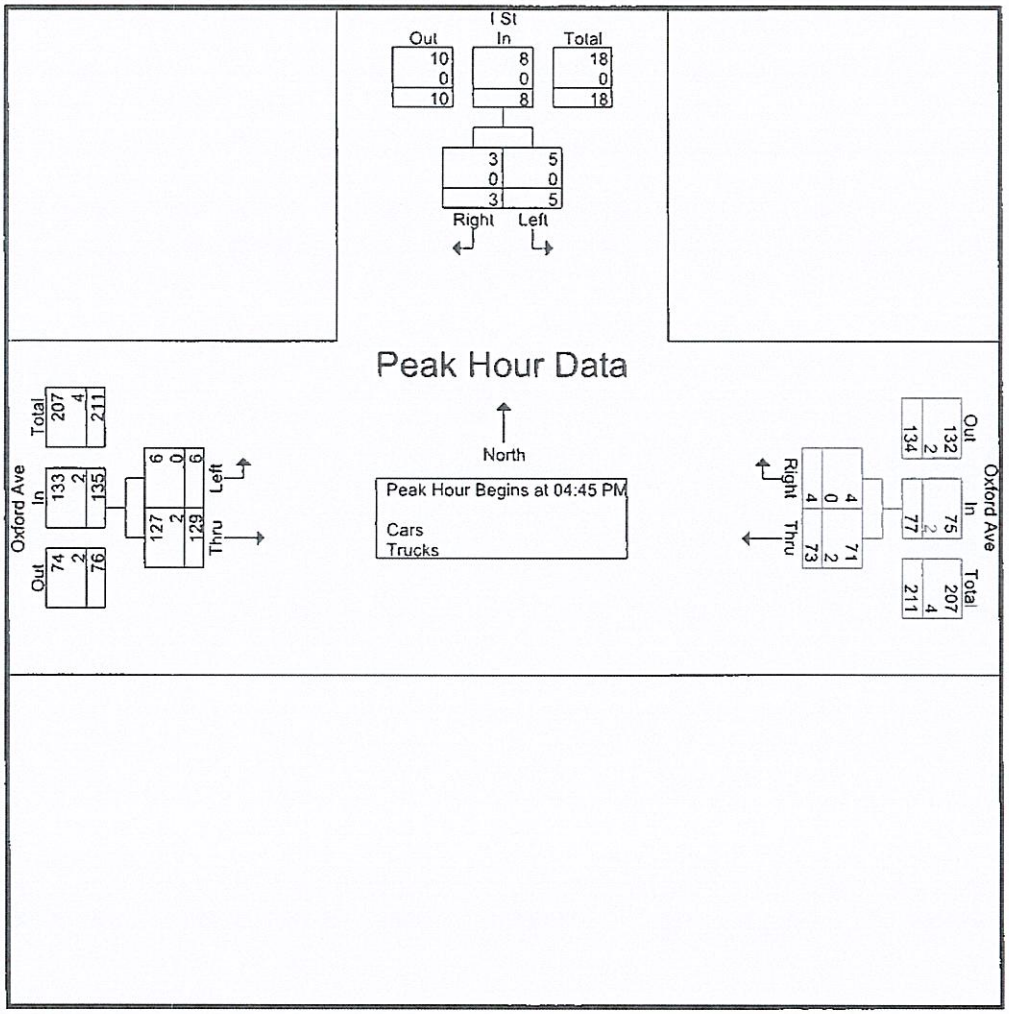
**Groups Printed- Cars - Trucks**

| | I St From North | | Oxford Ave From East | | Oxford Ave From West | | |
|---|---|---|---|---|---|---|---|
| Start Time | Left | Right | Thru | Right | Left | Thru | Int. Tot |
| 04:00 PM | 0 | 0 | 19 | 0 | 1 | 39 | 5 |
| 04:15 PM | 0 | 0 | 20 | 0 | 2 | 29 | 5 |
| 04:30 PM | 0 | 1 | 8 | 0 | 2 | 19 | 3 |
| 04:45 PM | 2 | 2 | 18 | 0 | 0 | 41 | 6 |
| Total | 2 | 3 | 65 | 0 | 5 | 128 | 20 |
| 05:00 PM | 0 | 1 | 20 | 2 | 3 | 32 | 5 |
| 05:15 PM | 0 | 0 | 17 | 1 | 1 | 31 | 5 |
| 05:30 PM | 3 | 0 | 18 | 1 | 2 | 25 | 4 |
| 05.45 PM | 0 | 4 | 16 | 1 | 2 | 24 | 4 |
| Total | 3 | 5 | 71 | 5 | 8 | 112 | 20 |
| Grand Total | 5 | 8 | 136 | 5 | 13 | 240 | 40 |
| Apprch % | 38.5 | 61.5 | 96.5 | 3.5 | 5.1 | 94.9 | |
| Total % | 1.2 | 2 | 33.4 | 1.2 | 3.2 | 59 | |
| Cars | 5 | 8 | 132 | 5 | 13 | 236 | 39 |
| % Cars | 100 | 100 | 97.1 | 100 | 100 | 98.3 | 9 |
| Trucks | 0 | 0 | 4 | 0 | 0 | 4 | |
| % Trucks | 0 | 0 | 2.9 | 0 | 0 | 1.7 | |

| | I St From North | | | Oxford Ave From East | | | Oxford Ave From West | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Right | App. Total | Thru | Right | App. Total | Left | Thru | App. Total | Int. Tota |
| ak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1 | | | | | | | | | | |
| ak Hour for Entire Intersection Begins at 04:45 PM | | | | | | | | | | |
| 04:45 PM | 2 | 2 | 4 | 18 | 0 | 18 | 0 | 41 | 41 | 6 |
| 05:00 PM | 0 | 1 | 1 | 20 | 2 | 22 | 3 | 32 | 35 | 5 |
| 05:15 PM | 0 | 0 | 0 | 17 | 1 | 18 | 1 | 31 | 32 | 5 |
| 05:30 PM | 3 | 0 | 3 | 18 | 1 | 19 | 2 | 25 | 27 | 4 |
| Total Volume | 5 | 3 | 8 | 73 | 4 | 77 | 6 | 129 | 135 | 22 |
| % App. Total | 62.5 | 37.5 | | 94.8 | 5.2 | | 4.4 | 95.6 | | |
| PHF | .417 | .375 | .500 | .913 | .500 | .875 | .500 | .787 | .823 | .87 |
| Cars | 5 | 3 | 8 | 71 | 4 | 75 | 6 | 127 | 133 | 21 |
| % Cars | 100 | 100 | 100 | 97.3 | 100 | 97.4 | 100 | 98.4 | 98.5 | 98. |
| Trucks | 0 | 0 | 0 | 2 | 0 | 2 | 0 | 2 | 2 | |
| % Trucks | 0 | 0 | 0 | 2.7 | 0 | 2.6 | 0 | 1.6 | 1.5 | 1. |

S Street : I Street
N Street : Oxford Avenue
y/State : Haverhill, MA
eather : Rain / Cloudy

File Name : 10758(
Site Code : 10758(
Start Date : 6/23/2(
Page No : 2

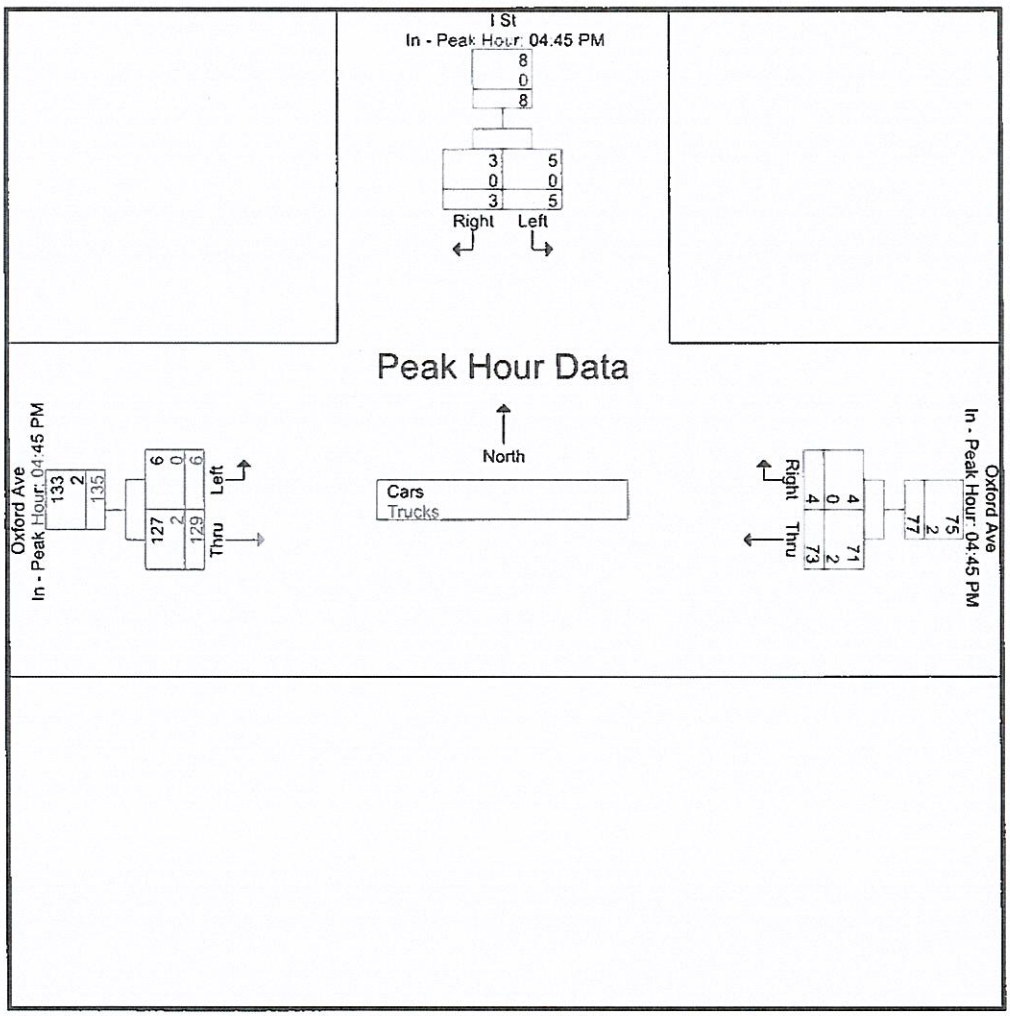



ak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1
ak Hour for Each Approach Begins at:

| | 04:45 PM | | | 04:45 PM | | | 04:45 PM | | |
|---|---|---|---|---|---|---|---|---|---|
| +0 mins. | 2 | 2 | 4 | 18 | 0 | 18 | 0 | 41 | 41 |
| +15 mins. | 0 | 1 | 1 | 20 | 2 | 22 | 3 | 32 | 35 |
| +30 mins. | 0 | 0 | 0 | 17 | 1 | 18 | 1 | 31 | 32 |
| +45 mins. | 3 | 0 | 3 | 18 | 1 | 19 | 2 | 25 | 27 |
| Total Volume | 5 | 3 | 8 | 73 | 4 | 77 | 6 | 129 | 135 |
| % App. Total | 62.5 | 37.5 | | 94.8 | 5.2 | | 4.4 | 95.6 | |
| PHF | .417 | .375 | .500 | .913 | .500 | .875 | .500 | .787 | .823 |
| Cars | 5 | 3 | 8 | 71 | 4 | 75 | 6 | 127 | 133 |
| % Cars | 100 | 100 | 100 | 97.3 | 100 | 97.4 | 100 | 98.4 | 98.5 |
| Trucks | 0 | 0 | 0 | 2 | 0 | 2 | 0 | 2 | 2 |
| % Trucks | 0 | 0 | 0 | 2.7 | 0 | 2.6 | 0 | 1.6 | 1.5 |

S Street : I Street
N Street : Oxford Avenue
y/State : Haverhill, MA
eather : Rain / Cloudy

File Name : 10758(
Site Code : 10758(
Start Date : 6/23/2(
Page No : 3



S Street : I Street
N Street : Oxford Avenue
y/State : Haverhill, MA
eather : Rain / Cloudy

File Name : 10758(
Site Code : 10758(
Start Date : 6/23/2(
Page No : 4

**Groups Printed- Cars**

| | I St From North | | Oxford Ave From East | | Oxford Ave From West | | |
|---|---|---|---|---|---|---|---|
| Start Time | Left | Right | Thru | Right | Left | Thru | Int. Tot |
| 04:00 PM | 0 | 0 | 18 | 0 | 1 | 39 | 5 |
| 04:15 PM | 0 | 0 | 20 | 0 | 2 | 28 | 5 |
| 04:30 PM | 0 | 1 | 7 | 0 | 2 | 19 | 2 |
| 04:45 PM | 2 | 2 | 18 | 0 | 0 | 40 | 6 |
| Total | 2 | 3 | 63 | 0 | 5 | 126 | 19 |
| 05:00 PM | 0 | 1 | 19 | 2 | 3 | 32 | 5 |
| 05:15 PM | 0 | 0 | 17 | 1 | 1 | 30 | 4 |
| 05:30 PM | 3 | 0 | 17 | 1 | 2 | 25 | 4 |
| 05:45 PM | 0 | 4 | 16 | 1 | 2 | 23 | 4 |
| Total | 3 | 5 | 69 | 5 | 8 | 110 | 20 |
| Grand Total | 5 | 8 | 132 | 5 | 13 | 236 | 39 |
| Apprch % | 38.5 | 61.5 | 96.4 | 3.6 | 5.2 | 94.8 | |
| Total % | 1.3 | 2 | 33.1 | 1.3 | 3.3 | 59.1 | |

| | I St From North | | | Oxford Ave From East | | | Oxford Ave From West | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Right | App. Total | Thru | Right | App. Total | Left | Thru | App. Total | Int. Tot |
| ak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1 | | | | | | | | | | |
| ak Hour for Entire Intersection Begins at 04:45 PM | | | | | | | | | | |
| 04:45 PM | 2 | 2 | 4 | 18 | 0 | 18 | 0 | 40 | 40 | 6. |
| 05:00 PM | 0 | 1 | 1 | 19 | 2 | 21 | 3 | 32 | 35 | 5 |
| 05:15 PM | 0 | 0 | 0 | 17 | 1 | 18 | 1 | 30 | 31 | 4 |
| 05:30 PM | 3 | 0 | 3 | 17 | 1 | 18 | 2 | 25 | 27 | 4 |
| Total Volume | 5 | 3 | 8 | 71 | 4 | 75 | 6 | 127 | 133 | 21 |
| % App. Total | 62.5 | 37.5 | | 94.7 | 5.3 | | 4.5 | 95.5 | | |
| PHF | .417 | .375 | .500 | .934 | .500 | .893 | .500 | .794 | .831 | .87 |

S Street : I Street
N Street : Oxford Avenue
y/State : Haverhill, MA
eather : Rain / Cloudy

File Name : 10758(
Site Code : 10758(
Start Date : 6/23/2(
Page No : 7

**Groups Printed- Trucks**

| | I St From North | | Oxford Ave From East | | Oxford Ave From West | | |
|---|---|---|---|---|---|---|---|
| Start Time | Left | Right | Thru | Right | Left | Thru | Int. Tot. |
| 04:00 PM | 0 | 0 | 1 | 0 | 0 | 0 | |
| 04:15 PM | 0 | 0 | 0 | 0 | 0 | 1 | |
| 04:30 PM | 0 | 0 | 1 | 0 | 0 | 0 | |
| 04:45 PM | 0 | 0 | 0 | 0 | 0 | 1 | |
| Total | 0 | 0 | 2 | 0 | 0 | 2 | |
| 05:00 PM | 0 | 0 | 1 | 0 | 0 | 0 | |
| 05:15 PM | 0 | 0 | 0 | 0 | 0 | 1 | |
| 05:30 PM | 0 | 0 | 1 | 0 | 0 | 0 | |
| 05:45 PM | 0 | 0 | 0 | 0 | 0 | 1 | |
| Total | 0 | 0 | 2 | 0 | 0 | 2 | |
| Grand Total | 0 | 0 | 4 | 0 | 0 | 4 | |
| Apprch % | 0 | 0 | 100 | 0 | 0 | 100 | |
| Total % | 0 | 0 | 50 | 0 | 0 | 50 | |

| | I St From North | | | Oxford Ave From East | | | Oxford Ave From West | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Right | App. Total | Thru | Right | App. Total | Left | Thru | App. Total | Int. Tota |
| ak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1 | | | | | | | | | | |
| ak Hour for Entire Intersection Begins at 04:00 PM | | | | | | | | | | |
| 04:00 PM | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| 04:15 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | |
| 04:30 PM | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| 04:45 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | |
| Total Volume | 0 | 0 | 0 | 2 | 0 | 2 | 0 | 2 | 2 | |
| % App. Total | 0 | 0 | | 100 | 0 | | 0 | 100 | | |
| PHF | .000 | .000 | .000 | .500 | .000 | .500 | .000 | .500 | .500 | 1.0 |

S Street : I Street
/V Street : Oxford Avenue
y/State : Haverhill, MA
eather : Rain / Cloudy

File Name : 10758(
Site Code : 10758(
Start Date : 6/23/2(
Page No : 10

**Groups Printed- Bikes Peds**

| | I St From North | | | Oxford Ave From East | | | Oxford Ave From West | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Right | Peds | Thru | Right | Peds | Left | Thru | Peds | Exclu. Total | Inclu. Total | Int. Tota |
| 04:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 04:15 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 04:30 PM | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | |
| 04:45 PM | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 2 | 1 | |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 2 | 2 | |
| 05:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 05:15 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 05:30 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 05:45 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Grand Total | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 2 | 2 | |
| Apprch % | 0 | 0 | | 0 | 0 | | 100 | 0 | | | | |
| Total % | 0 | 0 | | 0 | 0 | | 100 | 0 | | 50 | 50 | |

| | I St From North | | | Oxford Ave From East | | | Oxford Ave From West | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Right | App. Total | Thru | Right | App. Total | Left | Thru | App. Total | Int. Tota |
| ak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1 | | | | | | | | | | |
| ak Hour for Entire Intersection Begins at 04:00 PM | | | | | | | | | | |
| 04:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 04:15 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 04:30 PM | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | |
| 04:45 PM | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | |
| Total Volume | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | |
| % App. Total | 0 | 0 | | 0 | 0 | | 100 | 0 | | |
| PHF | .000 | .000 | .000 | .000 | .000 | .000 | .500 | .000 | .500 | .50 |

S Street : Boston Road
/N Street : Boston Rd / Oxford Ave
y/State : Haverhill, MA
eather : Rain / Cloudy

File Name : 10758(
Site Code : 10758(
Start Date : 6/23/2(
Page No : 1

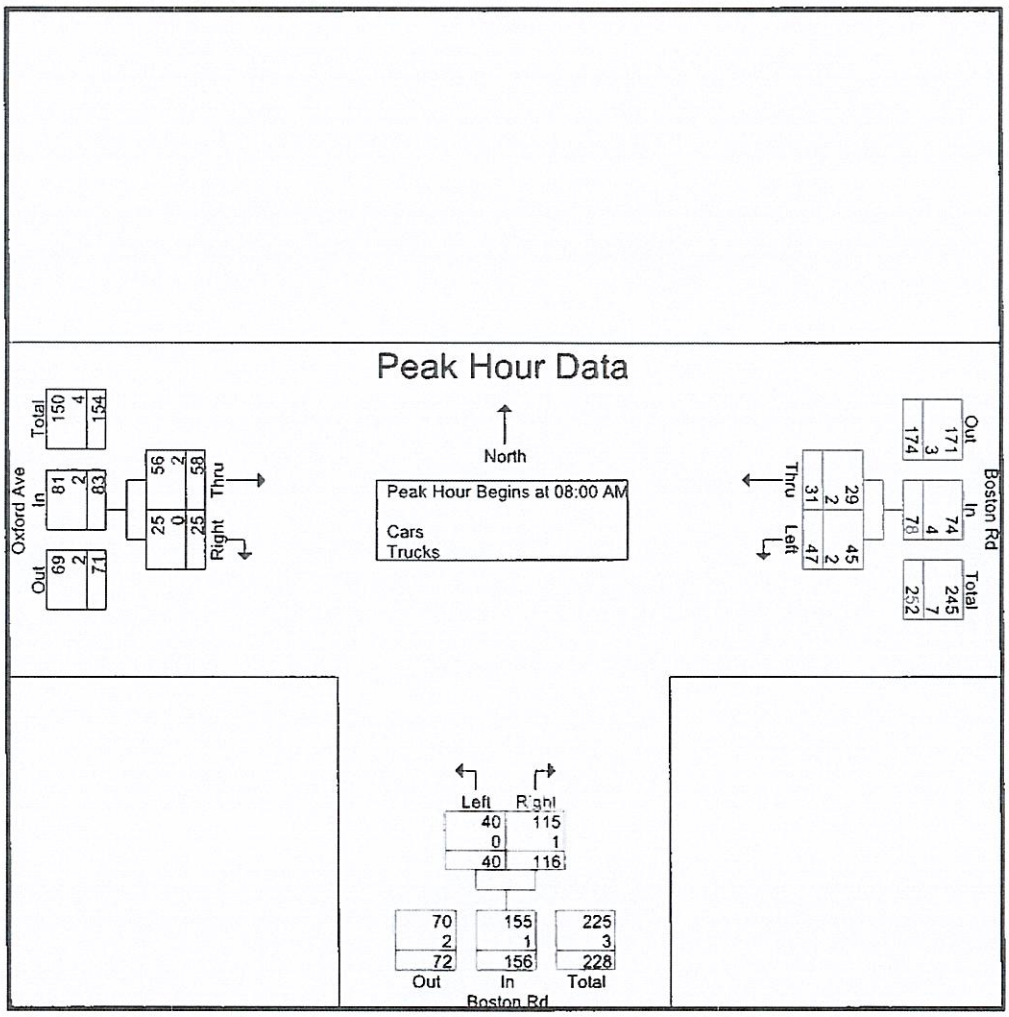
**Groups Printed- Cars - Trucks**

| | Boston Rd From East | | Boston Rd From South | | Oxford Ave From West | | |
|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Left | Right | Thru | Right | Int. Tot |
| 07:00 AM | 13 | 5 | 10 | 15 | 7 | 6 | 5 |
| 07:15 AM | 10 | 3 | 13 | 26 | 8 | 9 | 6 |
| 07:30 AM | 7 | 8 | 7 | 22 | 8 | 5 | 5 |
| 07:45 AM | 11 | 7 | 11 | 26 | 13 | 6 | 7 |
| Total | 41 | 23 | 41 | 89 | 36 | 26 | 25 |
| 08:00 AM | 12 | 3 | 3 | 23 | 7 | 3 | 5 |
| 08:15 AM | 12 | 7 | 16 | 20 | 6 | 6 | 6 |
| 08:30 AM | 11 | 8 | 15 | 30 | 21 | 7 | 9 |
| 08:45 AM | 12 | 13 | 6 | 43 | 24 | 9 | 10 |
| Total | 47 | 31 | 40 | 116 | 58 | 25 | 31 |
| Grand Total | 88 | 54 | 81 | 205 | 94 | 51 | 57 |
| Apprch % | 62 | 38 | 28.3 | 71.7 | 64.8 | 35.2 | |
| Total % | 15.4 | 9.4 | 14.1 | 35.8 | 16.4 | 8.9 | |
| Cars | 86 | 50 | 81 | 204 | 90 | 49 | 56 |
| % Cars | 97.7 | 92.6 | 100 | 99.5 | 95.7 | 96.1 | 97. |
| Trucks | 2 | 4 | 0 | 1 | 4 | 2 | 1 |
| % Trucks | 2.3 | 7.4 | 0 | 0.5 | 4.3 | 3.9 | 2. |

| | Boston Rd From East | | | Boston Rd From South | | | Oxford Ave From West | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | App. Total | Left | Right | App. Total | Thru | Right | App. Total | Int. Tota |
| ak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1 | | | | | | | | | | |
| ak Hour for Entire Intersection Begins at 08:00 AM | | | | | | | | | | |
| 08:00 AM | 12 | 3 | 15 | 3 | 23 | 26 | 7 | 3 | 10 | 5 |
| 08:15 AM | 12 | 7 | 19 | 16 | 20 | 36 | 6 | 6 | 12 | 6 |
| 08:30 AM | 11 | 8 | 19 | 15 | 30 | 45 | 21 | 7 | 28 | 9 |
| 08:45 AM | 12 | 13 | 25 | 6 | 43 | 49 | 24 | 9 | 33 | 10 |
| Total Volume | 47 | 31 | 78 | 40 | 116 | 156 | 58 | 25 | 83 | 31 |
| % App. Total | 60.3 | 39.7 | | 25.6 | 74.4 | | 69.9 | 30.1 | | |
| PHF | .979 | .596 | .780 | .625 | .674 | .796 | .604 | .694 | .629 | .74 |
| Cars | 45 | 29 | 74 | 40 | 115 | 155 | 56 | 25 | 81 | 31 |
| % Cars | 95.7 | 93.5 | 94.9 | 100 | 99.1 | 99.4 | 96.6 | 100 | 97.6 | 97. |
| Trucks | 2 | 2 | 4 | 0 | 1 | 1 | 2 | 0 | 2 | |
| % Trucks | 4.3 | 6.5 | 5.1 | 0 | 0.9 | 0.6 | 3.4 | 0 | 2.4 | 2. |

S Street : Boston Road
/N Street : Boston Rd / Oxford Ave
y/State : Haverhill, MA
eather : Rain / Cloudy

File Name : 10758(
Site Code : 10758(
Start Date : 6/23/2(
Page No : 2



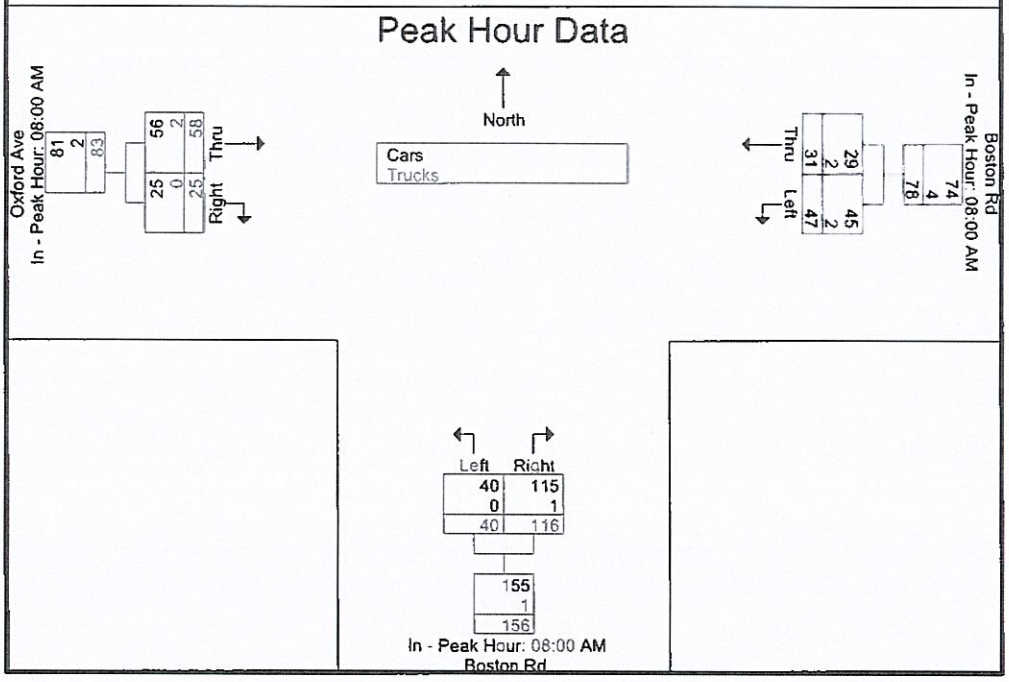

ak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1
ak Hour for Each Approach Begins at:

| | 08:00 AM | | | 08:00 AM | | | 08:00 AM | | |
|---|---|---|---|---|---|---|---|---|---|
| +0 mins. | 12 | 3 | 15 | 3 | 23 | 26 | 7 | 3 | 10 |
| +15 mins. | 12 | 7 | 19 | 16 | 20 | 36 | 6 | 6 | 12 |
| +30 mins. | 11 | 8 | 19 | 15 | 30 | 45 | 21 | 7 | 28 |
| +45 mins. | 12 | 13 | 25 | 6 | 43 | 49 | 24 | 9 | 33 |
| Total Volume | 47 | 31 | 78 | 40 | 116 | 156 | 58 | 25 | 83 |
| % App. Total | 60.3 | 39.7 | | 25.6 | 74.4 | | 69.9 | 30.1 | |
| PHF | .979 | .596 | .780 | .625 | .674 | .796 | .604 | .694 | .629 |
| Cars | 45 | 29 | 74 | 40 | 115 | 155 | 56 | 25 | 81 |
| % Cars | 95.7 | 93.5 | 94.9 | 100 | 99.1 | 99.4 | 96.6 | 100 | 97.6 |
| Trucks | 2 | 2 | 4 | 0 | 1 | 1 | 2 | 0 | 2 |
| % Trucks | 4.3 | 6.5 | 5.1 | 0 | 0.9 | 0.6 | 3.4 | 0 | 2.4 |

S Street : Boston Road
/N Street : Boston Rd / Oxford Ave
y/State : Haverhill, MA
eather : Rain / Cloudy

File Name : 10758(
Site Code : 10758(
Start Date : 6/23/2(
Page No : 3

# Peak Hour Data



S Street : Boston Road
N Street : Boston Rd / Oxford Ave
y/State : Haverhill, MA
eather : Rain / Cloudy

File Name : 10758(
Site Code : 10758(
Start Date : 6/23/2(
Page No : 4

**Groups Printed- Cars**

| | Boston Rd From East | | Boston Rd From South | | Oxford Ave From West | | |
|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Left | Right | Thru | Right | Int. Tot |
| 07:00 AM | 13 | 4 | 10 | 15 | 6 | 6 | 5 |
| 07:15 AM | 10 | 3 | 13 | 26 | 8 | 7 | 6 |
| 07:30 AM | 7 | 7 | 7 | 22 | 8 | 5 | 5 |
| 07:45 AM | 11 | 7 | 11 | 26 | 12 | 6 | 7 |
| Total | 41 | 21 | 41 | 89 | 34 | 24 | 25 |
| 08:00 AM | 12 | 2 | 3 | 23 | 7 | 3 | 5 |
| 08:15 AM | 12 | 7 | 16 | 20 | 5 | 6 | 6 |
| 08:30 AM | 10 | 7 | 15 | 29 | 20 | 7 | 8 |
| 08:45 AM | 11 | 13 | 6 | 43 | 24 | 9 | 10 |
| Total | 45 | 29 | 40 | 115 | 56 | 25 | 31 |
| Grand Total | 86 | 50 | 81 | 204 | 90 | 49 | 56 |
| Apprch % | 63.2 | 36.8 | 28.4 | 71.6 | 64.7 | 35.3 | |
| Total % | 15.4 | 8.9 | 14.5 | 36.4 | 16.1 | 8.8 | |

| | Boston Rd From East | | | Boston Rd From South | | | Oxford Ave From West | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | App. Total | Left | Right | App. Total | Thru | Right | App. Total | Int. Tota |
| ak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1 | | | | | | | | | | |
| ak Hour for Entire Intersection Begins at 08:00 AM | | | | | | | | | | |
| 08:00 AM | 12 | 2 | 14 | 3 | 23 | 26 | 7 | 3 | 10 | 5 |
| 08:15 AM | 12 | 7 | 19 | 16 | 20 | 36 | 5 | 6 | 11 | 6 |
| 08:30 AM | 10 | 7 | 17 | 15 | 29 | 44 | 20 | 7 | 27 | 8 |
| 08:45 AM | 11 | 13 | 24 | 6 | 43 | 49 | 24 | 9 | 33 | 10 |
| Total Volume | 45 | 29 | 74 | 40 | 115 | 155 | 56 | 25 | 81 | 31 |
| % App. Total | 60.8 | 39.2 | | 25.8 | 74.2 | | 69.1 | 30.9 | | |
| PHF | .938 | .558 | .771 | .625 | .669 | .791 | .583 | .694 | .614 | .73 |

S Street : Boston Road
N Street : Boston Rd / Oxford Ave
y/State : Haverhill, MA
eather : Rain / Cloudy

File Name : 10758(
Site Code : 10758(
Start Date : 6/23/2(
Page No : 10

**Groups Printed- Bikes Peds**

| | Boston Rd From East | | | Boston Rd From South | | | Oxford Ave From West | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Peds | Left | Right | Peds | Thru | Right | Peds | Exclu. Total | Inclu. Total | Int. Tota |
| 07:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 07:15 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 07:30 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 07:45 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 08:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 08:15 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 08:30 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 08:45 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Grand Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Apprch % | 0 | 0 | | 0 | 0 | | 0 | 0 | | | | |
| Total % | | | | | | | | | | 0 | 0 | |

| | Boston Rd From East | | | Boston Rd From South | | | Oxford Ave From West | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | App. Total | Left | Right | App. Total | Thru | Right | App. Total | Int. Tota |
| ak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1 | | | | | | | | | | |
| ak Hour for Entire Intersection Begins at 07:00 AM | | | | | | | | | | |
| 07:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 07:15 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 07:30 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 07:45 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Total Volume | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| % App. Total | 0 | 0 | | 0 | 0 | | 0 | 0 | | |
| PHF | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .00 |

S Street : Boston Road
N Street : Boston Rd / Oxford Ave
y/State : Haverhill, MA
eather : Rain / Cloudy

File Name : 10758(
Site Code : 10758(
Start Date : 6/23/2(
Page No : 7

**Groups Printed- Trucks**

| | Boston Rd From East | | Boston Rd From South | | Oxford Ave From West | | |
|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Left | Right | Thru | Right | Int. Tot |
| 07:00 AM | 0 | 1 | 0 | 0 | 1 | 0 | |
| 07:15 AM | 0 | 0 | 0 | 0 | 0 | 2 | |
| 07:30 AM | 0 | 1 | 0 | 0 | 0 | 0 | |
| 07:45 AM | 0 | 0 | 0 | 0 | 1 | 0 | |
| Total | 0 | 2 | 0 | 0 | 2 | 2 | |
| 08:00 AM | 0 | 1 | 0 | 0 | 0 | 0 | |
| 08:15 AM | 0 | 0 | 0 | 0 | 1 | 0 | |
| 08:30 AM | 1 | 1 | 0 | 1 | 1 | 0 | |
| 08:45 AM | 1 | 0 | 0 | 0 | 0 | 0 | |
| Total | 2 | 2 | 0 | 1 | 2 | 0 | |
| Grand Total | 2 | 4 | 0 | 1 | 4 | 2 | 1 |
| Apprch % | 33.3 | 66.7 | 0 | 100 | 66.7 | 33.3 | |
| Total % | 15.4 | 30.8 | 0 | 7.7 | 30.8 | 15.4 | |

| | Boston Rd From East | | | Boston Rd From South | | | Oxford Ave From West | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | App. Total | Left | Right | App. Total | Thru | Right | App. Total | Int. Tota |
| ak Hour Analysis From 07:00 AM to 08.45 AM - Peak 1 of 1 | | | | | | | | | | |
| ak Hour for Entire Intersection Begins at 07:45 AM | | | | | | | | | | |
| 07:45 AM | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | |
| 08:00 AM | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 08:15 AM | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | |
| 08:30 AM | 1 | 1 | 2 | 0 | 1 | 1 | 1 | 0 | 1 | |
| Total Volume | 1 | 2 | 3 | 0 | 1 | 1 | 3 | 0 | 3 | |
| % App. Total | 33.3 | 66.7 | | 0 | 100 | | 100 | 0 | | |
| PHF | .250 | .500 | .375 | .000 | .250 | .250 | .750 | .000 | .750 | .43 |

S Street : Boston Road
N Street : Boston Rd / Oxford Ave
y/State : Haverhill, MA
eather : Rain / Cloudy

File Name : 10758(
Site Code : 10758(
Start Date : 6/23/2(
Page No : 1

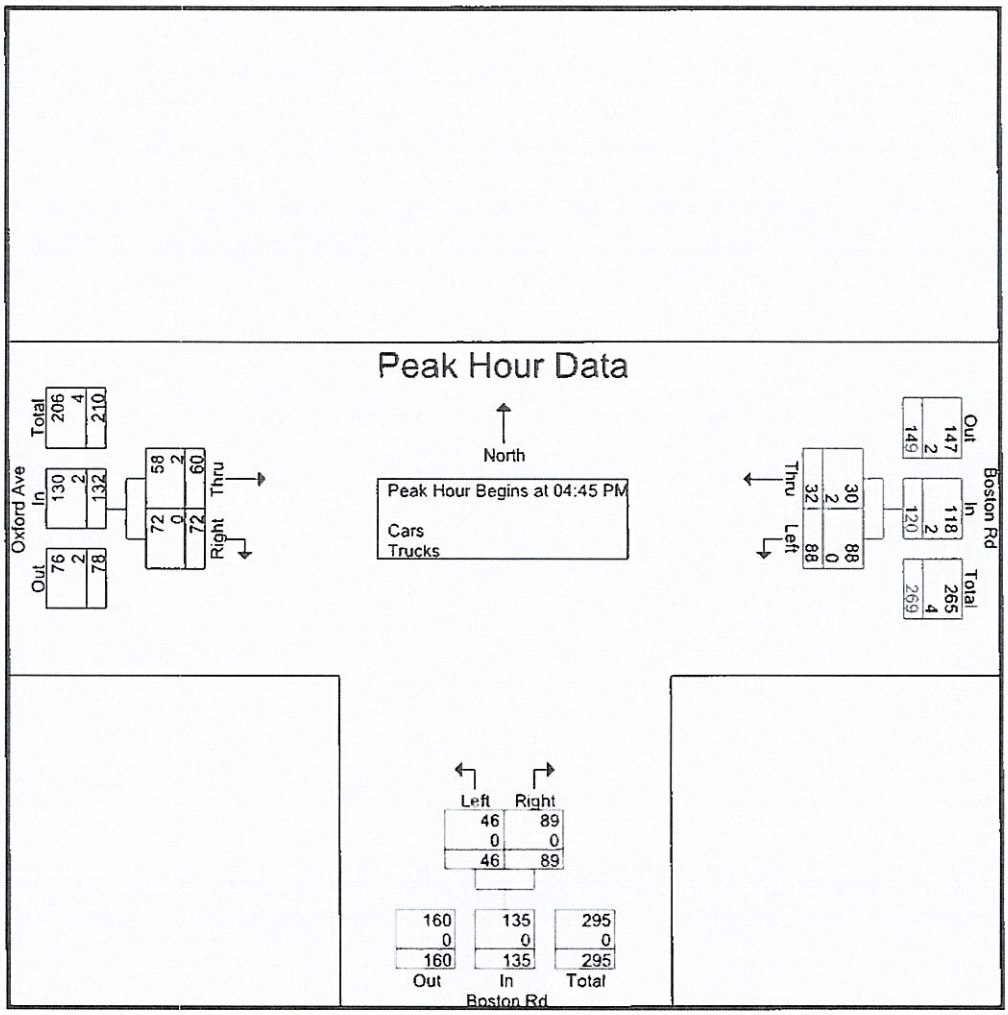
**Groups Printed- Cars - Trucks**

| | Boston Rd From East | | Boston Rd From South | | Oxford Ave From West | | |
|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Left | Right | Thru | Right | Int. Tot |
| 04:00 PM | 16 | 8 | 8 | 21 | 16 | 20 | 8 |
| 04:15 PM | 14 | 7 | 11 | 27 | 17 | 13 | 8 |
| 04:30 PM | 16 | 5 | 4 | 31 | 8 | 12 | 7 |
| 04:45 PM | 24 | 7 | 12 | 28 | 17 | 25 | 11 |
| Total | 70 | 27 | 35 | 107 | 58 | 70 | 36 |
| 05:00 PM | 16 | 9 | 12 | 17 | 14 | 18 | 8 |
| 05:15 PM | 26 | 6 | 13 | 21 | 16 | 15 | 9 |
| 05:30 PM | 22 | 10 | 9 | 23 | 13 | 14 | 9 |
| 05:45 PM | 20 | 7 | 10 | 21 | 11 | 10 | 7 |
| Total | 84 | 32 | 44 | 82 | 54 | 57 | 35 |
| Grand Total | 154 | 59 | 79 | 189 | 112 | 127 | 72 |
| Apprch % | 72.3 | 27.7 | 29.5 | 70.5 | 46.9 | 53.1 | |
| Total % | 21.4 | 8.2 | 11 | 26.2 | 15.6 | 17.6 | |
| Cars | 154 | 55 | 79 | 189 | 109 | 127 | 71 |
| % Cars | 100 | 93.2 | 100 | 100 | 97.3 | 100 | 9 |
| Trucks | 0 | 4 | 0 | 0 | 3 | 0 | |
| % Trucks | 0 | 6.8 | 0 | 0 | 2.7 | 0 | |

| | Boston Rd From East | | | Boston Rd From South | | | Oxford Ave From West | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | App. Total | Left | Right | App. Total | Thru | Right | App. Total | Int. Tota |
| ak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1 | | | | | | | | | | |
| ak Hour for Entire Intersection Begins at 04:45 PM | | | | | | | | | | |
| 04:45 PM | 24 | 7 | 31 | 12 | 28 | 40 | 17 | 25 | 42 | 11 |
| 05:00 PM | 16 | 9 | 25 | 12 | 17 | 29 | 14 | 18 | 32 | 8 |
| 05:15 PM | 26 | 6 | 32 | 13 | 21 | 34 | 16 | 15 | 31 | 9 |
| 05:30 PM | 22 | 10 | 32 | 9 | 23 | 32 | 13 | 14 | 27 | 9 |
| Total Volume | 88 | 32 | 120 | 46 | 89 | 135 | 60 | 72 | 132 | 38 |
| % App. Total | 73.3 | 26.7 | | 34.1 | 65.9 | | 45.5 | 54.5 | | |
| PHF | .846 | .800 | .938 | .885 | .795 | .844 | .882 | .720 | .786 | .85 |
| Cars | 88 | 30 | 118 | 46 | 89 | 135 | 58 | 72 | 130 | 38 |
| % Cars | 100 | 93.8 | 98.3 | 100 | 100 | 100 | 96.7 | 100 | 98.5 | 99. |
| Trucks | 0 | 2 | 2 | 0 | 0 | 0 | 2 | 0 | 2 | . |
| % Trucks | 0 | 6.3 | 1.7 | 0 | 0 | 0 | 3.3 | 0 | 1.5 | 1. |

S Street : Boston Road
N Street : Boston Rd / Oxford Ave
y/State : Haverhill, MA
eather : Rain / Cloudy

File Name : 10758(
Site Code : 10758(
Start Date : 6/23/2(
Page No : 2

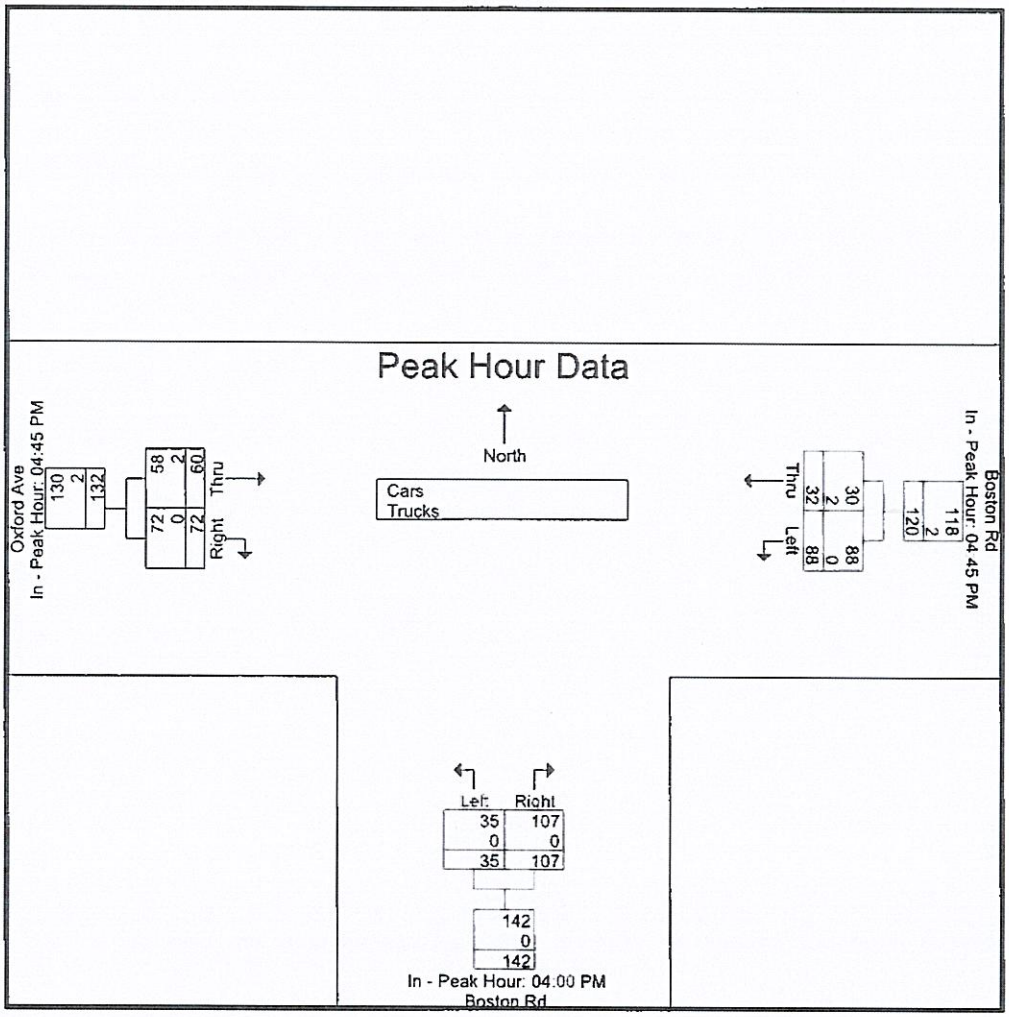



ak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1
ak Hour for Each Approach Begins at:

| | 04:45 PM | | | 04:00 PM | | | 04:45 PM | | |
|---|---|---|---|---|---|---|---|---|---|
| +0 mins. | 24 | 7 | 31 | 8 | 21 | 29 | 17 | 25 | 42 |
| +15 mins. | 16 | 9 | 25 | 11 | 27 | 38 | 14 | 18 | 32 |
| +30 mins. | 26 | 6 | 32 | 4 | 31 | 35 | 16 | 15 | 31 |
| +45 mins. | 22 | 10 | 32 | 12 | 28 | 40 | 13 | 14 | 27 |
| Total Volume | 88 | 32 | 120 | 35 | 107 | 142 | 60 | 72 | 132 |
| % App. Total | 73.3 | 26.7 | | 24.6 | 75.4 | | 45.5 | 54.5 | |
| PHF | .846 | .800 | .938 | .729 | .863 | .888 | .882 | .720 | .786 |
| Cars | 88 | 30 | 118 | 35 | 107 | 142 | 58 | 72 | 130 |
| % Cars | 100 | 93.8 | 98.3 | 100 | 100 | 100 | 96.7 | 100 | 98.5 |
| Trucks | 0 | 2 | 2 | 0 | 0 | 0 | 2 | 0 | 2 |
| % Trucks | 0 | 6.2 | 1.7 | 0 | 0 | 0 | 3.3 | 0 | 1.5 |

S Street : Boston Road
N Street : Boston Rd / Oxford Ave
y/State : Haverhill, MA
eather : Rain / Cloudy

File Name : 10758(
Site Code : 10758(
Start Date : 6/23/2(
Page No : 3



S Street : Boston Road
N Street : Boston Rd / Oxford Ave
y/State : Haverhill, MA
eather : Rain / Cloudy

File Name : 10758(
Site Code : 10758(
Start Date : 6/23/2(
Page No : 4

**Groups Printed- Cars**

| | Boston Rd From East | | Boston Rd From South | | Oxford Ave From West | | |
|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Left | Right | Thru | Right | Int. Tot |
| 04:00 PM | 16 | 7 | 8 | 21 | 16 | 20 | 8 |
| 04:15 PM | 14 | 7 | 11 | 27 | 16 | 13 | 8 |
| 04:30 PM | 16 | 4 | 4 | 31 | 8 | 12 | 7 |
| 04:45 PM | 24 | 7 | 12 | 28 | 16 | 25 | 11 |
| Total | 70 | 25 | 35 | 107 | 56 | 70 | 36 |
| 05:00 PM | 16 | 8 | 12 | 17 | 14 | 18 | 8 |
| 05:15 PM | 26 | 6 | 13 | 21 | 15 | 15 | 9 |
| 05:30 PM | 22 | 9 | 9 | 23 | 13 | 14 | 9 |
| 05:45 PM | 20 | 7 | 10 | 21 | 11 | 10 | 7 |
| Total | 84 | 30 | 44 | 82 | 53 | 57 | 35 |
| Grand Total | 154 | 55 | 79 | 189 | 109 | 127 | 71 |
| Apprch % | 73.7 | 26.3 | 29.5 | 70.5 | 46.2 | 53.8 | |
| Total % | 21.6 | 7.7 | 11.1 | 26.5 | 15.3 | 17.8 | |

| | Boston Rd From East | | | Boston Rd From South | | | Oxford Ave From West | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | App. Total | Left | Right | App. Total | Thru | Right | App. Total | Int. Tota |
| ak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1 | | | | | | | | | | |
| ak Hour for Entire Intersection Begins at 04:45 PM | | | | | | | | | | |
| 04:45 PM | 24 | 7 | 31 | 12 | 28 | 40 | 16 | 25 | 41 | 11 |
| 05:00 PM | 16 | 8 | 24 | 12 | 17 | 29 | 14 | 18 | 32 | 8: |
| 05:15 PM | 26 | 6 | 32 | 13 | 21 | 34 | 15 | 15 | 30 | 9 |
| 05:30 PM | 22 | 9 | 31 | 9 | 23 | 32 | 13 | 14 | 27 | 9 |
| Total Volume | 88 | 30 | 118 | 46 | 89 | 135 | 58 | 72 | 130 | 38 |
| % App. Total | 74.6 | 25.4 | | 34.1 | 65.9 | | 44.6 | 55.4 | | |
| PHF | .846 | .833 | .922 | .885 | .795 | .844 | .906 | .720 | .793 | .85 |

S Street : Boston Road
N Street : Boston Rd / Oxford Ave
y/State : Haverhill, MA
eather : Rain / Cloudy

File Name : 10758(
Site Code : 10758(
Start Date : 6/23/2(
Page No : 7

**Groups Printed- Trucks**

| | Boston Rd From East | | Boston Rd From South | | Oxford Ave From West | | |
|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Left | Right | Thru | Right | Int. Tot |
| 04:00 PM | 0 | 1 | 0 | 0 | 0 | 0 | |
| 04:15 PM | 0 | 0 | 0 | 0 | 1 | 0 | |
| 04:30 PM | 0 | 1 | 0 | 0 | 0 | 0 | |
| 04:45 PM | 0 | 0 | 0 | 0 | 1 | 0 | |
| Total | 0 | 2 | 0 | 0 | 2 | 0 | |
| 05:00 PM | 0 | 1 | 0 | 0 | 0 | 0 | |
| 05:15 PM | 0 | 0 | 0 | 0 | 1 | 0 | |
| 05:30 PM | 0 | 1 | 0 | 0 | 0 | 0 | |
| 05:45 PM | 0 | 0 | 0 | 0 | 0 | 0 | |
| Total | 0 | 2 | 0 | 0 | 1 | 0 | |
| Grand Total | 0 | 4 | 0 | 0 | 3 | 0 | |
| Apprch % | 0 | 100 | 0 | 0 | 100 | 0 | |
| Total % | 0 | 57.1 | 0 | 0 | 42.9 | 0 | |

| | Boston Rd From East | | | Boston Rd From South | | | Oxford Ave From West | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | App. Total | Left | Right | App. Total | Thru | Right | App. Total | Int. Tot |
| ak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1 | | | | | | | | | | |
| ak Hour for Entire Intersection Begins at 04:00 PM | | | | | | | | | | |
| 04:00 PM | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 04:15 PM | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | |
| 04:30 PM | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 04:45 PM | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | |
| Total Volume | 0 | 2 | 2 | 0 | 0 | 0 | 2 | 0 | 2 | |
| % App. Total | 0 | 100 | | 0 | 0 | | 100 | 0 | | |
| PHF | .000 | .500 | .500 | .000 | .000 | .000 | .500 | .000 | .500 | 1.0 |

S Street : Boston Road
N Street : Boston Rd / Oxford Ave
y/State : Haverhill, MA
eather : Rain / Cloudy

File Name : 10758(
Site Code : 10758(
Start Date : 6/23/2(
Page No : 10

Groups Printed- Bikes Peds

| | Boston Rd From East | | | Boston Rd From South | | | Oxford Ave From West | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Peds | Left | Right | Peds | Thru | Right | Peds | Exclu. Total | Inclu. Total | Int. Tota |
| 04:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 04:15 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 04:30 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 04:45 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 05:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 05:15 PM | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | |
| 05:30 PM | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | |
| 05:45 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Total | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | |
| Grand Total | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | |
| Apprch % | 0 | 0 | | 0 | 100 | | 0 | 0 | | | | |
| Total % | 0 | 0 | | 0 | 100 | | 0 | 0 | | 0 | 100 | |

| | Boston Rd From East | | | Boston Rd From South | | | Oxford Ave From West | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | App. Total | Left | Right | App. Total | Thru | Right | App. Total | Int. Tota |
| ak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1 | | | | | | | | | | |
| ak Hour for Entire Intersection Begins at 04:45 PM | | | | | | | | | | |
| 04:45 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 05:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 05:15 PM | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | |
| 05:30 PM | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | |
| Total Volume | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | |
| % App. Total | 0 | 0 | | 0 | 100 | | 0 | 0 | | |
| PHF | .000 | .000 | .000 | .000 | .375 | .375 | .000 | .000 | .000 | .37 |

SEASONAL ADJUSTMENT DATA

Massachusetts Highway Department
Statewide Traffic Data Collection
2025 Weekday Seasonal Factors

| Factor Group | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | Axle Factor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R1 | 1.32 | 1.28 | 1.19 | 1.04 | 0.98 | 0.94 | 0.89 | 0.86 | 0.98 | 1.00 | 1.05 | 1.13 | 0.77 |
| R3 | 1.06 | 1.04 | 1.04 | 0.99 | 0.96 | 0.87 | 0.86 | 0.86 | 0.91 | 0.92 | 1.00 | 1.06 | 0.98 |
| R4-R7 | 1.14 | 1.16 | 1.12 | 1.03 | 0.96 | 0.90 | 0.86 | 0.86 | 0.92 | 0.94 | 1.04 | 1.11 | 0.99 |
| U1-Boston | 1.08 | 1.05 | 0.98 | 0.94 | 0.93 | 0.91 | 0.93 | 0.91 | 0.94 | 0.95 | 0.98 | 1.03 | 0.95 |
| U1-Essex | 1.13 | 1.11 | 1.05 | 1.00 | 0.96 | 0.89 | 0.87 | 0.86 | 0.94 | 0.96 | 1.01 | 1.06 | 0.96 |
| U1-Southeast | 1.12 | 1.09 | 1.02 | 0.96 | 0.93 | 0.87 | 0.86 | 0.85 | 0.91 | 0.95 | 0.99 | 1.03 | 0.97 |
| U1-West | 1.05 | 1.03 | 0.99 | 0.97 | 0.96 | 0.93 | 0.93 | 0.91 | 0.92 | 0.92 | 0.97 | 1.02 | 0.80 |
| U1-Worcester | 1.07 | 1.05 | 0.98 | 0.94 | 0.93 | 0.89 | 0.92 | 0.90 | 0.92 | 0.93 | 0.96 | 1.02 | 0.92 |
| U3 | 1.03 | 1.02 | 0.96 | 0.93 | 0.92 | 0.90 | 0.93 | 0.92 | 0.93 | 0.94 | 0.97 | 0.99 | 0.95 |
| U4-U7 | 1.03 | 1.02 | 0.95 | 0.92 | 0.90 | 0.90 | 0.92 | 0.91 | 0.92 | 0.94 | 0.96 | 0.99 | 0.99 |
| UR2 | 1.06 | 1.03 | 0.97 | 0.93 | 0.93 | 0.89 | 0.91 | 0.90 | 0.92 | 0.93 | 0.96 | 1.01 | 0.97 |
| Rec - East | 1.15 | 1.16 | 1.08 | 0.98 | 0.89 | 0.80 | 0.77 | 0.80 | 0.91 | 1.00 | 1.05 | 1.13 | 0.98 |
| Rec - West | 1.31 | 1.35 | 1.16 | 1.07 | 0.93 | 0.81 | 0.61 | 0.72 | 0.96 | 0.97 | 1.17 | 1.29 | 0.99 |

Round off:
0-999 = 10
>1000 = 100

U = Urban
R = Rural

1 - Interstate
2 - Freeway and Expressway
3 - Other Principal Arterial
4 - Minor Arterial
5 - Major Collector
6 - Minor Collector
7 - Local Road and Street

**UR2 Group** - Combination of Urban Freeways and Expressways and Rural Freeways and Expressways.

**Recreational - East Group** - Cape Cod (all towns) including the town of Plymouth south of Route 3A (stations 7014,7079,7080,7090,7091,7092,7093,7094,7095,7096,7097,7108 and 7178), Martha's Vineyard and Nantucket.

**Recreational - West Group** - Continuous Stations 2 and 189 including stations 1066,1067,1083,1084,1085,1086,1087,1088,1089,1090,1091,1092,1093,1094,1095,1096,1097,1098,1099,1100,1101,1102,1103,1104,1105,1106,1107,1108,1113, 1114,1116,2196,2197 and 2198.

PUBLIC TRANSPORTATION DATA

# 14

**EFFECTIVE APRIL 6, 2026**
**A PARTIR DE 6 DE ABRIL, 2026**
**FREE Public Transportation from Haverhill to Lawrence**
**Transporte público GRATUITO de Haverhill a Lawrence**

## ROUTE 14 - LAWRENCE BOUND
## WARD HILL/AMAZON/MCGOVERN STATION

### WEEKDAYS

| 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|
| Bus starts at Washington Square | Bus leaves from Ward Hill Industrial Park | Bus leaves from BJ's | Bus leaves from Osgood Landing (Amazon) | Bus leaves from North Andover Senior Center | Bus ends at McGovern | Bus continues on as Route |
| 5:30 | 5:45 | 5:48 | 5:55 | 6:00 | 6:05 | 4 |
| 6:00 | 6:15 | 6:18 | 6:25 | 6:30 | 6:35 | - |
| 6:30 | 6:45 | 6:48 | 6:55 | 7:00 | 7:05 | 4 |
| 7:00 | 7:15 | 7:18 | 7:25 | 7:30 | 7:35 | 4 |
| 7:30 | 7:45 | 7:48 | 7:55 | 8:00 | 8:05 | 4 |
| 8:00 | 8:15 | 8:18 | 8:25 | 8:30 | 8:35 | 4 |
| 8:30 | 8:45 | 8:48 | 8:55 | 9:00 | 9:05 | 4 |
| 9:00 | 9:15 | 9:18 | 9:25 | 9:30 | 9:35 | 4 |
| 9:30 | 9:45 | 9:48 | 9:55 | 10:00 | 10:05 | 4 |
| 10:00 | 10:15 | 10:18 | 10:25 | 10:30 | 10:35 | 4 |
| 10:30 | 10:45 | 10:48 | 10:55 | 11:00 | 11:05 | 4 |
| 11:00 | 11:15 | 11:18 | 11:25 | 11:30 | 11:35 | 4 |
| 11:30 | 11:45 | 11:48 | 11:55 | 12:00 | 12:05 | 4 |
| 12:00 | 12:15 | 12:18 | 12:25 | 12:30 | 12:35 | 4 |
| 12:30 | 12:45 | 12:48 | 12:55 | 1:00 | 1:05 | 4 |
| 1:00 | 1:15 | 1:18 | 1:25 | 1:30 | 1:35 | 4 |
| 1:30 | 1:45 | 1:48 | 1:55 | 2:00 | 2:05 | 4 |
| 2:00 | 2:15 | 2:18 | 2:25 | 2:30 | 2:35 | 4 |
| 2:30 | 2:45 | 2:48 | 2:55 | 3:00 | 3:05 | 4 |
| 3:00 | 3:15 | 3:18 | 3:25 | 3:30 | 3:35 | 4 |
| 3:30 | 3:45 | 3:48 | 3:55 | 4:00 | 4:05 | 4 |
| 4:00 | 4:15 | 4:18 | 4:25 | 4:30 | 4:35 | 4 |
| 4:30 | 4:45 | 4:48 | 4:55 | 5:00 | 5:05 | 4 |
| 5:00 | 5:15 | 5:18 | 5:25 | 5:30 | 5:35 | 4 |
| 5:30 | 5:45 | 5:48 | 5:55 | 6:00 | 6:05 | 4 |
| 6:00 | 6:15 | 6:18 | 6:25 | 6:30 | 6:35 | 4 |
| 6:30 | 6:45 | 6:48 | 6:55 | 7:00 | 7:05 | - |
| 7:00 | 7:15 | 7:18 | 7:25 | 7:30 | 7:35 | - |

### SATURDAYS

| | | | | | | |
|---|---|---|---|---|---|---|
| 7:00 | 7:15 | 7:18 | 7:25 | 7:30 | 7:35 | 4 |
| 8:00 | 8:15 | 8:18 | 8:25 | 8:30 | 8:35 | 4 |
| 9:00 | 9:15 | 9:18 | 9:25 | 9:30 | 9:35 | 4 |
| 10:00 | 10:15 | 10:18 | 10:25 | 10:30 | 10:35 | 4 |
| 11:00 | 11:15 | 11:18 | 11:25 | 11:30 | 11:35 | 4 |
| 12:00 | 12:15 | 12:18 | 12:25 | 12:30 | 12:35 | 4 |
| 1:00 | 1:15 | 1:18 | 1:25 | 1:30 | 1:35 | 4 |
| 2:00 | 2:15 | 2:18 | 2:25 | 2:30 | 2:35 | 4 |
| 3:00 | 3:15 | 3:18 | 3:25 | 3:30 | 3:35 | 4 |
| 4:00 | 4:15 | 4:18 | 4:25 | 4:30 | 4:35 | 4 |
| 5:00 | 5:15 | 5:18 | 5:25 | 5:30 | 5:35 | 4 |
| 6:00 | 6:15 | 6:18 | 6:25 | 6:30 | 6:35 | - |

# 14

**EFFECTIVE APRIL 6, 2026**
**A PARTIR DE 6 DE ABRIL, 2026**
**FREE Public Transportation from Haverhill to Lawrence**
**Transporte público GRATUITO de Haverhill a Lawrence**

## ROUTE 14 - HAVERHILL BOUND
## AMAZON/WARD HILL/WASHINGTON SQUARE

### WEEKDAYS

| 6 | 7 | 8 | 9 | 10 | 11 | |
|---|---|---|---|---|---|---|
| Bus starts at McGovern | Bus leaves from North Andover Senior Center | Bus leaves from Osgood Landing/ Amazon | Bus leaves from Ward Hill Industrial Park | Bus leaves from BJ's | Bus ends at Washington Square | Bus continues on as Route |
| 6:00 | 6:05 | 6:10 | 6:20 | 6:23 | 6:45 | 14 |
| 6:30 | 6:35 | 6:40 | 6:50 | 6:53 | 7:15 | 14 |
| 7:00 | 7:05 | 7:10 | 7:20 | 7:23 | 7:45 | 14 |
| 7:30 | 7:35 | 7:40 | 7:50 | 7:53 | 8:15 | 14 |
| 8:00 | 8:05 | 8:10 | 8:20 | 8:23 | 8:45 | 14 |
| 8:30 | 8:35 | 8:40 | 8:50 | 8:53 | 9:15 | 14 |
| 9:00 | 9:05 | 9:10 | 9:20 | 9:23 | 9:45 | 14 |
| 9:30 | 9:35 | 9:40 | 9:50 | 9:53 | 10:15 | 14 |
| 10:00 | 10:05 | 10:10 | 10:20 | 10:23 | 10:45 | 14 |
| 10:30 | 10:35 | 10:40 | 10:50 | 10:53 | 11:15 | 14 |
| 11:00 | 11:05 | 11:10 | 11:20 | 11:23 | 11:45 | 14 |
| 11:30 | 11:35 | 11:40 | 11:50 | 11:53 | 12:15 | 14 |
| 12:00 | 12:05 | 12:10 | 12:20 | 12:23 | 12:45 | 14 |
| 12:30 | 12:35 | 12:40 | 12:50 | 12:53 | 1:15 | 14 |
| 1:00 | 1:05 | 1:10 | 1:20 | 1:23 | 1:45 | 14 |
| 1:30 | 1:35 | 1:40 | 1:50 | 1:53 | 2:15 | 14 |
| 2:00 | 2:05 | 2:10 | 2:20 | 2:23 | 2:45 | 14 |
| 2:30 | 2:35 | 2:40 | 2:50 | 2:53 | 3:15 | 14 |
| 3:00 | 3:05 | 3:10 | 3:20 | 3:23 | 3:45 | 14 |
| 3:30 | 3:35 | 3:40 | 3:50 | 3:53 | 4:15 | 14 |
| 4:00 | 4:05 | 4:10 | 4:20 | 4:23 | 4:45 | 14 |
| 4:30 | 4:35 | 4:40 | 4:50 | 4:53 | 5:15 | 14 |
| 5:00 | 5:05 | 5:10 | 5:20 | 5:23 | 5:45 | 14 |
| 5:30 | 5:35 | 5:40 | 5:50 | 5:53 | 6:15 | 14 |
| 6:00 | 6:05 | 6:10 | 6:20 | 6:23 | 6:45 | 14 |
| 6:30 | 6:35 | 6:40 | 6:50 | 6:53 | 7:15 | - |
| 7:00 | 7:05 | 7:10 | 7:20 | 7:23 | 7:45 | - |

### SATURDAYS

| | | | | | | |
|---|---|---|---|---|---|---|
| 7:00 | 7:05 | 7:10 | 7:20 | 7:23 | 7:45 | 14 |
| 8:00 | 8:05 | 8:10 | 8:20 | 8:23 | 8:45 | 14 |
| 9:00 | 9:05 | 9:10 | 9:20 | 9:23 | 9:45 | 14 |
| 10:00 | 10:05 | 10:10 | 10:20 | 10:23 | 10:45 | 14 |
| 11:00 | 11:05 | 11:10 | 11:20 | 11:23 | 11:45 | 14 |
| 12:00 | 12:05 | 12:10 | 12:20 | 12:23 | 12:45 | 14 |
| 1:00 | 1:05 | 1:10 | 1:20 | 1:23 | 1:45 | 14 |
| 2:00 | 2:05 | 2:10 | 2:20 | 2:23 | 2:45 | 14 |
| 3:00 | 3:05 | 3:10 | 3:20 | 3:23 | 3:45 | 14 |
| 4:00 | 4:05 | 4:10 | 4:20 | 4:23 | 4:45 | 14 |
| 5:00 | 5:05 | 5:10 | 5:20 | 5:23 | 5:45 | 14 |
| 6:00 | 7:05 | 6:10 | 6:20 | 6:23 | 6:45 | - |

# MASSDOT CRASH RATE WORKSHEETS

City of Haverhil 2019-2023

| Crash Number | Crash Date | Crash Severity | Light Conditions | Manner of Collision | Road Surface Condition | Vehicle Configuration (All Vehicles) | Weather Conditions |
|---|---|---|---|---|---|---|---|
| Oxford Avenue at I Street | | | | | | | |
| Oxford Avenue at Boston Road | | | | | | | |
| 4907244 | 12/08/2020 | Property damage only (none injured) | Dayl ght | Angle | Dry | V2:(Passenger car) / V1:(Tractor/doubles) | Cloudy |

Moving Massachusetts Forward. massDOT Highway

# INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Haverhill COUNT DATE : Jun-26

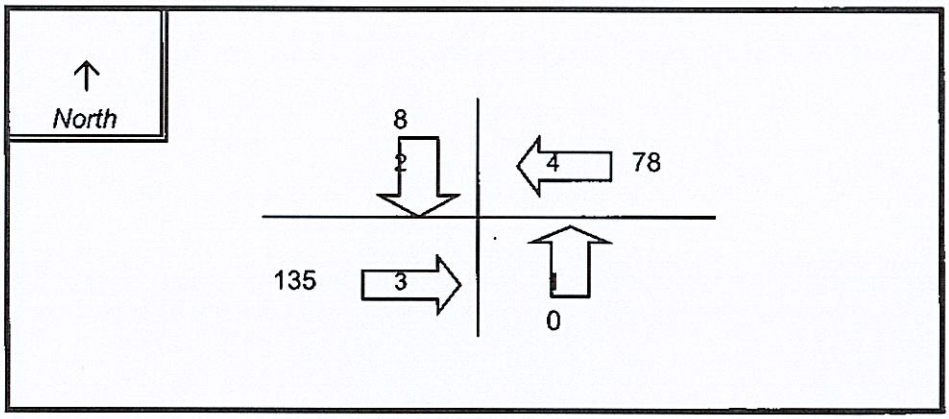
DISTRICT : 4 UNSIGNALIZED : X SIGNALIZED :

## ~ INTERSECTION DATA ~

MAJOR STREET : Oxford Avenue

MINOR STREET(S) : I Street

**INTERSECTION DIAGRAM**
**(Label Approaches)**




**PEAK HOUR VOLUMES**

| APPROACH : | 1 | 2 | 3 | 4 | 5 | Total Peak Hourly Approach Volume |
|---|---|---|---|---|---|---|
| DIRECTION : | EB | WB | NB | SB | | |
| PEAK HOURLY VOLUMES (PM) : | 135 | 78 | | 8 | | 221 |

" K " FACTOR : 0.090

INTERSECTION ADT ( V ) = TOTAL DAILY APPROACH VOLUME : 2,456

TOTAL # OF CRASHES : 0

# OF YEARS : 5

AVERAGE # OF CRASHES PER YEAR ( A ) : 0.00

**CRASH RATE CALCULATION :** 0.00

RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

Comments : Accident Rate for District 4 unsignalized intersections = 0.57

Moving Massachusetts Forward. massDOT Highway

# INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Haverhill COUNT DATE : Jun-26

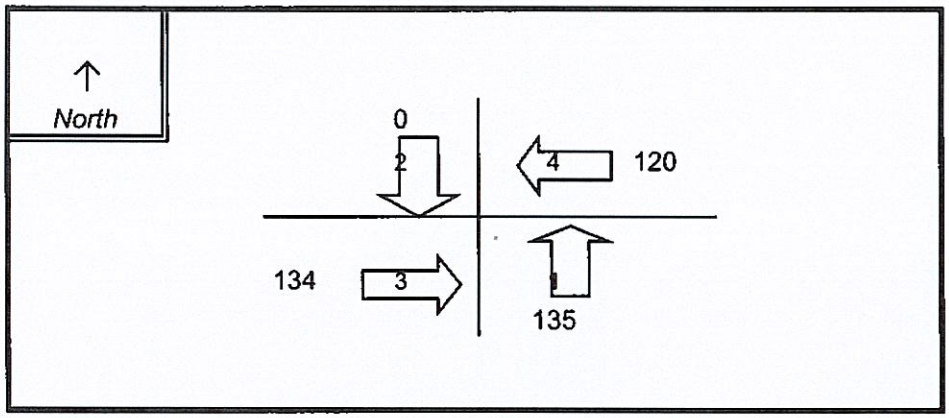
DISTRICT : 4 UNSIGNALIZED : X SIGNALIZED :

## ~ INTERSECTION DATA ~

MAJOR STREET : Oxford Avenue

MINOR STREET(S) : Boston Road

**INTERSECTION DIAGRAM (Label Approaches)**




**PEAK HOUR VOLUMES**

| APPROACH : | 1 | 2 | 3 | 4 | 5 | Total Peak Hourly Approach Volume |
|---|---|---|---|---|---|---|
| DIRECTION : | EB | WB | NB | SB | | |
| PEAK HOURLY VOLUMES (PM) : | 134 | 120 | 135 | | | 389 |

" K " FACTOR : **0.090** INTERSECTION ADT ( **V** ) = TOTAL DAILY APPROACH VOLUME : **4,322**

TOTAL # OF CRASHES : 1 # OF YEARS : 5 AVERAGE # OF CRASHES PER YEAR ( **A** ) : **0.20**

**CRASH RATE CALCULATION : 0.13** RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

Comments : Accident Rate for District 4 unsignalized intersections = 0.57

# GROWTH RATE DATA

# Massachusetts Highway Department
## Annual Growth Rate

| | | | |
|---|---|---|---|
| **Location ID:** | **3372571** | **Seasonal Factor Group:** | **U4-7** |
| **County:** | **Essex** | **Daily Factor Group:** | |
| **Functional Class** | **7 - Local Road or Street** | **Axle Factor Group:** | **U4-7** |
| **Location:** | **Bradford Street** | **Growth Factor Group:** | **U4-7** |
| | **East of Osgood Street** | | |

| Year | AADT |
|---|---|
| 2024 | 1,361 |
| 2019 | 1,434 |
| | |
| A =2024/2019 | 0.9491 |
| B = A^(1/5) | 0.9896 |
| **Average Annual Growth Rate** | **-1.04** |

# Massachusetts Highway Department
## Annual Growth Rate

| | | | |
|---|---|---|---|
| **Location ID:** | **3372723** | **Seasonal Factor Group:** | **U4-7** |
| **County:** | **Essex** | **Daily Factor Group:** | |
| **Functional Class** | **7 - Local Road or Street** | **Axle Factor Group:** | **U4-7** |
| **Location:** | **Oxford Avenue** | **Growth Factor Group:** | **U4-7** |
| | **East of Knipe Road** | | |

| **Year** | **AADT** |
|---|---|
| 2024 | 1,743 |
| 2019 | 1,838 |
| | |
| A =2024/2019 | 0.9483 |
| B = A^(1/5) | 0.9894 |
| **Average Annual Growth Rate** | **-1.06** |

# Massachusetts Highway Department
## Annual Growth Rate

| | | | |
|---|---|---|---|
| **Location ID:** | **5000** | **Seasonal Factor Group:** | **U3** |
| **County:** | **Essex** | **Daily Factor Group:** | |
| **Functional Class** | **3 - Other Principal Arterial** | **Axle Factor Group:** | **U3** |
| **Location:** | **Route 125** | **Growth Factor Group:** | **U3** |
| | **South of Route 125 Connector** | | |

| **Year** | **AADT** |
|---|---|
| 2024 | 24,617 |
| 2019 | 19,776 |
| | |
| A =2024/2019 | 1.2448 |
| B = A^(1/5) | 1.0448 |
| **Average Annual Growth Rate** | **4.48** |

# Massachusetts Highway Department
## Annual Growth Rate

| | | | |
|---|---|---|---|
| **Location ID:** | **5001** | **Seasonal Factor Group:** | **U3** |
| **County:** | **Essex** | **Daily Factor Group:** | |
| **Functional Class** | **3 - Other Principal Arterial** | **Axle Factor Group:** | **U3** |
| **Location:** | **South Main Street** | **Growth Factor Group:** | **U3** |
| | **North of Route 125 Connector** | | |

| **Year** | **AADT** |
|---|---|
| 2024 | 20,054 |
| 2019 | 18,251 |
| | |
| A =2024/2019 | 1.0988 |
| B = A^(1/5) | 1.0190 |
| **Average Annual Growth Rate** | **1.90** |

# Massachusetts Highway Department
## Annual Growth Rate

| | | | |
|---|---|---|---|
| **Location ID:** | **5034** | **Seasonal Factor Group:** | **U4-7** |
| **County:** | **Essex** | **Daily Factor Group:** | |
| **Functional Class** | **5 - Major Collector** | **Axle Factor Group:** | **U4-7** |
| **Location:** | **Ferry Road** | **Growth Factor Group:** | **U4-7** |
| | **West of Route 125** | | |

| **Year** | **AADT** |
|---|---|
| 2024 | 1,352 |
| 2019 | 1,459 |

| | |
|---|---|
| A =2024/2019 | 0.9267 |
| B = A^(1/5) | 0.9849 |
| **Average Annual Growth Rate** | **-1.51** |

# Massachusetts Highway Department

## Annual Growth Rate

| | | | |
|---|---|---|---|
| **Location ID:** | **5035** | **Seasonal Factor Group:** | **U4-7** |
| **County:** | **Essex** | **Daily Factor Group:** | |
| **Functional Class** | **5 - Major Collector** | **Axle Factor Group:** | **U4-7** |
| **Location:** | **Boston Road** | **Growth Factor Group:** | **U4-7** |
| | **East of Route 125** | | |

| **Year** | **AADT** |
|---|---|
| 2024 | 979 |
| 2019 | 1,030 |

| | |
|---|---|
| A =2024/2019 | 0.9505 |
| B = A^(1/5) | 0.9899 |
| **Average Annual Growth Rate** | **-1.01** |

# Massachusetts Highway Department
## Annual Growth Rate

| | | | |
|---|---|---|---|
| **Location ID:** | **5058** | **Seasonal Factor Group:** | **U4-7** |
| **County:** | **Essex** | **Daily Factor Group:** | |
| **Functional Class** | **5 - Major Collector** | **Axle Factor Group:** | **U4-7** |
| **Location:** | **Boston Road** | **Growth Factor Group:** | **U4-7** |
| | **East of Route 125** | | |

| **Year** | **AADT** |
|---|---|
| 2024 | 15,039 |
| 2019 | 13,311 |
| | |
| A =2024/2019 | 1.1298 |
| B = A^(1/5) | 1.0247 |
| **Average Annual Growth Rate** | **2.47** |

| Group | Station | Average Annual Growth |
|---|---|---|
| U7 | 3372571 | -1.04 |
| U7 | 3372723 | -1.06 |
| U3 | 5000 | 4.48 |
| U3 | 5001 | 1.90 |
| U5 | 5034 | -1.51 |
| U5 | 5035 | -1.01 |
| U3 | 5058 | 2.47 |
| | **Average** | **0.60** |

# TRIP GENERATION DATA

Average Vehicle Trips Ends vs: Dwelling Units
Independent Variable (X): 2

**AVERAGE WEEKDAY DAILY**

T = 9.09 * (X)
T = 9.09 * 2
T = 18.18
T = 18 vehicle trips
with 50% ( 9 vpd) entering and 50% ( 9 vpd) exiting.

**WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC**

T = 0.70 * (X)
T = 0.70 * 2
T = 1.40
T = 1 vehicle trips
with 27% ( 0 vph) entering and 73% ( 1 vph) exiting.

**WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC**

T = 0.93 * (X)
T = 0.93 * 2
T = 1.86
T = 2 vehicle trips
with 62% ( 1 vph) entering and 38% ( 1 vph) exiting.

## Land Use Code (LUC) 215 - Single-Family Attached Housing

Average Vehicle Trips Ends vs: Dwelling Units
Independent Variable (X): 12

### Average Weekday Daily

T = 6.57 * X
T = 6.57 * 12
T = 78.84
T = 78 vehicle trips
with 50% ( 39 vpd) entering and 50% ( 39 vpd) exiting.

### Weekday Morning Peak Hour Of Adjacent Street Traffic

T = 0.47 * X
T = 0.47 * 12
T = 5.64
T = 6
with 25% ( 2 vph) entering and 75% ( 4 vph) exiting.

### Weekday Evening Peak Hour Of Adjacent Street Traffic

T = 0.51 * X
T = 0.51 * 12
T = 6.12
T = 6
with 57% ( 3 vph) entering and 43% ( 3 vph) exiting.

# CAPACITY ANALYSIS METHODOLOGY

## METHODOLOGY

### Levels of Service

A primary result of capacity analyses is the assignment of level of service to traffic facilities under various traffic-flow conditions.[1] The concept of level of service is defined as a qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers. A level-of-service definition provides an index to quality of traffic flow in terms of such factors as speed, travel time, freedom to maneuver, traffic interruptions, comfort, convenience, and safety.

Six levels of service are defined for each type of facility. They are given letter designations from A to F, with level-of-service (LOS) A representing the best operating conditions and LOS F representing congested or constrained operating conditions.

Since the level of service of a traffic facility is a function of the traffic flows placed upon it, such a facility may operate at a wide range of levels of service, depending on the time of day, day of week, or period of year.

### Synchro: Unsignalized Intersections

The six levels of service for unsignalized intersections may be described as follows:

- *LOS A* represents a condition with little or no control delay to minor street traffic.
- *LOS B* represents a condition with short control delays to minor street traffic.
- *LOS C* represents a condition with average control delays to minor street traffic.
- *LOS D* represents a condition with long control delays to minor street traffic.
- *LOS E* represents operating conditions at or near capacity level, with very long control delays to minor street traffic.
- *LOS F* represents a condition where minor street demand volume exceeds capacity of an approach lane, with control delays resulting.

The levels of service of unsignalized intersections are determined by application of a procedure described in the *Highway Capacity Manual 7th Edition.* Level of service is measured in terms of average control delay. Mathematically, control delay is a function of the capacity and degree of saturation of the lane group and/or approach under study and is a quantification of motorist delay associated with traffic control devices such as traffic signals and STOP signs. Control delay includes the effects of initial deceleration delay approaching a STOP sign, stopped delay, queue move-up time, and final acceleration delay from a stopped condition. Definitions for level of service at unsignalized intersections are also given in the *Highway Capacity Manual 7th Edition*. Table A summarizes the relationship between level of service and average control delay.

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[1]The capacity analysis methodology is based on the concepts and procedures presented in the *Highway Capacity Manual 7th Edition;* Transportation Research Board; Washington, DC; 2022.

**Table A**
**LEVEL-OF-SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS[a]**

| Level-of-Service by Volume-to-Capacity Ratio | | Average Control Delay (Seconds Per Vehicle) |
|---|---|---|
| v/c ≤ 1.0 | v/c > 1.0 | |
| A | F | ≤10.0 |
| B | F | 10.1 to 15.0 |
| C | F | 15.1 to 25.0 |
| D | F | 25.1 to 35.0 |
| E | F | 35.1 to 50.0 |
| F | F | >50.0 |

[a]Source: *Highway Capacity Manual 7th Edition*, Transportation Research Board; Washington, DC; 2022; page 20-6.

**SIDRA: Unsignalized Intersections**

The unsignalized capacity analysis for the approaches at the Oxford Avenue at Boston Road is based on the procedures described in the Traffic Signalized and Unsignalized Intersection Design and Research Aid (SIDRA) Intersection.[2] The main features of the SIDRA Intersection method for unsignalized capacity estimation are the dependence of gap acceptance parameters on roadway geometry, entry lane flows, and the designation of traffic control on approach lanes.

The SIDRA analytical model calculates several components of delay. One of these, the average total delay component, produces level-of-service results based on the concepts described in the HCM. The delay ranges that define levels of service for roundabouts are shown in Table B.

**Table B**
**LEVEL-OF-SERVICE CRITERIA FOR SIDRA: UNSIGNALIZED INTERSECTIONS[a]**

| Level-Of-Service | Control Delay Per Vehicle (Seconds) |
|---|---|
| A | ≤10.0 |
| B | 10.1 to 20.0 |
| C | 20.1 to 35.0 |
| D | 35.1 to 50.0 |
| E | 50.1 to 70.0 |
| F | >70.0 |

[a]Source: *SIDRA Intersection 10.0 User Guide;* Akcelik & Associates Pty Ltd; Greythorn, Victoria 3104, Australia; April 2025.

[2]Traffic Signalized and Unsignalized Intersection Design and Research Aid, SIDRA Intersection 10.0 User Guide; Akcelik & Associates Pty Ltd; Greythorn, Victoria 3104, Australia; April 2025.

## CAPACITY ANALYSIS

2026 Existing Weekday Morning Peak Hour
2026 Existing Weekday Evening Peak Hour
2033 No-Build Weekday Morning Peak Hour
2033 No-Build Weekday Evening Peak Hour
2033 Build Weekday Morning Peak Hour
2033 Build Weekday Evening Peak Hour

2026 Existing Weekday Morning Peak Hour

| Intersection | |
|---|---|
| Int Delay, s/veh | 0.4 |

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 2 | 82 | 68 | 2 | 1 | 2 |
| Future Vol, veh/h | 2 | 82 | 68 | 2 | 1 | 2 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Free | Free | Free | Free | Stop | Stop |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | - | - | - | - | 0 | - |
| Veh in Median Storage, # | - | 0 | 0 | - | 0 | - |
| Grade, % | - | 0 | 0 | - | 0 | - |
| Peak Hour Factor | 64 | 64 | 76 | 76 | 38 | 38 |
| Heavy Vehicles, % | 0 | 2 | 3 | 0 | 0 | 0 |
| Mvmt Flow | 3 | 128 | 89 | 3 | 3 | 5 |

| Major/Minor | Major1 | | Major2 | | Minor2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 92 | 0 | - | 0 | 225 | 91 |
| Stage 1 | - | - | - | - | 91 | - |
| Stage 2 | - | - | - | - | 134 | - |
| Critical Hdwy | 4.1 | - | - | - | 6.4 | 6.2 |
| Critical Hdwy Stg 1 | - | - | - | - | 5.4 | - |
| Critical Hdwy Stg 2 | - | - | - | - | 5.4 | - |
| Follow-up Hdwy | 2.2 | - | - | - | 3.5 | 3.3 |
| Pot Cap-1 Maneuver | 1515 | - | - | - | 767 | 972 |
| Stage 1 | - | - | - | - | 938 | - |
| Stage 2 | - | - | - | - | 897 | - |
| Platoon blocked, % | | - | - | - | | |
| Mov Cap-1 Maneuver | 1515 | - | - | - | 766 | 972 |
| Mov Cap-2 Maneuver | - | - | - | - | 766 | - |
| Stage 1 | - | - | - | - | 936 | - |
| Stage 2 | - | - | - | - | 897 | - |

| Approach | EB | WB | SB |
|---|---|---|---|
| HCM Ctrl Dly, s/v | 0.18 | 0 | 9.07 |
| HCM LOS | | | A |

| Minor Lane/Major Mvmt | EBL | EBT | WBT | WBR | SBLn1 |
|---|---|---|---|---|---|
| Capacity (veh/h) | 43 | - | - | - | 892 |
| HCM Lane V/C Ratio | 0.002 | - | - | - | 0.009 |
| HCM Ctrl Dly (s/v) | 7.4 | 0 | - | - | 9.1 |
| HCM Lane LOS | A | A | - | - | A |
| HCM 95th %tile Q(veh) | 0 | - | - | - | 0 |

# LANE SUMMARY

**Site: [1] 1 - 2026 Existing Weekday Morning Peak Hour** (Folder1)
Output produced by SIDRA INTERSECTION Version: 10.0.9.250

Oxford Avenue at Boston Road
Site Category: Existing Design
Stop (Two-Way)
**Site Scenario: 1 | Local Volumes**

## Lane Use and Performance

| | Demand Flows [ Total veh/h | HV ] % | Arrival Flows [ Total veh/h | HV ] % | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Aver. Delay sec | Level of Service | 95% Back Of Queue [ Veh | Dist ] ft | Lane Config | Lane Length ft | Cap. Adj. % | Prob. Block. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Boston Road | | | | | | | | | | | | | | | |
| Lane 1 | 195 | 0.7 | 195 | 0.7 | 929 | 0.210 | 100 | 9.8 | LOS A | 1.1 | 26.9 | Full | 1600 | 0.0 | 0.0 |
| Approach | 195 | 0.7 | 195 | 0.7 | | 0.210 | | 9.8 | LOS A | 1.1 | 26.9 | | | | |
| East: Boston Road | | | | | | | | | | | | | | | |
| Lane 1 | 100 | 5.2 | 100 | 5.2 | 1824 | 0.055 | 100 | 0.0 | LOS A | 0.0 | 0.0 | Full | 1600 | 0.0 | 0.0 |
| Approach | 100 | 5.2 | 100 | 5.2 | | 0.055 | | 0.0 | NA | 0.0 | 0.0 | | | | |
| West: Oxford Avenue | | | | | | | | | | | | | | | |
| Lane 1 | 132 | 2.1 | 132 | 2.1 | 913 | 0.144 | 100 | 9.5 | LOS A | 0.6 | 14.9 | Full | 1600 | 0.0 | 0.0 |
| Approach | 132 | 2.1 | 132 | 2.1 | | 0.144 | | 9.5 | LOS A | 0.6 | 14.9 | | | | |
| All Vehicles | 427 | 2.2 | 427 | 2.2 | | 0.210 | | 7.4 | NA | 1.1 | 26.9 | | | | |

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c >1 irrespective of lane delay value (does not apply for approaches and intersection).
Minor Road Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard (HCM).
Delay Model: HCM Delay Formula (Stopline Delay: Geometric Delay is not included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

## Approach Lane Flows (veh/h)

South: Boston Road

| Mov. From S To Exit: | L2 W | R2 E | Total | %HV | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Prob. SL Ov. % | Ov. Lane No. |
|---|---|---|---|---|---|---|---|---|---|
| Lane 1 | 50 | 145 | 195 | 0.7 | 929 | 0.210 | 100 | NA | NA |
| Approach | 50 | 145 | 195 | 0.7 | | 0.210 | | | |

East: Boston Road

| Mov. From E To Exit: | L2 S | T1 W | Total | %HV | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Prob. SL Ov. % | Ov. Lane No. |
|---|---|---|---|---|---|---|---|---|---|
| Lane 1 | 60 | 40 | 100 | 5.2 | 1824 | 0.055 | 100 | NA | NA |
| Approach | 60 | 40 | 100 | 5.2 | | 0.055 | | | |

West: Oxford Avenue

| Mov. From W To Exit: | T1 E | R2 S | Total | %HV | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Prob. SL Ov. % | Ov. Lane No. |
|---|---|---|---|---|---|---|---|---|---|
| Lane 1 | 92 | 40 | 132 | 2.1 | 913 | 0.144 | 100 | NA | NA |

| | | | | | |
|---|---|---|---|---|---|
| Approach | 92 | 40 | 132 | 2.1 | 0.144 |

| | Total | %HV | Deg.Satn (v/c) |
|---|---|---|---|
| All Vehicles | 427 | 2.2 | 0.210 |

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

## Merge Analysis

| | Exit Lane Number | Short Lane Length ft | Percent Opng in Lane % | Opposing Flow Rate veh/h | Opposing Flow Rate pcu/h | Critical Gap sec | Follow-up Headway sec | Lane Flow Rate veh/h | Capacity veh/h | Deg. Satn v/c | Min. Delay sec | Merge Delay sec | Merge Queue [ Veh | Dist ] ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

There are no Exit Short Lanes for Merge Analysis at this Site.

## Variable Demand Analysis

| | Initial Queued Demand veh | Residual Queued Demand veh | Time for Residual Demand to Clear sec | Duration of Oversatn sec |
|---|---|---|---|---|
| South: Boston Road | | | | |
| Lane 1 | 0.0 | 0.0 | 0.0 | 0.0 |
| East: Boston Road | | | | |
| Lane 1 | 0.0 | 0.0 | 0.0 | 0.0 |
| West: Oxford Avenue | | | | |
| Lane 1 | 0.0 | 0.0 | 0.0 | 0.0 |

SIDRA INTERSECTION 10.0 | Copyright © 2000-2026 Akcelik and Associates Pty Ltd | sidrasolutions.com
Organisation: VANASSE & ASSOCIATES, INC. | Licence: PLUS / 1PC | Processed: Tuesday, June 30, 2026 3:57:45 PM
Project: S:\Jobs\10758 Haverhill\Analysis\SIDRA.sipx

2026 Existing Weekday Evening Peak Hour

| Intersection | |
|---|---|
| Int Delay, s/veh | 0.8 |

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 6 | 129 | 73 | 4 | 5 | 3 |
| Future Vol, veh/h | 6 | 129 | 73 | 4 | 5 | 3 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Free | Free | Free | Free | Stop | Stop |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | - | - | - | - | 0 | - |
| Veh in Median Storage, # | - | 0 | 0 | - | 0 | - |
| Grade, % | - | 0 | 0 | - | 0 | - |
| Peak Hour Factor | 82 | 82 | 88 | 88 | 50 | 50 |
| Heavy Vehicles, % | 0 | 2 | 3 | 0 | 0 | 0 |
| Mvmt Flow | 7 | 157 | 83 | 5 | 10 | 6 |

| Major/Minor | Major1 | | Major2 | | Minor2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 88 | 0 | - | 0 | 257 | 85 |
| Stage 1 | - | - | - | - | 85 | - |
| Stage 2 | - | - | - | - | 172 | - |
| Critical Hdwy | 4.1 | - | - | - | 6.4 | 6.2 |
| Critical Hdwy Stg 1 | - | - | - | - | 5.4 | - |
| Critical Hdwy Stg 2 | - | - | - | - | 5.4 | - |
| Follow-up Hdwy | 2.2 | - | - | - | 3.5 | 3.3 |
| Pot Cap-1 Maneuver | 1521 | - | - | - | 736 | 979 |
| Stage 1 | - | - | - | - | 943 | - |
| Stage 2 | - | - | - | - | 863 | - |
| Platoon blocked, % | | - | - | - | | |
| Mov Cap-1 Maneuver | 1521 | - | - | - | 732 | 979 |
| Mov Cap-2 Maneuver | - | - | - | - | 732 | - |
| Stage 1 | - | - | - | - | 938 | - |
| Stage 2 | - | - | - | - | 863 | - |

| Approach | EB | WB | SB |
|---|---|---|---|
| HCM Ctrl Dly, s/v | 0.33 | 0 | 9.54 |
| HCM LOS | | | A |

| Minor Lane/Major Mvmt | EBL | EBT | WBT | WBR | SBLn1 |
|---|---|---|---|---|---|
| Capacity (veh/h) | 80 | - | - | - | 809 |
| HCM Lane V/C Ratio | 0.005 | - | - | - | 0.02 |
| HCM Ctrl Dly (s/v) | 7.4 | 0 | - | - | 9.5 |
| HCM Lane LOS | A | A | - | - | A |
| HCM 95th %tile Q(veh) | 0 | - | - | - | 0.1 |

# LANE SUMMARY

**Site: [1 (2)] 2 - 2026 Existing Weekday Evening Peak Hour** (Folder1)
Output produced by SIDRA INTERSECTION Version: 10.0.9.250

Oxford Avenue at Boston Road
Site Category: Existing Design
Stop (Two-Way)
**Site Scenario: 1 | Local Volumes**

## Lane Use and Performance

| | Demand Flows [ Total veh/h | HV ] % | Arrival Flows [ Total veh/h | HV ] % | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Aver. Delay sec | Level of Service | 95% Back Of Queue [ Veh | Dist ] ft | Lane Config | Lane Length ft | Cap. Adj. % | Prob. Block. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Boston Road | | | | | | | | | | | | | | | |
| Lane 1 | 161 | 0.0 | 161 | 0.0 | 910 | 0.177 | 100 | 9.7 | LOS A | 0.9 | 21.9 | Full | 1600 | 0.0 | 0.0 |
| Approach | 161 | 0.0 | 161 | 0.0 | | 0.177 | | 9.7 | LOS A | 0.9 | 21.9 | | | | |
| East: Boston Road | | | | | | | | | | | | | | | |
| Lane 1 | 128 | 1.6 | 128 | 1.6 | 1877 | 0.068 | 100 | 0.0 | LOS A | 0.0 | 0.0 | Full | 1600 | 0.0 | 0.0 |
| Approach | 128 | 1.6 | 128 | 1.6 | | 0.068 | | 0.0 | NA | 0.0 | 0.0 | | | | |
| West: Oxford Avenue | | | | | | | | | | | | | | | |
| Lane 1 | 170 | 1.4 | 170 | 1.4 | 908 | 0.187 | 100 | 9.8 | LOS A | 0.8 | 20.9 | Full | 1600 | 0.0 | 0.0 |
| Approach | 170 | 1.4 | 170 | 1.4 | | 0.187 | | 9.8 | LOS A | 0.8 | 20.9 | | | | |
| All Vehicles | 458 | 1.0 | 458 | 1.0 | | 0.187 | | 7.1 | NA | 0.9 | 21.9 | | | | |

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c >1 irrespective of lane delay value (does not apply for approaches and intersection).
Minor Road Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard (HCM).
Delay Model: HCM Delay Formula (Stopline Delay: Geometric Delay is not included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

## Approach Lane Flows (veh/h)

South: Boston Road

| Mov. From S To Exit: | L2 W | R2 E | Total | %HV | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Prob. SL Ov. % | Ov. Lane No. |
|---|---|---|---|---|---|---|---|---|---|
| Lane 1 | 55 | 106 | 161 | 0.0 | 910 | 0.177 | 100 | NA | NA |
| Approach | 55 | 106 | 161 | 0.0 | | 0.177 | | | |

East: Boston Road

| Mov. From E To Exit: | L2 S | T1 W | Total | %HV | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Prob. SL Ov. % | Ov. Lane No. |
|---|---|---|---|---|---|---|---|---|---|
| Lane 1 | 94 | 34 | 128 | 1.6 | 1877 | 0.068 | 100 | NA | NA |
| Approach | 94 | 34 | 128 | 1.6 | | 0.068 | | | |

West: Oxford Avenue

| Mov. From W To Exit: | T1 E | R2 S | Total | %HV | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Prob. SL Ov. % | Ov. Lane No. |
|---|---|---|---|---|---|---|---|---|---|
| Lane 1 | 78 | 91 | 170 | 1.4 | 908 | 0.187 | 100 | NA | NA |

| | | | | | |
|---|---|---|---|---|---|
| Approach | 78 | 91 | 170 | 1.4 | 0.187 |

| | Total | %HV | Deg. Satn (v/c) |
|---|---|---|---|
| All Vehicles | 458 | 1.0 | 0.187 |

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

## Merge Analysis

| | Exit Lane Number | Short Lane Length ft | Percent Opng in Lane % | Opposing Flow Rate veh/h | Opposing Flow Rate pcu/h | Critical Gap sec | Follow-up Headway sec | Lane Flow Rate veh/h | Capacity veh/h | Deg. Satn v/c | Min. Delay sec | Merge Delay sec | Merge Queue [ Veh | Merge Queue Dist ] ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

There are no Exit Short Lanes for Merge Analysis at this Site.

## Variable Demand Analysis

| | Initial Queued Demand veh | Residual Queued Demand veh | Time for Residual Demand to Clear sec | Duration of Oversatn sec |
|---|---|---|---|---|
| South: Boston Road | | | | |
| Lane 1 | 0.0 | 0.0 | 0.0 | 0.0 |
| East: Boston Road | | | | |
| Lane 1 | 0.0 | 0.0 | 0.0 | 0.0 |
| West: Oxford Avenue | | | | |
| Lane 1 | 0.0 | 0.0 | 0.0 | 0.0 |

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2033 No-Build Weekday Morning Peak Hour

| Intersection | |
|---|---|
| Int Delay, s/veh | 0.2 |

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 2 | 91 | 76 | 2 | 1 | 2 |
| Future Vol, veh/h | 2 | 91 | 76 | 2 | 1 | 2 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Free | Free | Free | Free | Stop | Stop |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | - | - | - | - | 0 | - |
| Veh in Median Storage, # | - | 0 | 0 | - | 0 | - |
| Grade, % | - | 0 | 0 | - | 0 | - |
| Peak Hour Factor | 92 | 92 | 92 | 92 | 92 | 92 |
| Heavy Vehicles, % | 0 | 2 | 3 | 0 | 0 | 0 |
| Mvmt Flow | 2 | 99 | 83 | 2 | 1 | 2 |

| Major/Minor | Major1 | | Major2 | | Minor2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 85 | 0 | - | 0 | 187 | 84 |
| Stage 1 | - | - | - | - | 84 | - |
| Stage 2 | - | - | - | - | 103 | - |
| Critical Hdwy | 4.1 | - | - | - | 6.4 | 6.2 |
| Critical Hdwy Stg 1 | - | - | - | - | 5.4 | - |
| Critical Hdwy Stg 2 | - | - | - | - | 5.4 | - |
| Follow-up Hdwy | 2.2 | - | - | - | 3.5 | 3.3 |
| Pot Cap-1 Maneuver | 1525 | - | - | - | 807 | 981 |
| Stage 1 | - | - | - | - | 945 | - |
| Stage 2 | - | - | - | - | 926 | - |
| Platoon blocked, % | | - | - | - | | |
| Mov Cap-1 Maneuver | 1525 | - | - | - | 806 | 981 |
| Mov Cap-2 Maneuver | - | - | - | - | 806 | - |
| Stage 1 | - | - | - | - | 943 | - |
| Stage 2 | - | - | - | - | 926 | - |

| Approach | EB | WB | SB |
|---|---|---|---|
| HCM Ctrl Dly, s/v | 0.16 | 0 | 8.95 |
| HCM LOS | | | A |

| Minor Lane/Major Mvmt | EBL | EBT | WBT | WBR | SBLn1 |
|---|---|---|---|---|---|
| Capacity (veh/h) | 39 | - | - | - | 915 |
| HCM Lane V/C Ratio | 0.001 | - | - | - | 0.004 |
| HCM Ctrl Dly (s/v) | 7.4 | 0 | - | - | 8.9 |
| HCM Lane LOS | A | A | - | - | A |
| HCM 95th %tile Q(veh) | 0 | - | - | - | 0 |

# LANE SUMMARY

**Site: [1 (3)] 3 - 2033 No-Build Weekday Morning Peak Hour** (Folder1)
Output produced by SIDRA INTERSECTION Version: 10.0.9.250

)xford Avenue at Boston Road
ite Category: Future Conditions 1
top (Two-Way)
**ite Scenario: 1 | Local Volumes**

## Lane Use and Performance

| | Demand Flows [ Total veh/h | HV ] % | Arrival Flows [ Total veh/h | HV ] % | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Aver. Delay sec | Level of Service | 95% Back Of Queue [ Veh | Dist ] ft | Lane Config | Lane Length ft | Cap. Adj. % | Prob. Block. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Boston Road | | | | | | | | | | | | | | | |
| Lane 1 | 190 | 0.7 | 190 | 0.7 | 961 | 0.198 | 100 | 9.6 | LOS A | 1.0 | 25.3 | Full | 1600 | 0.0 | 0.0 |
| Approach | 190 | 0.7 | 190 | 0.7 | | 0.198 | | 9.6 | LOS A | 1.0 | 25.3 | | | | |
| East: Boston Road | | | | | | | | | | | | | | | |
| Lane 1 | 98 | 5.1 | 98 | 5.1 | 1823 | 0.054 | 100 | 0.0 | LOS A | 0.0 | 0.0 | Full | 1600 | 0.0 | 0.0 |
| Approach | 98 | 5.1 | 98 | 5.1 | | 0.054 | | 0.0 | NA | 0.0 | 0.0 | | | | |
| West: Oxford Avenue | | | | | | | | | | | | | | | |
| Lane 1 | 100 | 2.1 | 100 | 2.1 | 915 | 0.109 | 100 | 9.3 | LOS A | 0.4 | 10.9 | Full | 1600 | 0.0 | 0.0 |
| Approach | 100 | 2.1 | 100 | 2.1 | | 0.109 | | 9.3 | LOS A | 0.4 | 10.9 | | | | |
| All Vehicles | 388 | 2.2 | 388 | 2.2 | | 0.198 | | 7.1 | NA | 1.0 | 25.3 | | | | |

ite Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
ane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
OS F will result if v/c >1 irrespective of lane delay value (does not apply for approaches and intersection).
linor Road Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
IA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
wo-Way Sign Control Capacity Model: SIDRA Standard (HCM).
elay Model: HCM Delay Formula (Stopline Delay: Geometric Delay is not included).
ueue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
ap-Acceptance Capacity Formula: Traditional M1.
IV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
rrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

## Approach Lane Flows (veh/h)

South: Boston Road

| Mov. From S To Exit: | L2 W | R2 E | Total | %HV | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Prob. SL Ov. % | Ov. Lane No. |
|---|---|---|---|---|---|---|---|---|---|
| Lane 1 | 48 | 142 | 190 | 0.7 | 961 | 0.198 | 100 | NA | NA |
| Approach | 48 | 142 | 190 | 0.7 | | 0.198 | | | |

East: Boston Road

| Mov. From E To Exit: | L2 S | T1 W | Total | %HV | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Prob. SL Ov. % | Ov. Lane No. |
|---|---|---|---|---|---|---|---|---|---|
| Lane 1 | 61 | 37 | 98 | 5.1 | 1823 | 0.054 | 100 | NA | NA |
| Approach | 61 | 37 | 98 | 5.1 | | 0.054 | | | |

West: Oxford Avenue

| Mov. From W To Exit: | T1 E | R2 S | Total | %HV | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Prob. SL Ov. % | Ov. Lane No. |
|---|---|---|---|---|---|---|---|---|---|
| Lane 1 | 68 | 32 | 100 | 2.1 | 915 | 0.109 | 100 | NA | NA |

| | | | | | |
|---|---|---|---|---|---|
| Approach | 68 | 32 | 100 | 2.1 | 0.109 |

| | Total | %HV | Deg.Satn (v/c) |
|---|---|---|---|
| All Vehicles | 388 | 2.2 | 0.198 |

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

## Merge Analysis

| | Exit Lane Number | Short Lane Length ft | Percent Opng in Lane % | Opposing Flow Rate veh/h | Opposing Flow Rate pcu/h | Critical Gap sec | Follow-up Headway sec | Lane Flow Rate veh/h | Capacity veh/h | Deg. Satn v/c | Min. Delay sec | Merge Delay sec | Merge Queue [ Veh | Merge Queue Dist ] ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

There are no Exit Short Lanes for Merge Analysis at this Site.

## Variable Demand Analysis

| | Initial Queued Demand veh | Residual Queued Demand veh | Time for Residual Demand to Clear sec | Duration of Oversatn sec |
|---|---|---|---|---|
| **South: Boston Road** | | | | |
| Lane 1 | 0.0 | 0.0 | 0.0 | 0.0 |
| **East: Boston Road** | | | | |
| Lane 1 | 0.0 | 0.0 | 0.0 | 0.0 |
| **West: Oxford Avenue** | | | | |
| Lane 1 | 0.0 | 0.0 | 0.0 | 0.0 |

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2033 No-Build Weekday Evening Peak Hour

| Intersection | |
|---|---|
| Int Delay, s/veh | 0.5 |

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 6 | 139 | 83 | 4 | 5 | 3 |
| Future Vol, veh/h | 6 | 139 | 83 | 4 | 5 | 3 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Free | Free | Free | Free | Stop | Stop |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | - | - | - | - | 0 | - |
| Veh in Median Storage, # | - | 0 | 0 | - | 0 | - |
| Grade, % | - | 0 | 0 | - | 0 | - |
| Peak Hour Factor | 92 | 92 | 92 | 92 | 92 | 92 |
| Heavy Vehicles, % | 0 | 2 | 3 | 0 | 0 | 0 |
| Mvmt Flow | 7 | 151 | 90 | 4 | 5 | 3 |

| Major/Minor | Major1 | | Major2 | | Minor2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 95 | 0 | - | 0 | 257 | 92 |
| Stage 1 | - | - | - | - | 92 | - |
| Stage 2 | - | - | - | - | 164 | - |
| Critical Hdwy | 4.1 | - | - | - | 6.4 | 6.2 |
| Critical Hdwy Stg 1 | - | - | - | - | 5.4 | - |
| Critical Hdwy Stg 2 | - | - | - | - | 5.4 | - |
| Follow-up Hdwy | 2.2 | - | - | - | 3.5 | 3.3 |
| Pot Cap-1 Maneuver | 1512 | - | - | - | 737 | 970 |
| Stage 1 | - | - | - | - | 936 | - |
| Stage 2 | - | - | - | - | 870 | - |
| Platoon blocked, % | | - | - | - | | |
| Mov Cap-1 Maneuver | 1512 | - | - | - | 733 | 970 |
| Mov Cap-2 Maneuver | - | - | - | - | 733 | - |
| Stage 1 | - | - | - | - | 932 | - |
| Stage 2 | - | - | - | - | 870 | - |

| Approach | EB | WB | SB |
|---|---|---|---|
| HCM Ctrl Dly, s/v | 0.31 | 0 | 9.51 |
| HCM LOS | | | A |

| Minor Lane/Major Mvmt | EBL | EBT | WBT | WBR | SBLn1 |
|---|---|---|---|---|---|
| Capacity (veh/h) | 74 | - | - | - | 807 |
| HCM Lane V/C Ratio | 0.004 | - | - | - | 0.011 |
| HCM Ctrl Dly (s/v) | 7.4 | 0 | - | - | 9.5 |
| HCM Lane LOS | A | A | - | - | A |
| HCM 95th %tile Q(veh) | 0 | - | - | - | 0 |

# LANE SUMMARY

**Site: [1 (4)] 4 - 2033 No-Build Weekday Evening Peak Hour** (Folder1)
Output produced by SIDRA INTERSECTION Version: 10.0.9.250

)xford Avenue at Boston Road
ite Category: Future Conditions 1
top (Two-Way)
**ite Scenario: 1 | Local Volumes**

## Lane Use and Performance

| | Demand Flows [ Total veh/h | HV ] % | Arrival Flows [ Total veh/h | HV ] % | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Aver. Delay sec | Level of Service | 95% Back Of Queue [ Veh | Dist ] ft | Lane Config | Lane Length ft | Cap. Adj. % | Prob. Block. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Boston Road | | | | | | | | | | | | | | | |
| Lane 1 | 171 | 0.0 | 171 | 0.0 | 910 | 0.188 | 100 | 9.8 | LOS A | 0.9 | 23.5 | Full | 1600 | 0.0 | 0.0 |
| Approach | 171 | 0.0 | 171 | 0.0 | | 0.188 | | 9.8 | LOS A | 0.9 | 23.5 | | | | |
| East: Boston Road | | | | | | | | | | | | | | | |
| Lane 1 | 154 | 1.5 | 154 | 1.5 | 1877 | 0.082 | 100 | 0.0 | LOS A | 0.0 | 0.0 | Full | 1600 | 0.0 | 0.0 |
| Approach | 154 | 1.5 | 154 | 1.5 | | 0.082 | | 0.0 | NA | 0.0 | 0.0 | | | | |
| West: Oxford Avenue | | | | | | | | | | | | | | | |
| Lane 1 | 157 | 1.4 | 157 | 1.4 | 884 | 0.177 | 100 | 9.9 | LOS A | 0.8 | 19.5 | Full | 1600 | 0.0 | 0.0 |
| Approach | 157 | 1.4 | 157 | 1.4 | | 0.177 | | 9.9 | LOS A | 0.8 | 19.5 | | | | |
| All Vehicles | 482 | 0.9 | 482 | 0.9 | | 0.188 | | 6.7 | NA | 0.9 | 23.5 | | | | |

ite Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
ane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
OS F will result if v/c >1 irrespective of lane delay value (does not apply for approaches and intersection).
linor Road Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
IA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
wo-Way Sign Control Capacity Model: SIDRA Standard (HCM).
elay Model: HCM Delay Formula (Stopline Delay: Geometric Delay is not included).
ueue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
ap-Acceptance Capacity Formula: Traditional M1.
IV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
rrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

## Approach Lane Flows (veh/h)

South: Boston Road

| Mov. From S To Exit: | L2 W | R2 E | Total | %HV | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Prob. SL Ov. % | Ov. Lane No. |
|---|---|---|---|---|---|---|---|---|---|
| Lane 1 | 55 | 115 | 171 | 0.0 | 910 | 0.188 | 100 | NA | NA |
| Approach | 55 | 115 | 171 | 0.0 | | 0.188 | | | |

East: Boston Road

| Mov. From E To Exit: | L2 S | T1 W | Total | %HV | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Prob. SL Ov. % | Ov. Lane No. |
|---|---|---|---|---|---|---|---|---|---|
| Lane 1 | 115 | 39 | 154 | 1.5 | 1877 | 0.082 | 100 | NA | NA |
| Approach | 115 | 39 | 154 | 1.5 | | 0.082 | | | |

West: Oxford Avenue

| Mov. From W To Exit: | T1 E | R2 S | Total | %HV | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Prob. SL Ov. % | Ov. Lane No. |
|---|---|---|---|---|---|---|---|---|---|
| Lane 1 | 72 | 85 | 157 | 1.4 | 884 | 0.177 | 100 | NA | NA |

| | | | | | |
|---|---|---|---|---|---|
| Approach | 72 | 85 | 157 | 1.4 | 0.177 |

| | Total | %HV | Deg.Satn (v/c) |
|---|---|---|---|
| All Vehicles | 482 | 0.9 | 0.188 |

rrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

## Merge Analysis

| | Exit Lane Number | Short Lane Length ft | Percent Opng in Lane % | Opposing Flow Rate veh/h | pcu/h | Critical Gap sec | Follow-up Headway sec | Lane Flow Rate veh/h | Capacity veh/h | Deg. Satn v/c | Min. Delay sec | Merge Delay sec | Merge Queue [ Veh | Dist ] ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

There are no Exit Short Lanes for Merge Analysis at this Site.

## Variable Demand Analysis

| | Initial Queued Demand veh | Residual Queued Demand veh | Time for Residual Demand to Clear sec | Duration of Oversatn sec |
|---|---|---|---|---|
| South: Boston Road | | | | |
| Lane 1 | 0.0 | 0.0 | 0.0 | 0.0 |
| East: Boston Road | | | | |
| Lane 1 | 0.0 | 0.0 | 0.0 | 0.0 |
| West: Oxford Avenue | | | | |
| Lane 1 | 0.0 | 0.0 | 0.0 | 0.0 |

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roject: S:\Jobs\10758 Haverhill\Analysis\SIDRA.sipx

2033 Build Weekday Morning Peak Hour

| Intersection | |
|---|---|
| Int Delay, s/veh | 0.5 |

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 3 | 91 | 76 | 3 | 3 | 5 |
| Future Vol, veh/h | 3 | 91 | 76 | 3 | 3 | 5 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Free | Free | Free | Free | Stop | Stop |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | - | - | - | - | 0 | - |
| Veh in Median Storage, # | - | 0 | 0 | - | 0 | - |
| Grade, % | - | 0 | 0 | - | 0 | - |
| Peak Hour Factor | 92 | 92 | 92 | 92 | 92 | 92 |
| Heavy Vehicles, % | 0 | 2 | 3 | 0 | 0 | 0 |
| Mvmt Flow | 3 | 99 | 83 | 3 | 3 | 5 |

| Major/Minor | Major1 | | Major2 | | Minor2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 86 | 0 | - | 0 | 190 | 84 |
| Stage 1 | - | - | - | - | 84 | - |
| Stage 2 | - | - | - | - | 105 | - |
| Critical Hdwy | 4.1 | - | - | - | 6.4 | 6.2 |
| Critical Hdwy Stg 1 | - | - | - | - | 5.4 | - |
| Critical Hdwy Stg 2 | - | - | - | - | 5.4 | - |
| Follow-up Hdwy | 2.2 | - | - | - | 3.5 | 3.3 |
| Pot Cap-1 Maneuver | 1523 | - | - | - | 804 | 980 |
| Stage 1 | - | - | - | - | 944 | - |
| Stage 2 | - | - | - | - | 924 | - |
| Platoon blocked, % | | - | - | - | | |
| Mov Cap-1 Maneuver | 1523 | - | - | - | 802 | 980 |
| Mov Cap-2 Maneuver | - | - | - | - | 802 | - |
| Stage 1 | - | - | - | - | 942 | - |
| Stage 2 | - | - | - | - | 924 | - |

| Approach | EB | WB | SB |
|---|---|---|---|
| HCM Ctrl Dly, s/v | 0.24 | 0 | 9.02 |
| HCM LOS | | | A |

| Minor Lane/Major Mvmt | EBL | EBT | WBT | WBR | SBLn1 |
|---|---|---|---|---|---|
| Capacity (veh/h) | 57 | - | - | - | 905 |
| HCM Lane V/C Ratio | 0.002 | - | - | - | 0.01 |
| HCM Ctrl Dly (s/v) | 7.4 | 0 | - | - | 9 |
| HCM Lane LOS | A | A | - | - | A |
| HCM 95th %tile Q(veh) | 0 | - | - | - | 0 |

| Intersection | |
|---|---|
| Int Delay, s/veh | 3.1 |

| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 5 | 0 | 4 | 2 | 0 | 3 |
| Future Vol, veh/h | 5 | 0 | 4 | 2 | 0 | 3 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Free | Free | Free | Free |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | 0 | - | - | - | - | - |
| Veh in Median Storage, # | 0 | - | 0 | - | - | 0 |
| Grade, % | 0 | - | 0 | - | - | 0 |
| Peak Hour Factor | 92 | 92 | 92 | 92 | 92 | 92 |
| Heavy Vehicles, % | 2 | 2 | 0 | 2 | 2 | 0 |
| Mvmt Flow | 5 | 0 | 4 | 2 | 0 | 3 |

| Major/Minor | Minor1 | | Major1 | | Major2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 9 | 5 | 0 | 0 | 7 | 0 |
| Stage 1 | 5 | - | - | - | - | - |
| Stage 2 | 3 | - | - | - | - | - |
| Critical Hdwy | 6.42 | 6.22 | - | - | 4.12 | - |
| Critical Hdwy Stg 1 | 5.42 | - | - | - | - | - |
| Critical Hdwy Stg 2 | 5.42 | - | - | - | - | - |
| Follow-up Hdwy | 3.518 | 3.318 | - | - | 2.218 | - |
| Pot Cap-1 Maneuver | 1012 | 1078 | - | - | 1614 | - |
| Stage 1 | 1018 | - | - | - | - | - |
| Stage 2 | 1020 | - | - | - | - | - |
| Platoon blocked, % | | | - | - | | - |
| Mov Cap-1 Maneuver | 1012 | 1078 | - | - | 1614 | - |
| Mov Cap-2 Maneuver | 1012 | - | - | - | - | - |
| Stage 1 | 1018 | - | - | - | - | - |
| Stage 2 | 1020 | - | - | - | - | - |

| Approach | WB | NB | SB |
|---|---|---|---|
| HCM Ctrl Dly, s/v | 8.58 | 0 | 0 |
| HCM LOS | A | | |

| Minor Lane/Major Mvmt | NBT | NBR | WBLn1 | SBL | SBT |
|---|---|---|---|---|---|
| Capacity (veh/h) | - | - | 1012 | 1614 | - |
| HCM Lane V/C Ratio | - | - | 0.005 | - | - |
| HCM Ctrl Dly (s/v) | - | - | 8.6 | 0 | - |
| HCM Lane LOS | - | - | A | A | - |
| HCM 95th %tile Q(veh) | - | - | 0 | 0 | - |

# LANE SUMMARY

**Site: [1 (5)] 5 - 2033 Build Weekday Morning Peak Hour** (Folder1)
Output produced by SIDRA INTERSECTION Version: 10.0.9.250

Oxford Avenue at Boston Road
Site Category: Proposed Design 1
Stop (Two-Way)
**Site Scenario: 1 | Local Volumes**

## Lane Use and Performance

| | Demand Flows [ Total veh/h | HV ] % | Arrival Flows [ Total veh/h | HV ] % | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Aver. Delay sec | Level of Service | 95% Back Of Queue [ Veh | Dist ] ft | Lane Config | Lane Length ft | Cap. Adj. % | Prob. Block. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Boston Road | | | | | | | | | | | | | | | |
| Lane 1 | 191 | 0.7 | 191 | 0.7 | 959 | 0.199 | 100 | 9.6 | LOS A | 1.0 | 25.5 | Full | 1600 | 0.0 | 0.0 |
| Approach | 191 | 0.7 | 191 | 0.7 | | 0.199 | | 9.6 | LOS A | 1.0 | 25.5 | | | | |
| East: Boston Road | | | | | | | | | | | | | | | |
| Lane 1 | 98 | 5.1 | 98 | 5.1 | 1823 | 0.054 | 100 | 0.0 | LOS A | 0.0 | 0.0 | Full | 1600 | 0.0 | 0.0 |
| Approach | 98 | 5.1 | 98 | 5.1 | | 0.054 | | 0.0 | NA | 0.0 | 0.0 | | | | |
| West: Oxford Avenue | | | | | | | | | | | | | | | |
| Lane 1 | 102 | 2.0 | 102 | 2.0 | 916 | 0.112 | 100 | 9.4 | LOS A | 0.4 | 11.2 | Full | 1600 | 0.0 | 0.0 |
| Approach | 102 | 2.0 | 102 | 2.0 | | 0.112 | | 9.4 | LOS A | 0.4 | 11.2 | | | | |
| All Vehicles | 391 | 2.2 | 391 | 2.2 | | 0.199 | | 7.1 | NA | 1.0 | 25.5 | | | | |

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c >1 irrespective of lane delay value (does not apply for approaches and intersection).
Minor Road Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard (HCM).
Delay Model: HCM Delay Formula (Stopline Delay: Geometric Delay is not included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

## Approach Lane Flows (veh/h)

South: Boston Road

| Mov. From S To Exit: | L2 W | R2 E | Total | %HV | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Prob. SL Ov. % | Ov. Lane No. |
|---|---|---|---|---|---|---|---|---|---|
| Lane 1 | 49 | 142 | 191 | 0.7 | 959 | 0.199 | 100 | NA | NA |
| Approach | 49 | 142 | 191 | 0.7 | | 0.199 | | | |

East: Boston Road

| Mov. From E To Exit: | L2 S | T1 W | Total | %HV | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Prob. SL Ov. % | Ov. Lane No. |
|---|---|---|---|---|---|---|---|---|---|
| Lane 1 | 61 | 37 | 98 | 5.1 | 1823 | 0.054 | 100 | NA | NA |
| Approach | 61 | 37 | 98 | 5.1 | | 0.054 | | | |

West: Oxford Avenue

| Mov. From W To Exit: | T1 E | R2 S | Total | %HV | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Prob. SL Ov. % | Ov. Lane No. |
|---|---|---|---|---|---|---|---|---|---|
| Lane 1 | 70 | 33 | 102 | 2.0 | 916 | 0.112 | 100 | NA | NA |

| | | | | | |
|---|---|---|---|---|---|
| Approach | 70 | 33 | 102 | 2.0 | 0.112 |

| | Total | %HV | Deg.Satn (v/c) |
|---|---|---|---|
| All Vehicles | 391 | 2.2 | 0.199 |

rrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

## Merge Analysis

| | Exit Lane Number | Short Lane Length ft | Percent Opng in Lane % | Opposing Flow Rate veh/h | Opposing Flow Rate pcu/h | Critical Gap sec | Follow-up Headway sec | Lane Flow Rate veh/h | Capacity veh/h | Deg. Satn v/c | Min. Delay sec | Merge Delay sec | Merge Queue [ Veh | Merge Queue Dist ] ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

There are no Exit Short Lanes for Merge Analysis at this Site.

## Variable Demand Analysis

| | Initial Queued Demand veh | Residual Queued Demand veh | Time for Residual Demand to Clear sec | Duration of Oversatn sec |
|---|---|---|---|---|
| South: Boston Road | | | | |
| Lane 1 | 0.0 | 0.0 | 0.0 | 0.0 |
| East: Boston Road | | | | |
| Lane 1 | 0.0 | 0.0 | 0.0 | 0.0 |
| West: Oxford Avenue | | | | |
| Lane 1 | 0.0 | 0.0 | 0.0 | 0.0 |

2033 Build Weekday Evening Peak Hour

| Intersection | |
|---|---|
| Int Delay, s/veh | 0.7 |

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 8 | 139 | 83 | 6 | 7 | 5 |
| Future Vol, veh/h | 8 | 139 | 83 | 6 | 7 | 5 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Free | Free | Free | Free | Stop | Stop |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | - | - | - | - | 0 | - |
| Veh in Median Storage, # | - | 0 | 0 | - | 0 | - |
| Grade, % | - | 0 | 0 | - | 0 | - |
| Peak Hour Factor | 92 | 92 | 92 | 92 | 92 | 92 |
| Heavy Vehicles, % | 0 | 2 | 3 | 0 | 0 | 0 |
| Mvmt Flow | 9 | 151 | 90 | 7 | 8 | 5 |

| Major/Minor | Major1 | | Major2 | | Minor2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 97 | 0 | - | 0 | 262 | 93 |
| Stage 1 | - | - | - | - | 93 | - |
| Stage 2 | - | - | - | - | 168 | - |
| Critical Hdwy | 4.1 | - | - | - | 6.4 | 6.2 |
| Critical Hdwy Stg 1 | - | - | - | - | 5.4 | - |
| Critical Hdwy Stg 2 | - | - | - | - | 5.4 | - |
| Follow-up Hdwy | 2.2 | - | - | - | 3.5 | 3.3 |
| Pot Cap-1 Maneuver | 1509 | - | - | - | 731 | 969 |
| Stage 1 | - | - | - | - | 935 | - |
| Stage 2 | - | - | - | - | 866 | - |
| Platoon blocked, % | | - | - | - | | |
| Mov Cap-1 Maneuver | 1509 | - | - | - | 727 | 969 |
| Mov Cap-2 Maneuver | - | - | - | - | 727 | - |
| Stage 1 | - | - | - | - | 929 | - |
| Stage 2 | - | - | - | - | 866 | - |

| Approach | EB | WB | SB |
|---|---|---|---|
| HCM Ctrl Dly, s/v | 0.4 | 0 | 9.51 |
| HCM LOS | | | A |

| Minor Lane/Major Mvmt | EBL | EBT | WBT | WBR | SBLn1 |
|---|---|---|---|---|---|
| Capacity (veh/h) | 98 | - | - | - | 811 |
| HCM Lane V/C Ratio | 0.006 | - | - | - | 0.016 |
| HCM Ctrl Dly (s/v) | 7.4 | 0 | - | - | 9.5 |
| HCM Lane LOS | A | A | - | - | A |
| HCM 95th %tile Q(veh) | 0 | - | - | - | 0 |

| Intersection | |
|---|---|
| Int Delay, s/veh | 1.3 |

| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 4 | 0 | 10 | 4 | 0 | 8 |
| Future Vol, veh/h | 4 | 0 | 10 | 4 | 0 | 8 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Free | Free | Free | Free |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | 0 | - | - | - | - | - |
| Veh in Median Storage, # | 0 | - | 0 | - | - | 0 |
| Grade, % | 0 | - | 0 | - | - | 0 |
| Peak Hour Factor | 92 | 92 | 92 | 92 | 92 | 92 |
| Heavy Vehicles, % | 2 | 2 | 0 | 2 | 2 | 0 |
| Mvmt Flow | 4 | 0 | 11 | 4 | 0 | 9 |

| Major/Minor | Minor1 | | Major1 | | Major2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 22 | 13 | 0 | 0 | 15 | 0 |
| Stage 1 | 13 | - | - | - | - | - |
| Stage 2 | 9 | - | - | - | - | - |
| Critical Hdwy | 6.42 | 6.22 | - | - | 4.12 | - |
| Critical Hdwy Stg 1 | 5.42 | - | - | - | - | - |
| Critical Hdwy Stg 2 | 5.42 | - | - | - | - | - |
| Follow-up Hdwy | 3.518 | 3.318 | - | - | 2.218 | - |
| Pot Cap-1 Maneuver | 995 | 1067 | - | - | 1603 | - |
| Stage 1 | 1010 | - | - | - | - | - |
| Stage 2 | 1014 | - | - | - | - | - |
| Platoon blocked, % | | | - | - | | - |
| Mov Cap-1 Maneuver | 995 | 1067 | - | - | 1603 | - |
| Mov Cap-2 Maneuver | 995 | - | - | - | - | - |
| Stage 1 | 1010 | - | - | - | - | - |
| Stage 2 | 1014 | - | - | - | - | - |

| Approach | WB | NB | SB |
|---|---|---|---|
| HCM Ctrl Dly, s/v | 8.63 | 0 | 0 |
| HCM LOS | A | | |

| Minor Lane/Major Mvmt | NBT | NBR | WBLn1 | SBL | SBT |
|---|---|---|---|---|---|
| Capacity (veh/h) | - | - | 995 | 1603 | - |
| HCM Lane V/C Ratio | - | - | 0.004 | - | - |
| HCM Ctrl Dly (s/v) | - | - | 8.6 | 0 | - |
| HCM Lane LOS | - | - | A | A | - |
| HCM 95th %tile Q(veh) | - | - | 0 | 0 | - |

# LANE SUMMARY

**Site: [1 (6)] 6 - 2033 Build Weekday Evening Peak Hour**
(Folder1)

Output produced by SIDRA INTERSECTION Version: 10.0.9.250

Oxford Avenue at Boston Road
Site Category: Proposed Design 1
Stop (Two-Way)
**Site Scenario: 1 | Local Volumes**

**Lane Use and Performance**

| | Demand Flows [ Total veh/h | HV ] % | Arrival Flows [ Total veh/h | HV ] % | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Aver. Delay sec | Level of Service | 95% Back Of Queue [ Veh | Dist ] ft | Lane Config | Lane Length ft | Cap. Adj. % | Prob. Block. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Boston Road | | | | | | | | | | | | | | | |
| Lane 1 | 172 | 0.0 | 172 | 0.0 | 906 | 0.189 | 100 | 9.8 | LOS A | 1.0 | 23.8 | Full | 1600 | 0.0 | 0.0 |
| Approach | 172 | 0.0 | 172 | 0.0 | | 0.189 | | 9.8 | LOS A | 1.0 | 23.8 | | | | |
| East: Boston Road | | | | | | | | | | | | | | | |
| Lane 1 | 155 | 1.6 | 155 | 1.6 | 1877 | 0.083 | 100 | 0.0 | LOS A | 0.0 | 0.0 | Full | 1600 | 0.0 | 0.0 |
| Approach | 155 | 1.6 | 155 | 1.6 | | 0.083 | | 0.0 | NA | 0.0 | 0.0 | | | | |
| West: Oxford Avenue | | | | | | | | | | | | | | | |
| Lane 1 | 159 | 1.4 | 159 | 1.4 | 883 | 0.180 | 100 | 9.9 | LOS A | 0.8 | 19.8 | Full | 1600 | 0.0 | 0.0 |
| Approach | 159 | 1.4 | 159 | 1.4 | | 0.180 | | 9.9 | LOS A | 0.8 | 19.8 | | | | |
| All Vehicles | 486 | 0.9 | 486 | 0.9 | | 0.189 | | 6.7 | NA | 1.0 | 23.8 | | | | |

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c >1 irrespective of lane delay value (does not apply for approaches and intersection).
Minor Road Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard (HCM).
Delay Model: HCM Delay Formula (Stopline Delay: Geometric Delay is not included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

**Approach Lane Flows (veh/h)**

South: Boston Road

| Mov. From S To Exit: | L2 W | R2 E | Total | %HV | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Prob. SL Ov. % | Ov. Lane No. |
|---|---|---|---|---|---|---|---|---|---|
| Lane 1 | 57 | 115 | 172 | 0.0 | 906 | 0.189 | 100 | NA | NA |
| Approach | 57 | 115 | 172 | 0.0 | | 0.189 | | | |

East: Boston Road

| Mov. From E To Exit: | L2 S | T1 W | Total | %HV | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Prob. SL Ov. % | Ov. Lane No. |
|---|---|---|---|---|---|---|---|---|---|
| Lane 1 | 115 | 40 | 155 | 1.6 | 1877 | 0.083 | 100 | NA | NA |

| | | | | | | |
|---|---|---|---|---|---|---|
| Approach | 115 | 40 | 155 | 1.6 | | 0.083 |

West: Oxford Avenue

| Mov. From W To Exit: | T1 E | R2 S | Total | %HV | Cap. veh/h | Deg. Satn v/c | Lane Util. % | Prob. SL Ov. % | Ov. Lane No. |
|---|---|---|---|---|---|---|---|---|---|
| Lane 1 | 73 | 86 | 159 | 1.4 | 883 | 0.180 | 100 | NA | NA |
| Approach | 73 | 86 | 159 | 1.4 | | 0.180 | | | |

| | Total | %HV | Deg.Satn (v/c) |
|---|---|---|---|
| All Vehicles | 486 | 0.9 | 0.189 |

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

Merge Analysis

| | Exit Lane Number | Short Lane Length ft | Percent Opng in Lane % | Opposing Flow Rate veh/h | Opposing Flow Rate pcu/h | Critical Gap sec | Follow-up Headway sec | Lane Flow Rate veh/h | Capacity veh/h | Deg. Satn v/c | Min. Delay sec | Merge Delay sec | Merge [ Veh | Queue Dist ] ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

There are no Exit Short Lanes for Merge Analysis at this Site.

Variable Demand Analysis

| | Initial Queued Demand veh | Residual Queued Demand veh | Time for Residual Demand to Clear sec | Duration of Oversatn sec |
|---|---|---|---|---|
| South: Boston Road | | | | |
| Lane 1 | 0.0 | 0.0 | 0.0 | 0.0 |
| East: Boston Road | | | | |
| Lane 1 | 0.0 | 0.0 | 0.0 | 0.0 |
| West: Oxford Avenue | | | | |
| Lane 1 | 0.0 | 0.0 | 0.0 | 0.0 |

The Morin-Cameron GROUP, INC.

October 8, 2026

Haverhill City Council
Haverhill City Hall
4 Summer Street
Haverhill MA, 01830

RE: PDD-26-1 – City Coordination

Dear City Councilors,

In May 2026 a Plan Development District (PDD) application was submitted for the property located at 931 Boston Road by Pentucket North Development LLC(PND) for a multi-family housing development. The development includes a mix of single family and two-family dwellings with associated parking, utilities and appurtenances. Since that submittal, the applicant and applicant representatives have met with City officials on multiple occasions and has presented the project to the Planning Board for a recommendation. During this process the project has also undergone a traffic study, traffic peer review and stormwater peer review.

Based on discussions with the Planning Director, Police Department, Fire Department, Engineering Department and other City officials there have been concerns regarding the current conditions and adequacy of I Street. At this time we are actively working with the City for solutions for I Street improvements including the widening of the paved roadway width to a standard 24' width for the entirety. Attached is a sketch showing a preliminary widening of the roadway to 24'. This will be reviewed and discussed with City Officials. The City has also discussed the pavement surface and concerns of the roadway condition after construction. PND has agreed to mill/overlay the entire length of I Street post construction if the project moves forward.

In addition, we have been coordinating with the Engineering Department regarding adequacy of City utilities to serve the development. A sewer capacity analysis has been submitted to the Engineering Department for review and PND understands that a hydraulic analysis of the water distribution system will be required.

Some of the noted items will take time to perform and will not be completed prior to the City Council meeting. The applicant requests that the following be part of condition of approval if the PDD is granted.

- PND will be required to satisfy the Engineering Department, Fire Department and Police Department for the widening of I Street to 24' for the entirety. Approval from the departments will be required prior to construction.
- PND will coordinate with the water department to perform a hydraulic analysis to confirm adequate water supply is available prior to construction. If reasonable improvements to the water distribution system are required, PND will be responsible for the improvements.

- PND will mill/overlay I Street post construction.

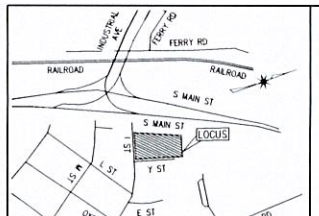
If you have any questions, please do not hesitate to contact our office at (978) 777-8586.
Sincerely,

**THE MORIN-CAMERON GROUP, INC.**

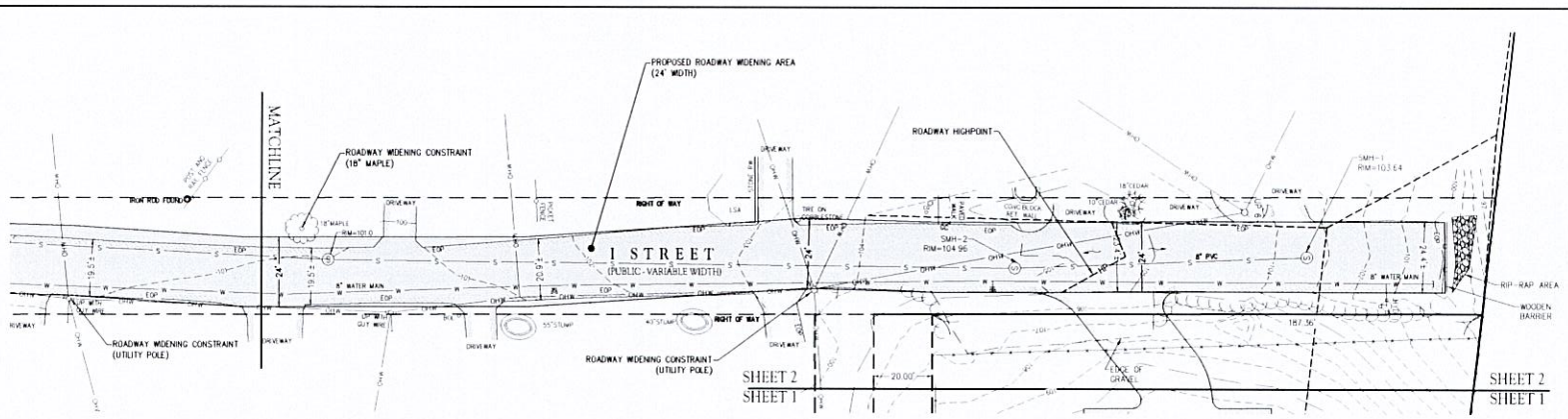
**William A. Schkuta, P.E.**
Director of Engineering

Attachments

cc: Ron Mailloux (via email)
Atty. Russell Channen (via email)




LOCUS MAP:
SCALE: 1"=500'

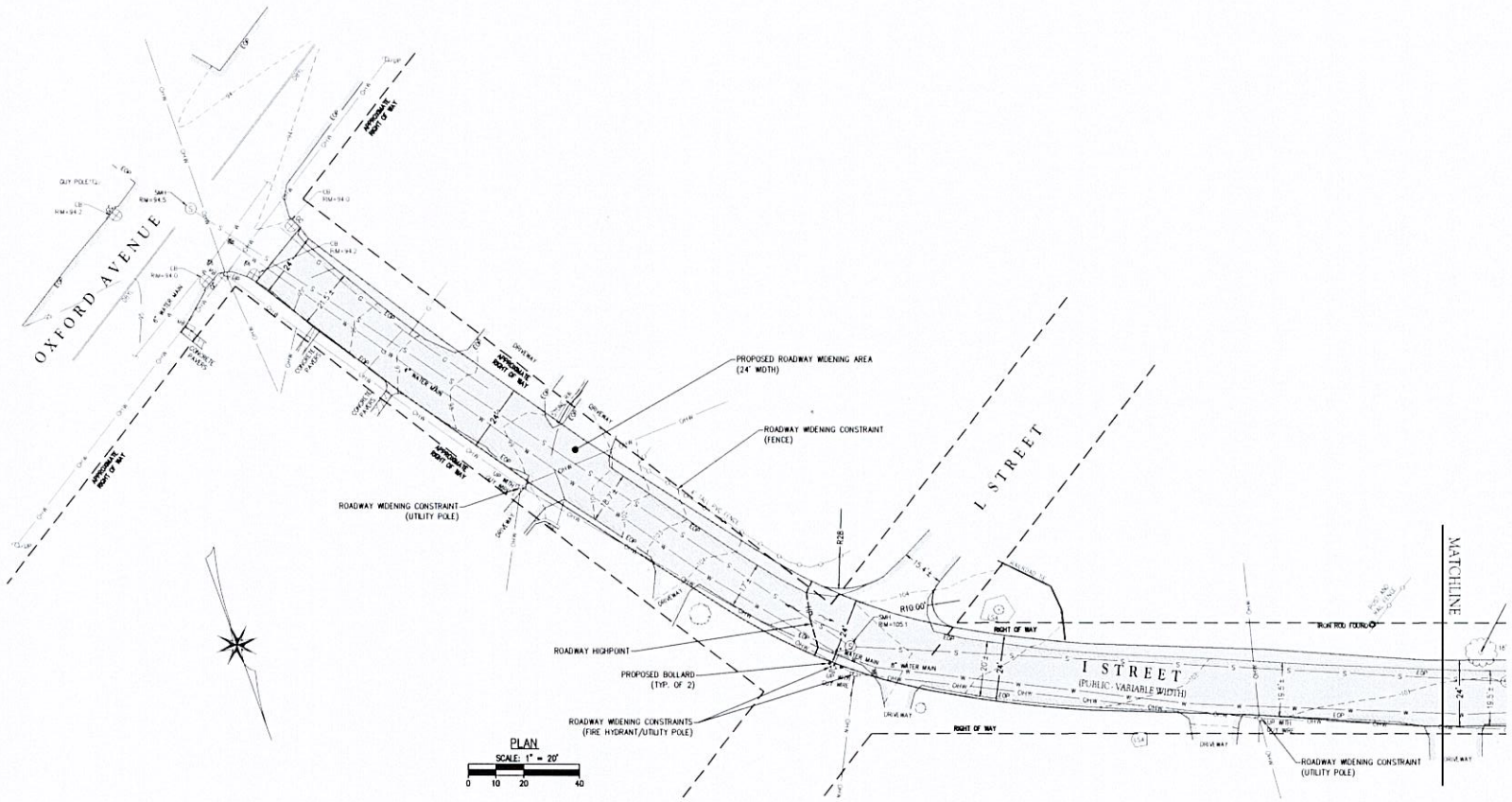



## LEGEND

| | |
|---|---|
| CONTOURS | |
| MAJOR | 115 |
| MINOR | 112 |
| CHAIN LINK FENCE | |
| FIRE HYDRANT | |
| GUY WIRE | |
| IRRIGATION CONTROL VALVE | |
| LIGHT POLE | |
| OVERHEAD WIRE | OHW |
| PROPERTY LINE | |
| SANITARY SEWER MANHOLE | S |
| SANITARY SEWER MAIN/SERVICE | S |
| SQUARE CATCH BASIN | |
| STORM SEWER/DRAINAGE | D |
| TREE LINE | |
| UTILITY POLE | UPO |
| WATER GATE | |
| WATER SPICKET MANHOLE | W |

## ABBREVIATIONS

| | |
|---|---|
| CB | CATCH BASIN |
| DMH | DRAIN MANHOLE |
| ELEV. | ELEVATION |
| EOC | EDGE OF CONCRETE |
| EOL | EDGE OF LAWN |
| EOP | EDGE OF ASPHALT PAVEMENT |
| EX. | EXISTING |
| INV | INVERT |
| N/F | NOW OR FORMERLY |
| PVC | POLYVINYL CHLORIDE |
| SF | SQUARE FEET |
| SMH | SEWER MANHOLE |
| TYP | TYPICAL |
| WMH | WATER SPICKET MANHOLE |




PLAN
SCALE: 1" = 20'
0 10 20 40

The Morin-Cameron GROUP, INC.
CIVIL ENGINEERS | ENVIRONMENTAL CONSULTANTS
LAND SURVEYORS | LAND USE PLANNERS
55 LAWRENCE STREET, HAVERHILL, MASSACHUSETTS 01832
P: 978-373-1666 • WWW.MORINCAMERON.COM

| REVISIONS | | |
|---|---|---|
| NO. | DESCRIPTION | DATE |

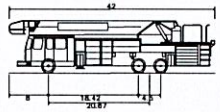
SURVEY BY: SR / TP
DRAFTED BY: DS
CHECKED BY: WAS
APPROVED BY: WAS
SCALE: 1"=20'
DATE: OCTOBER 8, 2024

# SKETCH PLAN
## HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(ASSESSOR'S MAP 754, BLOCK 2, LOT 21)
PREPARED FOR:
PENTUCKET NORTH DEVELOPMENT LLC

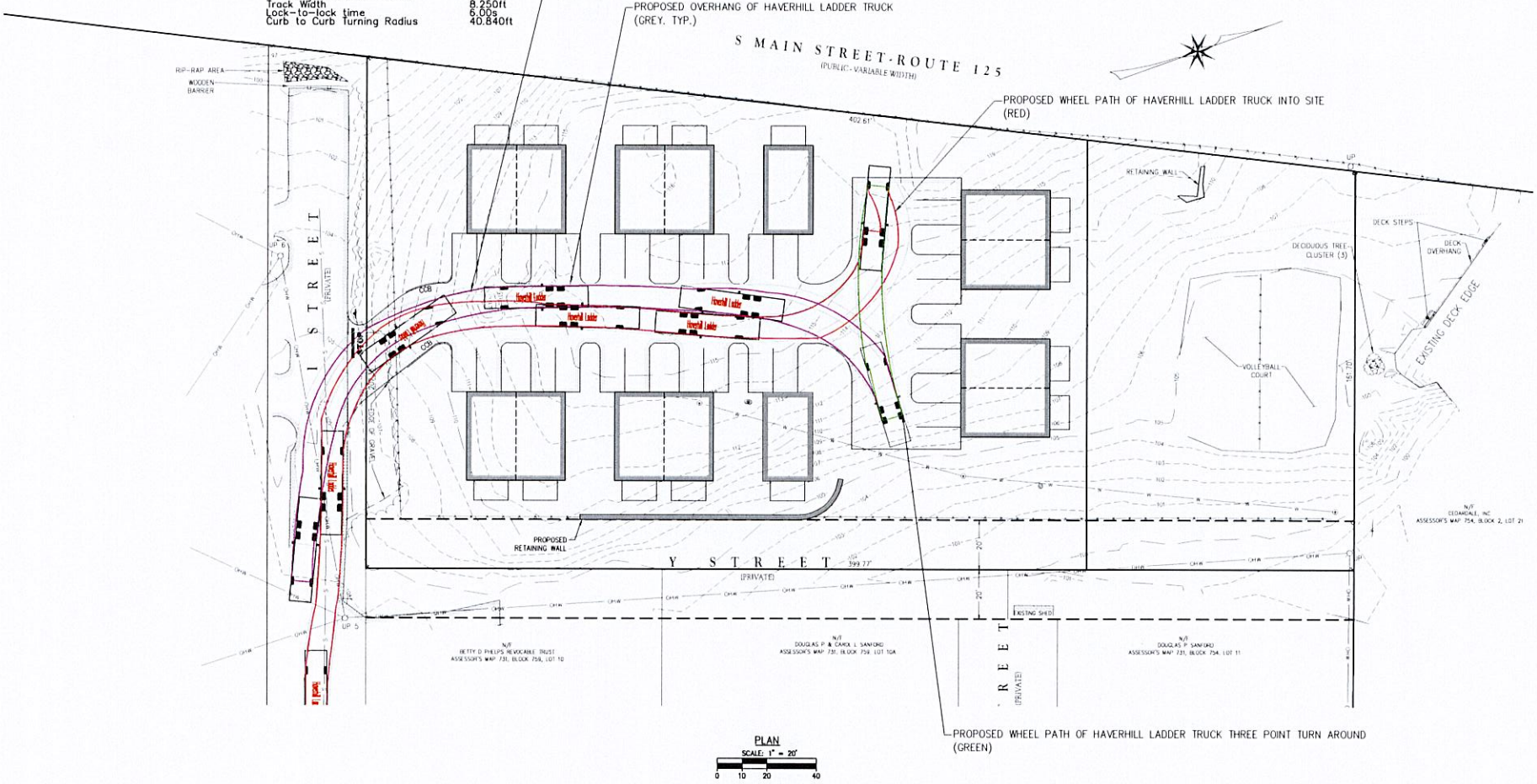
SKETCH

DRAWING NO. 1 OF 1

PROJ. #4316
DRAWING: 4316_Roadway.dwg




| Haverhill Ladder | |
|---|---|
| Overall Length | 42.000ft |
| Overall Width | 8.750ft |
| Overall Body Height | 10.601ft |
| Min Body Ground Clearance | 0.906ft |
| Track Width | 8.250ft |
| Lock-to-lock time | 6.00s |
| Curb to Curb Turning Radius | 40.840ft |




PLAN
SCALE: 1" = 20'
0 10 20 40

The Morin-Cameron GROUP, INC.
CIVIL ENGINEERS | ENVIRONMENTAL CONSULTANTS
LANDSCAPE ARCHITECTS | LAND SURVEYORS
16 J.W. PEIRCE | DANVERS, MASSACHUSETTS 01923
T: 978-777-8381 | W: WWW.MORIN-CAMERON.COM

| REVISIONS | | |
|---|---|---|
| NO. | DESCRIPTION | DATE |

SURVEY BY: SR / TP
DRAFTED BY: WAS/DTS
CHECKED BY: WAS
APPROVED BY: SPC
SCALE: 1"=20'
DATE: FEBRUARY 13, 2026

SITE PLAN OF LAND
IN
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(ASSESSOR'S MAP 754, BLOCK 2, LOT 21)
PREPARED FOR
RONALD J MAILLOUX SR.

SWEPT PATH ANALYSIS

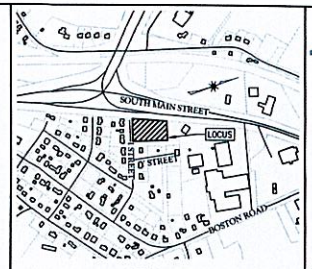
DRAWING NO.
1 OF 1

PROJ: #4316
DRAWING: 4316_MAIN.dwg

# SITE DEVELOPMENT PLANS

## FOR A
## MULTI-FAMILY DEVELOPMENT
## LOCATED AT
## 931 BOSTON ROAD
## HAVERHILL, MASSACHUSETTS

(PORTION OF ASSESSOR'S MAP 754, BLOCK 2, LOT 21)

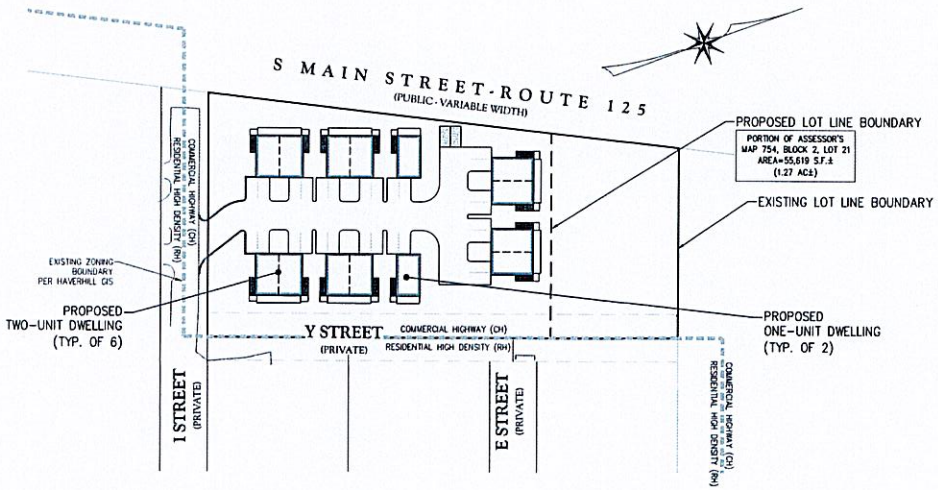



LOCUS MAP
SCALE: 1"=500'±

SCHEDULE OF PLAN SET DRAWINGS:


| | |
|---|---|
| SHEET 1 OF 11 | COVER SHEET |
| SHEET 2 OF 11 | SITE CONTEXT PLAN |
| SHEET 3 OF 11 | EXISTING CONDITIONS PLAN |
| SHEET 4 OF 11 | SITE PREPARATION & EROSION CONTROL |
| SHEET 5 OF 11 | SITE LAYOUT PLAN |
| SHEET 6 OF 11 | GRADING, DRAINAGE & UTILITY PLAN |
| SHEET 7 OF 11 | DETAILS |
| SHEET 8 OF 11 | DETAILS |
| SHEET 9 OF 11 | STORMWATER DETAILS |
| SHEET 10 OF 11 | STORMWATER DETAILS |
| SHEET 11 OF 11 | STORMWATER DETAILS |
| SHEET A0.0 | SITE PLAN |
| SHEET A1.1 | 1ST FLOOR PLAN DUPLEX BUILDING |
| SHEET A1.2 | 2ND FLOOR PLAN DUPLEX BUILDING |
| SHEET A1.3 | 3RD FLOOR PLAN DUPLEX BUILDING |
| SHEET A1.4 | ROOF PLAN DUPLEX BUILDING |
| SHEET A2.1 | ELEVATIONS DUPLEX BUILDING |
| SHEET A2.2 | ELEVATIONS DUPLEX BUILDING |
| SHEET A2.3 | STREET ELEVATIONS |
| SHEET A1.1B | 1ST & 2ND FLOOR PLAN SINGLE BUILDING |
| SHEET A1.2B | 3RD FLOOR & ROOF PLAN SINGLE BUILDING |
| SHEET A2.1B | ELEVATIONS SINGLE BUILDING |
| SHEET L-100 | LANDSCAPE PLAN |


ZONING DISTRICT: COMMERCIAL HIGHWAY (CH)
PROPOSED ZONING DISTRICT: PLANNED RESIDENTIAL DEVELOPMENT DISTRICT (PDD)
(PENDING CITY COUNCIL APPROVAL)




PLAN
SCALE: 1" = 50'
0 25 50 100

APPLICANT:
PENTUCKET NORTH DEVELOPMENT LLC
C/O RONALD J. MALLOUX SR.
55 CHASE STREET
METHUEN, MA 01844

OWNER:
CEDARDALE, INC
931 BOSTON ROAD
HAVERHILL, MA 01835
BOOK 6023, PAGE 614

CIVIL ENGINEER/SURVEYOR:
THE MORIN-CAMERON GROUP, INC.
66 ELM STREET
DANVERS, MA 01923
PHONE: 978-777-8586

ARCHITECT:
SCOTT BROWN ARCHITECTS
48 MARKET STREET
NEWBURYPORT, MA 01950
PHONE: 978-465-3535

LANDSCAPE DESIGNER:
CORLISS LANDSCAPE & IRRIGATION
31 ESSEX ROAD
IPSWICH, MA 01938
PHONE: 978-356-4224

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UTILITIES UNDERGROUND PLANT DAMAGE PREVENTION SYSTEM

NOTE:
UNDERGROUND UTILITIES SHOWN ON THIS PLAN ARE BASED UPON VISIBLE ABOVE GROUND UTILITIES AND RECORD INFORMATION OF BELOW GROUND UTILITIES AND ARE APPROXIMATE ONLY. CONTRACTOR IS RESPONSIBLE FOR TAKING ALL NECESSARY PRECAUTIONS BEFORE BEGINNING ANY EXCAVATION.


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LAND SURVEYORS | LAND USE PLANNERS
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P. 978-777-8586, W. WWW.MORINCAMERON.COM


COMMONWEALTH OF MASSACHUSETTS WILLIAM SCOTT CAMERON No. 36844 REGISTERED PROFESSIONAL ENGINEER

| REVISIONS | | |
|---|---|---|
| NO. | DESCRIPTION | DATE |
| 1 | PEER REVIEW & CITY COMMENTS | 9/30/2026 |

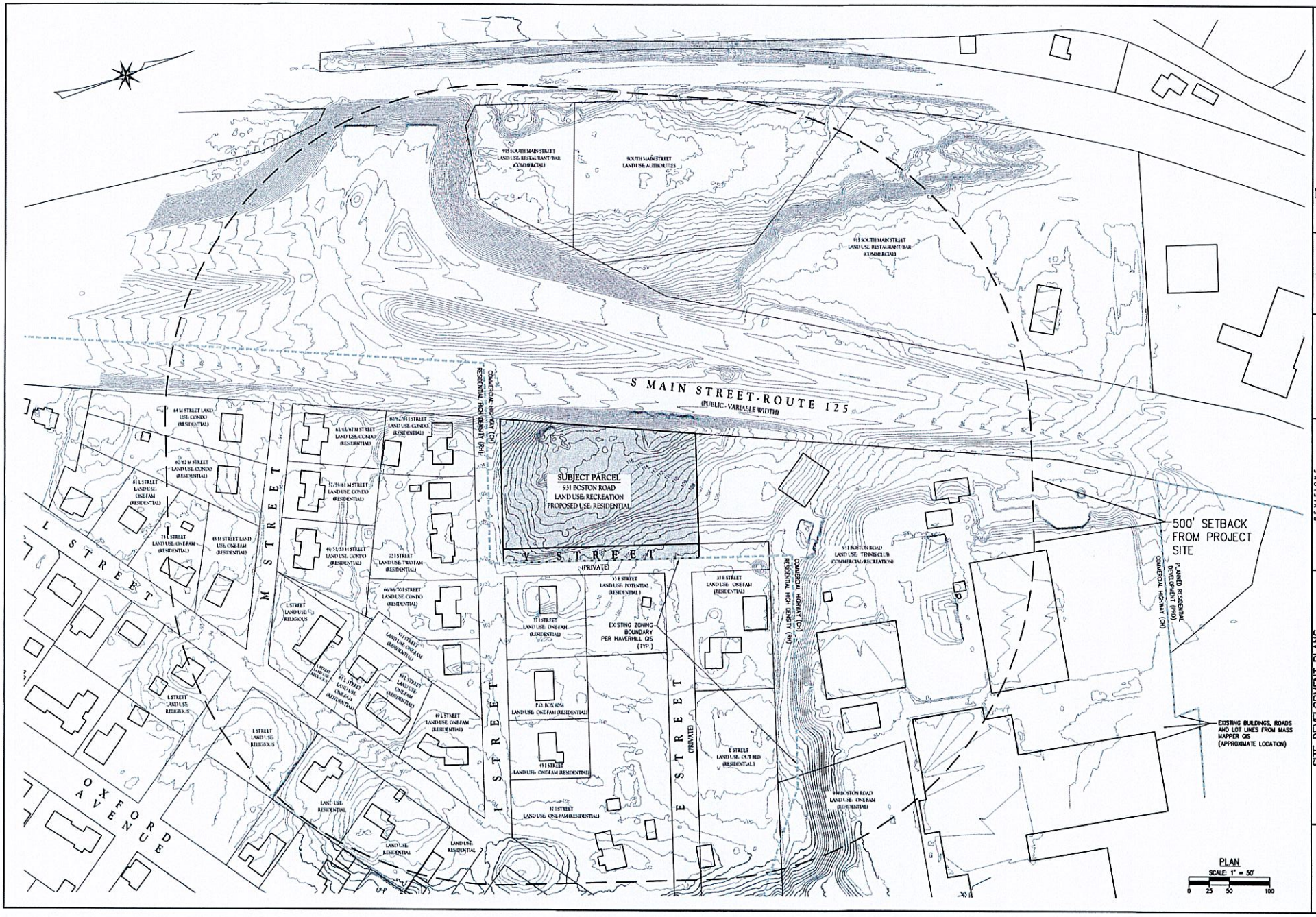
SURVEY BY: MCG
DRAFTED BY: DTS
CHECKED BY: WAS
APPROVED BY: SPC
SCALE: AS NOTED
DATE: APRIL 28, 2026

SITE DEVELOPMENT PLANS
IN
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(PORTION OF ASSESSOR'S MAP 754, BLOCK 2, LOT 21)
PREPARED FOR:
PENTUCKET NORTH DEVELOPMENT LLC

COVER SHEET

DRAWING NO. 1 OF 11

PROJ. #4316
DRAWING: 4316_MAIN.dwg

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APPROVED BY: SPC
SCALE: AS NOTED
DATE: APRIL 29, 2025

SITE DEVELOPMENT PLANS
IN
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(PORTION OF ASSESSOR'S MAP 754, BLOCK 2, LOT 21)
PREPARED FOR:
PENTUCKET NORTH DEVELOPMENT LLC

SITE CONTEXT PLAN

DRAWING NO. 2 OF 11

PROJ. #4316
DRAWING: 4316_MAIN.dwg

## LEGEND

CONTOURS
- MAJOR
- MINOR
- CHAIN LINK FENCE
- FIRE HYDRANT
- GUY WIRE
- IRRIGATION CONTROL VALVE
- LIGHT POLE
- OVERHEAD WIRE
- PROPERTY LINE
- SANITARY SEWER MANHOLE
- SANITARY SEWER MAIN/SERVICE
- SQUARE CATCH BASIN
- STORM SEWER/DRAINAGE
- TREE LINE
- UTILITY POLE
- WATER GATE
- WATER SPICKET MANHOLE

## GENERAL NOTE:

1. THESE PLANS ARE PREPARED FOR OUR CLIENTS USE FOR THE SPECIFIC PURPOSE OF OBTAINING PERMITS AND LOCAL APPROVALS, AND ARE NOT TO BE USED OR RELIED UPON AS A CONSTRUCTION DOCUMENT OR ANY OTHER USE BY OTHER WITHOUT THE WRITTEN CONSENT OF THE MORIN-CAMERON GROUP, INC.

## PLAN NOTES:

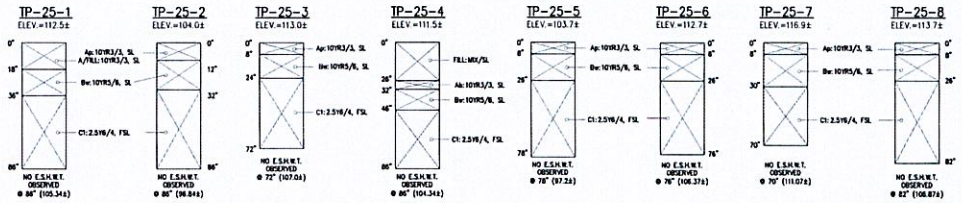
1. THE EXISTING CONDITIONS DEPICTED HEREON ARE BASED ON INFORMATION PROVIDED BY ON THE GROUND SURVEY BY THE MORIN-CAMERON GROUP, INC., ON AUGUST 19, 2025.
2. ABUTTER INFORMATION SHOWN HEREON WAS TAKEN FROM THE HAVERHILL GIS DATABASE.
3. THE PROPERTY BOUNDARY IS BASED ON A PLAN ENTITLED "PLAN OF LAND, LOCATED IN HAVERHILL, MA" PREPARED BY CHRISTIANSEN & SERGI, DATED JANUARY 6, 1998 AND RECORDED AT THE SOUTH ESSEX DISTRICT REGISTRY OF DEEDS IN BOOK 16530, PAGE 429.
4. ELEVATIONS HERON REFER TO VERTICAL DATUM NAVD88.
5. PROJECT SITE LOCATED WITHIN ZONING AREA COMMERCIAL HIGHWAY (CH).
6. PROJECT SITE IS NOT LOCATED WITHIN A WETLANDS AREA.
7. PROJECT SITE IS NOT LOCATED WITHIN A FEMA FLOOD ZONE.

## FLOOD NOTE:

THE SUBJECT PROPERTY IS LOCATED IN A ZONE X: AREA OF MINIMAL FLOOD HAZARD ABOVE 500-YEAR FLOOD LEVEL AS ILLUSTRATED ON THE FLOOD INSURANCE RATE MAP COMMUNITY PANEL NO. 25009C0088G, WHICH HAS AN EFFECTIVE DATE OF JULY 8, 2025.

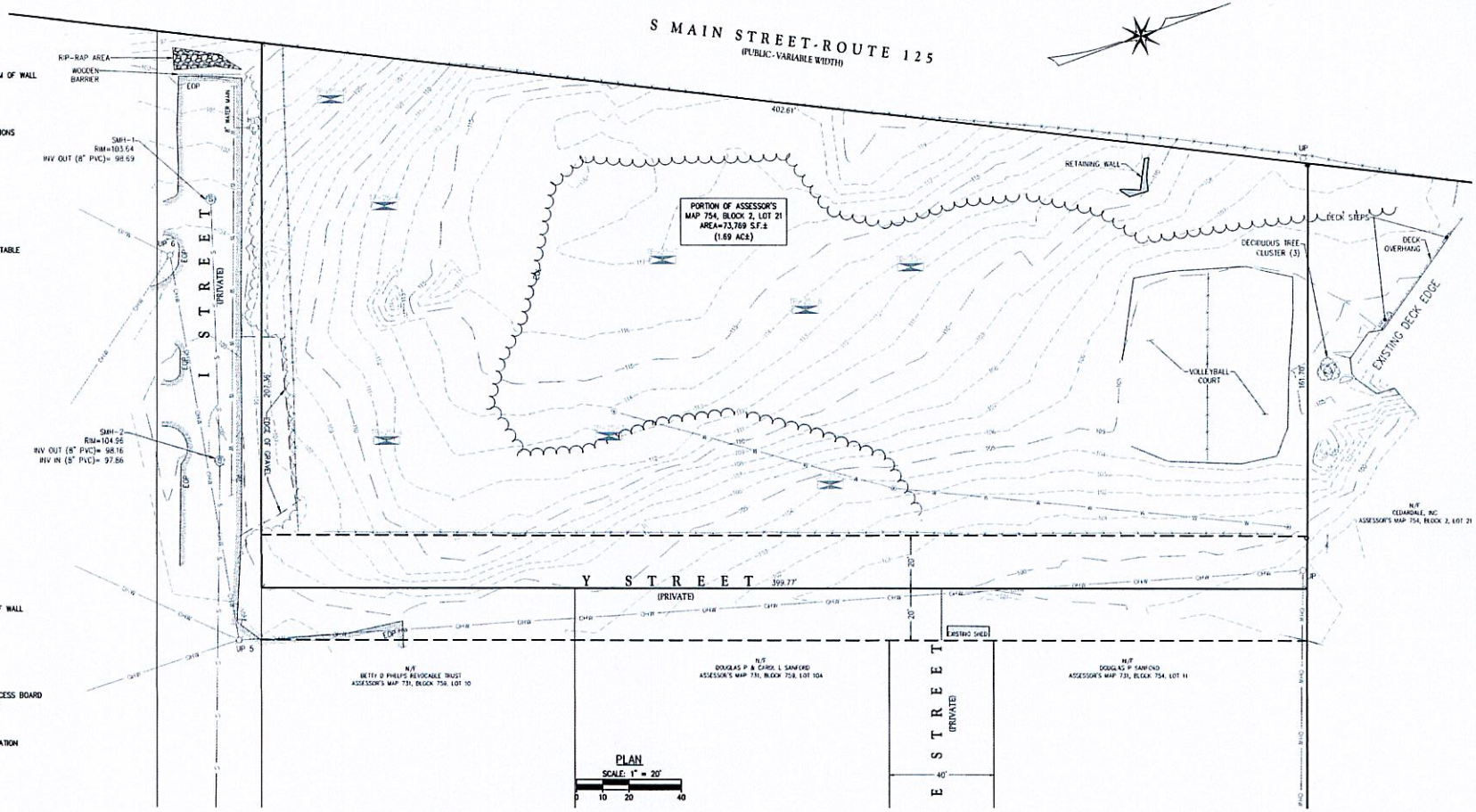
## SOIL LOGS

DATE PERFORMED: NOVEMBER 13, 2025
PERFORMED BY: WILL SCHKUTA, SE #14030




## ABBREVIATIONS:

| | |
|---|---|
| AC | ACRES |
| APPROX | APPROXIMATE |
| BIT | BITUMINOUS |
| BLDG | BUILDING |
| BVW | BORDERING VEGETATED WETLAND |
| BW | FINISH GRADE ADJACENT TO BOTTOM OF WALL |
| CCB | CAPE COD BERM |
| CB | CATCH BASIN |
| CF | CUBIC FEET |
| CI | CAST IRON |
| CLDI | CEMENT LINED DUCTILE IRON |
| CMR | CODE OF MASSACHUSETTS REGULATIONS |
| CONC | CONCRETE |
| CY | CUBIC YARD |
| DI | DUCTILE IRON |
| DIA | DIAMETER |
| DMH | DRAIN MANHOLE |
| DS | DOWNSTREAM |
| DYL | DOUBLE YELLOW LINE |
| ELEC | ELECTRIC |
| EL/ELEV | ELEVATION |
| EOG | EDGE OF GRAVEL |
| EOP | EDGE OF PAVEMENT |
| ESHWT | ESTIMATED SEASONAL HIGH WATER TABLE |
| EXIST | EXISTING |
| FG | FINAL GRADE |
| FT | FEET |
| GAR | GARAGE |
| GG | GAS GATE |
| HDPE | HIGH DENSITY POLYETHYLENEL |
| ID | INNER DIAMETER |
| IN | INCH |
| INV | INVERT |
| L | LENGTH |
| LB | POUNDS |
| MAX | MAXIMUM |
| MCC | MONOLITHIC CONCRETE CURB |
| MIN | MINIMUM |
| N/F | NOW OR FORMERLY |
| OC | ON CENTER |
| OHW | OVERHEAD WIRES |
| PE | POLYETHYLENE |
| ± | PLUS OR MINUS |
| PCC | PRECAST CONCRETE CURB |
| RGP | RIGID CONCRETE PIPE |
| REC | RECORD |
| PROP | PROPOSED |
| PSI | POUNDS PER SQUARE INCH |
| PVC | POLYVINYL CHLORIDE |
| R | RADIUS |
| RC | RELATIVE COMPACTION |
| REQ'D | REQUIRED |
| ROW | RIGHT OF WAY |
| S | SLOPE |
| SF | SQUARE FEET |
| SGO | SAND, GAS AND OIL SEPARATOR |
| SMH | SEWER MANHOLE |
| SQ | SQUARE |
| TBD | TO BE DETERMINED |
| TC | TOP OF CURB/TRANSITION CURB |
| TW | FINISH GRADE ADJACENT TO TOP OF WALL |
| TYP | TYPICAL |
| UGE | UNDERGROUND ELECTRIC |
| UNK | UNKNOWN |
| VAR | VARIANCE |
| VGC | VERTICAL GRANITE CURB |
| VIF | VERIFY IN FIELD |
| LSA | LANDSCAPE AREA |
| LF | LINEAR FEET |
| MAAB | MASSACHUSETTS ARCHITECTURE ACCESS BOARD |
| MEP | MECHANICAL ELECTRICAL PLUMBING |
| MCC | MONOLITHIC CONCRETE CURB |
| MIL | MILLIMETER |
| NF | NOT FOUND |
| NFPA | NATIONAL FIRE PROTECTION ASSOCIATION |
| US | UPSTREAM |
| WF | WETLAND FLAG |
| WG | WATER GATE |
| WQU | WATER QUALITY UNIT |
| WSO | WATER SHUTOFF |
| W/ | WITH |

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APPROVED BY: SPC
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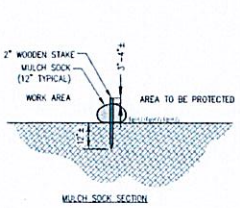
| REVISIONS | | |
|---|---|---|
| NO. | DESCRIPTION | DATE |
| 1 | PEER REVIEW & CITY COMMENTS | 9/30/2026 |

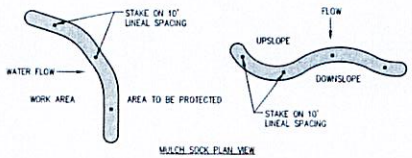
# SITE DEVELOPMENT PLANS
IN
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(PORTION OF ASSESSOR'S MAP 754, BLOCK 2, LOT 21)
PREPARED FOR:
PENTUCKET NORTH DEVELOPMENT LLC

EXISTING CONDITIONS PLAN

DRAWING NO. 3 OF 11

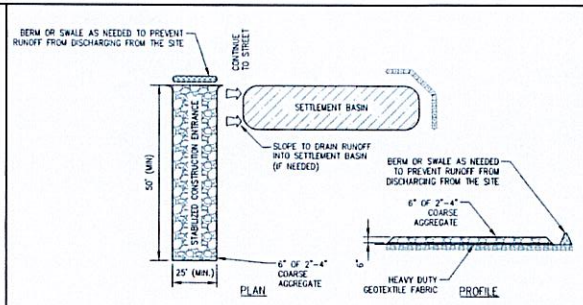
PROJ. #4316
DRAWING: 4316_MAIN.dwg



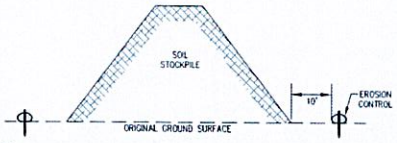

NOTES:
1. MULCH CAN BE SUBSTITUTED WITH COMPOST.
2. WRAP SHALL BE CUT & REMOVED AFTER STABILIZATION IS ESTABLISHED. MULCH TO REMAIN.

## MULCH SOCK
(NOT TO SCALE)



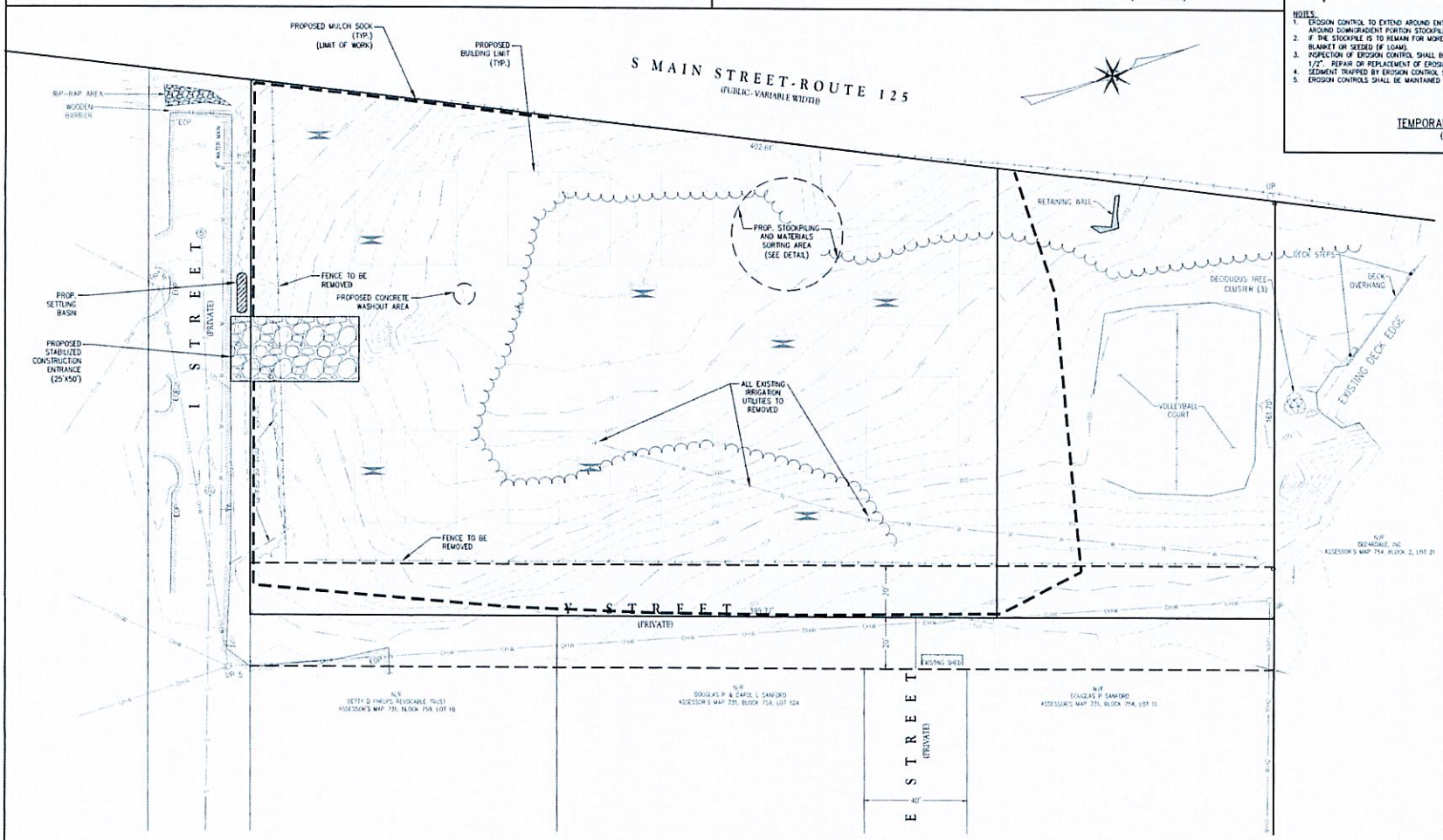

SITE CONSTRUCTION EXIT SPECIFICATIONS:
1. STONE FOR STABILIZATION CONSTRUCTION ENTRANCE SHALL BE 2"-4" STONE.
2. THE LENGTH OF THE STABILIZED ENTRANCE SHALL NOT BE LESS THAN 40 FEET.
3. THE WIDTH OF THE ENTRANCE SHALL BE NO LESS THAN THE WIDTH OF THE INGRESS OR EGRESS DRIVE, OR 16 FEET, WHICHEVER IS GREATER.
4. GEOTEXTILE FILTER FABRIC SHALL BE PLACED OVER THE ENTIRE AREA PRIOR TO PLACING STONE.
5. ALL SURFACE WATER THAT IS FLOWING TO OR DIVERTED TOWARDS THE CONSTRUCTION ENTRANCE SHALL BE PIPED BENEATH THE ENTRANCE. IF PIPING IS IMPRACTICAL, A BERM WITH MINIMUM 1 TO 5 SLOPES THAT CAN BE CROSSED BY VEHICLES CAN BE SUBSTITUTED.
6. THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO RIGHTS OF WAY. THIS MAY REQUIRE PERIODIC TOPDRESSING WITH ADDITIONAL STONE AS CONDITIONS DEMAND AND REPAIR AND/OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT. SEDIMENT SPILLED, WASHED OR TRACKED ONTO THE RIGHT OF WAY MUST BE REMOVED IMMEDIATELY.

## STABILIZED CONSTRUCTION ENTRANCE DETAIL
(NOT TO SCALE)




NOTES:
1. EROSION CONTROL TO EXTEND AROUND ENTIRE PERIMETER OF STOCKPILE IF ON LEVEL GROUND OR TO EXTEND AROUND DOWNGRADIENT PORTION STOCKPILE IS ON SLOPE.
2. IF THE STOCKPILE IS TO REMAIN FOR MORE THAN 14 DAYS IT SHALL BE STABILIZED WITH AN EROSION CONTROL BLANKET OR SEEDED (IF LOAM).
3. INSPECTION OF EROSION CONTROL SHALL BE AT LEAST ONCE PER WEEK AND AFTER RAIN EVENTS IN EXCESS OF 1/2". REPAIR OR REPLACEMENT OF EROSION CONTROL SHALL BE MADE PROMPTLY AS NEEDED.
4. SEDIMENT TRAPPED BY EROSION CONTROL SHALL BE REMOVED AND PROPERLY DISPOSED OF.
5. EROSION CONTROLS SHALL BE MAINTAINED UNTIL STOCKPILE IS ELIMINATED.

## TEMPORARY SOIL STOCKPILE
(NOT TO SCALE)




PLAN
SCALE: 1" = 20'
0 10 20 40

The Morin-Cameron GROUP, INC.
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14 CHESTNUT STREET, HAVERHILL, MASSACHUSETTS 01832
P 978-777-0500 W WWW.MORINCAMERON.COM

COMMONWEALTH OF MASSACHUSETTS WILLIAM D. MORIN III No. 36618 REGISTERED PROFESSIONAL ENGINEER

| NO. | REVISIONS DESCRIPTION | DATE |
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| 1 | PEER REVIEW & CITY COMMENTS | 9/30/2025 |

SURVEY BY: MCG
DRAFTED BY: DTS
CHECKED BY: WAS
APPROVED BY: SPC
SCALE: AS NOTED
DATE: APRIL 28, 2025

SITE DEVELOPMENT PLANS
IN
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(PORTION OF ASSESSOR'S MAP 754, BLOCK 2, LOT 21)
PREPARED FOR:
PENTUCKET NORTH DEVELOPMENT LLC

SITE PREPARATION & EROSION CONTROL

DRAWING NO. 4 OF 11

PROJ. #4316
DRAWING: 4316_MAIN.dwg

## PLANNED DEVELOPMENT (PD) SUBMITTAL TABLE

| | |
|---|---|
| TOTAL LAND AREA | 55,620 SF |
| DEVELOPABLE SITE AREA | 55,620 SF |
| COMMON OR USABLE OPEN SPACE | 28,640 SF |
| SITE COVERAGE OF BUILDINGS | 10,080 SF |
| IMPERVIOUS SURFACE AREA | 23,788 SF |
| IMPERVIOUS SURFACE RATIO | 0.428 (42.8%) |
| GROSS FLOOR AREA OF ALL NON RESIDENTIAL BUILDINGS | 0 SF |
| FLOOR AREA RATIO | 0.181 (18.1%) |
| DENSITY OF DWELLING UNITS | 3,972± SF/UNIT |
| NUMBER OF OFF-STREET PARKING SPACES | 28 SPACES |

## BUILDING HEIGHTS

| BUILDING | (A) AVERAGE FINISHED GRADE ELEVATION BASED ON BUILDING CORNERS (FT) | (B) GARAGE ENTRANCE ELEVATION (FT) | (C) MEAN ROOF HEIGHT ABOVE GARAGE ENTRANCE ELEVATION (FT) | (D) ELEVATION OF MEAN ROOF HEIGHT (FT) (B+C) | PROPOSED BUILDING HEIGHT (FT) (D–A) |
|---|---|---|---|---|---|
| 1 | 110.10 | 110.7 | 28.10 | 138.80 | 28.70 |
| 2 | 113.90 | 113.0 | 28.10 | 141.10 | 27.20 |
| 3 | 115.60 | 115.3 | 25.75 | 141.05 | 25.45 |
| 4 | 117.10 | 116.2 | 28.10 | 144.30 | 27.20 |
| 5 | 115.10 | 114.7 | 28.10 | 142.80 | 27.70 |
| 6 | 115.30 | 115.3 | 25.75 | 141.05 | 25.75 |
| 7 | 114.00 | 113.0 | 28.10 | 141.10 | 27.10 |
| 8 | 110.00 | 109.0 | 28.10 | 137.10 | 27.10 |

### BUILDING HEIGHT NOTE:

BUILDING HEIGHT IS CALCULATED AS THE VERTICAL DISTANCE FROM THE AVERAGE FINISHED GRADE (AVERAGE OF FINISHED GROUND ELEVATION AT THE MAIN CORNERS OF THE STRUCTURE) TO THE HIGHEST POINT OF THE ROOF: TOP OF THE HIGHEST ROOF BEAM (FLAT ROOF), DECK OF A MANSARD ROOF, OR MEAN LEVEL BETWEEN EAVES AND RIDGE (GABLE, HIP, SHED, GAMBREL, PYRAMID, OR SIMILAR ROOFS). MAXIMUM ALLOWABLE HEIGHTS ARE ESTABLISHED IN TABLE 2 (DIMENSIONAL REGULATIONS) BY ZONING DISTRICT. DEFINITION PER HAVERHILL ZONING ORDINANCE § 11.0 (DEFINITIONS).

### SNOW STORAGE NOTE:

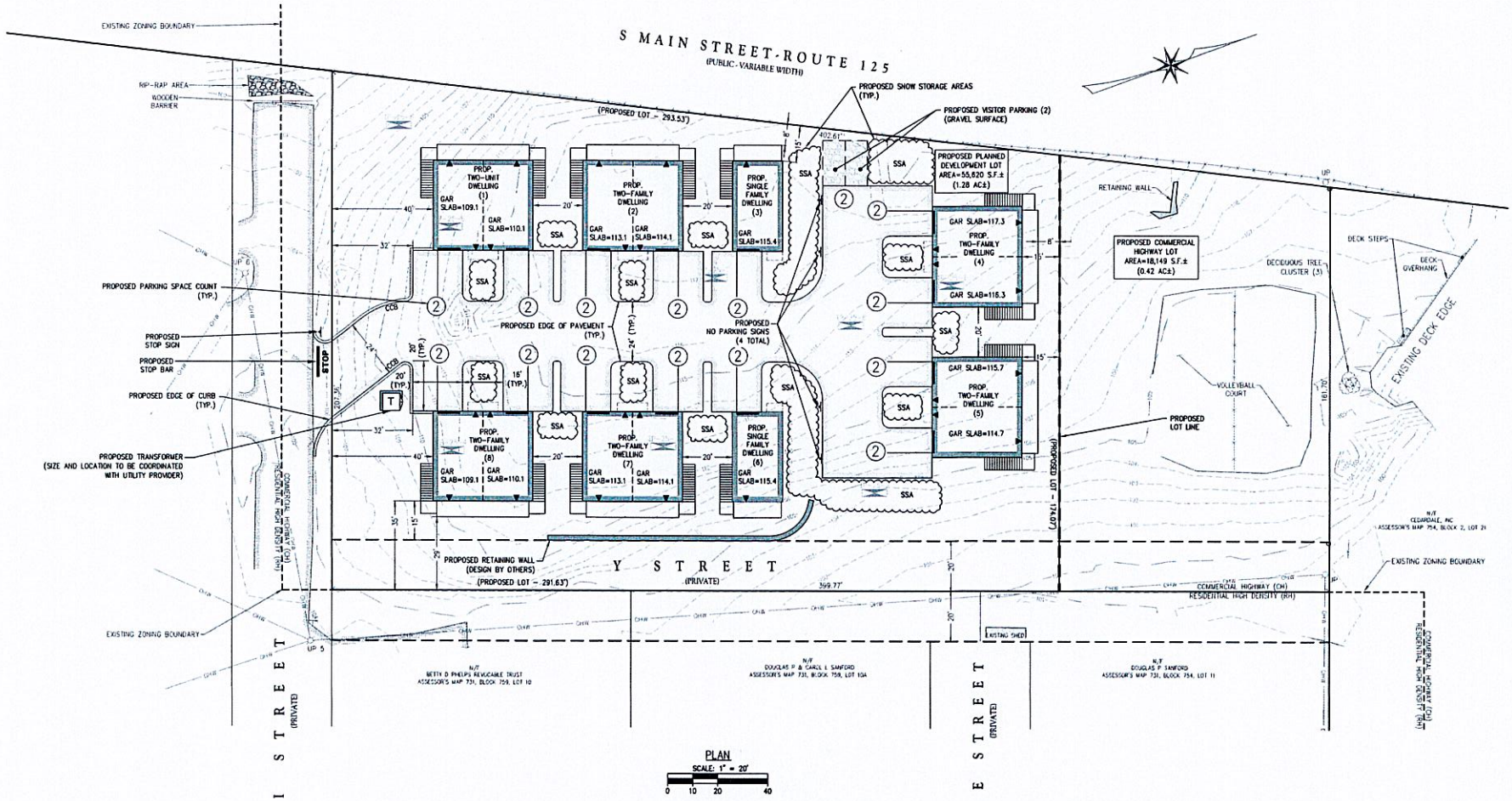
EXCESS SNOW TO BE REMOVED FROM THE SITE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE AND LOCAL REGULATIONS.

### PARKING SPACE COUNT SUMMARY

| | NUMBER OF SPACES |
|---|---|
| SURFACE (RESIDENTS) | 28 |
| SURFACE (VISITORS) | 2 |
| GARAGE | 14 |
| RATIO (14 UNITS) | 3.14 SPACES/ UNIT |

## ZONING TABLE – PLANNED DEVELOPMENT (PD)

| SETBACK | RESIDENTIAL HIGH DENSITY (RH) 1-FAM | RESIDENTIAL HIGH DENSITY (RH) 2-FAM | COMMERCIAL HIGHWAY (CH) | PROPOSED PD LOT |
|---|---|---|---|---|
| LOT AREA (MIN.) | 7,500 SF | 9,600 SF | 22,500 SF | 55,620 SF± |
| LOT AREA REQUIRED PER DWELLING UNIT (MIN.) | N/A | N/A | N/A | 3,972 SF± |
| LOT FRONTAGE (MIN.) | 75' | 80' | 175' | 207.36' |
| LOT DEPTH (MIN.) | 100' | 100' | 100' | 291' |
| FRONT SETBACK (MIN.) | 20' | 20' | 30' | 40' |
| SIDE SETBACK (MIN.) | 10' | 10' | 15' | 15' |
| REAR SETBACK (MIN.) | 30' | 30' | 15' | 15' |
| BUILDING HEIGHT (MAX.) | 35' | 35' | 40' | <40' |
| BUILDING HEIGHT – STORIES (MAX.) | 2.5 | 2.5 | 3.5 | <3.5 |
| BUILDING COVERAGE (%, MAX.) | 25% | 25% | NONE | 18.1% |
| FLOOR AREA RATIO (FAR, MAX.) | N/A | N/A | 0.50 | <0.50 |
| OPEN SPACE, (%, MIN.) | 45% | 45% | 25% | 51% |




PLAN
SCALE: 1" = 20'
0 10 20 40

The Morin-Cameron GROUP, INC.
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SURVEY BY: MCG
DRAFTED BY: DTS
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SITE DEVELOPMENT PLANS
IN
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(PORTION OF ASSESSOR'S MAP 754, BLOCK 2, LOT 21)
PREPARED FOR:
PENTUCKET NORTH DEVELOPMENT LLC

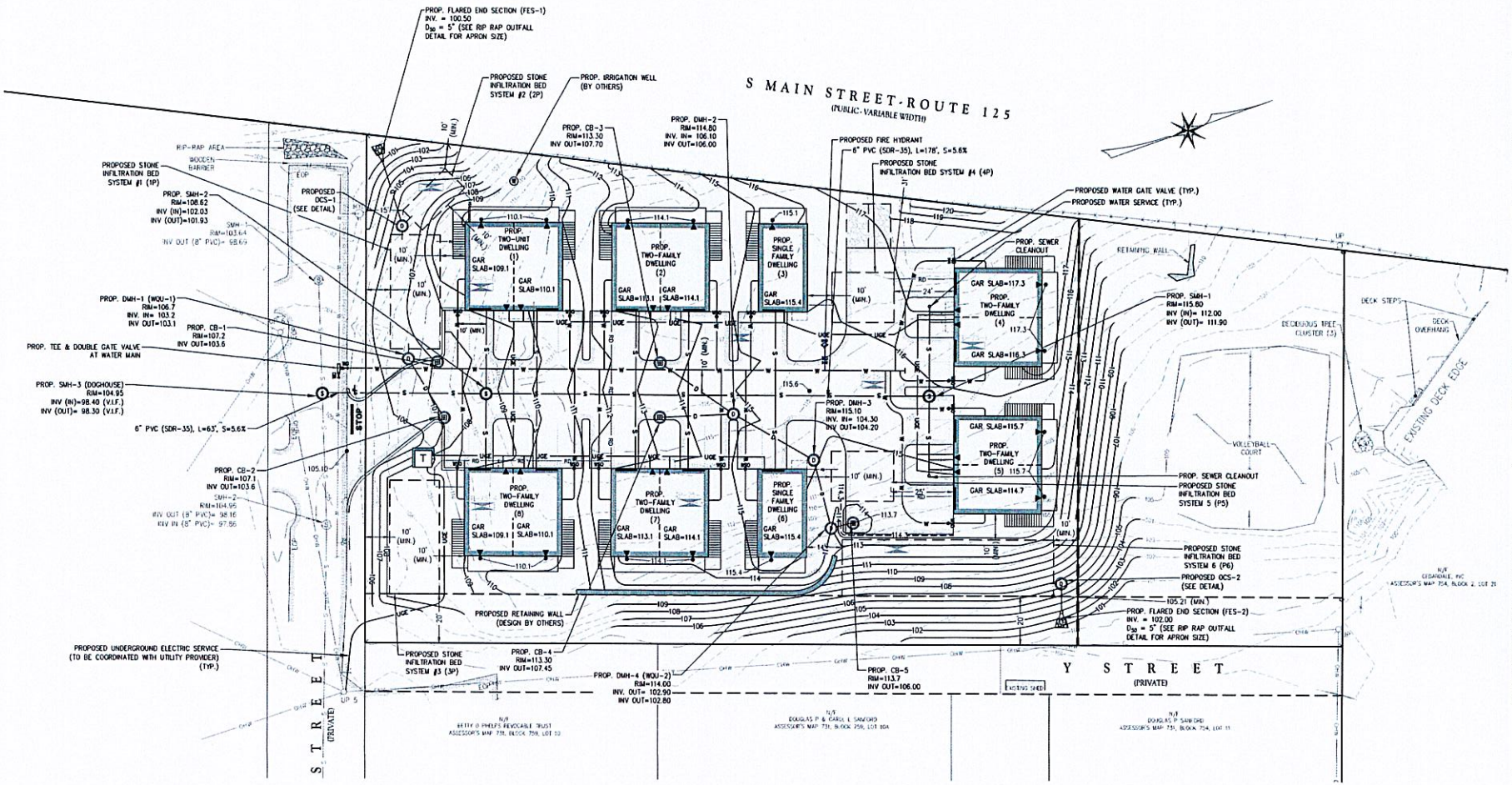
SITE LAYOUT PLAN

DRAWING NO. 5 OF 11

PROJ. #4316
DRAWING: 4316_MAIN.dwg

NOTES:

1. FINAL HYDRANT LOCATIONS TO BE COORDINATED WITH HAVERHILL FIRE DEPARTMENT.
2. FINAL ELECTRIC LOCATIONS TO BE COORDINATED WITH UTILITY PROVIDER.
2. FINAL WATER CONNECTION TO BE COORDINATED WITH HAVERHILL WATER DEPARTMENT.
3. ALL ROOF STORMWATER TO BE DIRECTED TO STORMWATER SYSTEMS. FINAL CONNECTIONS TO BE COORDINATED WITH ARCHITECTURAL PLANS.




PLAN
SCALE: 1" = 20'
0 10 20 40

The Morin-Cameron GROUP, INC.
CIVIL ENGINEERS | ENVIRONMENTAL CONSULTANTS
LAND SURVEYORS | LANDSCAPE ARCHITECTS
86 ELM STREET, SALEM, MASSACHUSETTS 01970
P: 978-777-5068, W: WWW.MORIN-CAMERON.COM

COMMONWEALTH OF MASSACHUSETTS
WILLIAM SCHMITZ
No. 50705
PROFESSIONAL ENGINEER

| REVISIONS | | |
|---|---|---|
| NO. | DESCRIPTION | DATE |
| 1 | PEER REVIEW & CITY COMMENTS | 9/30/2026 |

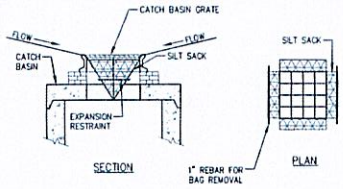
SURVEY BY: MCG
DRAFTED BY: DTS
CHECKED BY: WAS
APPROVED BY: SPC
SCALE: AS NOTED
DATE: APRIL 28, 2026

SITE DEVELOPMENT PLANS
IN
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(PORTION OF ASSESSOR'S MAP 754, BLOCK 2, LOT 21)
PREPARED FOR:
PENTUCKET NORTH DEVELOPMENT LLC

GRADING, DRAINAGE & UTILITIES

DRAWING NO. 6 OF 11

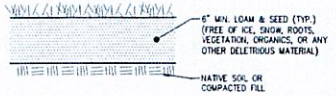
PROJ. #4316
DRAWING: 4316_MAIN.dwg



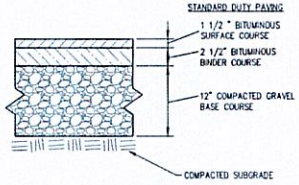

SILT SACK NOTES:

1. INSTALL SILT SACKS IN EXISTING CATCH BASINS. INSTALL SILT SACKS IN NEW CATCH BASINS AFTER INSTALLATION.
2. GRATES TO BE PLACED OVER SILT SACKS.
3. SILTSACK SHALL BE INSPECTED PERIODICALLY AND AFTER ALL STORM EVENTS AND CLEANING OR REPLACEMENT SHALL BE PERFORMED WHEN DEPTH OF SEDIMENT IS WITHIN 6" OF GRATE.

SILT SACK
(NOT TO SCALE)



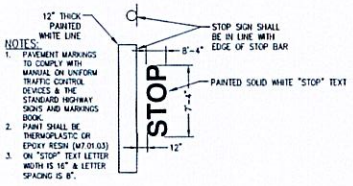

LOAM & SEED
(NOT TO SCALE)




NOTES:

1. PAVEMENT SHALL BE TYPE 1, CLASS 1, BITUMINOUS CONCRETE
2. PAVEMENT THICKNESS AFTER ROLLING.
3. SUBSOILS TO BE INSPECTED PRIOR TO INSTALLATION OF PAVEMENT SUBBASE. IF UNCOMPACTED FILL OR UNSUITABLE SOIL IS PRESENT, IT SHALL BE REMOVED TO UNDISTURBED NATIVE SOIL AND REPLACED WITH STRUCTURAL FILL COMPACTED TO 95% R.C.

TYPICAL PAVEMENT SECTION
(NOT TO SCALE)

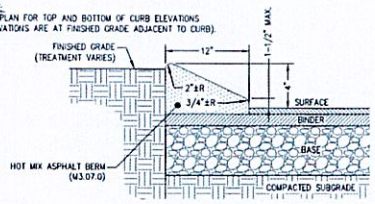



NOTES:

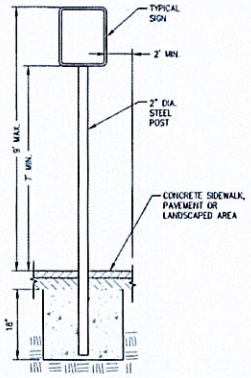
1. PAVEMENT MARKINGS TO COMPLY WITH MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES & THE STANDARD HIGHWAY SIGNS AND MARKINGS BOOK.
2. PAINT SHALL BE THERMOPLASTIC OR EPOXY RESIN (M7.01.03)
3. ON "STOP" TEXT LETTER WIDTH IS 16" & LETTER SPACING IS 8".

STOP BAR
(NOT TO SCALE)

NOTE:
SEE PLAN FOR TOP AND BOTTOM OF CURB ELEVATIONS (ELEVATIONS ARE AT FINISHED GRADE ADJACENT TO CURB).



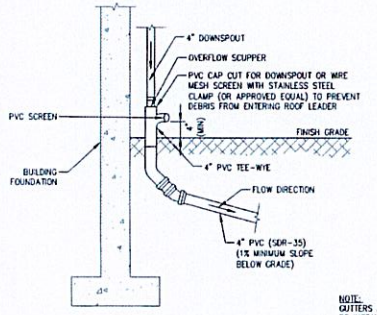

CAPE COD BERM
(NOT TO SCALE)




SIGN POST FOR SIGNS IN PARKING AREAS
(NOT TO SCALE)

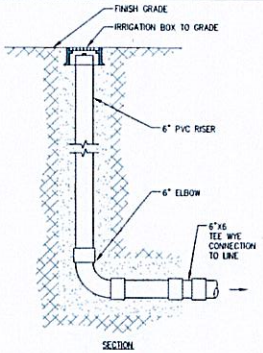
| M.U.T.C.D. LEGEND | WIDTH | HEIGHT | SYMBOL |
|---|---|---|---|
| R1-1 | 30" | 30" | STOP |

SIGN KEY
(NOT TO SCALE)

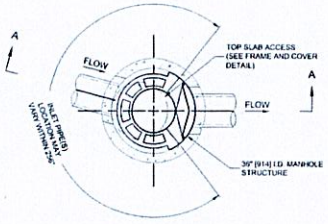



DOWN SPOUT ROOF LEADER
NOT TO SCALE

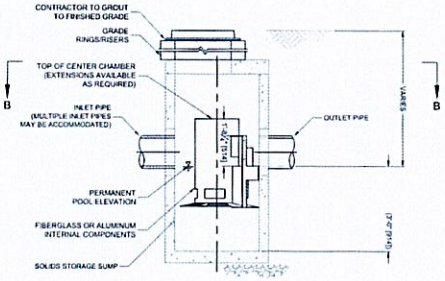
NOTE:
GUTTERS AND DOWNSPOUTS SHALL BE INSTALLED TO COLLECT ALL ROOF RUNOFF FROM THE HOUSE & CONVEY IT TO THE INFILTRATION AREAS.




SEWER CLEANOUT
(NOT TO SCALE)




PLAN VIEW B-B
NOT TO SCALE




ELEVATION A-A
NOT TO SCALE

CONTECH CS-3 (WQU-1 & WQU-2)
(NOT TO SCALE)

The Morin-Cameron GROUP, INC.
CIVIL ENGINEERS | ENVIRONMENTAL CONSULTANTS
LAND SURVEYORS | LANDSCAPE PLANNERS
18 ESE STREET, DANVERS, MASSACHUSETTS 01923
T: 978-777-8006 W: WWW.MORIN-CAMERON.COM

COMMONWEALTH OF MASSACHUSETTS — MELISSA C. WAS — No. 52811 — REGISTERED PROFESSIONAL ENGINEER

9/30/2026

SURVEY BY: MCG
DRAFTED BY: DTS
CHECKED BY: MAS
APPROVED BY: SPC
SCALE: AS NOTED
DATE: APRIL 28, 2026

REVISIONS

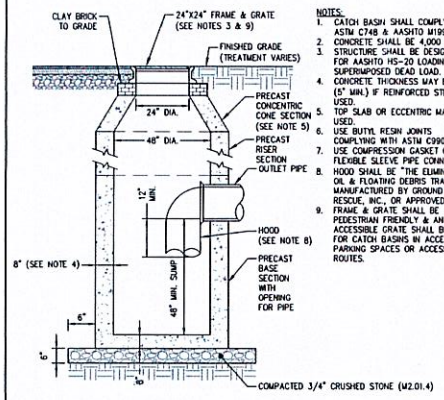
| NO. | DESCRIPTION | DATE |
|---|---|---|
| 1 | PEER REVIEW & CITY COMMENTS | 9/30/2026 |

SITE DEVELOPMENT PLANS
IN
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(PORTION OF ASSESSOR'S MAP 754, BLOCK 2, LOT 21)
PREPARED FOR:
PENTUCKET NORTH DEVELOPMENT LLC

DETAILS

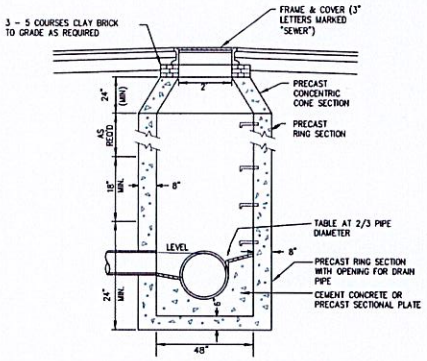
DRAWING NO. 7 OF 11

PROJ. #4316
DRAWING: 4316_MAIN.dwg



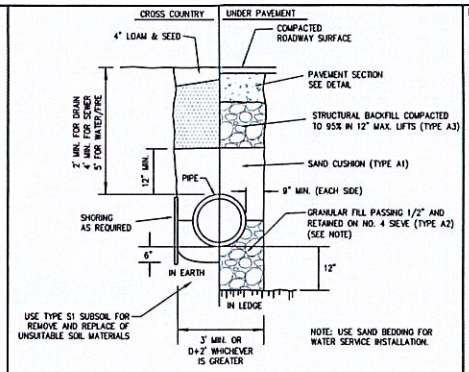

NOTES:
1. CATCH BASIN SHALL COMPLY WITH ASTM C748 & AASHTO M199.
2. CONCRETE SHALL BE 4,000 PSI MIN.
3. STRUCTURE SHALL BE DESIGNED FOR AASHTO HS-20 LOADING & SUPERIMPOSED DEAD LOAD.
4. CONCRETE THICKNESS MAY BE LESS (5" MIN.) IF REINFORCED STEEL IS USED.
5. TOP SLAB OR ECCENTRIC MAY BE USED.
6. USE BUTYL RESIN JOINTS COMPLYING WITH ASTM C990.
7. USE COMPRESSION GASKET OR FLEXIBLE SLEEVE PIPE CONNECTION.
8. HOOD SHALL BE "THE ELIMINATOR" OIL & FLOATING DEBRIS TRAP AS MANUFACTURED BY GROUND WATER RESCUE, INC., OR APPROVED EQUAL.
9. FRAME & GRATE SHALL BE PEDESTRIAN FRIENDLY & AN ACCESSIBLE GRATE SHALL BE USED FOR CATCH BASINS IN ACCESSIBLE PARKING SPACES OR ACCESSIBLE ROUTES.

CATCH BASIN
(NOT TO SCALE)



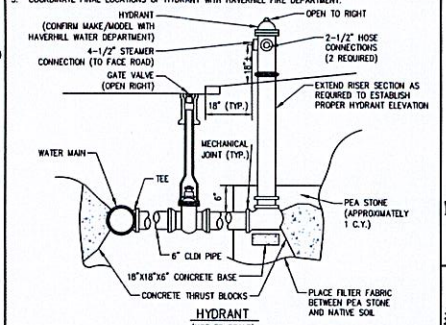

NOTE: OUTLET INVERT IS A MINIMUM 0.10' LOWER THAN INLET INVERT.

SEWER MANHOLE DETAIL
(NOT TO SCALE)

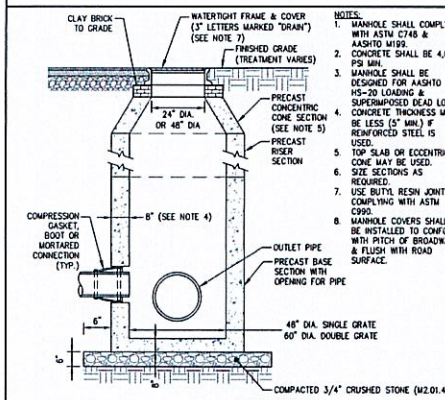



UTILITY TRENCH DETAIL
(NOT TO SCALE)

NOTES:
1. CONCRETE THRUST BLOCKS TO BE USED ONLY WHERE THEY CAN BEAR ON UNDISTURBED EARTH AS SHOWN. USE CLAMPS AND TIE RODS OR OTHER ACCEPTABLE METHOD OF JOINT RESTRAINT WHERE SOIL CONDITIONS PROHIBIT THE USE OF THRUST BLOCKS.
2. HYDRANT IN SIDEWALK AREAS TO BE LOCATED TO PROVIDE MINIMUM CLEAR SIDEWALK PASSAGE WIDTH OF 3 FEET AT HYDRANT.
3. COORDINATE FINAL LOCATIONS OF HYDRANT WITH HAVERHILL FIRE DEPARTMENT.

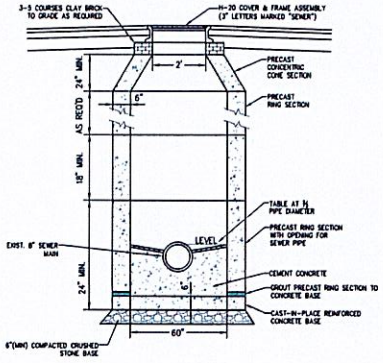



HYDRANT
(NOT TO SCALE)



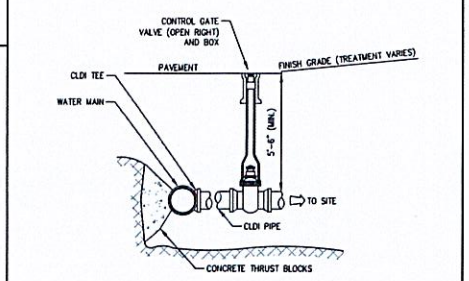

NOTES:
1. MANHOLE SHALL COMPLY WITH ASTM C748 & AASHTO M199.
2. CONCRETE SHALL BE 4,000 PSI MIN.
3. MANHOLE SHALL BE DESIGNED FOR AASHTO HS-20 LOADING & SUPERIMPOSED DEAD LOAD.
4. CONCRETE THICKNESS MAY BE LESS (5" MIN.) IF REINFORCED STEEL IS USED.
5. TOP SLAB OR ECCENTRIC CONE MAY BE USED.
6. SIZE SECTIONS AS REQUIRED.
7. USE BUTYL RESIN JOINTS COMPLYING WITH ASTM C990.
8. MANHOLE COVERS SHALL BE INSTALLED TO CONFORM WITH PITCH OF BROADWAY & FLUSH WITH ROAD SURFACE.

DRAIN MANHOLE
(NOT TO SCALE)

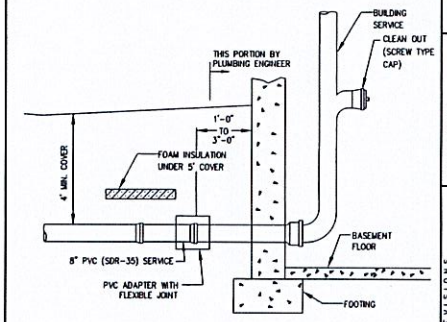



NOTES:
1. EXISTING SEWER MAIN LOCATION, SIZE AND MATERIAL SHALL BE VERIFIED IN FIELD.
2. IF LEDGE ENCOUNTERED BELOW EXISTING SEWER MAIN, REINFORCING DOWELS SHALL BE SET A MIN. OF 6" INTO EXISTING LEDGE PRIOR TO CASTING BASE OF DOG HOUSE MANHOLE.

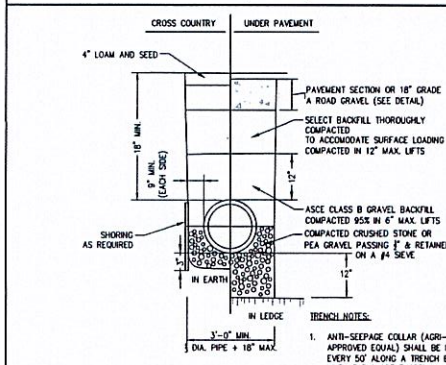
SEWER MANHOLE DETAIL (DOGHOUSE)
(NOT TO SCALE)




WATER MAIN GATE VALVE CONNECTION
(NOT TO SCALE)

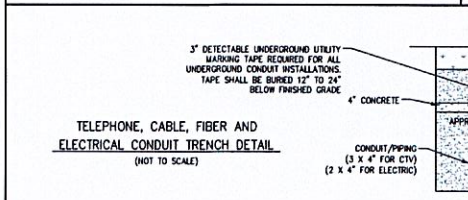



TYPICAL BUILDING SEWER SERVICE
(NOT TO SCALE)



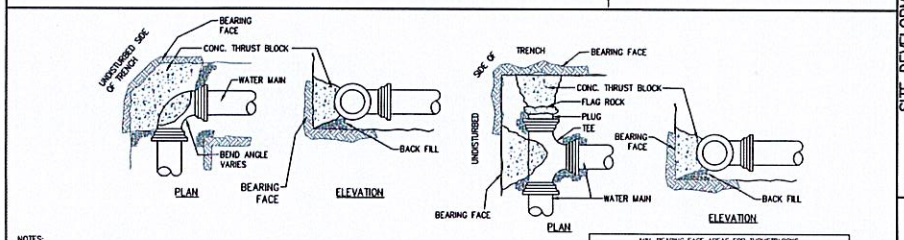

TRENCH NOTES:
1. ANTI-SEEPAGE COLLAR (AGRI-DRAIN OR APPROVED EQUAL) SHALL BE INSTALLED EVERY 50' ALONG A TRENCH EXCAVATION WHEN THE SLOPE EXCEEDS 4%.
2. SHEETING, IF USED, SHALL BE CUT OFF 12 INCHES (12") ABOVE TOP OF PIPE OR CONDUIT.

TYPICAL DRAIN TRENCH DETAIL
(NOT TO SCALE)




TELEPHONE, CABLE, FIBER AND ELECTRICAL CONDUIT TRENCH DETAIL
(NOT TO SCALE)

ELECTRICAL CONDUIT TRENCH DETAIL NOTES:
1. ADJUST FOR ANY LOCAL MODIFICATIONS TO NFPA 70/NEC.
2. COORDINATE CONDUITS WITH APPLICABLE SERVICE PROVIDERS.




NOTES:
1. ALL WATER MAIN FITTINGS, BENDS, TEES, PLUGS ETC. SHALL BE RESTRAINED W/ THRUST BLOCKS EXCEPT WHERE NOTED.
2. ALL THRUST BLOCKS & COLLARS SHALL BE INSTALLED SO THAT THEY BEAR AGAINST UNDISTURBED EARTH.
3. MINIMUM COMPRESSIVE STRENGTH OF THRUST BLOCK CONCRETE SHALL BE 3,000 P.S.I.
4. KEEP CONCRETE CLEAR OF MECHANICAL JOINTS.

THRUST BLOCK DETAIL
(NOT TO SCALE)

| MIN. BEARING FACE AREAS FOR THRUSTBLOCKS | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 90° | 45° | 22.5° | TEES | PLUGS | CAPS | HYDRANTS |
| 0'-6" | 8 | 5 | 6 | 4 | 4 | 4 | 4 |
| 0'-8" | 12 | 8 | 5 | 6 | 6 | 6 | 6 |

The Morin-Cameron GROUP, INC.
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18 ROSE STREET, HAVERHILL, MA 01832
P. 978-777-0568, W. WWW.MORINCAMERON.COM

SURVEY BY: MCG
DRAFTED BY: DTS
CHECKED BY: MAS
APPROVED BY: SPC
SCALE: AS NOTED
DATE: APRIL 28, 2025

| REVISIONS | | |
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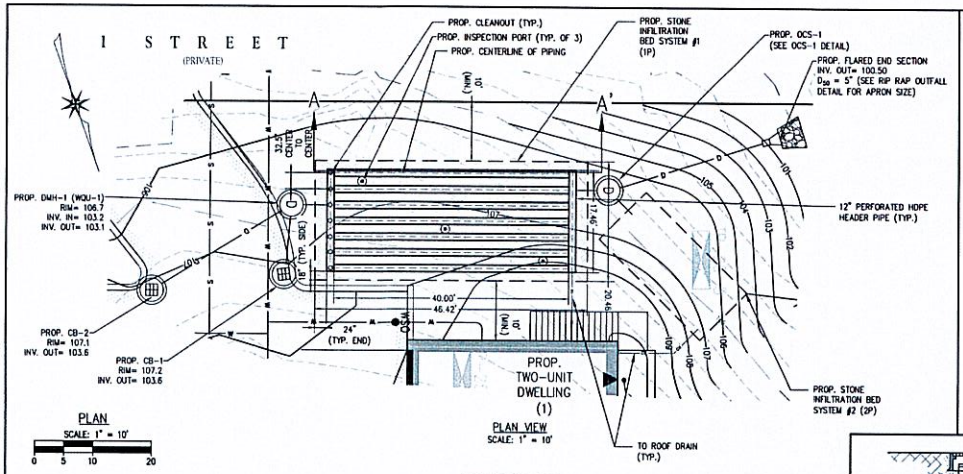
| NO. | DESCRIPTION | DATE |
| 1 | PEER REVIEW & CITY COMMENTS | 9/30/2025 |

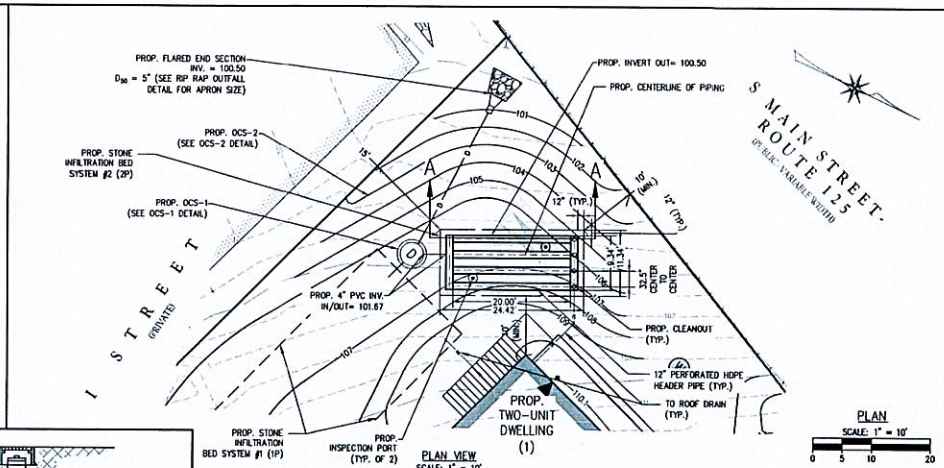
# SITE DEVELOPMENT PLANS
IN
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(PORTION OF ASSESSOR'S MAP 754, BLOCK 2, LOT 21)
PREPARED FOR:
PENTUCKET NORTH DEVELOPMENT LLC

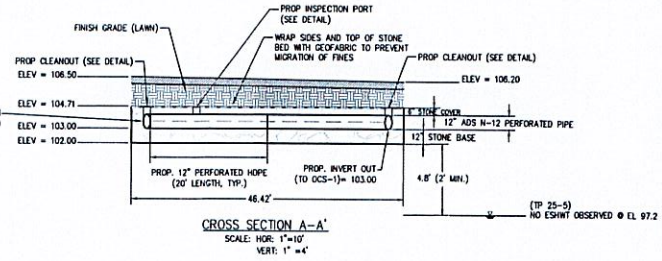
DETAILS

DRAWING NO. 8 OF 11

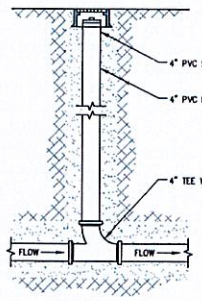
PROJ. #4316
DRAWING: 4316_MAIN.dwg



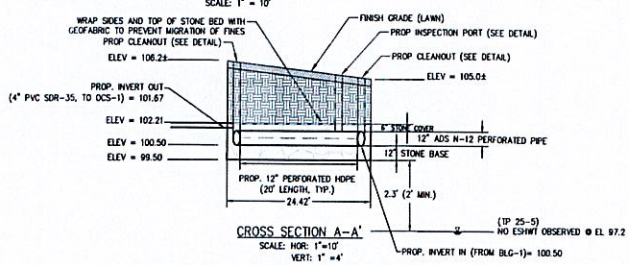



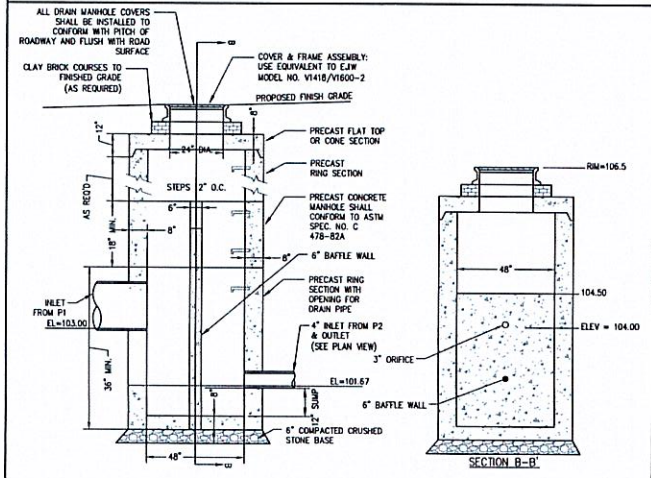

STONE INFILTRATION BED SYSTEM #1 DETAIL (1P)
(46.42 LENGTH X 20.46' WIDTH)
SCALE: AS NOTED



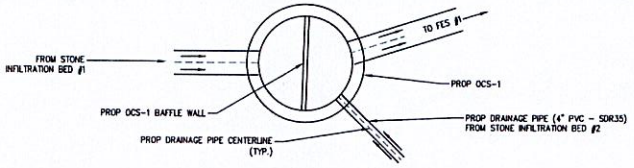

CLEANOUT
(NOT TO SCALE)



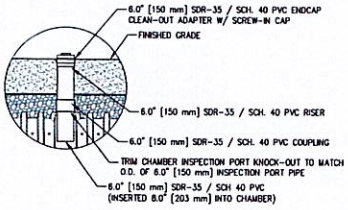

STONE INFILTRATION BED SYSTEM #2 DETAIL (SIS2)(2P)
(24.42' LENGTH X 11.34' WIDTH)
SCALE: AS NOTED




OUTLET CONTROL STRUCTURE (OCS-1)
(NOT TO SCALE)



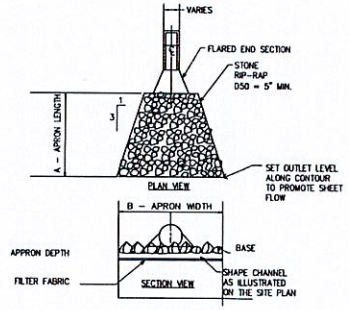

OUTLET CONTROL STRUCTURE (OCS-1, PLAN VIEW)
(NOT TO SCALE)




INSPECTION PORT
NOT TO SCALE

RIP RAP/OUTLET SIZING

| OUTLET | PIPE DIAMETER (IN) | DESIGN 100-YR DISCHARGE (CFS) | $D_{50}$ MIN. (IN) | SELECTED $D_{50}$ (IN) | DESIGN APRON LENGTH "A" (FT) | DESIGN APRON LENGTH "B" (FT) | DESIGN APRON DEPTH "D" (FT) |
|---|---|---|---|---|---|---|---|
| FES-1 | 12 | 0.3 | 1 | 5 | 4 | 5.5 | 1.5 |
| FES-2 | 12 | 0.8 | 1 | 5 | 4 | 5.5 | 1.5 |




6 RIP RAP OUTFALL
(NOT TO SCALE)


The Morin-Cameron GROUP, INC.
CIVIL ENGINEERS | ENVIRONMENTAL CONSULTANTS
LAND SURVEYORS | LAND USE PLANNERS
10 CONSTITUTION AVENUE, HAVERHILL, MA 01835
P: 978-777-0326, F: WWW.MORINCAMERON.COM


SURVEY BY: MCG
DRAFTED BY: DTS
CHECKED BY: MAS
APPROVED BY: SPC
SCALE: AS NOTED
DATE: APRIL 28, 2026

REVISIONS

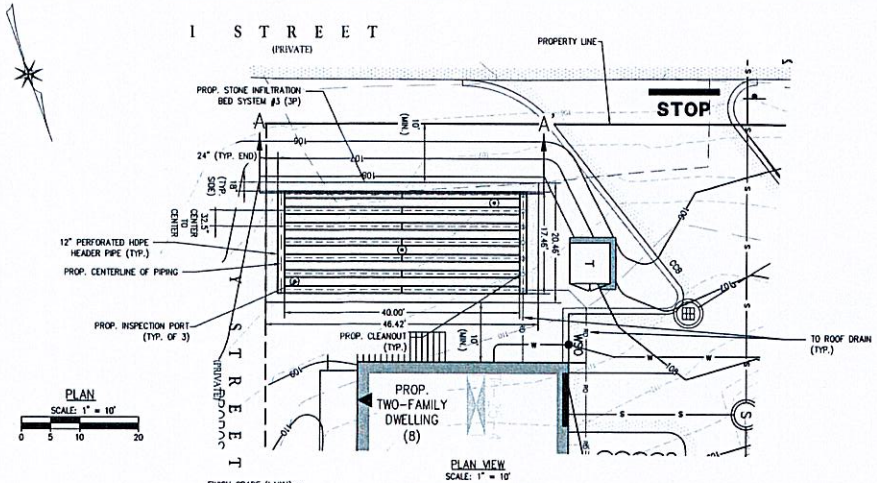
| NO. | DESCRIPTION | DATE |
|---|---|---|
| 1 | PEER REVIEW & CITY COMMENTS | 9/30/2026 |

SITE DEVELOPMENT PLANS
IN
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(PORTION OF ASSESSOR'S MAP 754, BLOCK 2, LOT 21)
PREPARED FOR:
PENTUCKET NORTH DEVELOPMENT LLC

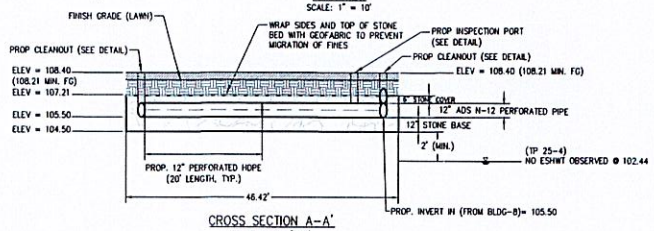
STORMWATER DETAILS

DRAWING NO. 9 OF 11

PROJ. #4316
DRAWING: 4316_MAIN.dwg

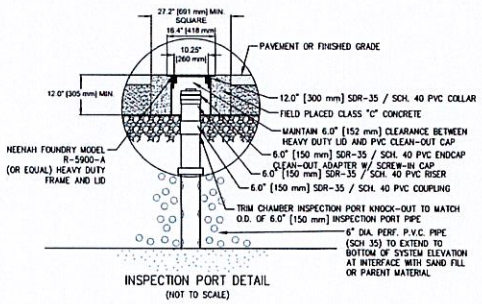



PLAN VIEW
SCALE: 1" = 10'

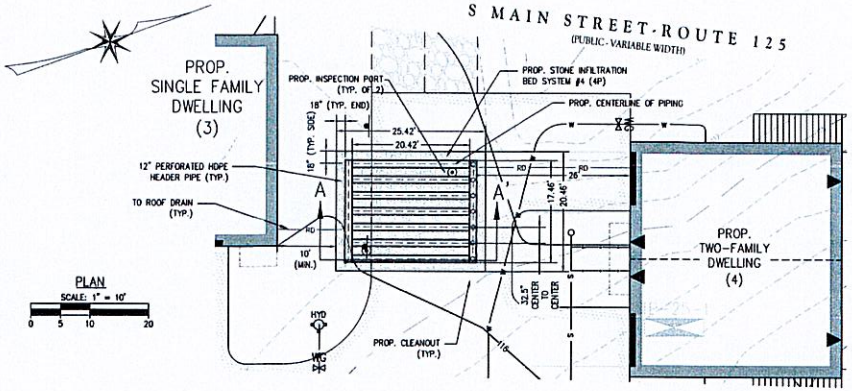



CROSS SECTION A-A'
SCALE: HOR: 1"=10'
VERT: 1" =4'

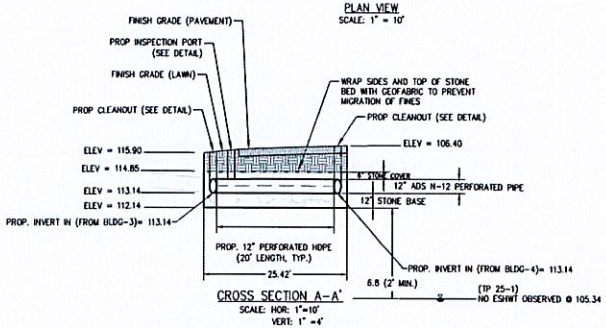
STONE INFILTRATION BED SYSTEM #3 DETAIL (3P)
(46.42' LENGTH X 20.46' WIDTH)
SCALE: AS NOTED




INSPECTION PORT DETAIL
(NOT TO SCALE)




PLAN VIEW
SCALE: 1" = 10'




CROSS SECTION A-A'
SCALE: HOR: 1"=10'
VERT: 1" =4'

STONE INFILTRATION BED SYSTEM #4 DETAIL (4P)
(25.42' LENGTH X 20.46' WIDTH)
SCALE: AS NOTED

The Morin-Cameron GROUP, INC.
CIVIL ENGINEERS | ENVIRONMENTAL CONSULTANTS
LAND SURVEYORS | LAND USE PLANNERS
18 Low Street, Newburyport, MA 01950
P. 978-777-8326, W. WWW.MORINCAMERON.COM

SURVEY BY: MCG
DRAFTED BY: DTS
CHECKED BY: MAS
APPROVED BY: SPC
SCALE: AS NOTED
DATE: APRIL 29, 2026

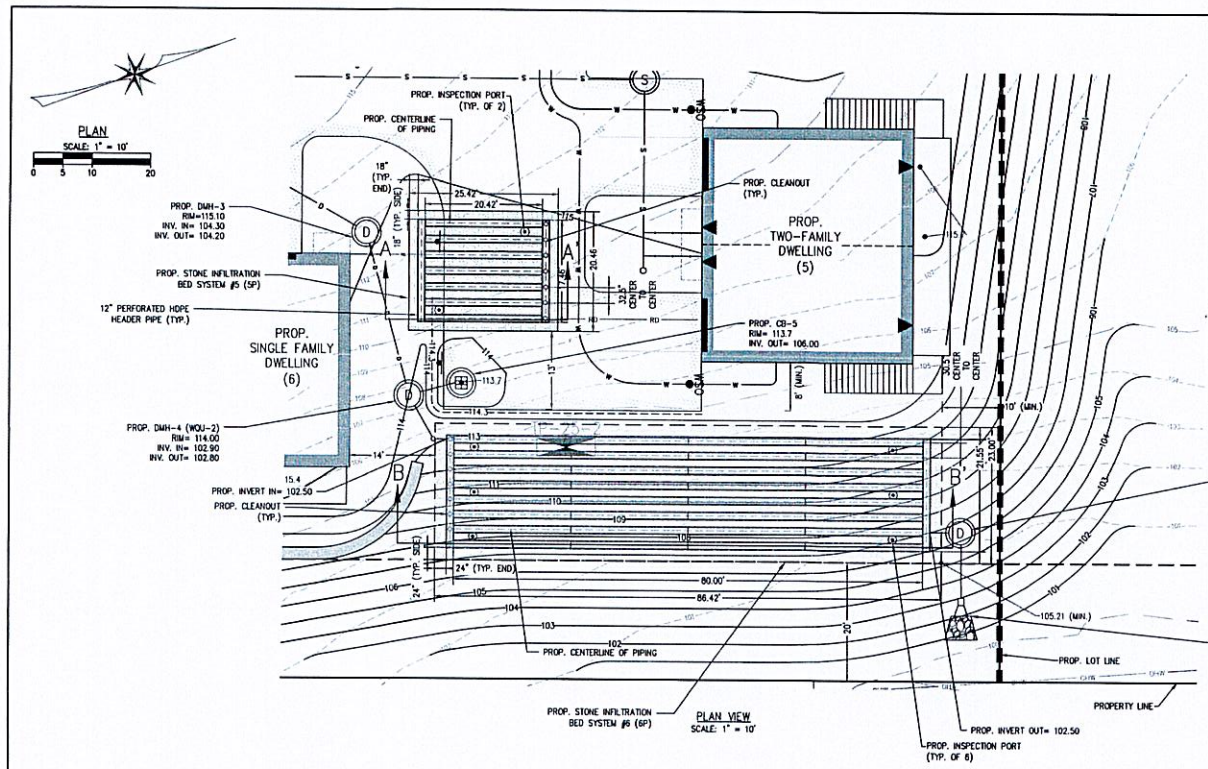
| REVISIONS | | |
|---|---|---|
| NO. | DESCRIPTION | DATE |
| 1 | PEER REVIEW & CITY COMMENTS | 9/30/2026 |

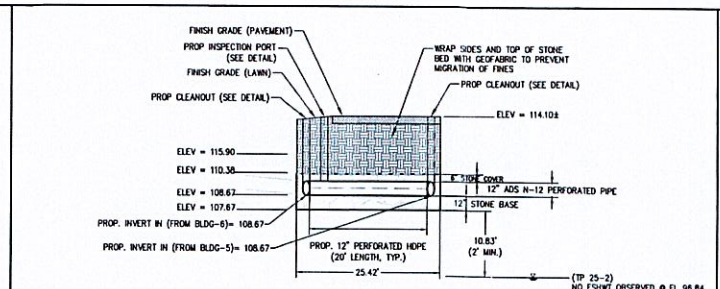
SITE DEVELOPMENT PLANS
IN
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(PORTION OF ASSESSOR'S MAP 754, BLOCK 2, LOT 21)
PREPARED FOR:
PENTUCKET NORTH DEVELOPMENT LLC

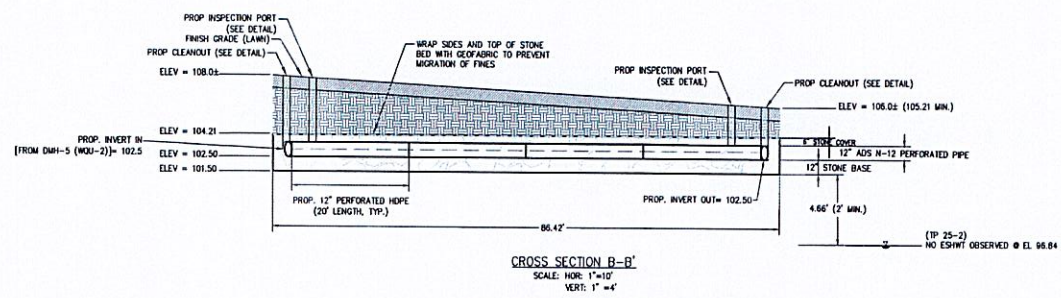
STORMWATER DETAILS

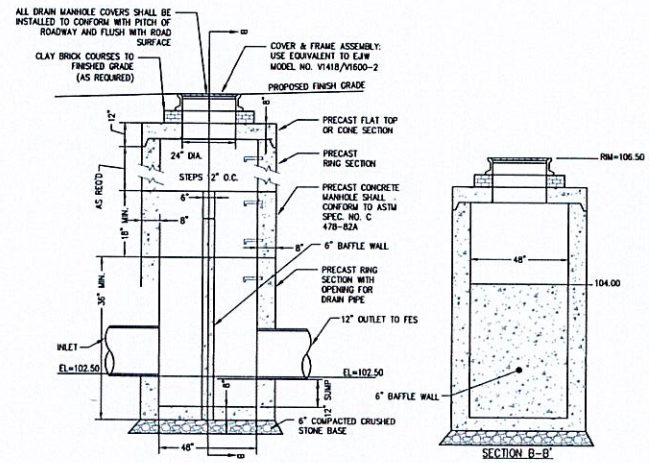
DRAWING NO.
10 OF 11

PROJ. #4316
DRAWING: 4316_MAIN.dwg




The Morin-Cameron GROUP, INC.
CIVIL ENGINEERS | ENVIRONMENTAL CONSULTANTS
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18 CHESTNUT STREET, HAVERHILL, MASSACHUSETTS
P: 978-777-0006, F: WWW.MORINCAMERON.COM

| NO. | REVISIONS DESCRIPTION | DATE |
|---|---|---|
| 1 | PEER REVIEW & CITY COMMENTS | 9/30/2026 |

SURVEY BY: MCG
DRAFTED BY: DTS
CHECKED BY: WAS
APPROVED BY: SPC
SCALE: AS NOTED
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SITE DEVELOPMENT PLANS
IN
HAVERHILL, MASSACHUSETTS
931 BOSTON ROAD
(PORTION OF ASSESSOR'S MAP 754, BLOCK 2, LOT 21)
PREPARED FOR:
PENTUCKET NORTH DEVELOPMENT LLC

STORMWATER DETAILS

DRAWING NO. 11 OF 11

PROJ. #4316
DRAWING: 4316_MAIN.dwg

ORDERED:

TO AMEND THE CITY OF HAVERHILL ZONING ORDINANCE CHAPTER 255 BY ADDING THE FOLLOWING: "I STREET PLANNED RESIDENTIAL DEVELOPMENT DISTRTCT, (ISPRD)" AS SET FORTH IN SECTION 8.5.C:

**Item 1.** In Section 2.1.2, add "I Street Planned Residential Development District" to the list.
**Item 2.** Add the following new Section 8.5.C

**8.5C**

**I STREET PLANNED RESIDENTIAL DEVELOPMENT DISTRICT (ISPRD)**

**8.5.C.1 Purpose.** The purpose of the I Street Planned Residential Development District ("ISPRD") is as follows:

1. To promote a diversity of housing in the City; and
2. To promote the reuse of vacant land transforming the same into 14 condominium units.

**8.5.C. 2 Location**. The ISPRD is a portion of land located on Tax Parcel Map 754, Block 2, Lot21, containing approximately 55,820 square feet of land.

**8.5.C.3 As of Right Uses.** The following uses are allowed in the ISPRD upon the issuance of Development Review approval pursuant to Section 10.1.4:

1. Six (6) duplex and Two (2) single family Condominium units.

**8.5.C.4 Dimensional and Density Regulations**. The following dimensional and density regulations shall apply in the ISPRD:

| Set Back | Proposed PD Lot |
|---|---|
| | |
| Lot Area | 55,820' |
| Lot Area Required Per Dwelling Unit | 3,972' |
| Lot Frontage | 207.36' |
| Lot Depth | 291' |
| Front Setback | 40' |
| Side Setback | 15' |
| Rear Setback | 15' |
| Building Height | <40' |
| Building Height – Stores | <3.5' |
| Building Coverage | 18.1% |
| Floor Area Ratio | <0.50' |
| Open Space | 51% |

**8.5C.5 Parking and Loading**. The following parking requirements shall apply in the BRPRD. Both surface and underground parking areas are permissible.

1. **Multifamily Dwellings:** 3.0 spaces per dwelling unit; 1 garage and 2 outdoor surface spaces.

Parking and loading shall generally comply with the standards set forth in Section 6.1 of this Ordinance, unless waived by the City during Development Review.

**8.5.C.6 Roads and Utilities**. The principal roadway(s) and driveways serving the site shall be adequate for the intended use and vehicular traffic and shall be maintained privately. The connection of all buildings in the ISPRD to the municipal water and sewer systems is required. All water, sewer, gas, electricity, cable, and telephone lines shall be installed underground.

**8.5.C.7 Performance Standards**. All development in the ISPRD shall comply with the performance standards set forth in the Zoning Code, unless waived during developmental review.

## Lori Robertson

**From:** Christine Neals <cneals92@gmail.com>
**Sent:** Wednesday, October 21, 2026 4:52 PM
**To:** Tim Jordan; City Council
**Subject:** 931 Boston Road Development: Impact on I Street Residents

Warning! External Email. Exercise caution when opening attachments or clicking on any links.

Dear Council President Jordan,

I am writing as a homeowner and resident of I Street in Bradford to express my serious concerns regarding the proposed residential development at 931 Boston Road, particularly the plans to utilize I Street as an access point for the development.

I grew up playing outside on this very street, just as I still see children doing today. It has always been a quiet, close-knit neighborhood where families feel comfortable letting their children play in their yards and along the dead-end road. I'm incredibly proud to now own a home in the same neighborhood where I grew up. My husband and I hope to start a family of our own in the very near future, and the thought that the neighborhood I have known and loved my entire life could be fundamentally changed is deeply concerning.

I Street is a narrow, dead-end residential road that was never designed to accommodate the traffic associated with a development of this size. The addition of 14 residential units would bring a significant increase in vehicles, along with construction traffic, deliveries, and service vehicles. Without sidewalks or infrastructure designed to support this additional activity, I worry about pedestrian safety, emergency vehicle access, road conditions, and, most importantly, the safety of the children and families who live here.

Equally frustrating has been the experience of residents throughout the review process. Many of my neighbors and I have attended Planning Board meetings, taken the time to understand the proposal, and raised legitimate concerns about its impact. Unfortunately, the responses we have received have often been vague and have done little to reassure us that these issues are being adequately considered or addressed.

We understand that development is a necessary part of a growing city, and I am not opposed to responsible growth. However, I strongly believe that new development should not come at the expense of the safety and quality of life of existing residents. It is difficult to understand why a quiet residential street should be expected to accommodate the traffic and demands of a development located along Boston Road, particularly without a more thorough examination of alternative access options.

I respectfully ask the City Council to consider the following before making a decision:

- Whether I Street can safely accommodate the additional traffic, including emergency and service vehicles.
- What alternative access routes have been explored and why they have not been pursued.
- •How the concerns raised by residents throughout this process have been meaningfully addressed.
- What long-term impact this development will have on the safety, infrastructure, and character of our neighborhood.

I recognize that the City must balance many interests when considering development proposals. However, the voices of the people who already live in these neighborhoods deserve to carry meaningful weight in those decisions.

**Our neighborhood is more than an access road on a developer's site plan. It is our home.** The decisions made regarding this project will have lasting consequences for the people who live here, and I sincerely hope those voices will be reflected in the Council's deliberations.

I sincerely ask that you and your fellow councilors give these concerns careful consideration and refrain from approving the proposal in its current form until the impacts on existing residents have been thoroughly evaluated and addressed.

Thank you for your time and consideration. I appreciate your service to our community and hope that the voices of I Street residents will be heard before a decision with such lasting consequences is made.

Given the upcoming October 27 meeting, I would greatly appreciate a brief acknowledgment that my concerns have been received and will be shared with the appropriate Council members.

Sincerely,

Christine Mahoney
59 I Street Resident & Homeowner
Bradford, MA
(978) 604-8545

LAW OFFICES OF
Phillips, Gerstein & Channen, LLP
25 Kenoza Avenue ■ Haverhill, MA 01830
Tel: (978) 374-1131 ■ Fax: (978) 372-3086
www.pgclawoffice.com

Herbert P. Phillips (1933 - 2017)
Michael A. Gerstein
Russell S. Channen

Of Counsel:
Jane M. Owens Triano

October 22, 2026

Timothy J. Jordan, President
Haverhill City Council
City Hall
4 Summer Street
Haverhill, MA 01830

RE: Applicant: Pentucket North Builders, LLC
Project: 931 Boston Road, Haverhill, Massachusetts

Dear President Jordan:

Please accept this letter as an Impact Statement regarding the Proposed Plan Development District for 931 Boston Road, Haverhill, Massachusetts.

## I. Community Needs Served by Proposal.

Pentucket North Builders, LLC ("Pentucket North") believes that this Project will have a huge beneficial impact for the City of Haverhill. Local cities and towns have been in dire need for additional housing. Cities and towns have gone so far to relax zoning requirements, allowing for Accessory Dwelling Units by right and are contemplating the reduction of lot area for future development.

This project would allow for the creation of fourteen residential/condominium units. Photographs of the proposed development have been previously provided and illustrate the beautiful design for the various buildings. The City of Haverhill currently has a small inventory of homes/condos on the market. Coldwell Banker/Realty, which has been hired to assist with this Project, will speak as to the current local conditions and explain the need for additional homeownership in Haverhill.

Coldwell Banker expects these homes would be perfect for couples looking to purchase either their first home or looking to downsize from their single-family homes. Coldwell Banker sees this development as an opportunity for a young or older couples looking to establish a foothold in the Merrimack Valley area.

During a Planning Board hearing, a neighbor expressed her concern that the Developments would become rental property. Pentucket North has agreed to create a Home Owner's Association ("HOA") which will include among other things, a restriction prohibiting the rental of any units.

## II. Traffic and Pedestrian Flow and Safety.

Pentucket North performed a traffic study and the City of Haverhill conducted its own peer review.

Vanasse & Associates, Inc. ("VAI") determined the following:

1. Traffic-volume increases related to the Project, external to the Study, are anticipated to range from 1 to 4 vehicles or 0.4 to 2.3 percent, during peak periods; and
2. The Project will generally not have a significant impact on motorist delays or vehicle queuing at study area intersections compared to anticipated future conditions without the Project (No-Build conditions)

The City's peer report, performed by McClure Engineering Co. ("McClure"), determined that VAI's methodologies were consistent with accepted MassDOT practices, and the findings were reasonable. McClure further recommended plans depicting the turnaround for fire apparatus and widening and fixing I Street.

**Pentucket North has agreed to widen I Street to 24 feet and to mill and overlay I Street post construction. Such work would be coordinated with the required City Departments.**

The studies confirm Pentucket North's belief that the proposed development is properly scaled to minimally impact any traffic concerns and the widening and repairs to I street will further help to alleviate any additional concerns.

## III. Adequacy of Utilities and Other Public Services.

The Morin-Cameron Group, Inc. has spearheaded the Engineering work and taken the lead for all necessary studies. William A. Schkuta, P.E., Director of Engineering has coordinated Storm Water Reports and Responded to Peer Review Reports conducted by the City and comments from other City Departments, Environmental. Mr. Schkuta will be able to provide details regarding said reports at the City Council Meeting. All reports have been positive and in accordance with the Planning Board's approval recommendation, the Project remains subject only to the hydraulic analysis.

Utility poles already exist and no additional work would be necessary to establish power and services to the development.

The Fire Department is satisfied with the plans and layout of the Development and their only request was for Pentucket North to install an additional fire hydrant at the Development's entrance. Pentucket North has no issue with this request.

## IV. Neighborhood Character and Social Structures.

The neighborhood currently consists of single family and multi-family homes. The Planning Board meetings included spirited comments from the neighbors. Most, if not all of their concerns, centered upon the potential increase of traffic and I Street's current condition. Pentucket North's traffic study and the City's peer review suggest that there would not be any significant traffic increase Acknowledging the neighbor's concerns, Pentucket North has agreed to both widen and repair I Street.

Pentucket North is also working with the Postmaster to determine if it is feasible to have the mailboxes placed on each home rather than all at the end of I Street. If so, Pentucket North would cover such costs to relocate the same.

Change is never easy. Mr. Mailloux understands this and is sympathetic to the older generation currently residing in the area. However, Pentucket North beliefs that the Project's benefits outweigh the acknowledged inconveniences to the neighbors.

## V. Impact on the Natural Environment

There will be no impact to the Natural Environment.

## VI. Potential Fiscal Impact, including Impact on City Services, Tax Base and Employment.

Michael Joy and Robert DiBurro, seasoned Coldwell Banker Realtors were engaged to assist with this Application and if approved will list and market the development.
Michael and Bob have examined the market and based upon the proposed upscale development, envision listing the 12 condex units and 2 single units within the $600,000.00 to $650,000.00 range. Haverhill's current residential tax rate is $10.61. This would result in yearly property tax revenue of approximately $90,000.00. The parcel is currently undeveloped land and garners little to no tax revenue.

Pentucket North believes that owner/occupied Units will have a positive impact on City Services. From utilizing the many businesses within the community to employment opportunities, this Project will further stimulate Haverhill's economic growth.

Respectfully submitted,
Pentucket North Development, LLC
By its Attorney,

Russell S. Channen, Esquire

g:\gloria\russ\r-estate\mailloux, ron\impact letter jordan 081326.gdp.docx

## Lori Robertson

**From:** Patti Neals <pneals50@gmail.com>
**Sent:** Thursday, October 22, 2026 2:46 PM
**To:** Tim Jordan; City Council
**Subject:** 931 Boston Rd. Development: Impact on I Street Residents

Warning: External Email. Exercise caution when opening attachments or clicking on any links.

Dear Mr. Jordan and Members of the Haverhill City Council:

I am writing in my capacity as Executor of the property located at 37 I Street in Haverhill, Massachusetts, to formally express my serious concerns regarding the proposed development of approximately 1.5 acres of CH-zoned land at the end of I Street, currently part of the larger Cedardale property.

My family has owned our property for more than 55 years, and we have a vested interest in protecting both its future development potential and the character of the neighborhood we have called home for generations.

Of particular concern is the proposed alteration of Y Street, an undeveloped public right-of-way, commonly referred to as a "paper street." Portions of my family's property may require access via Y Street should we choose to develop the rear sections of our land in the future. The developer's proposed modifications appear to create significant obstacles to that access, potentially limiting our ability to make reasonable use of property we have owned for decades.

According to the submitted plans, the proposed regrading of the western half of the Y Street right-of-way would raise existing elevations by as much as seven feet in certain areas. This substantial change appears intended to reduce the size and cost of a retaining wall necessary to support the proposed development. While this approach may benefit the developer financially, it would create considerable engineering challenges and additional expenses for my family should we pursue future development of our own property.

Additionally, the proposed drainage outflow pipe and associated riprap splash pad appear to extend approximately 10 to 15 feet into the Y Street right-of-way. These improvements raise further concerns about potential encroachments, drainage impacts, and restrictions on future access.

It is neither reasonable nor equitable for one developer's cost-saving measures to create permanent obstacles and financial burdens for neighboring property owners. My family should not be placed in a position where the future use and development of our property are compromised simply to make another project more financially advantageous.

Beyond these direct impacts, I am deeply concerned about the broader consequences of this proposal for the I Street neighborhood.

Currently, I Street serves 15 residential units spread across roughly four to five acres of land. The proposed development would introduce an additional 14 residential units on just 1.5 acres, nearly doubling the number of households relying on this single dead-end street for access. One relatively small parcel would account for nearly half of all residential units on I Street following development.

While the roadway itself may be technically capable of accommodating the additional vehicle trips, that does not diminish the substantial change this project would bring to the neighborhood. The concentration of 14 new residential units on a single parcel would more than double existing vehicle activity, fundamentally changing the day-to-day experience of residents who have lived on this street for decades.

This is not simply a matter of whether the road can accommodate more cars. It is a question of whether the proposed density and intensity of development are appropriate for an established residential neighborhood of this size and character.

activity, children and families spending time outdoors, and the general residential atmosphere that has existed for generations.

Adding nearly as many residential units on 1.5 acres as currently exist throughout the surrounding neighborhood represents a significant and disproportionate increase in density. Such a substantial change should not be evaluated solely on whether it meets minimum technical requirements, but also on its long-term impact on the surrounding community and neighboring property owners.

Development should not come at the expense of the people who already live here, nor should the financial interests of a developer take precedence over the property rights and long-term interests of neighboring families.

My family has been part of this neighborhood for more than half a century. We recognize that properties may be developed over time, but new development must be thoughtfully planned, responsibly designed, and respectful of the rights of those who have already invested their lives and livelihoods in this community.

I strongly oppose the proposal in its current form and ask that these concerns be meaningfully addressed before any approvals are granted.

Thank you for your time and consideration. I respectfully request that this letter be included in the official record of any proceedings concerning this development.

Sincerely,

Patricia Neals
Executor, 37 I St., Haverhill
(978) 930-0612

10.3

# Document # 21-B

Ordinance: re: Amend Chapter 255 Zoning Ordinance and Zoning Map – Battery Energy Storage Systems Overlay District (BESS)– by inserting a new section 7.9 Battery Energy Storage Systems, amending section 3.1.3 Table of Use and Parking regulations by allowing a Tier 1, Tier 2 and Tier 3 BESS and amending the Zoning Map to include the BESS Overlay District. The overlay district will be creating regulations for the installation and use of free-standing battery energy storage systems ("BESS"), adding to the table the overlay district with the allowed Tiers and updating the zoning map to include the BESS Overlay District, or take any other action related to

**IN CITY COUNCIL: March 24, 2026**

**File for 14 Days + Council hearing for May 19th**

**9 YEAS, 0 NAYS, 1 ABSENT,** 1 ABSTENTATION

Attest: Kaitlin M. Wright

Kaitlin M. Wright, CMC
City Clerk

IN CITY COUNCIL: AUGUST 25 2026
CON'T TO SEPTEMBER 15, 2026
10 YEAS, 0 NAYS, 1 ABSENT

ATTEST: Kaitlin M. Wright Esposito
KAITLIN M. WRIGHT ESPOSITO, CMC
CITY CLERK

IN CITY COUNCIL: SEPTEMBER 15 2026
CON'T TO OCTOBER 27 2026
11 YEAS, 0 NAYS, 0 ABSENT

ATTEST: Kaitlin M. Wright Esposito
KAITLIN M. WRIGHT ESPOSITO,CMC
CITY CLERK

IN CITY COUNCIL: MAY 19, 2026
10 YEAS, 0 NAYS, 1 ABSENT
CONTINUE TO JULY 14th
SEND TO PLANNING AND DEVELQPMENT COMMITTEE

ATTEST: Kaitlin M. Wright
KAITLIN M. WRIGHT, CMC
CITY CLERK

IN CITY COUNCIL: JULY 14 2026
CON'T TO AUGUST 25th 2026
9 YEAS, 0 NAYS, 2 ABSENT

ATTEST: Kaitlin M. Wright Esposito
KAITLIN M. WRIGHT ESPOSITO, CMC
CITY CLERK

**Kaitlin Wright Esposito**

| | |
|---|---|
| **From:** | City Council |
| **Sent:** | Tuesday, September 15, 2026 8:16 AM |
| **To:** | Tim Jordan; Tim Jordan |
| **Cc:** | Kaitlin Wright Esposito |
| **Subject:** | FW: Opposition to the proposed Hilldale Ave Battery Farm site |

*Lori A. Robertson*
Administrative Assistant
Haverhill City Council
4 Summer Street- Room #204
Haverhill, MA 01830
978-374-2328 phone
978-374-2329-fax
lrobertson@haverhillma.gov
citycouncil@haverhillma.gov

SEP 15 AM8:41
HAVCITYCLERK

**From:** PAMELA CARR <pcarr12@comcast.net>
**Sent:** Monday, September 14, 2026 6:12 PM
**To:** City Council <CityCouncil@haverhillma.gov>
**Subject:** Opposition to the proposed Hilldale Ave Battery Farm site

Warning! External Email. Exercise caution when opening attachments or clicking on any links.

Dear City Council President Jordan and members of the City Council,

On August 31st, I sent the below email to Mr. McGonagle expressing my concerns with the proposed location of upper Hilldale Ave for placement of a Battery Farm. I have not heard back from Mr. McGonagle, so I am forwarding this email to you and the other council members to state that I am strongly opposed to the expansion of the proposed BESS Zoning Overlay District in the Upper Hilldale Ave area.

Thank you for your time and dedication to the residents of Haverhill.

I am requesting that my opposition to this project be noted in the minutes of the September 15th City Council meeting minutes.

Regards,

Pamela J Carr
60 Atlanta Street
Haverhill, MA 01832

---------- Original Message ----------
From: PAMELA CARR <pcarr12@comcast.net>
To: "mmcgonagle@haverhillma.gov" <mmcgonagle@haverhillma.gov>
Date: 08/31/2026 8:43 PM EDT
Subject: Proposed Hilldale Ave Battery Farm site

Hi Mike,

My name is Pam Carr, 60 Atlanta Street. I have questions and concerns that at last week's council meeting it was determined that Hilldale Ave would be the preferred place to put a Battery Farm.

My first question is, why does Haverhill need to allow a Battery Farm in our city? Currently, I am very opposed to the idea of allowing a Battery Farm in Haverhill, never mind on upper Hilldale. How was it determined that Hilldale Ave ranked the highest?

This neighborhood already has to deal with all the trucks from the NETTS business, the 18 wheel tractor trailer trucks that are stored from renting the spaces that were just created on upper Hilldale, along with the Republic Waste and Garbage Disposal Service trucks. Our roads in this area are taking a beating. They have recently been working on the Hilldale bridge decking that goes over 495, which needed to be repaired for some time. I'm sure the heavy truck traffic contributed to the road degradation. How much more does this neighborhood have to endure?

What is the recommendation from the Fire Chief for upper Hilldale? He was in favor of a different location. Does Haverhill have the manpower or equipment to handle a battery fire if that should occur? What chemicals would the residents in this area be exposed to if there was a fire? I know little about battery fires, except that they are difficult to extinguish. My knowledge is only from incidents that I have read about regarding electric vehicle fires, laptop battery fires, hover board battery fires and recently electric scooters. These are small batteries, but difficult to extinguish. I would think the batteries at a battery farm are larger and definitely more numerous in a confined space and would take a long time to extinguish, all the while emitting hazardous smoke.

Where on Hilldale are they proposing to allow this Battery Farm. If it's on the same side as the NETTS business, how far would it be from Little River? Are there any setbacks to prevent pollution if a catastrophe should occur? If it's on the opposite side, is the land area any part of wetlands? From the newspaper article, there isn't enough acreage in this area. Why would you or the councilors agree to allow this if there wasn't the required amount of space? Would there need to be an override?

What about the impact this could have on Syrybny Farm? Councilor Dan Diodati opposed having it in the Ward 2 area because of the agricultural land. (I am very familiar with Ward Hill, because that is where I grew up) Well, Syrbny Farms would fall into that same category. Ward 3 Councilor Devan M. Ferreira also concurred that Hilldale would be the best location. Do either of these councilors understand what we have been dealing with in this area? Were you present at this meeting, and did you voice any opposition?

I not only have to deal with the traffic issues these tractor trailer trucks cause during all hours of the day, but I also deal with police, ambulance and fire coming to my neighborhood on a fairly frequent basis, when they get a call of someone 'wandering', which I belief they are coming from the business located at the end of Cogswell Street. I no longer feel safe letting my grandson play in the backyard because I never know when there will be a call for assistance with someone 'wandering' in the neighborhood.

I have lived in this neighborhood 49 years. I love this community, but it now seems like this part of the city is bearing the brunt of many disruptive businesses. I've never complained, and have been dealing with the additional traffic for many years, and the 'wanderers' for over a year. Now, learning that I may have a 14+ acre battery farm in my back yard is more than I want to think about.

I would greatly appreciate hearing from you to help me understand why you and your fellow councilors think that the upper Hilldale Ave area is the best place to allow a Battery Farm as opposed to any of the other locations that were suggested.

My cell number is 978-697-2284, or you can reach me at this email address.

Sincerely,

Pam Carr

**Kaitlin Wright Esposito**

| | |
|---|---|
| **From:** | City Council |
| **Sent:** | Tuesday, September 15, 2026 8:15 AM |
| **To:** | Tim Jordan; Tim Jordan |
| **Cc:** | Kaitlin Wright Esposito |
| **Subject:** | FW: Lithium Battery Storage, Hilldale Ave site Formal opposition to BESS Overlay expansion |

***I'm blind copying everyone on this email rather than sending separate emails to each Councilor, which is how I've been doing it. This helps keep things a little easier on my end and avoids any accidental 'Reply All' responses***

*Lori A. Robertson*
Administrative Assistant
Haverhill City Council
4 Summer Street- Room #204
Haverhill, MA 01830
978-374-2328 phone
978-374-2329-fax
lrobertson@haverhillma.gov
citycouncil@haverhillma.gov

SEP 15 AM8:41
HAVCITYCLERK

**From:** Diane Desjardins <diandgeo2002@yahoo.com>
**Sent:** Monday, September 14, 2026 7:56 PM
**To:** City Council <CityCouncil@haverhillma.gov>
**Subject:** Fw: Lithium Battery Storage, Hilldale Ave site Formal opposition to BESS Overlay expansion

Warning! External Email. Exercise caution when opening attachments or clicking on any links.
Dear Council President and Council members:

My name is Diane Desjardins, and I am a resident of 28 Country Meadow Road, which is in close proximity to the proposed Battery Energy Storage Systems (BESS) zoning overlay district into the Upper Hilldale corridor. Upper Hilldale already has a plethora of industrial and commercial businesses, causing high levels of truck traffic, with NETTS trucks, Republic waste trucks, and numerous tractor trailer trucks parking trailers in large paved lots. There is constant noise generated by this activity. We also have a large solar energy farm right next to St. Joseph's cemetery.

My concern regarding the possibility of a BESS lithium battery storage facility is many fold.

This facility was first proposed on land where Dutton Airport was once located, a spot which was fairly remote from houses and businesses. As you know, the site was found to be near an area where Blanding's turtles live, and because they are endangered, the site cannot be used. Are the people who live near the Hilldale site not more important than turtles?

A site in Bradford was also proposed. It was decided that since there is farmland nearby, it would not be a good place for this facility. Then Hilldale Ave was proposed.

I believe that the proposed site on Hilldale Avenue is detrimental to existing farmland, that being Syrbney Farms, as well its' proximity to Little River, which runs near the parcel, the wetlands that are throughout the area, and the nearby businesses and houses. We also have Amtrak and freight trains running close to the proposed site. This site is also close to our border with Plaistow and Atkinson, NH. This site is not large enough for the proposed facility, it needing 20 acres where there are only 14 acres. I know that a hearing is scheduled for the September 15th Council meeting and I would request that the council take the very real concern of those of us who live here seriously.

I would also question as to how these batteries are going to be stored. I have read that they are stored in metal containers. Are these metal containers going to be stored in a climate controlled building with adequate fire suppression for this type of fire? Does our fire department have the equipment needed should this facility have a fire? Are our firefighters trained in fighting this type of fire? Do we even have enough equipment and personnel? If they are just going to be large metal containers placed on a cement pad what is to stop this from perhaps becoming a Superfund Site in the future due to inadequate knowledge of long term effects or lack of proper maintenance.

Since these facilities are newer, not much long term research is available. I do not think that potential risks to the people living nearby, nor the factual noise pollution these sites generate are in the best interests of the citizens of the City. I do not believe that this is a good fit for Hilldale Avenue nor for the entire City of Haverhill. I have lived in the Hilldale Ave area since 1983. I am saddened to see that the development without regard to the long term effects to this area are not being considered with careful consideration.

I respectfully ask that I receive acknowledgement of this email letter to you with your thoughts, explanations and other information pertinent to this matter.

I also request that my opposition be entered into the official record for the September 15, 2026 Haverhill City Council meeting.

Attached also is the email sent to my Ward 6 Councilor, Michael Mc Gonagle, sent on August 31, 2026, to which I have received no response from him as of this date.

With regards,

Diane E Desjardins
28 Country Meadow Rd
Haverhill, MA 01832

Yahoo Mail: Search, Organize, Conquer

----- Forwarded Message -----
**From:** "Diane Desjardins" <diandgeo2002@yahoo.com>
**To:** "macanddrealty@gmail.com" <macanddrealty@gmail.com>
**Cc:**
**Sent:** Mon, Aug 31, 2026 at 2:01 PM
**Subject:** Lithium Battery Storage, Hilldale Ave site
Dear Councilor McGonagle:

As a resident of Ward 6 in Haverhill Massachusetts, I am writing this to you with regard to the lithium battery storage facility being located on Hilldale Avenue. I believe that to have this facility on that location is detrimental to the people who live in the area as well as the people who live in Atkinson New Hampshire and Plaistow New Hampshire. I do not believe that enough research has been done with regard to storage of such volatile material, as well as impact to groundwater, Little River, and our natural resources. I also would like to know how our fire department would be able to contain a fire should this be built at that location. As I've seen many times on news reports showing electric car fires, in most cases the fire just burns and burns until it runs out of fuel to burn. I do not think that our fire department has the equipment needed for this type of business. I would also question as to how these batteries are going to be stored. I have read that they will be put in metal containers. Are these metal containers going to be stored in a climate controlled building with adequate fire suppression for this type of fire? If they are just going to be large metal containers placed on the ground what is to stop this from becoming a Superfund Site due to inadequate storage. How much research has been done with regard to how these batteries break down? I do not believe that this is a good business to be located anywhere in the city of Haverhill. I respectfully ask that you do more research and that this is not decided in a quick manner. I believe that the residents living within the city of Haverhill should have much more input as to this type of business being located here. I hope that you will take this letter to heart and ask your constituency their thoughts on having this located in Ward 6, and also anywhere else in Haverhill.
I thank you for your time and attention to this matter and look forward to hearing from you with your thoughts.

Best regards,

Diane E Desjardins
28 Country Meadow Road
Haverhill, Massachusetts 01832

Yahoo Mail: Search, Organize, Conquer

**Kaitlin Wright Esposito**

| | |
|---|---|
| **From:** | Lisa Walsh <jojalis@yahoo.com> |
| **Sent:** | Monday, September 14, 2026 9:34 AM |
| **To:** | CityClerk |
| **Cc:** | Tim Jordan; Melissa Lewandowski; Shaun Toohey; Catherine Rogers; macanddrealty@gmail.com; Devan Ferreira; Dan Diodati; Ralph T. Basiliere; Thomas J. Sullivan; Colin LePage; John Michitson |
| **Subject:** | Public Hearing Comment: BESS zoning ordinance amendment request - Dawn Circle resident |

Warning! External Email. Exercise caution when opening attachments or clicking on any links.

Dear President Jordan and Members of the Haverhill City Council,

As a resident of Dawn Circle living adjacent to the Upper Hilldale Avenue industrial corridor, I am writing to formally request that the Council include specific neighborhood noise protections in the text of the proposed Battery Energy Storage System (BESS) ordinance before it is approved.

Because our neighborhood experiences significant fluctuations in background noise throughout the day, I ask that the final zoning ordinance mandate the following two protections for all future developers targeting the Hilldale corridor:

1. **Pre-Construction Ambient Sound Studies:** Require a mandatory, continuous 7-day sound monitoring study—including specialized nighttime metrics ($L_{90}$ tracking between 1:00 AM and 4:00 AM)—at the nearest residential property lines *before* a site plan can be approved.
2. **Strict Post-Construction Enforcement:** Include clear language giving the Haverhill Building Inspector the immediate authority to mandate independent, third-party field verification testing if residents log continuous low-frequency noise or "pure tone" hum complaints after the facility is operational.

Please enter this specific amendment request into the official public hearing record for the September 15, 2026 meeting. Thank you for your time and for protecting the peace and quiet of the Dawn Circle neighborhood.

Sincerely,

SEP 14 PM3:05
HAVCITYCLERK

Joe Walsh

26 Dawn Cir

**Kaitlin Wright Esposito**

**From:** Lisa Walsh <jojalis@yahoo.com>
**Sent:** Wednesday, August 26, 2026 7:43 AM
**To:** CityClerk
**Subject:** Formal Opposition to BESS Overlay Expansion – Protect Hilldale Ave Residential Neighborhoods

**Follow Up Flag:** Follow up
**Flag Status:** Flagged

AUG 27 AM8:07
HAVCITYCLERK

Warning! External Email. Exercise caution when opening attachments or clicking on any links.

Dear President and Members of the Haverhill City Council,

My name is Joe Walsh, a resident of 26 Dawn Circle, which sits adjacent to the 16-acre industrial parcel at 1050 Hilldale Avenue. I am writing to express my strong opposition to any expansion of the proposed Battery Energy Storage Systems (BESS) zoning overlay district into the Upper Hilldale Avenue corridor.

Our neighborhood has already absorbed an overwhelming amount of industrial and commercial development over the years. The existing industrial operations, the massive solar farm right behind my house, heavy traffic - including truck "Jake braking"- noises from the trucking school, are already directly impacting my daily quality of life, specifically through constant, disruptive noise and loss of open space.

Bulldozing acres of woods for massive parking lots on Hilldale has already diminished acoustic screens that used to dampen the persistent roar of traffic from Rt 495. Removing even more mature trees and wooded buffers for a battery storage plant will further degrade the noise barrier. As it is now, highway traffic can be heard in my neighborhood most days and nights.

BESS installations rely on heavy-duty, continuous HVAC cooling systems and inverters that generate a persistent, low-frequency hum. Introducing a BESS facility or expanded industrial utility footprint right around the corner from our homes will make the noise levels in our neighborhood completely unbearable.

During the upcoming September 15 public hearing, I strongly urge the City Council to restrict the BESS overlay district strictly to isolated locations in Haverhill - or none at all. Please do not establish secondary zones or expand definitions that allow these industrial utility installations near established residential areas like Hilldale Avenue and Dawn Circle. Our neighborhood has already given enough.

Thank you for your time, your leadership, and your commitment to protecting the peace and well-being of Haverhill's residents.

I request that my opposition be entered into the official record for the September 15 City Council meeting.

Joe Walsh

10.2

**Kaitlin Wright**

| | |
|---|---|
| **From:** | John A Michitson <michitson@mitre.org> |
| **Sent:** | Thursday, July 9, 2026 12:51 PM |
| **To:** | Kaitlin Wright Esposito |
| **Cc:** | Lori Robertson |
| **Subject:** | RE: Social Consumption CC withdrawal.pdf |
| **Follow Up Flag:** | Follow up |
| **Flag Status:** | Flagged |

JUL 9 PM1:58
HAVCITYCLERK

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Understood. It will be continued to the 2nd Council meeting in August. P&D committee needs another meeting in August (likely August 3rd) to compare candidate sites versus siting criteria. (Does this work for you?)

**From:** Kaitlin Wright Esposito <kwright@haverhillma.gov>
**Sent:** Thursday, July 9, 2026 12:40 PM
**To:** John A Michitson <michitson@mitre.org>
**Cc:** Lori Robertson <lrobertson@haverhillma.gov>
**Subject:** [EXT] RE: Social Consumption CC withdrawal.pdf

Hi John,

I understand, but the zoning ordinance for BESS was originally scheduled to be heard by Council on May 19th and at that time was referred to P&D for July 7th and the hearing was voted to be continued to July 14th, with the anticipation that P&D would have completed their review. Since that has not happened, I need something in writing indicating that it is not ready to be heard on July 14th and needs to be continued again.

Please provide a City Council meeting date that you would like to continue the hearing to pending P&D review. Perhaps, August 11th or 25th?

Hope that makes sense.

All my best,

Kaitlin

**Kaitlin M. Wright Esposito, CMC**
*City Clerk*
4 Summer Street, Room 118
Office: (978) 374-2312
Fax: (978) 373-8490
kwright@haverhillma.gov

10.2

Mead, Talerman & Costa, LLC
Attorneys at Law

30 Green Street
Newburyport, MA 01950

978.463.7700
www.mtclawyers.com

March 16, 2026

MAR 20 AM9:10
HAVCITYCLERK

By Electronic Delivery

Tim Jordan
City Council President
Haverhill City Council
4 Summer Street,
Room 204
Haverhill, MA 01830

Re: Zoning Amendment / Battery Energy Storage Systems ("BESS")

Dear Mr. Jordan:

Reference is made to the above captioned matter. In that connection, on January 7, 2025 the former Economic Development Director submitted a Battery Energy Storage System Ordinance to the Council for your consideration. Since that time, the Mayor's office along with the Planning Director and myself have revised the 2025 submission. Additionally, the Department of Energy Resources has further issued guidance on BESS Zoning Ordinances. Finally, the Mayor has received comments from a potential developer of a BESS facility in the City.

I have attached for your advertisement and consideration a revised BESS Zoning Ordinance. I would ask that you table indefinitely the January 2025 Ordinance at the opening of the public hearing on this revised Ordinance, Further, I ask that the Council refer this Ordinance to the Planning Board for a public hearing and thereafter schedule a public hearing for the Council as well.

The Planning Director and I look forward to addressing questions you might have at the time of the public hearing.

Sincerely,

Atty. Lisa Mead, City Solicitor

Enclosure(s)

cc: Melinda E. Barrett, Mayor
Jacki Byerly, Planning Director

**New Bedford Office**
227 Union Street
New Bedford, MA 02740
Phone 774.206.6857

**Millis Office**
730 Main Street, Suite 1F
Millis, MA 02054
Phone 508.376.8400

10.3.1
10.2.1

**MUNICIPAL ORDINANCE CHAPTER 255 Zoning**

## AN ORDINANCE RELATING TO AMENDING CHAPTER 255, ZONING BY ADDING A NEW SECTION 7.9 BATTERY ENTERGY STORAGE SYSTEMS

**BE IT ORDAINED by the City Council of the City of Haverhill that Chapter 255, Zoning, of the Code of the City of Haverhill, as amended, being and is hereby further amended as follows by inserting the following new section 7.9 entitled "Battery Energy Storage Systems";**

§7.9 BATTERY ENERGY STORAGE SYSTEMS

§7.9.1. Purpose.

The purpose of this Section is to advance and protect the public health, safety, welfare, and quality of life by creating regulations for the installation and use of free-standing battery energy storage systems ("BESS"), with the following objectives:

A. To provide a regulatory scheme for the location, construction and operation of free-standing BESS consistent with best practices and safety protocols;
B. To ensure compatible land uses in the vicinity of the areas affected by BESS and to mitigate any potential impacts on abutting and nearby properties; and
C. To mitigate the impacts of BESS on environmental resources such as agricultural lands, forests, wildlife, wetlands and other natural resources.

This Section shall be construed to be consistent with state law, including but not limited to the provisions of General Laws chapter 40A, section 3, and state regulations, including but not limited to the provisions of the State Building Code, State Fire Code, and State Electrical Code. In the event of any conflict between the provisions of this section and the provisions of state law or regulations, the state law and regulations shall prevail.

§7.9.2. Establishment of the BESS Overlay District
The BESS Overlay District is an overlay district superimposed over the underlying district set forth in this Zoning Ordinance. Within the BESS, the requirements of the underlying district continue to apply, except when the following uses are proposed then the following provisions of this section 7.9 shall apply:

Tier 1 BESS

Tier 2 BESS and

Tier 3 BESS

§7.9.3 Applicability.

A. The requirements of this ordinance shall apply to BESS permitted, installed, decommissioned or modified after the effective date of this ordinance, excluding general maintenance and repair. BESS subject to this ordinance are only those that exceed the following capacities:

- Lead-acid with a capacity of greater than 70 kW
- Nickel with a capacity of greater than 70 kW
- Lithium-ion with a capacity of greater than 30 kW
- Sodium nickel chloride with a capacity of greater than 20 kW
- Flow with a capacity of greater than 20 kW
- Other battery technologies with a capacity of greater than 20 kW

B. Only BESS that meet the criteria herein shall be permitted under this ordinance. BESS permitted under and subject to this ordinance shall be classified either as a Tier 1, Tier 2 or Tier 3 BESS as set forth herein. All sizes noted in this section shall include the total capacity of the proposed facility and not refer solely as a limitation on total export. For avoidance of doubt, a proposed system which has an export capacity of 50 MW but has a total storage or redundance capacity of 100 MW shall be treated as a 100 MW system.

1. Tier 1 BESS have an aggregate energy capacity less than or equal to 500 kWh, derive 51% or more of their power from Solar Energy Systems as defined herein, and, if in a room or enclosed area, consist of only a single energy storage system technology.

2. Tier 2 BESS consist of those which meet one or more of the following criteria;

    a. have an aggregate energy capacity greater than 500kWh and less than 10 MWh, but no greater than 10 MWh;

    b. are comprised of more than one storage battery facility in a room or enclosed area;

    c. derive less than 51% of their power from Solar Energy Systems as defined herein.

3. Tier 3 BESS consist of those which meet one or more of the following criteria;

    a. have an aggregate energy capacity greater than 10 MWh, but no greater than 350MWh;

    b. are comprised of more than one storage battery facility in a room or enclosed area;

c. derive less than 51% of their power from Solar Energy Systems as defined herein.

§ 7.9.4. General Requirements

A. All permits required by state codes, including but not limited to building permit, an electrical permit, and a fire department permit shall be required for installation of all BESS.

B. All BESS, all Dedicated Use Buildings, and all other buildings or structures that (a) contain or are otherwise associated with a battery energy storage system; and (b) subject to the requirements of the State Building Code, shall be designed, erected, and installed in accordance with all applicable provisions of the State Building Code 780 CMR, State Fire Code 527 CMR 1.00, and State Electrical Code 527 CMR 12.00. All BESS shall comply with NFPA 855, Standard for the Installation of Stationary Energy Storage Systems or subsequent standard.

C. Energy storage system capacities, including array capacity and separation, are limited to the thresholds contained in NFPA 855 or subsequent standard.

§ 7.9.5. Permitting Requirements for Tier 1 BESS

Tier 1 BESS are allowed by right in all zoning districts, including the BESS Overlay District, subject to applicable provisions of the State Building Code, Electrical Code, Fire Code, and other applicable codes, and are subject to site plan review in accordance with section 10.8 hereof and such provisions of this ordinance as are applicable.

Tier 1 BESS and appurtenances shall be prohibited in the Zone A and Zone 1 public water supply protection areas.

§ 7.9.6. Permitting Requirements for, Tier 2 and Tier 3 BESS shall be permitted by Special Permit in the BESS Overlay District in accordance with the requirements below.

§ 7.9.6.1 Special Permit Required. Tier 2 and Tier 3 BESS subject to this ordinance require the issuance of a Special Permit in the BESS Overlay District and are subject to Major Site Plan Review pursuant to Section 10.8. Tier 2 and Tier 3 BESS shall comply with the applicable requirements set forth in this ordinance including the General Special Permit Criteria set forth in section 10.4.2, as well as this Section 7.9 , and the Haverhill General Ordinances. The City Council shall be the Special Permit Granting Authority ("SPGA"). The Applicant shall be required to submit all materials required in accordance with the SPGA Rules and Regulations, in addition to any other materials necessary or as may be required in order to support that the Application meets the Design Requirements set forth in section 7.9.6.2 herein.

§ 7.9.6.1.1 Development Review Required As Part of Hearing Process: For the purpose of a Special Permit filed hereunder, the Applicant shall be required to submit a complete application for a Special Permit in accordance with the Requirements hereunder. Following the opening of the Public Hearing by the SPGA, the Application shall be referred to the Development Review Committee as set forth in

§10.1.4 hereof. The Development Review Committee shall meet with the Applicant who shall be required to provide any additional information as the Committee may reasonably request and the Development Review Committee shall provide the SPGA with its recommendations within ninety (90) days of the date upon which the application was thereto referred.

§ 7.9.6.1.2 Prohibitions: Notwithstanding the foregoing, Tier 2 and Tier 3 BESS and appurtenances shall be prohibited in the Zone A and Zone I public water supply protection areas.

§ 7.9.6.2 Design Requirements. The following requirements apply to all BESS subject to this ordinance, except where it is specifically noted to apply only to Tier 2 or Tier 3BESS:

A. Site Plan Drawings. The Applicant shall provide a full set of Site Drawings stamped by a Massachusetts Registered Professional Engineer inclusive of items set forth in section 7.9.7.K.1 hereof.

B. Utility Lines and Electrical Circuitry. All on-site utility lines shall be placed underground to the extent feasible and as permitted by the serving utility, with the exception of the main service connection at the utility company right-of-way and any new interconnection equipment, including without limitation any poles.

C. Signage. Signage shall comply with the requirements of Section 6.2 of this Zoning Ordinance and the following additional requirements; in the event of a conflict between the provisions of Section 6.2 and this section, the requirements of this section shall control.

    1. The signage shall be in compliance with ANSI Z535 and shall include the type of technology associated with the BESS, any special hazards associated, the type of suppression system installed in the area of BESS, and 24-hour emergency contact information, including reach-back phone number.

    2. As required by the state electrical code, disconnect and other emergency shutoff information shall be clearly displayed on a light reflective surface. A clearly visible warning sign concerning voltage shall be placed at the base of all pad-mounted transformers and substations.

    3. Signage compliant with ANSI Z535 shall be provided on doors to rooms, entrances to BESS facilities, and on BESS outdoor containers.

D. Lighting. Lighting of the BESS shall be limited to that minimally required for safety, security and operational purposes, shall be shielded from abutting properties, shall be directed downward, shall incorporate full cut-off fixtures to reduce light pollution and shall otherwise be consistent with local, state and federal law. A photometric plan shall be required.

E. Vegetation and tree cutting. Areas within ten feet on each side of Tier 2 and Tier 3 BESS shall be cleared of combustible vegetation and other combustible growth. Single specimens of trees, shrubbery, or cultivated ground cover such as green grass, ivy, succulents, or similar plants used as ground covers shall be permitted provided that they do not form a means of readily transmitting fire. Removal of trees should be minimized to the extent possible. No tree or vegetation clearing shall be permitted within the Setbacks as noted below except for the

purposes of the area of ingress and egress to the site. Vegetation control in the Water Supply Protection Overlay District (WSPOD) shall be by mowing or other mechanical means. The use of synthetic pesticides, herbicides, and fertilizers shall be prohibited for BESS facilities within the WSPOD.

F. Setbacks. Tier 2 and Tier 3 BESS shall be set back a minimum of 150 feet from all side, rear, and front lot lines; except that Tier 2 and Tier 3 BESS shall be set back a minimum of 300 feet from side, rear, and front lot lines that abut or are across a street from residential zoning districts or existing single, two-family, or multi-family structures. The minimum setback areas shall include a Buffer Area at least fifty feet wide along all property lines. Access drives and parking are allowed in the setback areas, except emergency access as noted below, but shall not intrude into the required setback areas except where necessary to provide access or egress to the property. In addition, a minimum of 50 feet must be maintained between BESS components and all buildings, stored combustible materials, hazardous materials, high-piled storage, personnel means of egress, and other exposure hazards not associated with electrical grid infrastructure. The Special Permit Granting Authority may waive these setback requirements so long as the approved setbacks protect the health and safety of nearby abutters.

G. Emergency Access: There shall be a 60-foot-wide paved emergency access road around the complete perimeter of the facility but inside the required setback area which may not exceed a 7% grade at any time. Ongoing maintenance of the access road including snow removal after 3 inches of snow shall be included as part of the Operations and Maintenance Plan required herein.

H. Lot Size. The minimum lot size for Tier 1 BESS shall not be less than 1 acre. The minimum lot size for a Tier 2 BESS shall be not less than 10 acres and the minimum lot size for a Tier 3 BESS shall be no less than 20.

I. Dimensional. All BESS shall comply with the dimensional limitations for principal structures of the underlying zoning district as provided in Appendix B, Table 2, of this Zoning Ordinance, unless otherwise provided in this ordinance. No BESS shall exceed 15 feet in height and there shall be no vertical stacking of BESS units.

J. Fencing Requirements. Tier 2 and Tier 3 BESS, including all mechanical equipment, shall be enclosed by a minimum eight-foot high fence with a self-locking gate to prevent unauthorized access unless housed in a dedicated-use building. All gates shall accomodate a knox box or other accessible means to allow access to public safety personnel. Security barriers, fences, landscaping, and other enclosures must not inhibit required air flow to or exhaust from the BESS and components. Electrical equipment greater than 1,000V require a separate and additional means to restrict access. NFPA 855 requires specialty safety systems to be provided based on the BESS chemistry and installed location.

K. Screening and Visibility. Tier 2 and Tier 3 BESS shall have views minimized from adjacent properties to the extent reasonably practicable using architectural features, earth berms, landscaping, or other screening methods that will harmonize with the character of the property and surrounding area. Such features may not inhibit required air flow to or exhaust from the BESS and components and must comply with the setbacks established in paragraph G above.

L. Failure Protection. All Tier 2 and Tier 3 BESS shall include an impenetrable layer beneath the

surface and no closer than four (4) feet to the closest water table which will cause any discharge to flow into a basin located on site which will then capture and/or treat any runoff as a result of a failed battery or fire or other destruction. The Application shall include details of the proposed catchment system along with a detailed stormwater report and stamped detailed engineering plans from a Massachusetts Registered Professional Engineer depicting the stormwater system. All BESS facilities located within the WSPOD shall have full containment to capture all releases, either intentionally from maintenance or accidental in nature. Release and runoff shall not be allowed.

M. Batteries. Failed battery cells and modules shall not be stored on the site and shall be removed no later than 30 days after deemed failed by the BESS operator or cell/module manufacturer. The operator shall notify the Haverhill Fire Chief in advance if the type of battery or batteries used onsite is to be changed. All failed battery cells and modules shall not be stored outdoors and must be protected from further damage and potential release of contaminants to the environment.

N. Storage. No equipment or hazardous materials, in liquid, dry, or gas form, shall be stored onsite of the BESS other than those items in quantities necessary for the proper operation of the facility. Any storage for materials deemed necessary shall be properly labeled, covered and contained to protect from release to the environment.

O. Acoustical Impacts. No system shall cause an increase in acoustical levels over ambient at the Property line. An acoustical study prepared by a Massachusetts Registered Acoustical Engineer shall be provided.

P. Water Source. A municipal water source shall be provided including a FDC within 100 feet before the entrance to the Hazard Area on the Property. The Applicant shall present evidence including a hydraulic analysis in accordance to the City standard to support that there is adequate volume and pressure for fire suppression on the Property and not have a detrimental impact on the surrounding neighborhood. The applicant shall be required to make any related offsite improvement to achieve the required standard to alleviate any impact on the adjacent users.

Q. Stormwater Management. The applicant shall submit a stormwater management plan consistent with the Massachusetts Stormwater Management Policy.

R. Decommissioning Plan. The applicant shall submit with its application a decommissioning plan for all BESS to be implemented upon abandonment and/or in conjunction with removal of the facility. The owner or operator of the BESS shall notify the Building Commissioner in writing at least twenty days prior to when a BESS will be decommissioned. Decommissioning of an abandoned or discontinued BESS shall be completed within six months after the facility ceases operation. The decommissioning plan shall include:

1. A narrative description of the activities to be accomplished, including who will perform that activity and at what point in time, for complete physical removal of all BESS components, structures, equipment, security barriers, and transmission lines from the site;

2. Disposal of all solid and hazardous waste in accordance with local, state, and

federal waste disposal regulations;

3. The anticipated life of the BESS;

4. The estimated decommissioning costs and how said estimate was determined, including an allowance for annual cost of living increases or increases due to inflation;

5. The method of ensuring that funds will be available for decommissioning and restoration;

6. The method by which the decommissioning cost will be kept current;

7. The manner in which the site will be restored, including a description of how any changes to the surrounding areas and other systems adjacent to the BESS, such as, but not limited to, structural elements, building penetrations, means of egress, and required fire detection suppression systems, will be protected during decommissioning and confirmed as being acceptable after the system is removed; and

8. A listing of any contingencies for removing an intact operational energy storage system from service, and for removing an energy storage system from service that has been damaged by a fire or other event.

S. Decommissioning Fund. The owner and/or operator of the energy storage system, shall continuously maintain a fund or other surety acceptable to the City, in a form approved by the City Council and City Solicitor, for the removal of the BESS, in an amount to be determined by the City, and which includes the City as loss payee, for the period of the life of the facility. All costs of the financial security shall be borne by the Applicant.

T. Proof of Liability Insurance. The applicant or property owner shall provide evidence of commercial liability insurance in an amount and type generally acceptable in the industry and approved by the Planning Board prior to the issuance of a building permit, and shall continue such insurance in effect until such facility has been decommissioned, removed, and the site restored in accordance with this ordinance.

§ 7.9.6.3 Special Permit Criteria. In addition to the general Special Permit criteria set forth in section 10.4.2 of this Ordinance, an application for Tier 2 or Tier 3 BESS shall meet the following criteria:

A. The project protects the ground water and surrounding properties from catastrophic failure of one or more of the batteries or cells by implementing appropriate catchment and filtration systems for water run off or run off from the system.

B. The project appropriately attenuates sound intrusion beyond the property lines onto adjacent properties so that there is no change in ambient sound after construction and during operations of the system.

C. The project includes only dark sky compliant down lighting which does not intrude beyond the property lines onto adjacent properties.

D. The project is secure and addresses possible trespass or other intrusion by individuals not affiliated with the project.

E. The project meets the public safety needs of the City.

F. The project minimizes visual impacts from utility infrastructure for interconnection.

F. The project is minimally visible from adjacent properties.

§ 7.9.7. Site Plan application.

For all BESS the Site Plan application shall include the following information, in addition to that required by Section 10.8 of this Zoning Ordinance and the applicable Planning Board requirements governing Site Plan Applications:

A. Utility Infrastructure information requirements:

1. A one- or three-line electrical diagram detailing the BESS layout, associated components, and electrical interconnection methods, with all State Electrical Code compliant disconnects and over current devices.

2. The Applicant shall provide certified verification that there is a fully executed Interconnection Services Agreement ("ISA") with the local utility distribution company. Said certification shall include the cover and signature pages of the ISA.

3. If the ISA has not been issued, the Applicant shall be required to provide a full copy of the Application for Interconnection filed with the local utility distribution company.

B. Preliminary equipment specification sheets that document the proposed BESS components, inverters and associated electrical equipment that are to be installed. A final equipment specification sheet shall be submitted prior to the issuance of building permit.

C. Name, address, and contact information of proposed or potential system installer and the owner and/or operator of the BESS. Such information of the final system installer shall be submitted prior to the issuance of building permit.

D. Large-scale fire test data, evaluation information, and calculations, and modeling data. For any of the following, UL 9540A fire test data must be made available to the Planning Board for review:

- BESS systems with a capacity of greater than 50 kW
- BESS systems with spacing between arrays of less than 3 feet

E. Commissioning Plan. The system installer or commissioning agent shall prepare a commissioning plan prior to the start of commissioning. Such plan shall be compliant with NFPA 855 and document and verify that the system and its associated controls and safety

systems are in proper working condition per requirements set forth in applicable state codes. Where commissioning is required by the Building Code, BESS commissioning shall be conducted by a Massachusetts Licensed Professional Engineer after the installation is complete but prior to final inspection and approval. A corrective action plan shall be developed for any open or continuing issues that are allowed to be continued after commissioning. A report describing the results of the system commissioning and including the results of the initial acceptance testing required by applicable state codes shall be provided to Zoning Enforcement Officer prior to final inspection and approval and maintained at an approved on-site location.

F. Fire Safety Compliance Plan. Such plan shall document and verify that the system and its associated controls and safety systems are in compliance with state codes, including documentation that BESS components comply with the safety standards set forth in subsection 7.9.9. Such plan shall also include a detailed training plan for public safety personnel.

G. Operation and Maintenance Manual. Such plan shall describe continuing BESS maintenance and property upkeep, as well as design, construction, installation, testing and commissioning information and shall meet all requirements set forth state codes and NFPA 855. Maintenance provisions will be driven by manufacturer requirements for the specific listed system. It shall address maintenance of the access and perimeter roadways, perimeter fencing, and shall include a snow removal plan and 24 hours access requirements by public safety officials. There shall be an annual; acoustical review to assure ongoing compliance with the requirement of no change from ambient at the property line and fire department inspection.

H. Depending on the location of the BESS in relation to and its interaction with the electrical grid, interconnection will be completed per 527 CMR 12.00. System interconnections into utility grids shall be in accordance with NFPA 855 and the local distribution company standards for interconnection of distributed energy resources. An accessible disconnect is required per 527 CMR 12.00.

I. Prior to the issuance of the building permit, As Built engineering documents must be signed and sealed by a Massachusetts Licensed Professional Engineer and provided to the Building Commissioner and Planning Department .

J. Emergency Operations Plan. An Emergency Operations Plan compliant with NFPA 855 is required. A copy of the approved Emergency Operations Plan shall be given to the system operator, the local fire department, local fire code official and police department. For so long as the BESS is operational, the operator shall provide the Fire Department, Police Department, Building Commissioner, and Mayor's office with contact information for personnel that can be reached 24 hours per day every day, and this contact information shall be updated by the operator whenever there is a change in the information. The operator shall also be required to have an official representative be present onsite not later than two hours after notification by the Fire Chief, Police Chief, or their designee. A permanent copy shall also be placed in an approved location to be accessible to facility personnel, fire code officials, and emergency responders. The emergency operations plan shall include the following information:

1. Procedures for safe shutdown, de-energizing, or isolation of equipment and systems under emergency conditions to reduce the risk of fire, electric shock, and personal injuries, and for safe start-up following cessation of emergency conditions.

2. Procedures for inspection and testing of associated alarms, interlocks, and controls, including time intervals for inspection and testing.

3. Procedures to be followed in response to notifications from the Battery Energy Storage Management System, when provided, that could signify potentially dangerous conditions, including shutting down equipment, summoning service and repair personnel, and providing agreed upon notification to fire department personnel for potentially hazardous conditions in the event of a system failure.

4. Emergency procedures to be followed in case of fire, explosion, release of liquids or vapors, damage to critical moving parts, or other potentially dangerous conditions. Procedures can include sounding the alarm, notifying the fire department, evacuating personnel, de-energizing equipment, and controlling and extinguishing the fire.

5. Response considerations similar to a safety data sheet (SDS) that will address response safety concerns and extinguishment when an SDS is not required.

6. Procedures for safe disposal of BESS equipment damaged in a fire or other emergency event, including maintaining contact information for personnel qualified to safely remove damaged BESS equipment from the facility.

7. Other procedures as determined necessary by the City to provide for the safety of occupants, neighboring properties, and emergency responders.

8. Procedures and schedules for conducting drills of these procedures and for training local first responders on the contents of the plan and appropriate response procedures.

K. Each Application shall be accompanied by the following information:

1. A certified plot plan at a minimum scale of one inch equals 40 feet and a maximum scale of one inch equals 20 feet. The site plan shall contain:
   a. Date of site plan with all revisions noted and dated. Title of development, North arrow, scale, map and lot number, name and address of record owner, name and address of person preparing the site plan.
   b. The names of all owners of record of adjacent properties, and the map and lot number of the properties and all buildings.
   c. Zoning district boundaries and flood zone boundaries shall be shown as they affect the property including limits of the WSPOD and public water supply Zone A and Zone I on the overall site plan.
   d. Boundaries of the property and lines of existing street, lots, easements and

areas dedicated to public use, including rights of way.

e. A locus map showing the location of the property with reference to surrounding area.
f. A table indicating all calculations necessary to determine conformance to Bylaw regulations including current required and proposed regulations.
g. Square footage of property to the nearest 10 square feet.

2. All plans must include the location of existing and proposed buildings, walls, fences, culverts, parking areas, loading areas, walkways and driveways.

   a. Location and dimensions of utilities, gas, telephone, electrical, communications, water drainage, sewer and other waste disposal.

   b. Location, type and dimensions of landscaping and screening.

   c. Location of existing rock outcroppings, high points, vistas, ponds, depressions, wetlands, major trees (twelve-inch caliper and over) and any other significant existing features.

   d. Two-foot contours where slopes are less than 15% and five-foot contours when 15% or more. Existing contours shall be indicated by dashed line. Proposed contours shall be indicated by solid line.

   e. Dimensioned schematic drawings of all proposed buildings. Scale shall not exceed ¼ inch equals one foot nor less than 1/8 inch equals one foot.

   f. A narrative describing the proposal and addressing the foregoing requirements.

   g. Location of street numbers indicated on the schematic drawings and/or site plan.

   h. Surface and water pollution. A report on the impact of Stormwater runoff on adjacent and downstream surface water bodies, subsurface groundwater and the water table.

   i. Soils. The potential dangers of erosion and sedimentation caused by the operation and maintenance of the proposed development.

   j. General environmental impact. A report on the relationship of the proposed development of the major botanical, zoological, geological and hydrological resources of the site, and compatibility of the proposed development with adjacent or surrounding land uses and neighborhoods.

   k. Traffic impact. A report on existing street capacities, estimated average

daily traffic generation, composition, peak hour levels and directional flows resulting from the proposed development, proposed methods to mitigate the estimated traffic impact and methodology and sources used to derive existing data and estimations.

l. Renderings showing the proposed project in relationship to its surroundings.

§ 7.9.8. Ownership Changes.

If the owner of the BESS changes or the owner of the property changes, the Special Permit shall remain in effect, provided that the successor owner or operator assumes in writing all of the obligations of the Special Permit, Site Plan approval, and decommissioning plan. A new owner or operator of the BESS shall notify the Building Commissioner of such change in ownership or operator within 14 days of the ownership change. A new owner or operator must provide such notification to the Building Commissioner in writing.

§ 7.9.9. Safety

System Certification. BESS and equipment shall be listed by a Nationally Recognized Testing Laboratory to UL 9540 (Standard for BESS and Equipment) or approved equivalent, with subcomponents meeting each of the following standards as applicable:

A. UL 1973 (Standard for Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail Applications),
B. UL 1642 (Standard for Lithium Batteries),
C. UL 1741 or UL 62109 (Inverters and Power Converters),
D. Certified under the applicable electrical, building, and fire prevention codes as required.
E. Alternatively, field evaluation by an approved testing laboratory for compliance with UL 9540 (or approved equivalent) and applicable codes, regulations and safety standards may be used to meet system certification requirements.

Site Access. BESS shall be maintained in good working order and in accordance with industry standards. Site access shall be maintained, including snow removal at a level acceptable to the local fire department.

BESS, components, and associated ancillary equipment shall have required working space clearances, and electrical circuitry shall be within weatherproof enclosures marked with the environmental rating suitable for the type of exposure in compliance with NFPA 70.

§ 7.9.11. Abandonment

The BESS shall be considered abandoned when it ceases to operate consistently for more than one year. If the owner and/or operator fails to comply with decommissioning upon any abandonment, the City may, after compliance with any applicable state and federal constitutional requirements, enter the property and utilize the available bond and/or security for the removal of any BESS and restoration of the site in accordance with the decommissioning plan.

**And further add the following new definition to § 11.1 of Chapter 255**

§ 11.1

AGGREGATE ENERGY CAPACITY: Total amount of energy stored that can be stored in all batteries that are a part of the BESS measured in kilowatt-hours (kWh) or megawatt-hours (MWh).

BATTERY or BATTERIES: A single cell or group of cells connected electrically in series, in parallel, or combination of both, which can charge, discharge and store energy electrochemically. For the purpose of this Ordinance, batteries utilized in consumer products are excluded from these requirements.

BATTERY ENERGY STORAGE SYSTEM ("BESS") – A system containing one of more battery modules for storing electrical energy, any equipment needed to support the safe and proper function or usage of the battery modules, and one or moe physical container(s) providing secondary containment to any of the above. It may be a primary use or an Accessory Use to a solar generating facility, power generation facility, electrical substation, or other similar uses. For the purposes of this bylaw, BESS are comprised of three (3) types as further described in § 7.9.3.B. of this bylaw; Tier 1 BESS, Tier 2 BESS and Tier 3 BESS.

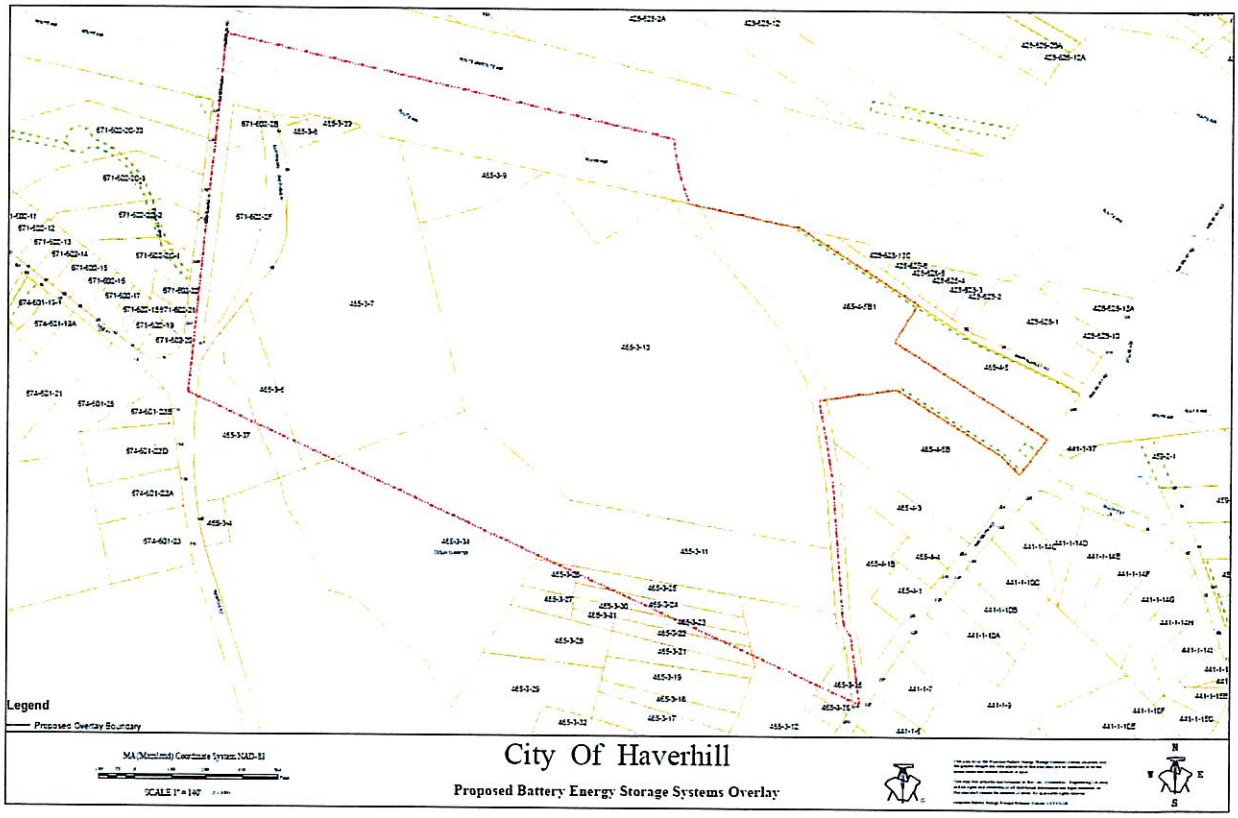
**And further to amend section 3.1.3, Table of Use and Parking regulations by allowing Tier 1, Tier 2 and Tier 3 BESS in the districts as follows:**

BESS Overlay District - OD

| | RS | RR | RL | RM | RH | RU | CN | CH | CG | CC | CM | OP | BG | BP | BESS OD | PC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **I. MISCELLANEOUS COMMERCIAL USES (cont'd)** | | | | | | | | | | | | | | | | |
| 22. Kennel or veterinary hospital in which all animals, fowl or other forms of life are completely enclosed in pens or other structures | BA | BA | N | N | N | N | N | BA | N | N | N | N | N | N | | D |
| 23. Commercial communications and/or television tower, provided that it shall be at least 500 feet from any R District | BA | N | N | N | N | N | N | BA | BA | BA | N | BA | BA | BA | | None |
| **24. Battery Energy Storage Systems: Tier 1** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **N** | **Y** | **Y** | **Y** | **None** |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **25. Battery Energy Storage Systems: Tier 2** | N | N | N | N | N | N | N | N | N | N | N | N | N | N | CC | None |
| **26. Battery Energy Storage Systems: Tier 3** | N | N | N | N | N | N | N | N | N | N | N | N | N | N | CC | None |

**And further to amend the City of Haverhill Zoning Map to include the BESS Overlay District as set forth below:**



DOCUMENT

# CITY OF HAVERHILL

In Municipal Council

ORDERED:

Municipal Ordinance Chapter 255

An Ordinance Relating to Amend Chapter 255 Zoning Ordinance and Zoning Map

Ordinance: re: Amend Chapter 255 Zoning Ordinance and Zoning Map – Battery Energy Storage Systems Overlay District (BESS)– by inserting a new section 7.9 Battery Energy Storage Systems, amending section 3.1.3 Table of Use and Parking regulations by allowing a Tier 1, Tier 2 and Tier 3 BESS and amending the Zoning Map to include the BESS Overlay District. The overlay district will be creating regulations for the installation and use of free-standing battery energy storage systems ("BESS"), adding to the table the overlay district with the allowed Tiers and updating the zoning map to include the BESS Overlay District, or take any other action related to.

Since this Ordinance exceeds in length eight octavo pages of ordinary book print, in lieu of advertising, it is published by the City Council in a municipal bulletin, placed on file in the City Clerk's Office, and posted on the municipal bulletin in City Hall.

PLACED ON FILE for at least 14 days

Advertise in Gazette:
Thursday April 16th and Thursday April 23rd

Attest:

Kaitlin M. Wright, CMC
City Clerk

## Kaitlin Wright

**From:** North of Boston <noreply@wave2adportal.com>
**Sent:** Monday, March 23, 2026 10:49 AM
**To:** CityClerk
**Cc:** cmacdonald@northofboston.com; Kaitlin Wright; Natalia Hernandez
**Subject:** Thank you for placing your order with us.

Warning! External Email. Exercise caution when opening attachments or clicking on any links.

## THANK YOU for your notice submission!

This is your confirmation that your order has been submitted. Below are the details of your transaction. Please save this confirmation for your records.

### Job Details

Order Number:
**W0142797**

Business Type:
All Other Public Notices

Notice Size:
Public Notices

Notice Estimate:
$196.16

Referral Code:
**Amend Chapter 255 Zoning Ord**

### Account Details

Haverhill Clerk
4 SUMMER ST STE 118
HAVERHILL, MA □ 01830
978-374-2312
cityclerk@cityofhaverhill.com
HAVERHILL CITY CLERK

### Schedule for notice number W01427970

**Thu Apr 16, 2026**

**Haverhill Gazette Public Notices**

*All Zones*

**Thu Apr 23, 2026**

**Haverhill Gazette Public Notices**

*All Zones*

**CITY OF HAVERHILL**
**In Municipal Council**
**ORDERED:**
**Municipal Ordinance Chapter 255**

An Ordinance Relating to Amend Chapter 255 Zoning Ordinance and Zoning Map

Ordinance: re: Amend Chapter 255 Zoning Ordinance and Zoning Map - Battery Energy Storage Systems Overlay District (BESS)-by inserting anew section 7.9 Battery Energy Storage Systems, amending section 3.1.3 Table of Use and Parking regulations by allowing a Tier 1, Tier 2 and Tier 3 BESS and amending the Zoning Map to include the BESS Overlay District. The overlay district will be creating regulations for the installation and use of free-standing battery energy storage systems ("BESS"), adding to the table the overlay district with the allowed Tiers and updating the zoning map to include the BESS Overlay District, or take any other action related to.

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PLACED ON FILE for at least 14 days

Attest: Kaitlin M. Wright, CMC
City Clerk

HG - Publication Dates

*The North of Boston Media Group is not responsible for any false, inaccurate or omitted notices.*

10. 3. 1

**MUNICIPAL ORDINANCE CHAPTER 255 Zoning**

**AN ORDINANCE RELATING TO AMENDING CHAPTER 255, ZONING BY ADDING A NEW SECTION 7.9 BATTERY ENTERGY STORAGE SYSTEMS**

**BE IT ORDAINED by the City Council of the City of Haverhill that Chapter 255, Zoning, of the Code of the City of Haverhill, as amended, being and is hereby further amended as follows by inserting the following new section 7.9 entitled "Battery Energy Storage Systems";**

§7.9 BATTERY ENERGY STORAGE SYSTEMS

§7.9.1. Purpose.

The purpose of this Section is to advance and protect the public health, safety, welfare, and quality of life by creating regulations for the installation and use of free-standing battery energy storage systems ("BESS"), with the following objectives:

A. To provide a regulatory scheme for the location, construction and operation of free-standing BESS consistent with best practices and safety protocols;
B. To ensure compatible land uses in the vicinity of the areas affected by BESS and to mitigate any potential impacts on abutting and nearby properties; and
C. To mitigate the impacts of BESS on environmental resources such as agricultural lands, forests, wildlife, wetlands and other natural resources.

This Section shall be construed to be consistent with state law, including but not limited to the provisions of General Laws chapter 40A, section 3, and state regulations, including but not limited to the provisions of the State Building Code, State Fire Code, and State Electrical Code. In the event of any conflict between the provisions of this section and the provisions of state law or regulations, the state law and regulations shall prevail.

§7.9.2. Establishment of the BESS Overlay District
The BESS Overlay District is an overlay district superimposed over the underlying district set forth in this Zoning Ordinance. Within the BESS, the requirements of the underlying district continue to apply, except when the following uses are proposed then the following provisions of this section 7.9 shall apply:

Tier 1 BESS

Tier 2 BESS and

Tier 3 BESS

§7.9.3 Applicability.

A. The requirements of this ordinance shall apply to BESS permitted, installed, decommissioned or modified after the effective date of this ordinance, excluding general maintenance and repair. BESS subject to this ordinance are only those that exceed the following capacities:

- Lead-acid with a capacity of greater than 70 kW
- Nickel with a capacity of greater than 70 kW
- Lithium-ion with a capacity of greater than 30 kW
- Sodium nickel chloride with a capacity of greater than 20 kW
- Flow with a capacity of greater than 20 kW
- Other battery technologies with a capacity of greater than 20 kW

B. Only BESS that meet the criteria herein shall be permitted under this ordinance. BESS permitted under and subject to this ordinance shall be classified either as a Tier 1, Tier 2 or Tier 3 BESS as set forth herein. All sizes noted in this section shall include the total capacity of the proposed facility and not refer solely as a limitation on total export. For avoidance of doubt, a proposed system which has an export capacity of 50 MW but has a total storage or redundance capacity of 100 MW shall be treated as a 100 MW system.

1. Tier 1 BESS have an aggregate energy capacity less than or equal to 500 kWh, derive 51% or more of their power from Solar Energy Systems as defined herein, and, if in a room or enclosed area, consist of only a single energy storage system technology.

2. Tier 2 BESS consist of those which meet one or more of the following criteria;

    a. have an aggregate energy capacity greater than 500kWh and less than 10 MWh, but no greater than 10 MWh;

    b. are comprised of more than one storage battery facility in a room or enclosed area;

    c. derive less than 51% of their power from Solar Energy Systems as defined herein.

3. Tier 3 BESS consist of those which meet one or more of the following criteria;

    a. have an aggregate energy capacity greater than 10 MWh, but no greater than 350MWh;

    b. are comprised of more than one storage battery facility in a room or enclosed area;

c. derive less than 51% of their power from Solar Energy Systems as defined herein.

§ 7.9.4. General Requirements

A. All permits required by state codes, including but not limited to building permit, an electrical permit, and a fire department permit shall be required for installation of all BESS.

B. All BESS, all Dedicated Use Buildings, and all other buildings or structures that (a) contain or are otherwise associated with a battery energy storage system; and (b) subject to the requirements of the State Building Code, shall be designed, erected, and installed in accordance with all applicable provisions of the State Building Code 780 CMR, State Fire Code 527 CMR 1.00, and State Electrical Code 527 CMR 12.00. All BESS shall comply with NFPA 855, Standard for the Installation of Stationary Energy Storage Systems or subsequent standard.

C. Energy storage system capacities, including array capacity and separation, are limited to the thresholds contained in NFPA 855 or subsequent standard.

§ 7.9.5. Permitting Requirements for Tier 1 BESS

Tier 1 BESS are allowed by right in all zoning districts, including the BESS Overlay District, subject to applicable provisions of the State Building Code, Electrical Code, Fire Code, and other applicable codes, and are subject to site plan review in accordance with section 10.8 hereof and such provisions of this ordinance as are applicable.

Tier 1 BESS and appurtenances shall be prohibited in the Zone A and Zone 1 public water supply protection areas.

§ 7.9.6. Permitting Requirements for, Tier 2 and Tier 3 BESS shall be permitted by Special Permit in the BESS Overlay District in accordance with the requirements below.

§ 7.9.6.1 Special Permit Required. Tier 2 and Tier 3 BESS subject to this ordinance require the issuance of a Special Permit in the BESS Overlay District and are subject to Major Site Plan Review pursuant to Section 10.8. Tier 2 and Tier 3 BESS shall comply with the applicable requirements set forth in this ordinance including the General Special Permit Criteria set forth in section 10.4.2, as well as this Section 7.9 , and the Haverhill General Ordinances. The City Council shall be the Special Permit Granting Authority ("SPGA"). The Applicant shall be required to submit all materials required in accordance with the SPGA Rules and Regulations, in addition to any other materials necessary or as may be required in order to support that the Application meets the Design Requirements set forth in section 7.9.6.2 herein.

§ 7.9.6.1.1 Development Review Required As Part of Hearing Process: For the purpose of a Special Permit filed hereunder, the Applicant shall be required to submit a complete application for a Special Permit in accordance with the Requirements hereunder. Following the opening of the Public Hearing by the SPGA, the Application shall be referred to the Development Review Committee as set forth in

§10.1.4 hereof. The Development Review Committee shall meet with the Applicant who shall be required to provide any additional information as the Committee may reasonably request and the Development Review Committee shall provide the SPGA with its recommendations within ninety (90) days of the date upon which the application was thereto referred.

§ 7.9.6.1.2 Prohibitions: Notwithstanding the foregoing, Tier 2 and Tier 3 BESS and appurtenances shall be prohibited in the Zone A and Zone I public water supply protection areas.

§ 7.9.6.2 Design Requirements. The following requirements apply to all BESS subject to this ordinance, except where it is specifically noted to apply only to Tier 2 or Tier 3BESS:

A. Site Plan Drawings. The Applicant shall provide a full set of Site Drawings stamped by a Massachusetts Registered Professional Engineer inclusive of items set forth in section 7.9.7.K.1 hereof.

B. Utility Lines and Electrical Circuitry. All on-site utility lines shall be placed underground to the extent feasible and as permitted by the serving utility, with the exception of the main service connection at the utility company right-of-way and any new interconnection equipment, including without limitation any poles.

C. Signage. Signage shall comply with the requirements of Section 6.2 of this Zoning Ordinance and the following additional requirements; in the event of a conflict between the provisions of Section 6.2 and this section, the requirements of this section shall control.

    1. The signage shall be in compliance with ANSI Z535 and shall include the type of technology associated with the BESS, any special hazards associated, the type of suppression system installed in the area of BESS, and 24-hour emergency contact information, including reach-back phone number.

    2. As required by the state electrical code, disconnect and other emergency shutoff information shall be clearly displayed on a light reflective surface. A clearly visible warning sign concerning voltage shall be placed at the base of all pad-mounted transformers and substations.

    3. Signage compliant with ANSI Z535 shall be provided on doors to rooms, entrances to BESS facilities, and on BESS outdoor containers.

D. Lighting. Lighting of the BESS shall be limited to that minimally required for safety, security and operational purposes, shall be shielded from abutting properties, shall be directed downward, shall incorporate full cut-off fixtures to reduce light pollution and shall otherwise be consistent with local, state and federal law. A photometric plan shall be required.

E. Vegetation and tree cutting. Areas within ten feet on each side of Tier 2 and Tier 3 BESS shall be cleared of combustible vegetation and other combustible growth. Single specimens of trees, shrubbery, or cultivated ground cover such as green grass, ivy, succulents, or similar plants used as ground covers shall be permitted provided that they do not form a means of readily transmitting fire. Removal of trees should be minimized to the extent possible. No tree or vegetation clearing shall be permitted within the Setbacks as noted below except for the

purposes of the area of ingress and egress to the site. Vegetation control in the Water Supply Protection Overlay District (WSPOD) shall be by mowing or other mechanical means. The use of synthetic pesticides, herbicides, and fertilizers shall be prohibited for BESS facilities within the WSPOD.

F. Setbacks. Tier 2 and Tier 3 BESS shall be set back a minimum of 150 feet from all side, rear, and front lot lines; except that Tier 2 and Tier 3 BESS shall be set back a minimum of 300 feet from side, rear, and front lot lines that abut or are across a street from residential zoning districts or existing single, two-family, or multi-family structures. The minimum setback areas shall include a Buffer Area at least fifty feet wide along all property lines. Access drives and parking are allowed in the setback areas, except emergency access as noted below, but shall not intrude into the required setback areas except where necessary to provide access or egress to the property. In addition, a minimum of 50 feet must be maintained between BESS components and all buildings, stored combustible materials, hazardous materials, high-piled storage, personnel means of egress, and other exposure hazards not associated with electrical grid infrastructure. The Special Permit Granting Authority may waive these setback requirements so long as the approved setbacks protect the health and safety of nearby abutters.

G. Emergency Access: There shall be a 60-foot-wide paved emergency access road around the complete perimeter of the facility but inside the required setback area which may not exceed a 7% grade at any time. Ongoing maintenance of the access road including snow removal after 3 inches of snow shall be included as part of the Operations and Maintenance Plan required herein.

H. Lot Size. The minimum lot size for Tier 1 BESS shall not be less than 1 acre. The minimum lot size for a Tier 2 BESS shall be not less than 10 acres and the minimum lot size for a Tier 3 BESS shall be no less than 20.

I. Dimensional. All BESS shall comply with the dimensional limitations for principal structures of the underlying zoning district as provided in Appendix B, Table 2, of this Zoning Ordinance, unless otherwise provided in this ordinance. No BESS shall exceed 15 feet in height and there shall be no vertical stacking of BESS units.

J. Fencing Requirements. Tier 2 and Tier 3 BESS, including all mechanical equipment, shall be enclosed by a minimum eight-foot high fence with a self-locking gate to prevent unauthorized access unless housed in a dedicated-use building. All gates shall accomodate a knox box or other accessible means to allow access to public safety personnel. Security barriers, fences, landscaping, and other enclosures must not inhibit required air flow to or exhaust from the BESS and components. Electrical equipment greater than 1,000V require a separate and additional means to restrict access. NFPA 855 requires specialty safety systems to be provided based on the BESS chemistry and installed location.

K. Screening and Visibility. Tier 2 and Tier 3 BESS shall have views minimized from adjacent properties to the extent reasonably practicable using architectural features, earth berms, landscaping, or other screening methods that will harmonize with the character of the property and surrounding area. Such features may not inhibit required air flow to or exhaust from the BESS and components and must comply with the setbacks established in paragraph G above.

L. Failure Protection. All Tier 2 and Tier 3 BESS shall include an impenetrable layer beneath the

surface and no closer than four (4) feet to the closest water table which will cause any discharge to flow into a basin located on site which will then capture and/or treat any runoff as a result of a failed battery or fire or other destruction. The Application shall include details of the proposed catchment system along with a detailed stormwater report and stamped detailed engineering plans from a Massachusetts Registered Professional Engineer depicting the stormwater system. All BESS facilities located within the WSPOD shall have full containment to capture all releases, either intentionally from maintenance or accidental in nature. Release and runoff shall not be allowed.

M. Batteries. Failed battery cells and modules shall not be stored on the site and shall be removed no later than 30 days after deemed failed by the BESS operator or cell/module manufacturer. The operator shall notify the Haverhill Fire Chief in advance if the type of battery or batteries used onsite is to be changed. All failed battery cells and modules shall not be stored outdoors and must be protected from further damage and potential release of contaminants to the environment.

N. Storage. No equipment or hazardous materials, in liquid, dry, or gas form, shall be stored onsite of the BESS other than those items in quantities necessary for the proper operation of the facility. Any storage for materials deemed necessary shall be properly labeled, covered and contained to protect from release to the environment.

O. Acoustical Impacts. No system shall cause an increase in acoustical levels over ambient at the Property line. An acoustical study prepared by a Massachusetts Registered Acoustical Engineer shall be provided.

P. Water Source. A municipal water source shall be provided including a FDC within 100 feet before the entrance to the Hazard Area on the Property. The Applicant shall present evidence including a hydraulic analysis in accordance to the City standard to support that there is adequate volume and pressure for fire suppression on the Property and not have a detrimental impact on the surrounding neighborhood. The applicant shall be required to make any related offsite improvement to achieve the required standard to alleviate any impact on the adjacent users.

Q. Stormwater Management. The applicant shall submit a stormwater management plan consistent with the Massachusetts Stormwater Management Policy.

R. Decommissioning Plan. The applicant shall submit with its application a decommissioning plan for all BESS to be implemented upon abandonment and/or in conjunction with removal of the facility. The owner or operator of the BESS shall notify the Building Commissioner in writing at least twenty days prior to when a BESS will be decommissioned. Decommissioning of an abandoned or discontinued BESS shall be completed within six months after the facility ceases operation. The decommissioning plan shall include:

1. A narrative description of the activities to be accomplished, including who will perform that activity and at what point in time, for complete physical removal of all BESS components, structures, equipment, security barriers, and transmission lines from the site;

2. Disposal of all solid and hazardous waste in accordance with local, state, and

federal waste disposal regulations;

3. The anticipated life of the BESS;

4. The estimated decommissioning costs and how said estimate was determined, including an allowance for annual cost of living increases or increases due to inflation;

5. The method of ensuring that funds will be available for decommissioning and restoration;

6. The method by which the decommissioning cost will be kept current;

7. The manner in which the site will be restored, including a description of how any changes to the surrounding areas and other systems adjacent to the BESS, such as, but not limited to, structural elements, building penetrations, means of egress, and required fire detection suppression systems, will be protected during decommissioning and confirmed as being acceptable after the system is removed; and

8. A listing of any contingencies for removing an intact operational energy storage system from service, and for removing an energy storage system from service that has been damaged by a fire or other event.

S. Decommissioning Fund. The owner and/or operator of the energy storage system, shall continuously maintain a fund or other surety acceptable to the City, in a form approved by the City Council and City Solicitor, for the removal of the BESS, in an amount to be determined by the City, and which includes the City as loss payee, for the period of the life of the facility. All costs of the financial security shall be borne by the Applicant.

T. Proof of Liability Insurance. The applicant or property owner shall provide evidence of commercial liability insurance in an amount and type generally acceptable in the industry and approved by the Planning Board prior to the issuance of a building permit, and shall continue such insurance in effect until such facility has been decommissioned, removed, and the site restored in accordance with this ordinance.

§ 7.9.6.3 Special Permit Criteria. In addition to the general Special Permit criteria set forth in section 10.4.2 of this Ordinance, an application for Tier 2 or Tier 3 BESS shall meet the following criteria:

A. The project protects the ground water and surrounding properties from catastrophic failure of one or more of the batteries or cells by implementing appropriate catchment and filtration systems for water run off or run off from the system.

B. The project appropriately attenuates sound intrusion beyond the property lines onto adjacent properties so that there is no change in ambient sound after construction and during operations of the system.

C. The project includes only dark sky compliant down lighting which does not intrude beyond the property lines onto adjacent properties.

D. The project is secure and addresses possible trespass or other intrusion by individuals not affiliated with the project.

E. The project meets the public safety needs of the City.

F. The project minimizes visual impacts from utility infrastructure for interconnection.

F. The project is minimally visible from adjacent properties.

§ 7.9.7. Site Plan application.

For all BESS the Site Plan application shall include the following information, in addition to that required by Section 10.8 of this Zoning Ordinance and the applicable Planning Board requirements governing Site Plan Applications:

A. Utility Infrastructure information requirements:

1. A one- or three-line electrical diagram detailing the BESS layout, associated components, and electrical interconnection methods, with all State Electrical Code compliant disconnects and over current devices.

2. The Applicant shall provide certified verification that there is a fully executed Interconnection Services Agreement ("ISA") with the local utility distribution company. Said certification shall include the cover and signature pages of the ISA.

3. If the ISA has not been issued, the Applicant shall be required to provide a full copy of the Application for Interconnection filed with the local utility distribution company.

B. Preliminary equipment specification sheets that document the proposed BESS components, inverters and associated electrical equipment that are to be installed. A final equipment specification sheet shall be submitted prior to the issuance of building permit.

C. Name, address, and contact information of proposed or potential system installer and the owner and/or operator of the BESS. Such information of the final system installer shall be submitted prior to the issuance of building permit.

D. Large-scale fire test data, evaluation information, and calculations, and modeling data. For any of the following, UL 9540A fire test data must be made available to the Planning Board for review:

- BESS systems with a capacity of greater than 50 kW
- BESS systems with spacing between arrays of less than 3 feet

E. Commissioning Plan. The system installer or commissioning agent shall prepare a commissioning plan prior to the start of commissioning. Such plan shall be compliant with NFPA 855 and document and verify that the system and its associated controls and safety

systems are in proper working condition per requirements set forth in applicable state codes. Where commissioning is required by the Building Code, BESS commissioning shall be conducted by a Massachusetts Licensed Professional Engineer after the installation is complete but prior to final inspection and approval. A corrective action plan shall be developed for any open or continuing issues that are allowed to be continued after commissioning. A report describing the results of the system commissioning and including the results of the initial acceptance testing required by applicable state codes shall be provided to Zoning Enforcement Officer prior to final inspection and approval and maintained at an approved on-site location.

F. Fire Safety Compliance Plan. Such plan shall document and verify that the system and its associated controls and safety systems are in compliance with state codes, including documentation that BESS components comply with the safety standards set forth in subsection 7.9.9. Such plan shall also include a detailed training plan for public safety personnel.

G. Operation and Maintenance Manual. Such plan shall describe continuing BESS maintenance and property upkeep, as well as design, construction, installation, testing and commissioning information and shall meet all requirements set forth state codes and NFPA 855. Maintenance provisions will be driven by manufacturer requirements for the specific listed system. It shall address maintenance of the access and perimeter roadways, perimeter fencing, and shall include a snow removal plan and 24 hours access requirements by public safety officials. There shall be an annual; acoustical review to assure ongoing compliance with the requirement of no change from ambient at the property line and fire department inspection.

H. Depending on the location of the BESS in relation to and its interaction with the electrical grid, interconnection will be completed per 527 CMR 12.00. System interconnections into utility grids shall be in accordance with NFPA 855 and the local distribution company standards for interconnection of distributed energy resources. An accessible disconnect is required per 527 CMR 12.00.

I. Prior to the issuance of the building permit, As Built engineering documents must be signed and sealed by a Massachusetts Licensed Professional Engineer and provided to the Building Commissioner and Planning Department .

J. Emergency Operations Plan. An Emergency Operations Plan compliant with NFPA 855 is required. A copy of the approved Emergency Operations Plan shall be given to the system operator, the local fire department, local fire code official and police department. For so long as the BESS is operational, the operator shall provide the Fire Department, Police Department, Building Commissioner, and Mayor's office with contact information for personnel that can be reached 24 hours per day every day, and this contact information shall be updated by the operator whenever there is a change in the information. The operator shall also be required to have an official representative be present onsite not later than two hours after notification by the Fire Chief, Police Chief, or their designee. A permanent copy shall also be placed in an approved location to be accessible to facility personnel, fire code officials, and emergency responders. The emergency operations plan shall include the following information:

1. Procedures for safe shutdown, de-energizing, or isolation of equipment and systems under emergency conditions to reduce the risk of fire, electric shock, and personal injuries, and for safe start-up following cessation of emergency conditions.

2. Procedures for inspection and testing of associated alarms, interlocks, and controls, including time intervals for inspection and testing.

3. Procedures to be followed in response to notifications from the Battery Energy Storage Management System, when provided, that could signify potentially dangerous conditions, including shutting down equipment, summoning service and repair personnel, and providing agreed upon notification to fire department personnel for potentially hazardous conditions in the event of a system failure.

4. Emergency procedures to be followed in case of fire, explosion, release of liquids or vapors, damage to critical moving parts, or other potentially dangerous conditions. Procedures can include sounding the alarm, notifying the fire department, evacuating personnel, de-energizing equipment, and controlling and extinguishing the fire.

5. Response considerations similar to a safety data sheet (SDS) that will address response safety concerns and extinguishment when an SDS is not required.

6. Procedures for safe disposal of BESS equipment damaged in a fire or other emergency event, including maintaining contact information for personnel qualified to safely remove damaged BESS equipment from the facility.

7. Other procedures as determined necessary by the City to provide for the safety of occupants, neighboring properties, and emergency responders.

8. Procedures and schedules for conducting drills of these procedures and for training local first responders on the contents of the plan and appropriate response procedures.

K. Each Application shall be accompanied by the following information:

1. A certified plot plan at a minimum scale of one inch equals 40 feet and a maximum scale of one inch equals 20 feet. The site plan shall contain:
   a. Date of site plan with all revisions noted and dated. Title of development, North arrow, scale, map and lot number, name and address of record owner, name and address of person preparing the site plan.
   b. The names of all owners of record of adjacent properties, and the map and lot number of the properties and all buildings.
   c. Zoning district boundaries and flood zone boundaries shall be shown as they affect the property including limits of the WSPOD and public water supply Zone A and Zone I on the overall site plan.
   d. Boundaries of the property and lines of existing street, lots, easements and

areas dedicated to public use, including rights of way.

e. A locus map showing the location of the property with reference to surrounding area.
f. A table indicating all calculations necessary to determine conformance to Bylaw regulations including current required and proposed regulations.
g. Square footage of property to the nearest 10 square feet.

2. All plans must include the location of existing and proposed buildings, walls, fences, culverts, parking areas, loading areas, walkways and driveways.

   a. Location and dimensions of utilities, gas, telephone, electrical, communications, water drainage, sewer and other waste disposal.

   b. Location, type and dimensions of landscaping and screening.

   c. Location of existing rock outcroppings, high points, vistas, ponds, depressions, wetlands, major trees (twelve-inch caliper and over) and any other significant existing features.

   d. Two-foot contours where slopes are less than 15% and five-foot contours when 15% or more. Existing contours shall be indicated by dashed line. Proposed contours shall be indicated by solid line.

   e. Dimensioned schematic drawings of all proposed buildings. Scale shall not exceed ¼ inch equals one foot nor less than 1/8 inch equals one foot.

   f. A narrative describing the proposal and addressing the foregoing requirements.

   g. Location of street numbers indicated on the schematic drawings and/or site plan.

   h. Surface and water pollution. A report on the impact of Stormwater runoff on adjacent and downstream surface water bodies, subsurface groundwater and the water table.

   i. Soils. The potential dangers of erosion and sedimentation caused by the operation and maintenance of the proposed development.

   j. General environmental impact. A report on the relationship of the proposed development of the major botanical, zoological, geological and hydrological resources of the site, and compatibility of the proposed development with adjacent or surrounding land uses and neighborhoods.

   k. Traffic impact. A report on existing street capacities, estimated average

daily traffic generation, composition, peak hour levels and directional flows resulting from the proposed development, proposed methods to mitigate the estimated traffic impact and methodology and sources used to derive existing data and estimations.

l. Renderings showing the proposed project in relationship to its surroundings.

§ 7.9.8. Ownership Changes.

If the owner of the BESS changes or the owner of the property changes, the Special Permit shall remain in effect, provided that the successor owner or operator assumes in writing all of the obligations of the Special Permit, Site Plan approval, and decommissioning plan. A new owner or operator of the BESS shall notify the Building Commissioner of such change in ownership or operator within 14 days of the ownership change. A new owner or operator must provide such notification to the Building Commissioner in writing.

§ 7.9.9. Safety

System Certification. BESS and equipment shall be listed by a Nationally Recognized Testing Laboratory to UL 9540 (Standard for BESS and Equipment) or approved equivalent, with subcomponents meeting each of the following standards as applicable:

A. UL 1973 (Standard for Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail Applications),
B. UL 1642 (Standard for Lithium Batteries),
C. UL 1741 or UL 62109 (Inverters and Power Converters),
D. Certified under the applicable electrical, building, and fire prevention codes as required.
E. Alternatively, field evaluation by an approved testing laboratory for compliance with UL 9540 (or approved equivalent) and applicable codes, regulations and safety standards may be used to meet system certification requirements.

Site Access. BESS shall be maintained in good working order and in accordance with industry standards. Site access shall be maintained, including snow removal at a level acceptable to the local fire department.

BESS, components, and associated ancillary equipment shall have required working space clearances, and electrical circuitry shall be within weatherproof enclosures marked with the environmental rating suitable for the type of exposure in compliance with NFPA 70.

§ 7.9.11. Abandonment

The BESS shall be considered abandoned when it ceases to operate consistently for more than one year. If the owner and/or operator fails to comply with decommissioning upon any abandonment, the City may, after compliance with any applicable state and federal constitutional requirements, enter the property and utilize the available bond and/or security for the removal of any BESS and restoration of the site in accordance with the decommissioning plan.

**And further add the following new definition to § 11.1 of Chapter 255**

§ 11.1

AGGREGATE ENERGY CAPACITY: Total amount of energy stored that can be stored in all batteries that are a part of the BESS measured in kilowatt-hours (kWh) or megawatt-hours (MWh).

BATTERY or BATTERIES: A single cell or group of cells connected electrically in series, in parallel, or combination of both, which can charge, discharge and store energy electrochemically. For the purpose of this Ordinance, batteries utilized in consumer products are excluded from these requirements.

BATTERY ENERGY STORAGE SYSTEM ("BESS") – A system containing one of more battery modules for storing electrical energy, any equipment needed to support the safe and proper function or usage of the battery modules, and one or moe physical container(s) providing secondary containment to any of the above. It may be a primary use or an Accessory Use to a solar generating facility, power generation facility, electrical substation, or other similar uses. For the purposes of this bylaw, BESS are comprised of three (3) types as further described in § 7.9.3.B. of this bylaw; Tier 1 BESS, Tier 2 BESS and Tier 3 BESS.

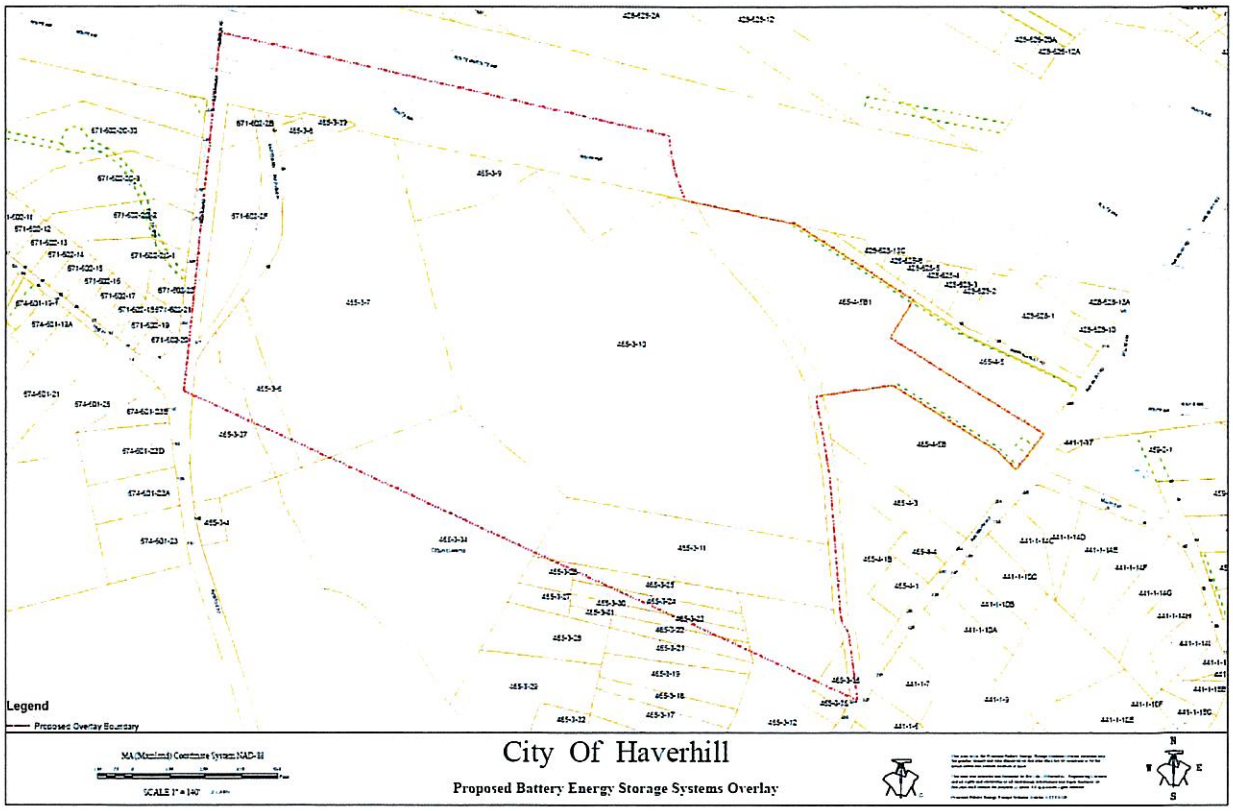
**And further to amend section 3.1.3, Table of Use and Parking regulations by allowing Tier 1, Tier 2 and Tier 3 BESS in the districts as follows:**

BESS Overlay District - OD

| | RS | RR | RL | RM | RH | RU | CN | CH | CG | CC | CM | OP | BG | BP | BESS OD | PC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **I. MISCELLANEOUS COMMERCIAL USES (cont'd)** | | | | | | | | | | | | | | | | |
| 22. Kennel or veterinary hospital in which all animals, fowl or other forms of life are completely enclosed in pens or other structures | BA | BA | N | N | N | N | N | BA | N | N | N | N | N | N | | D |
| 23. Commercial communications and/or television tower, provided that it shall be at least 500 feet from any R District | BA | N | N | N | N | N | N | BA | BA | BA | N | BA | BA | BA | | None |
| **24. Battery Energy Storage Systems: Tier 1** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | N | Y | Y | Y | None |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **25. Battery Energy Storage Systems: Tier 2** | N | N | N | N | N | N | N | N | N | N | N | N | N | N | CC | None |
| **26. Battery Energy Storage Systems: Tier 3** | N | N | N | N | N | N | N | N | N | N | N | N | N | N | CC | None |

**And further to amend the City of Haverhill Zoning Map to include the BESS Overlay District as set forth below:**



DOCUMENT

# CITY OF HAVERHILL

In Municipal Council

ORDERED:

Municipal Ordinance Chapter 116

An Ordinance Relating to Amendment to Chapter 116 of the Haverhill City Ordinances

Since this Ordinance exceeds in length eight octavo pages of ordinary book print, in lieu of advertising, it is published by the City Council in a municipal bulletin, placed on file in the City Clerk's Office, and posted on the municipal bulletin in City Hall.

PLACED ON FILE for at least 10 days

Advertise in Gazette:
Thursday March 26, 2026

Attest:

Kaitlin M. Wright

Kaitlin M. Wright, CMC
**City Clerk**

## Kaitlin Wright

**From:** North of Boston <noreply@wave2adportal.com>
**Sent:** Monday, March 23, 2026 10:53 AM
**To:** CityClerk
**Cc:** cmacdonald@northofboston.com; Kaitlin Wright; Natalia Hernandez
**Subject:** Thank you for placing your order with us.

Warning! External Email. Exercise caution when opening attachments or clicking on any links.

## THANK YOU for your notice submission!

This is your confirmation that your order has been submitted. Below are the details of your transaction. Please save this confirmation for your records.

### Job Details

Order Number:
**W0142798**
Business Type:
All Other Public Notices
Notice Size:
Public Notices
Notice Estimate:
$51.92
Referral Code:
**Amend Ch. 116 Ord.**

### Account Details

Haverhill Clerk
4 SUMMER ST STE 118
HAVERHILL, MA □ 01830
978-374-2312
cityclerk@cityofhaverhill.com
HAVERHILL CITY CLERK

### Schedule for notice number W01427980

**Thu Mar 26, 2026**

**Haverhill Gazette Public Notices**

*All Zones*

**CITY OF HAVERHILL**
**In Municipal Council**
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HG - Publication Dates

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# Haverhill

Economic Development and Planning
Jacki Byerley, Planning Director
jbyerley@haverhillma.gov
Phone: 978-374-2330

MAY 14 AM9:24
HAVCITYCLERK

To: City Council

From: Jacki Byerley, AICP, Planning Director JB

Re: Zoning Ordinance and Map amendment - Battery Energy Storage Systems

Date: May 14, 2026

Following review of the proposed amendment to Chapter 255 of the City of Haverhill Zoning Ordinance to add a new Section 7.9 entitled "Battery Energy Storage Systems" ("BESS"), the Planning Board forwards a favorable recommendation to the City Council for adoption of the ordinance as drafted.

The proposed ordinance establishes a comprehensive local regulatory framework governing the siting, permitting, construction, operation, maintenance, and decommissioning of Battery Energy Storage System facilities within the City. The ordinance is intended to address emerging energy infrastructure technologies while ensuring that appropriate public safety, environmental and land use protections are in place.

The ordinance appropriately distinguishes between small-scale accessory systems and larger utility-scale facilities through the establishment of Tier 1, Tier 2, and Tier 3 classifications based on system capacity and operational characteristics. Smaller Tier 1 systems are permitted by right subject to Site Plan Review and applicable code requirements, while larger Tier 2 and Tier 3 facilities require a Special Permit and are limited to the proposed BESS Overlay District.

The Planning Board finds that the ordinance incorporates significant public safety standards consistent with current industry practices and guidance issued by the Massachusetts Department of Energy Resources ("DOER"). The ordinance requires compliance with all applicable building, fire and electrical codes.

The ordinance further provides the City Council, acting as the Special Permit Granting Authority, with the ability to review larger-scale proposals on a case-by-case basis through the Special Permit and Development Review process to ensure that impacts to surrounding properties and neighborhoods are appropriately addressed.

Accordingly, the Planning Board respectfully recommends that the City Council vote to adopt the proposed Battery Energy Storage Systems Ordinance and Overlay District as drafted.

Mead, Talerman & Costa, LLC
Attorneys at Law

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Newburyport, MA 01950
Phone 978.463.7700
Fax 978.463.7747

www.mtclawyers.com

TO: Pres. Jordan and Members of the Council
FR: Lisa L. Mead, City Solicitor
CC: Mayor Barrett
Jacki Byerly, Planning Director
RE: BESS Zoning amendment
DA: May 12, 2026

MAY 14 PM2:19
HAVCITYCLERK

Reference is made to the above captioned matter. In that connection, the Council has before it 2 proposed amendments to the Zoning Ordinance related to Battery Energy Storage Systems ("BESS"). I request that you receive and file the proposed ordinance from January 2025. I request that the Council act on the Ordinance filed last month. The Planning Board has held their public hearing and voted to recommend that the Council adopt the Ordinance.

**Why a BESS Zoning Ordinance?**

The City currently has no Zoning Ordinance regulating the location and use of a BESS facility or any size. In the case of Duxbury Energy Storage, LLC v. the Town of Duxbury Zoning Board of Appeals, Land Court Misc. 000643 (2025) the Land Court decided that the exemption set forth in G. L. c. 40A sec. 3 par. 9 for solar facilities applied to BESS as well. Noting that the Supreme Judicial Court in the case of Tracer Lane II Realty, LLC v. Waltham, 489 Mass 781 determined that Waltham's zoning code violates the Solar Energy Provision, concluding that "[a]n outright ban ... restricts rather than promotes the legislative goal of promoting solar energy. In the absence of a reasonable basis grounded in public health, safety, or welfare, such a prohibition is impermissible under the provision." *Id.* at 782. Further the Court in Duxbury provided that "…evaluating a bylaw's validity under G.L. c. 40A, § 3 requires balancing "the interest that the ordinance or bylaw advances and the impact on the protected use." *Id.* at 781. This requires assessing whether a restriction genuinely furthers a legitimate municipal interest and is rationally related to it, or if it impermissibly restricts the establishment of uses protected by the provision, and so is unreasonable. *Id.*, citing *Rogers v. Norfolk*, 432 Mass. 374, 379 (2000).(at 15). It is with this background that the Duxbury court determined that the exemption under G.L. c. 40A sec. 3 par. 9 applies to BESS facilities. Specifically, they said;

> The Solar Energy Provision specifically protects "***the building of structures*** that facilitate the collection of solar energy" (emphasis added). This means any aspects of a project that involve building qualifying structures gain the statute's protection.13 This interpretation aligns with how appellate courts have construed other provisions of the Dover Amendment. For instance, in *Watros v. Greater Lynn Mental Health & Retardation Assoc., Inc.*, 421 Mass. 106, 114 (1995), the Supreme Judicial Court held that where G.L. c. 40A, § 3, second par. explicitly exempted "land or structures" from certain zoning regulations, an accessory structure intended for

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New Bedford, MA 02740

> educational use qualified for protection, even though it shared a lot with other unprotected residential structures. Thus, even if only the battery cabinets are considered structures – a point the Board 19 concedes and cannot reasonably dispute – building such structures at the Project site would be protected from prohibition or unreasonable regulation, provided they "facilitate the collection of solar energy. Id 18-19.

As a result and based upon the determination in Tracer Lane and its application to BESS facilities in Duxbury, the City should have an Ordinance reasonably regulating BESS facilities on a reasonable amount of land area. Otherwise the City would be at the will of someone who wants to locate one of these facilities anywhere in the City it so choses given the uses exemption under G.L. c. 40A sec. 3 par. 9.

Further, over the past year, the Department of Energy Resource ("DOER") has promulgated new consolidated permitting regulations related to Solar and BESS facilities, among other energy generating facilities, with which the City must comply by October of this year. The intent of the Act is to streamline and expedite the permitting of such facilities by allowing permit applicants to submit a single, Consolidated Local Permit Application. Municipalities will still handle all local permitting required for "small" projects, which are generally generation projects up to 25MW, battery storage projects up to 100 MWh, transmission or distribution infrastructure in existing rights of way less than 10 miles in length, or a new right of way of less than 1 mile. The state Energy Facilities Siting Board will handle all state and local permitting needed for "large" projects which exceed these thresholds.

Municipal implementation of the consolidated permitting program is anticipated to begin on July 1, 2026, and municipalities must accept consolidated permitting applications by **October 1, 2026**. Under the proposed framework, Applicants will initiate the consolidated permitting process by filing a Notice of Intent with the designated local government representative, identifying basic project features and describing community outreach efforts. The process includes meetings with municipal officials to review project details, identify required permits, and discuss stakeholder engagement. Applicants will conduct a preliminary site suitability assessment to be reviewed and approved by DOER, submit the same for review and feedback from the municipality on potential project modifications prior and as a requirement of filing a complete application. This process must be completed not more than 60 days prior to filing with the municipality, or the application shall be denied without prejudice. Applicants will file a pre-filing checklist with the municipality which must be reviewed by the municipality within 10 days of submission for completeness. If the prefiling requirements are not complete, the applicant will have an additional 30 days to complete the required items on the checklist, subject to an additional 30-day extension by the municipality. A determination that the pre-filing requirements has not been completed may be contested by the applicant. A single consolidated application will be used statewide and will encompass all approvals required for small clean energy facility projects. Municipalities will designate a permitting authority or coordinating official responsible for serving as a gatekeeper and managing the review process and ensuring coordination among local boards and departments. The municipality must issue a determination regarding completeness within 30 days of receiving an application or within 30 days of receiving any additional materials provided in response to a determination that the application is incomplete.

Notwithstanding the consolidated application process, municipal boards and departments will continue to apply existing state statutes and local bylaws, including but not limited to zoning, wetlands protection, historic preservation, and health regulations. Decisions of individual boards

under any such locally administered processes will be incorporated into a single consolidated local permit decision issued by the municipality.

Under the DOER framework, upon determination by the municipality's designated gatekeeper, that the application is complete, the municipality must issue a final decision under any local permitting scheme within twelve (12) months, absent extensions authorized by statute or regulation, or as may be agreed to by the Applicant. The Planning Director and I will be providing to the Council in the near future, any changes required to the Ordinance to reflect the requirements of the consolidated permitting required by DOER.

**Proposed Zoning Ordinance**

As a result of the foregoing, without yet providing the Council with a proposed Ordinance related to the Consolidated Permitting, but in light of the fact that there is a developer of BESS examining the possibility of coming into Haverhill, we proposed the attached Ordinance. It should be noted that the Mayor, City staff, Fire, Building, Health, Conservation, Planning, and many more have been intimately involved in the development of this ordinance.

Overall, the proposed ordinance establishes a comprehensive local regulatory framework governing the siting, permitting, construction, operation, maintenance, and decommissioning of Battery Energy Storage System facilities within the City, as noted in the Planning Board report. The ordinance provides for a permitting framework for various sizes of BESS facilities, Tier 1, Tier 2, and Tier 3 classifications, which are defined based upon the size or capacity of the system. Importantly, and in compliance with Tracer Lane as well as the litany of cases governing the exemptions under G.L. c. 40A sec. 3, smaller Tier 1 systems are permitted by right subject to Site Plan Review and applicable code requirements, while larger Tier 2 and Tier 3 facilities require a Special Permit and are limited to the proposed BESS Overlay District.

There is a noted change in the permitting process, different from that which the Council has followed in the past. In the proposed ordinance, an Applicant must file with the Council for a Special Permit after it has been determined that a complete application has been filed. The Council will then schedule and open its public hearing. Following an overview of the application, the public hearing will be continued and the application referred to the Development Review Committee which must thereafter provide to the Council its recommendations on the Applications within 90 days of referral to the Committee. By incorporating the Development Review Committee process into the Special Permit process, any conditions or changes recommended by the Committee will then, if the Council determines they are appropriate or desired, be included in the final decision.

All Tier 2 and Tier 3 BESS are subject to both Special Permit and Major Site Plan Review. The Applicants are required to comply with the Ordinance general special permit criteria as well as the specific Special Permit criteria of the BESS section.

It should be noted that the design requirements, lighting, vegetation, setbacks, emergency access, lot size and other dimensional requirements, fencing and screening, safety requirements and the like were all well vetted by the Fire, Police, Building, Electrical and other code professionals. The decommissioning plan, fund and insurance were modeled after previously approved and enacted ordinances and bylaws and best practices as well.

I look forward to discussing this with you next week.

# Haverhill

Economic Development and Planning
Phone: 978-374-2330


To: Planning & Development Committee

From: Jacki Byerley, AICP, Planning Director

Date: August 19, 2026

Re: Review of Proposed BESS Zoning Areas

Over the last several weeks, the Planning Department has coordinated with the Fire, Police, Conservation, Engineering, Department of Public Works, Water & Sewer, Assessing, and Inspectional Services Departments to review potential areas for a Battery Energy Storage System (BESS) zoning district.

Six areas were initially identified for review: Amesbury Road, Computer Drive, Cross Road, Groveland Road, Hilldale Avenue, and Neck Road. These areas were identified based on their existing Business Park zoning in some cases the current use and characteristics of the land this was done in coordination with the Conservation Division.

The purpose of the departmental review was to have each department look at the proposed areas from the perspective of its own area of responsibility and provide information that would assist the committee in evaluating the sites.

Fire, Water & Sewer, Conservation and Engineering have provided a scoring spreadsheet evaluating the six areas based on accessibility to the site, proximity to residential & commercial structures, wetland & riverfront, open space protection, topography & soils, wildlife habitat, water supply protection, water infrastructure, sewer infrastructure, stormwater infrastructure and future projects.

The scoring ranks for Water & Sewer and Engineer have Computer Drive first, followed by Hilldale Avenue, Neck Road, Groveland Road, Amesbury Road, and Cross Road. The spreadsheet also identifies specific infrastructure issues that would need to be considered with each site.

Conservation has Hilldale Avenue first, followed by Groveland Road, Neck Road, Cross Road, Computer Drive and Amesbury Road. Review of proximity to wetlands and riverfront, public water supply, open space, wildlife habitat were all factors within each of the areas.

The Assessor's Office has provided a written review of the six areas from the perspective of

highest and best use and potential tax revenue. The Assessor did not identify one preferred location but provided comments and considerations for each site. In several cases, the review notes that if conventional industrial development is not feasible, a BESS could provide the City with a source of tax revenue through a PILOT agreement. The review also identifies potential advantages associated with individual sites, including the capped landfill at Groveland Road and the possibility of BESS use at Amesbury Road if industrial development is not feasible because of the site's characteristics and infrastructure limitations.

Planning has reviewed the six areas and identified Amesbury Road as its suggested location. The Fire Department has also indicated that it supports Amesbury Road as the zoning location, with the understanding that any future BESS project proposed within the district will be subject to a thorough review by the Fire Department to ensure that it meets all applicable fire safety requirements. The Fire Department's support of the zoning location does not mean that every future project will necessarily meet those requirements or receive its approval.

The departmental reviews do not result in one unanimous recommendation. Planning and Fire have identified Amesbury Road as their preferred location, while the most recent Water & Sewer and Engineering scoring ranks Computer Drive highest from an infrastructure standpoint and Conservation has Hilldale Ave as their highest ranking. The Assessor's review provides additional information regarding the potential tax implications and highest and best use of the individual sites.

The different results are a reflection of the different factors each department considered. The purpose of bringing this information together is to provide the committee with the various perspectives so that it can weigh the land use, infrastructure, public safety, environmental, and fiscal considerations when making its recommendation.

For example, Amesbury Road has the support of Planning and the Fire Department, but the Water & Sewer and Engineering review identifies infrastructure and environmental considerations, including the need for substantial water improvements and on-site stormwater mitigation. Computer Drive received the highest infrastructure score and has strong existing water and sewer infrastructure, although additional water infrastructure would still be necessary. Hilldale Avenue and Neck Road also scored well from an infrastructure standpoint. Groveland Road has the potential benefit of being a capped landfill but has greater water and sewer limitations. Cross Road received the lowest infrastructure score and presents several infrastructure and access challenges.

The Assessor's review also provides a fiscal perspective. Depending on the site and whether conventional development is feasible, a BESS could provide a potential source of tax revenue to the City through a PILOT agreement.

At this point, the information gathered from the departments is before the committee for its consideration. Planning's identification of Amesbury Road is intended to provide the committee with the benefit of our professional review but the final determination of which area should be recommended for the BESS zoning district is up to the committee.

Items to keep in mind are that a Tier 3 BESS (energy capacity greater than 10 MWh) requires 20 acres of land under the proposed regulation. Of the six areas proposed, Hilldale Avenue does not currently meet that requirement. The committee still has the ability to make a decision that is consistent with the proposed regulation, either by selecting another proposed area that meets the 20-acre requirement or by determining that the regulation should be amended to allow a 15-acre minimum or by adding additional acreage to the Hilldale Avenue proposal.

If the committee decides to select a different area than the one proposed in the original hearing, a new public hearing advertisement will be required. This would also provide an opportunity to address the acreage of the Hilldale Avenue proposal if the committee determines that a change to the proposed acreage is appropriate.

| Natural Resource Characteristic | Floodplain | | Proximity to Wetland & Riverfront Areas | | Public Water Supply Protection | | Open Space Protection | | Stormwater Management and Land Cover | | Topography and Soils | | Wildlife Habitat | | Total Score | Final Ranking (with lowest score being preferred location) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Scoring Basis for a 5 point scale | [illegible] | | [illegible] | | [illegible] | | [illegible] | | [illegible] | | [illegible] | | [illegible] | | | |
| Location | Comments | Score | Comments | Score | Comments | Score | Comments | Score | Comments | Score | Comments | Score | Comments | Score | | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

NOTES:

[illegible]

Project Name: Battery Energy Storage Systems Zone and Ordinance
Project Number:

| Location | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Water Supply Protection Overlay District (WSPOD) | | Water Infrastructure | | Sewer Infrastructure | | Stormwater Infrastructure | | Future Projects | | | | | |
| | Comments | Points Awarded (1= Least Desirable, 5= Most desirable) | Comments | Points Awarded (1= Least Desirable, 5= Most desirable) | Comments | Points Awarded (1= Least Desirable, 5= Most desirable) | Comments | Points Awarded (1= Least Desirable, 5= Most desirable) | Comments | Points Awarded (1= Least Desirable, 5= Most desirable) | Comments | Points Awarded (1= Least Desirable, 5= Most desirable) | Total Points | Rank (by Points) |
| Amesbury Road | Approximately 8,300 sq-ft of Zone Allocated along northeast edge of proposed zone (parcel 485-4-58F). Requirements should stipulate no hazardous materials stored in this area | 4 | Historical Pressure: 50-100 PSI<br>Fire Flow: 1,000 GPM<br><br>8-inch cast iron water main (1912) runs along Amesbury Road<br>8-inch water main (1930) runs along Newton Road and Dutton Road<br><br>Development of buildable area in this zone would require substantial water infrastructure upgrades (> 1,000 feet of new water main for structures and fire control and potential replacement of older mains). Given location to WTP, hydraulics should not be a concern | 3 | 15-inch PVC sewer located along Dutton Road. Any structure which is occupied regularly will likely require bathroom facilities. Development would require a sewer service to the Dutton road main. May require pumping depending on location | 4 | Wetland areas and flood plain around the site would likely require on site stormwater mitigation | 4 | No known projects at this time | 5 | | | 20 | 5 |
| Computer Drive | Area is not located within WSPOD | 5 | Historical Pressure: >100PSI<br>Fire Flow: 1,250 GPM<br><br>Distribution water mains are located along the South and North of the proposed zone. Water distribution within the proposed zone is privately owned. Any development would require substantial water infrastructure upgrades (>1,000 feet of new water main for structures and fire control) | 4 | Newer 15-inch PVC sewer mains located on Computer Drive, Research Drive, and Creek Brook Drive. Any structure which is occupied regularly will likely require bathroom facilities. Development would require a sewer service to one of these mains. May require pumping depending on location | 4 | MS4 is not available. Site would likely require on site stormwater mitigation | 4 | No known projects at this time | 5 | | | 22 | 3 |
| Cross Road | Area is not located within WSPOD | 5 | Historical Pressure: 50-100 PSI<br>Fire Flow: 530 GPM<br>12-inch cast iron water main (1956) runs along Amesbury Road<br>8-inch water main (1916) runs along Newton Road and Dutton Road<br><br>Distribution water mains are located along the North of the proposed zone on Cross Road. Any development would require substantial water infrastructure upgrades (> 1,000 feet of new water main for structures and fire control). Installation, other than from the North of the proposed zone would likely be cost prohibitive due to location of railroad. | 2 | 12-inch PVC sewer main (1981) runs along Cross Road<br><br>Sewer main is located along the North of the proposed zone on Cross Road Any structure which is occupied regularly will likely require bathroom facilities. Development would require a sewer service to the Cross Road main. May require pumping depending on location. Installation, other than from the North of the proposed zone would likely be cost prohibitive due to location of railroad. | 2 | MS4 is not available. Site would likely require on site stormwater mitigation | 4 | No known projects at this time | 5 | | | 18 | 6 |
| Groveland Road | Area is not located within WSPOD | 5 | Historical Pressure: 50-100 PSI<br>Fire Flow: 530 GPM<br><br>4-inch cast iron water main (1908) runs along Groveland Road<br><br>Development of buildable area in this zone would require substantial water infrastructure upgrades. City would likely require upgrade of 4-inch main along Groveland Road, along with any additional water service connections. Given location to WTP, hydraulics (flow and pressure) could be a concern. It may make sense to complete loop on Lawrence Road to increase flow. | 4 | There are no sewer mains located along Groveland Road. Any structure which is occupied regularly will likely require bathroom facilities. Development would likely require a septic system. Require installation of new main along Groveland Road (approx.1,500 feet)? | 4 | MS4 is not available. Site would likely require on site stormwater mitigation | 4 | No known projects at this time | 5 | | | 22 | 3 |
| Hillside Avenue | Area is not located within WSPOD | 5 | Historical Pressure: >100 PSI<br>Fire Flow: 1,400 GPM<br><br>12-inch Ductile Iron water main runs along Hillside Avenue. Additional hydraulic analysis may be required due to dead end at NH line | 4 | 12-inch PVC sewer main (1988) runs along Hillside Avenue<br><br>Any structure which is occupied regularly will likely require bathroom facilities. Development would require a sewer service to the Hillside Avenue main | 5 | MS4 is not available. Site would likely require on site stormwater mitigation | 4 | Owner of several parcels looking at development at this time | 3 | | | 21 | 4 |
| Neck Road | Area is not located within WSPOD | 5 | Historical Pressure: 50-100 PSI<br>Fire Flow: 1,382<br><br>12-inch ductile iron water main (1994) runs along Neck Road<br>6-inch cast iron water main (1928) runs along Neck Road<br>8-inch water main runs along Ferry Road | 4 | 8-inch PVC sewer main (1981) runs along Neck Road<br>15-inch PVC sewer main (1981) runs along Ferry Road<br><br>Any structure which is occupied regularly will likely require bathroom facilities. Development would require a sewer service to one of these mains | 5 | Some available stormwater infrastructure along Neck Road if needed | 5 | 30-inch sewer main runs through two largest parcels. Likely city owned easements for maintenance | 4 | | | 23 | 1 |

Criteria No.

Additional Comments

Additional requirements for Li-ion Batteries under higher tiers? Cabinets with specialized fire suppression?

Report showing potential plume and air dispersion modeling for any higher tier BESS? Typical wind patterns few South and Southwest

**From:** Chris Loughnane
**To:** Jacki Byerley
**Subject:** RE: Battery Energy Storage Systems Zone and Ordinance
**Date:** Wednesday, July 29, 2026 11:43:22 AM
**Attachments:** image001.png

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Hi Jacki,

Your presentation yesterday morning was informative and well received.

I have the following thoughts on each site that was presented concentrating on the highest and best use of land for the City:

Amesbury Rd.

1. If an industrial building will not be feasible here given the habitat, size, availability of water and sewer then a BESS would be seen as a positive tax flow for the city with a PILOT agreement.

Computer Dr.

1. I tend to agree with you that this land may be better used for an industrial building however, if a 20 or 25 year PILOT agreement could be made for a Tier 2 that surpasses 10K a year, this may be better tax revenue for the city.

Cross Rd.

1. This land is owned by NE Power so may be an incentive for the owners to sell or lease to a BESS rather than a building site?

Groveland Rd.

1. This site being a capped land fill may be ideal for a BESS rather than a building that would inhabit people during the day which may prohibit a building structure.

Hilldale Ave.

1. Rob Moore had mentioned that this (12 good acre) site was looked at for a 20K or 30K square foot building previously? If this would not be approved, then a BESS would allow the city to obtain tax dollars with a PILOT agreement.

Neck Rd.

1. 766-1-1 is Chapter land 61A but 766-1-3 came out of 61A in FY2024 with a small rollback left is sold before FY2029. 61A land that is not in APR can be rolled back and produce more tax dollars with a PILOT agreement.

I will keep thinking about these sites and if there is more input I can give to you to help the Council decide, I will let you know.

Thank you,
Chris Loughnane

Chris M. Loughnane, MAA
Tax Assessor
Haverhill City Hall
4 Summer St. Rm 115
Haverhill, MA 01830
PH 978-420-3637
FX 978-374-2319
cloughnane@haverhillma.gov

**From:** Jacki Byerley <JByerley@HaverhillMa.gov>
**Sent:** Thursday, July 23, 2026 11:08 AM
**To:** Thomas Bridgewater <tbridgewater@haverhillma.gov>; Lisa DeMeo <ldemeo@HaverhillMa.gov>; Chris Loughnane <cloughnane@haverhillma.gov>; Christopher Cesati <CCesati@HAVERHILLFIRE.COM>; rirvine@haverhillfire.com; Bonnie Dufresne <bdufresne@haverhillma.gov>; Mark Tolman <mtolman@haverhillma.gov>; Richard MacDonald <rmacdonald@haverhillma.gov>; etarpy@haverhillfire.com; Ally Ruth <aruth@haverhillma.gov>; Charles Ethier <c_ethier@haverhillma.gov>; Robert Kimball <rkimball@HaverhillMa.gov>; Nicholas Aylward <naylward@haverhillma.gov>; Robert Ward <rward@HaverhillMa.gov>; Shaun Burrier <SBurrier@HaverhillMa.gov>; Andrew Carvalho <acarvalho@HaverhillMa.gov>; Rob Moore <rmoore@haverhillma.gov>; klynch <klynch@haverhillpolice.com>; J Pearl

<jpearl@haverhillpolice.com>
**Cc:** Mayor <mayor@haverhillma.gov>; Christine Lindberg <clindberg@haverhillma.gov>
**Subject:** Battery Energy Storage Systems Zone and Ordinance

Good morning,

As many of you know, I have been coordinating with the Fire, Police, Conservation, Engineering, Department of Public Works, Water & Sewer, Assessing, and Inspectional Services Departments to evaluate a number of potential land areas for a proposed Battery Energy Storage System (BESS) zoning district.

Over the past several weeks, I have been trying to meet with each department to review these potential locations and obtain your assessment of their suitability based on your department's operational needs, expertise, and evaluation criteria. To ensure we have a collaborative discussion and an opportunity to hear each department's perspectives, I would like to invite everyone to meet on Tuesday, July 28, following the Department Review meeting (10:15 am ish) in Room 301. The purpose of this meeting is to review the proposed land areas as a group, discuss any concerns or recommendations and gather feedback on both the proposed zoning district boundaries and the draft BESS ordinance.

Following our meeting, I will compile each department's evaluations into a summary spreadsheet identifying the proposed land areas along with each department's findings and considerations. This information will be presented for review and discussion at the Planning & Development Committee meeting on August 24.

Attached are the latest versions of the proposed BESS zoning district maps and the draft Battery Energy Storage Systems ordinance for your review prior to the meeting.

If you are unable to attend, please send me your comments and recommendations regarding the proposed zoning areas and draft ordinance in advance so they can be included in the departmental summary.

Thank you,
Jacki

Jacki Byerley, AICP
Planning Director
City of Haverhill
Economic Development & Planning, Room 201

4 Summer Street
Haverhill, MA 01830
Main Office: 978-374-2330

Project Name: Battery Energy Storage Systems Zone and Ordinance

Project Number:

| Overall Ranking (Best to Worst) | |
|---|---|
| 1 | Computer Drive |
| 2 | Hillside Avenue |
| 3 | Neck Road |
| 4 | Groveland Road |
| 5 | Amesbury Road |
| 6 | Cross Road |

Criteria No.

| Location | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Water Supply Protection Overlay District (WSPOD) | | Water Infrastructure | | Sewer Infrastructure | | Stormwater Infrastructure | | Future Projects | | | | | |
| | Comments | Points Awarded (1= Least Desirable, 5= Most desirable) | Comments | Points Awarded (1= Least Desirable, 5= Most desirable) | Comments | Points Awarded (1= Least Desirable, 5= Most desirable) | Comments | Points Awarded (1= Least Desirable, 5= Most desirable) | Comments | Points Awarded (1= Least Desirable, 5= Most desirable) | Comments | Points Awarded (1= Least Desirable, 5= Most desirable) | Total Points | Rank to best benefit the City (by Points, #1 being best choice) |
| Amesbury Road | Approximately 9.500 sq ft of Zone A located along northeast edge of proposed zone (parcel M24-4-M1). Requirements should stipulate no hazardous materials stored in this area and follow impervious area requirements | 3 | Historical Pressure: 50-100 PSI<br>Fire Flow: 1,000 GPM<br><br>8-inch cast iron water main (1912) runs along Amesbury Road<br>8-inch water main (1916) runs along Newton Road and Dutton Road<br><br>Development of buildable area in this zone should require builder to complete substantial water infrastructure upgrades (> 1,000 feet of new water main for structures and fire control and potential replacement of older mains). Given location to WTP, hydraulics should not be a concern. | 3 | 15-inch PVC sewer located along Dutton Road. Any structure which is occupied regularly will likely require bathroom facilities. Development could require a sewer service to the Dutton road sewer main. May require pumping depending on location | 4 | Wetland areas and flood plain around the site would likely require on site stormwater mitigation | 4 | No known projects at this time | 5 | | | 19 | 5 |
| Computer Drive | Area is not located within WSPOD | 5 | Historical Pressure: >100PSI<br>Fire Flow: 1,200 GPM<br><br>Distribution water mains are located along the South and North of the proposed zone. Water distribution within the proposed zone is privately owned. Any development would require builder to install substantial water infrastructure upgrades (> 1,000 feet of new water main for structures and fire control). | 4 | Newer 10-inch PVC sewer mains located on Computer Drive, Research Drive, and Green Street Drive. Any structure which is occupied regularly will likely require bathroom facilities. Development would require a sewer service to one of these mains. May require pumping depending on location | 5 | MS4 is not available. Site would likely require on site stormwater mitigation | 4 | No known projects at this time | 5 | | | 23 | 1 |
| Cross Road | Area is not located within WSPOD | 5 | Historical Pressure: 50-100 PSI<br>Fire Flow: 530 GPM<br>12-inch cast iron water main (1956) runs along Amesbury Road<br>8-inch water main (1916) runs along Newton Road and Dutton Road<br><br>Distribution water mains are located along the North of the proposed zone on Cross Road. Any development would require builder to install substantial water infrastructure upgrades (> 1,000 feet of new water main for structures and fire control).<br><br>Note: Installation, other than from the North of the proposed zone would likely require coordination with railroad. | 2 | 12-inch PVC sewer main (1981) runs along Cross Road<br><br>Sewer main is located along the North of the proposed zone on Cross Road.Any structure which is occupied regularly will likely require bathroom facilities. Development would require a sewer service to the Cross Road main. May require pumping depending on location. Installation, other than from the North of the proposed zone would likely require coordination with railroad. | 2 | MS4 is not available. Site would likely require on site stormwater mitigation | 4 | No known projects at this time | 5 | | | 18 | 6 |
| Groveland Road | Area is not located within WSPOD | 5 | Historical Pressure: 50-100 PSI<br>Fire Flow: 530 GPM<br><br>8-inch cast iron water main (1916) runs along Groveland Road<br><br>Development of buildable area in this zone would require builder to install substantial water infrastructure upgrades. City would likely require upgrade of 8-inch main along Groveland Road, along with any additional water service connections. Given location to WTP, hydraulics (flow and pressure) could be a concern. Would look to have builder complete loop on Lawrence Road to increase flow. | 2 | There are no sewer mains located along Groveland Road. Any structure which is occupied regularly will likely require bathroom facilities. Development would likely require a septic system or require builder to install new main along Groveland Road (approx 1,500 feet)? | 4 | MS4 is not available. Site would likely require on site stormwater mitigation | 4 | No known projects at this time | 5 | | | 29 | 4 |
| Hillside Avenue | Area is not located within WSPOD | 5 | Historical Pressure: >100 PSI<br>Fire Flow: 1,400 GPM<br><br>12-inch Ductile iron water main runs along Hillside Avenue. Additional hydraulic analysis may be required due to dead end at NH line. | 5 | 12-inch PVC sewer main (1988) runs along Hillside Avenue<br><br>Any structure which is occupied regularly will likely require bathroom facilities. Development would require a sewer service to the Hillside Avenue main. | 4 | MS4 is not available. Site would likely require on site stormwater mitigation | 4 | Owner of several parcels looking at development at this time | 4 | | | 22 | 2 |
| Neck Road | Area is not located within WSPOD | 5 | Historical Pressure: 50-100 PSI<br>Fire Flow: 1,382<br><br>12-inch ductile iron water main (1984) runs along Neck Road<br>8-inch cast iron water main (1928) runs along Neck Road<br>8-inch water main runs along Ferry Road | 4 | 8-inch PVC sewer main (1981) runs along Neck Road<br>15-inch PVC sewer main (1981) runs along Ferry Road<br><br>Any structure which is occupied regularly will likely require bathroom facilities. Development would require a sewer service to one of these mains. | 5 | Some available stormwater infrastructure along Neck Road if needed | 5 | 30-inch sewer main runs through two largest parcels. Likely city owned easements for maintenance which could cause issues | 2 | | | 21 | 3 |

Additional Comments

Additional requirements for Lion Batteries under higher tiers? Cabinets with specialized fire suppression?

Report showing potential plume and air dispersion modeling for any higher tier (IE SS1) Typical wind patterns fow South and Southwest.

Project Name: Battery Energy Storage Systems Zone and Ordinance

Project Number:

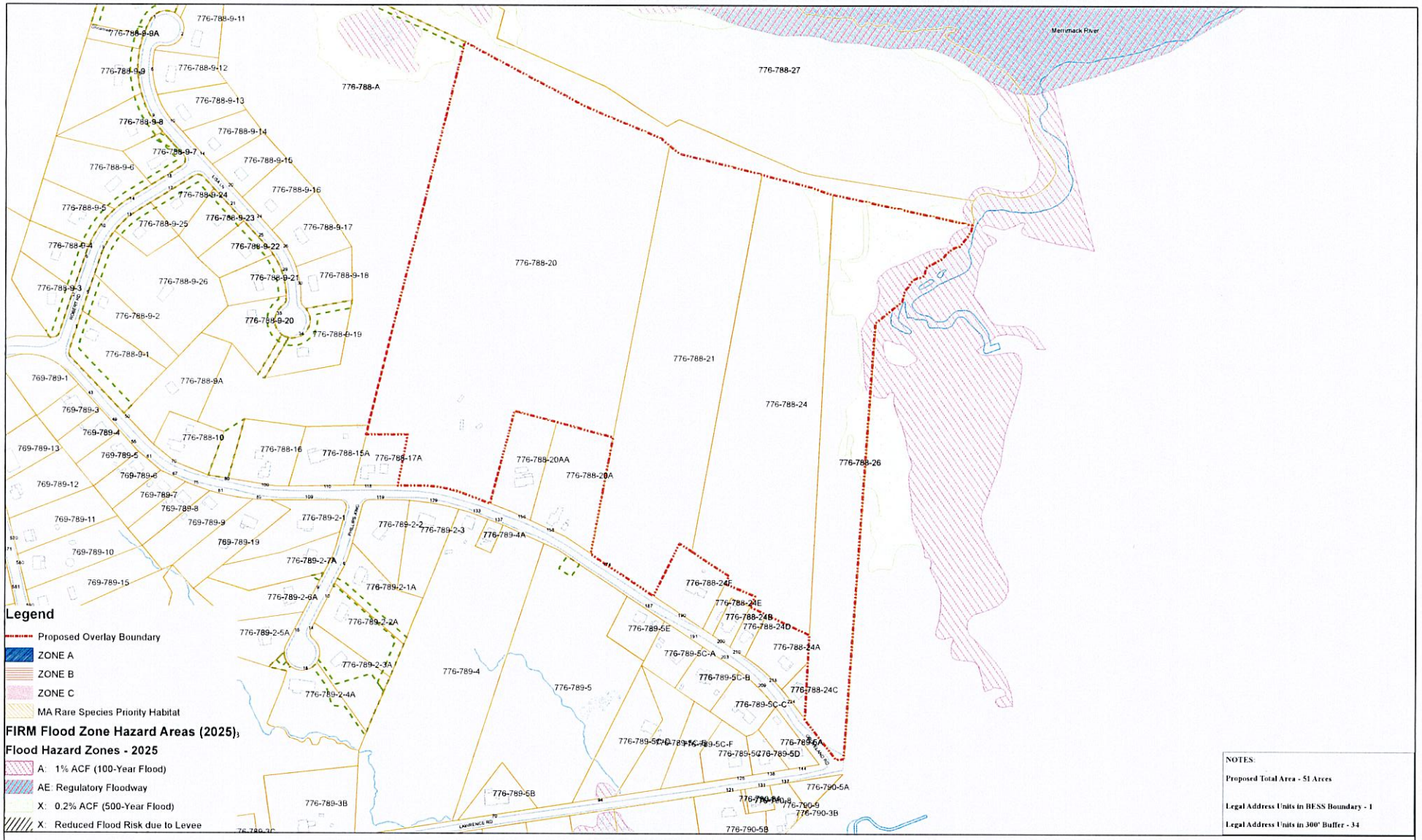
| Overall Ranking (Best to Worst): | |
|---|---|
| 1 | Amesbury Rd |
| 2 | Computer Dr |
| 3 | Cross Rd |
| 4 | Hillside Ave |
| 5 | Groveland Rd |
| 6 | Neck Rd |

| Location | Criteria No. 1 | | 2 | | 3 | 5 | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Proximity To Residential & Commercial Structures | | Water Infrastructure | | Accesibility To The Site | Future Projects | | | |
| | Comments | Points Awarded (1= Least Desirable, 5= Most desirable) | Comments | Points Awarded (1= Least Desirable, 5= Most desirable) | Comments | Comments | Points Awarded (1 = Least Desirable, 5 = Most Desirable) | Total Points | Rank to best benefit the City (by Points, #1 being best choice) |
| Amesbury Road | Moderate Residential spread out in all directions around the site | 4 | Historical Pressure: 50-100 PSI<br>Fire Flow: 1,086 GPM<br><br>8-inch cast iron water main (1912) runs along Amesbury Road<br>8-inch water main (1930) runs along Newton Road and Dutton Road<br><br>Development of buildable area in this zone should require builder to complete substantial water infrastructure upgrades (> 1,000 feet of new water main for structures and fire control and potential replacement of older mains) Given location to WTP, hydraulics should not be a concern | 4 | Good Accesibility for Fire Apparatus | No known projects at this time | 5 | 13 | 1 |
| Computer Drive | High Residential North East and East side and south and South West side. Moderate Commercial abutting the site | 2 | Historical Pressure: >100PSI<br>Fire Flow: 1,266 GPM<br><br>Distribution water mains are located along the South and North of the proposed zone. Water distribution within the proposed zone is privately owned. Any development would require builder to install substantial water infrastructure upgrades (> 1,000 feet of new water main for structures and fire control) | 5 | Limited Accesibility For Fire Apparatus | No known projects at this time | 3 | 10 | 2 |
| Cross Road | Moderate Residential to the North and North West and to the North and North East. | 3 | Historical Pressure: 50-100 PSI<br>Fire Flow: 530 GPM<br>12-inch cast iron water main (1950) runs along Amesbury Road<br>6-inch water main (1914) runs along Newton Road and Dutton Road<br><br>Distribution water mains are located along the North of the proposed zone on Cross Road. Any development would require builder to install substantial water infrastructure upgrades (> 1,000 feet of new water main for structures and fire control).<br><br>Note: Installation, other than from the North of the proposed zone would likely require coordination with railroad. | 2 | Limited Accesibility For Fire Apparatus : Railroad tracks. New commercial and residential in the area removed an access road to the area | No known projects at this time | 2 | 7 | 3 |
| Groveland Road | Moderate Residential to the South West South and South East. South East Side Includes Homes in The Town of Groveland. | 3 | Historical Pressure: 50-100 PSI<br>Fire Flow: 530 GPM<br><br>4-inch cast iron water main (1909) runs along Groveland Road<br><br>Development of buildable area in this zone would require builder to install substantial water infrastructure upgrades. City would likely require upgrade of 4-inch main along Groveland Road, along with any additional water service connections. Given location to WTP, hydraulics (flow and pressure) could be a concern. Would look to have builder complete loop on Lawrence Road to increase flow. | 2 | Limited Accesibility For Fire Apparatus : One side of approach is through Groveland | No known projects at this time | 2 | 7 | 5 |
| Hillside Avenue | Low Residential. Moderate Commercial in Neighboring Industrial Park. | 3 | Historical Pressure: >100 PSI<br>Fire Flow: 1,499 GPM<br><br>12-inch Ductile Iron water main runs along Hillside Avenue. Additional hydraulic analysis may be required due to dead end at NH line | 4 | Limited Accesibility For Fire Apparatus : | Owner of several parcels looking at development at this time | 2 | 9 | 4 |
| Neck Road | Moderate Residential to the South East Side of The Site. North of The Site Multiple High Hazard Buildings In The Industrial park. | 2 | Historical Pressure: 50-100 PSI<br>Fire Flow: 1,382<br><br>12-inch ductile iron water main (1964) runs along Neck Road<br>6-inch cast iron water main (1929) runs along Neck Road<br>8-inch water main runs along Ferry Road | 4 | Very Limited Accesibility Due To Grade. Only Have Acces From One Side of The Site. | 30-inch sewer main runs through two largest parcels. Likely city owned easements for maintenance which could cause issues | 1 | 7 | 6 |

Additional Comments

Additional requirements for Lion Batteries under higher tiers? Cabinets with specialized fire suppression?

Report showing potential plume and air dispoersion modeling for any higher tier BESS? Typical wind patterns fow South and Southwest




## Legend

- Proposed Overlay Boundary
- ZONE A
- ZONE B
- ZONE C
- MA Rare Species Priority Habitat

**FIRM Flood Zone Hazard Areas (2025)**

**Flood Hazard Zones - 2025**

- A: 1% ACF (100-Year Flood)
- AE: Regulatory Floodway
- X: 0.2% ACF (500-Year Flood)
- X: Reduced Flood Risk due to Levee

NOTES:

**Proposed Total Area - 51 Acres**

**Legal Address Units in BESS Boundary - 1**

**Legal Address Units in 300' Buffer - 34**

MA (Mamland) Coordinate System NAD-83

140 75 0 140 280 420 560 Feet

SCALE 1" = 140' (1:1,680)

# City Of Haverhill

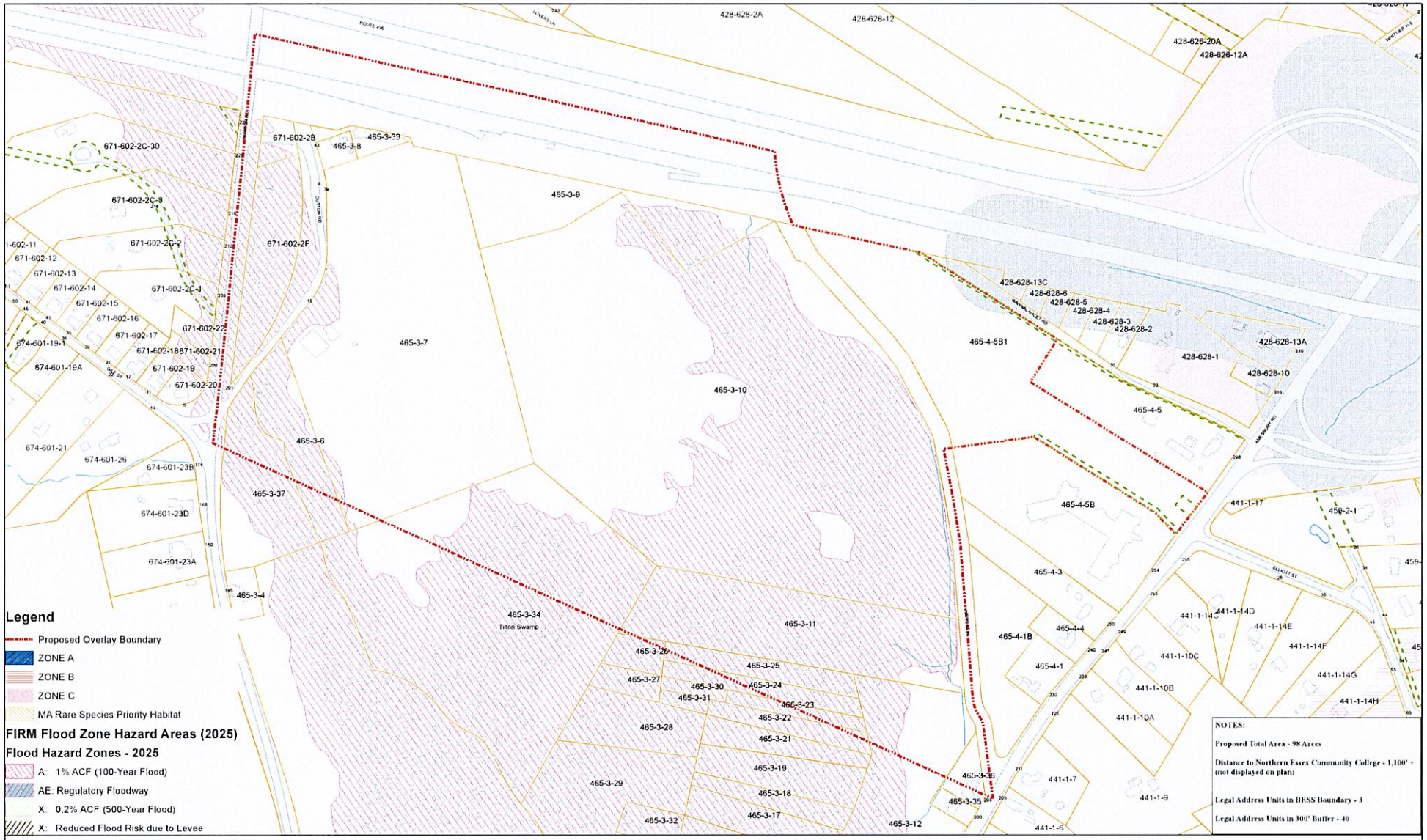
**Proposed Battery Energy Storage Systems Overlay - Groveland Rd - En**

This plan is for the Proposed Battery Energy Storage Systems Overlay purposes only the graphic accepts and data displayed on this plan shall not be construed to be the actual metes and bounds location of such.

This map was prepared and formatted by the City Of Haverhill - Engineering Division, and all rights and ownership of all intellectual information and logos displayed on this plan shall remain the property of same. All applicable rights reserved.

Proposed Battery Energy Storage Systems Overlay: 07/17/2024

N W E S



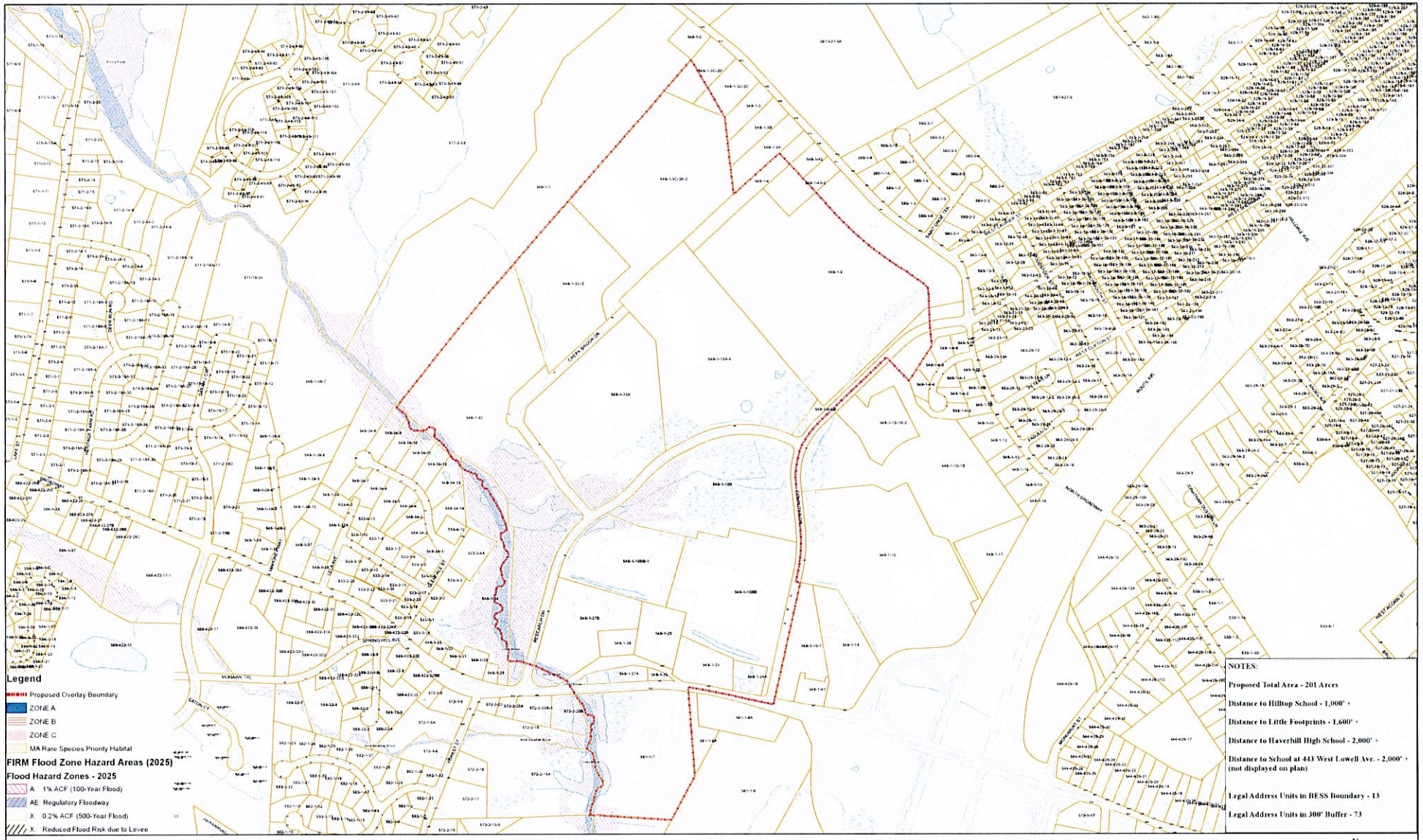

# City Of Haverhill

**Proposed Battery Energy Storage Systems Overlay - Amesbury Rd - En**

This plan is for the Proposed Battery Energy Storage Systems Overlay purposes only. The graphic images and data displayed on this plan shall not be construed to be the actual metes and bounds location of such.

This map was prepared and formatted by the City Of Haverhill - Engineering Division and all rights and ownership of all intellectual information and layout displayed on this plan shall remain the property of same. All applicable rights reserved.

Proposed Battery Energy Storage Systems Overlay 07/17/2026




NOTES:

Proposed Total Area - 201 Acres

Distance to Hilltop School - 1,000' +

Distance to Little Footprints - 1,600' +

Distance to Haverhill High School - 2,000' +

Distance to School at 443 West Lowell Ave. - 2,000' + (not displayed on plan)

Legal Address Units in BESS Boundary - 13

Legal Address Units in 300' Buffer - 73

MA (Mainland) Coordinate System NAD-83

140 75 0 140 280 420 560 Feet

SCALE 1" = 140' (1:1,680)

# City Of Haverhill

## Proposed Battery Energy Storage Systems Overlay - Computer Dr - En

This plan is for the Proposed Battery Energy Storage Systems Overlay purposes only. The graphic images and data displayed on this plan shall not be construed to be the actual sites and bounds location of such.

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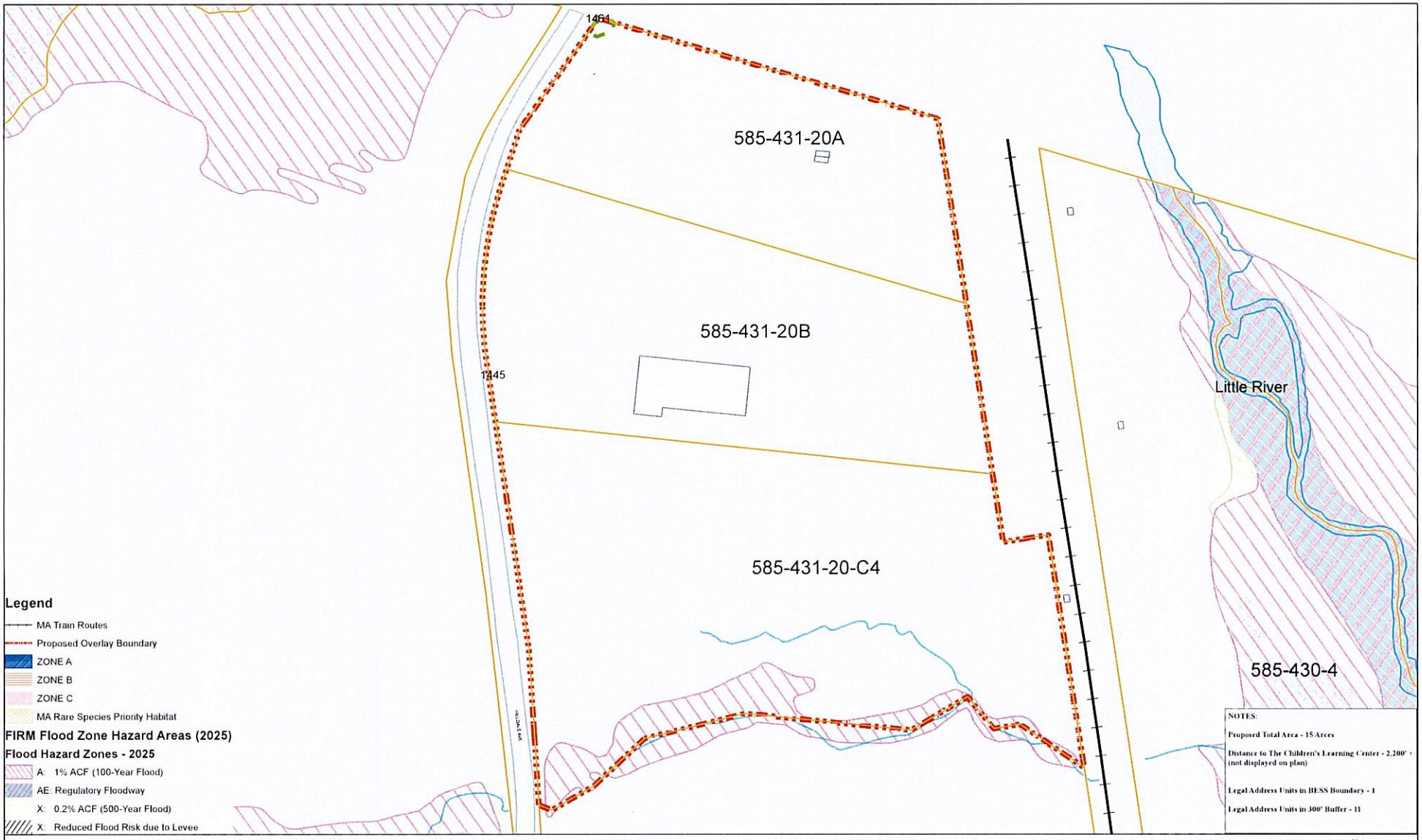
Proposed Battery Energy Storage Systems Overlay 07/17/2026

N W E S




# City Of Haverhill

**Proposed Battery Energy Storage Systems Overlay - Hilldale Ave - En**

This plan is for the Proposed Battery Energy Storage Systems Overlay purposes only. The graphic images and data displayed on this plan shall not be construed to be the actual metes and bounds location of such.

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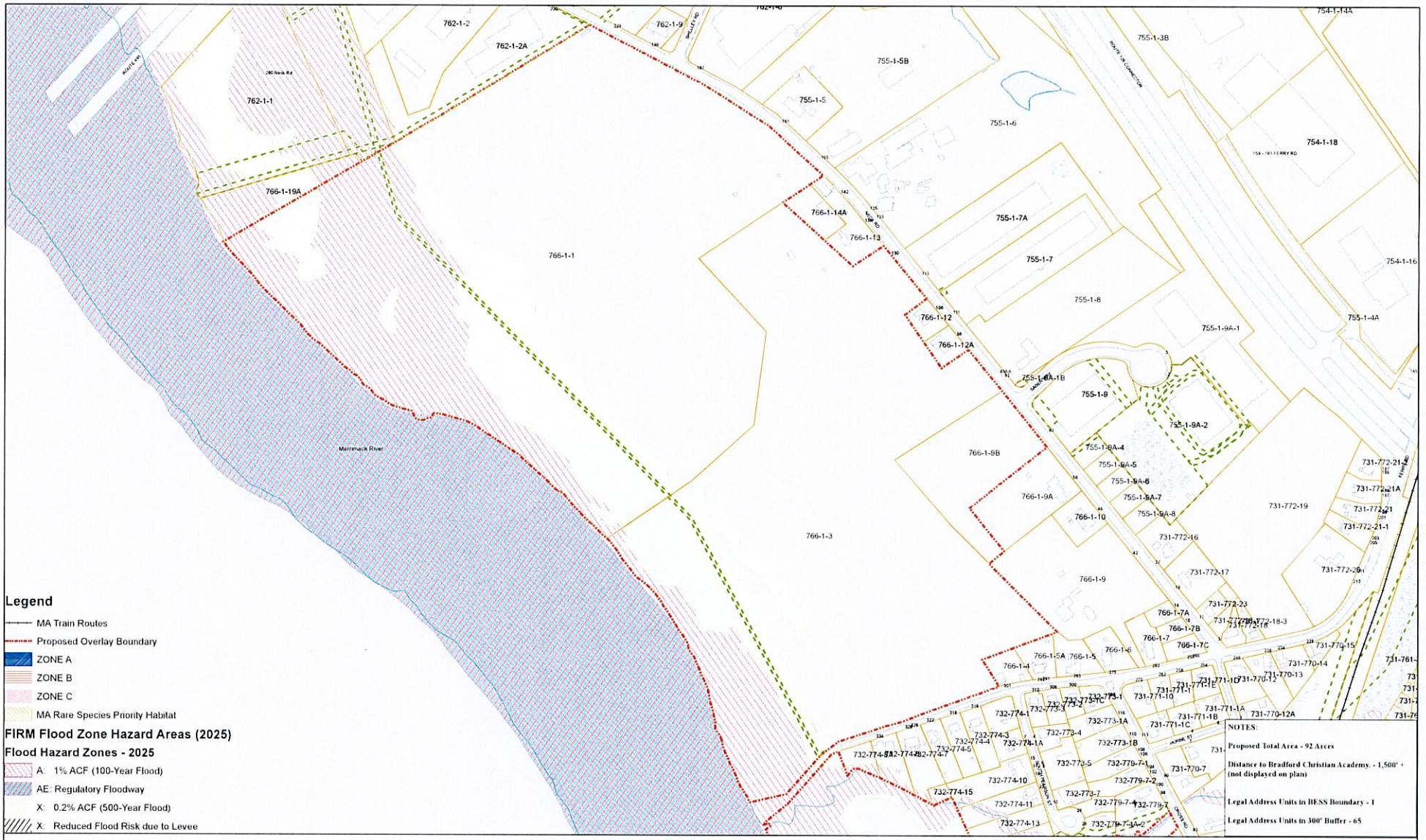
Proposed Battery Energy Storage Systems Overlay 03/17/2026




## Legend

- MA Train Routes
- Proposed Overlay Boundary
- ZONE A
- ZONE B
- ZONE C
- MA Rare Species Priority Habitat

**FIRM Flood Zone Hazard Areas (2025)**

**Flood Hazard Zones - 2025**

- A: 1% ACF (100-Year Flood)
- AE: Regulatory Floodway
- X: 0.2% ACF (500-Year Flood)
- X: Reduced Flood Risk due to Levee

**NOTES:**

**Proposed Total Area - 92 Acres**

**Distance to Bradford Christian Academy. - 1,500' + (not displayed on plan)**

**Legal Address Units in BESS Boundary - 1**

**Legal Address Units in 300' Buffer - 65**

MA (Mainland) Coordinate System NAD-83

140 70 0 140 280 420 560 Feet

SCALE 1" = 140' (1:1,680)

# City Of Haverhill

## Proposed Battery Energy Storage Systems Overlay - Neck Rd - En

This plan is for the Proposed Battery Energy Storage Systems Overlay purposes only. the graphic images and data displayed on this plan shall not be construed to be the actual metes and bounds locations of such.

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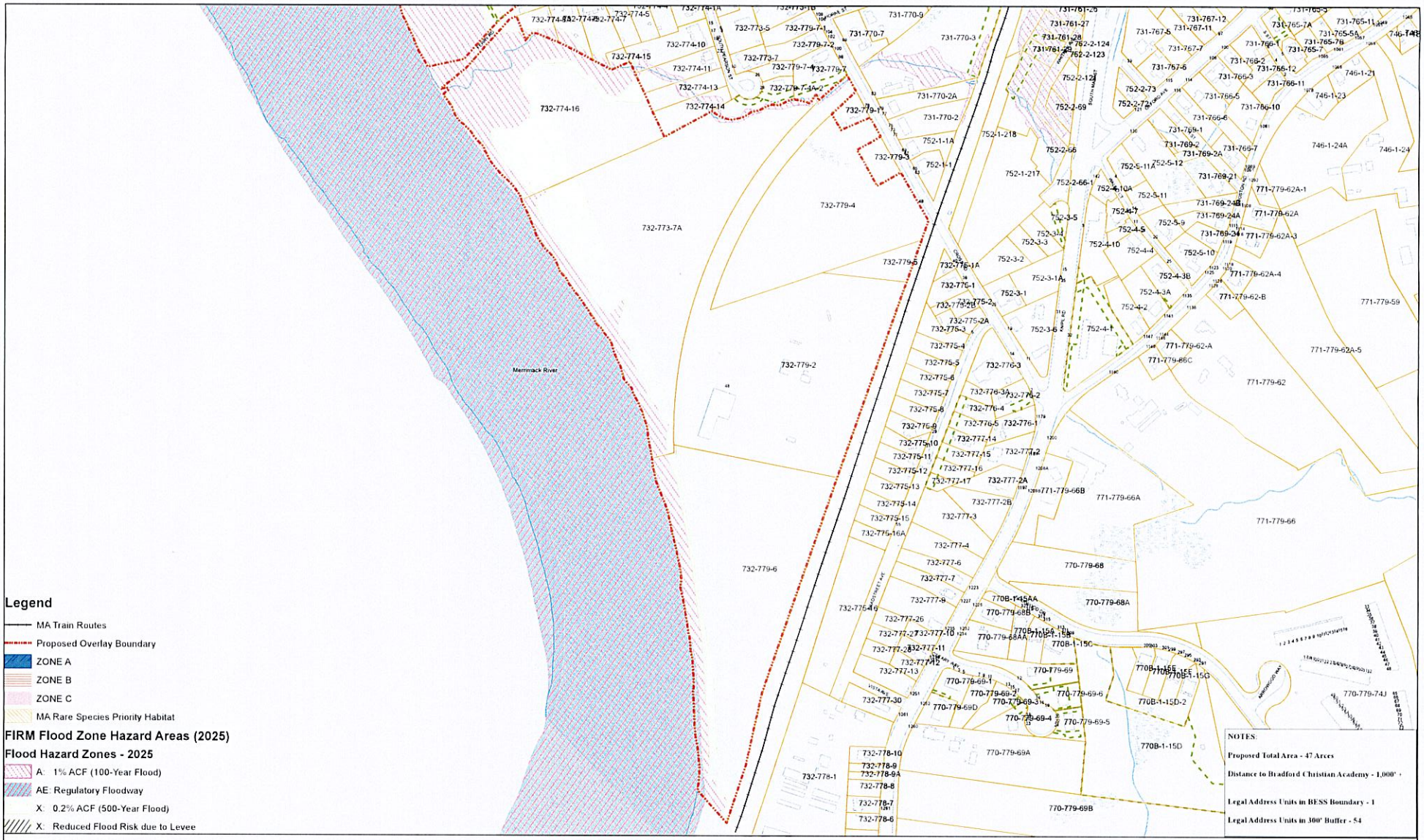
Proposed Battery Energy Storage Systems Overlay - 07/17/2024

N W E S




MA (Mainland) Coordinate System NAD-83

SCALE 1" = 140'

# City Of Haverhill

**Proposed Battery Energy Storage Systems Overlay - Cross Rd - En**

This plan is for the Proposed Battery Energy Storage Systems Overlay purposes only. All graphics, images and data displayed on this plan shall not be construed to be construction plans and show the location of such.

This map was prepared and formatted by the City Of Haverhill - Engineering Division and all rights and ownership of all intellectual information and logos displayed on this plan shall remain the property of same. All applicable rights reserved.

Proposed Battery Energy Storage Systems Overlay 07/17/2024

N
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S

DOCUMENT

# CITY OF HAVERHILL

In Municipal Council

ORDERED:

Municipal Ordinance Chapter 255 Zoning

An Ordinance Relating to Amending Chapter 255, Zoning by adding a new section 7.9 Battery Energy Storage Systems

Since this Ordinance exceeds in length eight octavo pages of ordinary book print, in lieu of advertising, it is published by the City Council in a municipal bulletin, placed on file in the City Clerk's Office, and posted on the municipal bulletin in City Hall.

PLACED ON FILE for at least 10 days

Attest:

Kaitlin M Wright Esposito

Kaitlin M. Wright, CMC, City Clerk

10.4

# Document # 41-B

Vice President Michitson submits the summary of minutes and recommendations of the Planning and Development Committee held on August 24, 2026 for acceptance and approval

**IN CITY COUNCIL: September 15, 2026**

**Accepted & Placed on file**

**Schedule hearing for October 27 for a new ordinance for Hilldale Ave location**

**11 YEAS, 0 NAYS, 0 ABSENT**

Attest: Kaitlin M. Wright Esposito

Kaitlin M. Wright Esposito, CMC,

City Clerk

# Haverhill

Economic Development and Planning
Phone: 978-374-2330

OCT 15 PM12:57
HAVCITYCLERK

To: City Council

From: Jacki Byerley, AICP, Planning Director

Re: Battery Energy Storage Systems Overlay District (BESS) Hilldale Ave

Date: October 15, 2026

At the regularly scheduled Planning Board meeting of October 14, 2026 the Planning Board voted to send a favorable recommendation of the attached Battery Energy Storage Systems Section 7.9 and overlay district on Hilldale Avenue.

The Planning Board previously recommended adopting the BESS regulations along with an overlay district on Amesbury Road. That recommendation was forwarded to the City Council, which then referred the matter to the Planning & Development Committee for further review.

On August 24, 2026, the Planning & Development Committee reviewed six potential locations (Computer Drive, Hilldale Avenue, Neck Road, Groveland Road, Amesbury Road, and Cross Road) along with input from various departments regarding operational needs. Based on this evaluation, the Committee determined that the overlay district should be located on Hilldale Avenue. Because the proposed overlay district location has changed, a new public hearing was required. A revised map reflecting this change has been prepared and submitted with the ordinance.

The proposed ordinance establishes a local regulatory framework governing the siting, permitting, construction, operation, maintenance, and decommissioning of BESS facilities within the City.

The ordinance appropriately differentiates between small-scale accessory systems and larger utility-scale facilities by establishing Tier 1, Tier 2, and Tier 3 classifications based on system capacity and operational characteristics. Smaller Tier 1 systems are permitted by right subject to site plan review and applicable code requirements, while larger Tier 2 and Tier 3 systems require a Special Permit and are restricted to the BESS Overlay District.

The ordinance also incorporates substantial public safety protections consistent with current industry standards and state guidance. All facilities are required to comply with applicable state building, fire, and electrical codes, including NFPA 855 standards governing stationary energy storage systems. The ordinance further requires emergency

operations plans, fire safety compliance plans, emergency access roads, containment systems, and ongoing coordination with local emergency responders.

The ordinance limits larger-scale facilities to the BESS Overlay District and provides the City Council, acting as the Special Permit Granting Authority, with the ability to evaluate each proposal on a case-by-case basis through the Special Permit and Development Review process.

The Planning Board voted to send a favorable recommendation to the City Council for approval of the proposed Battery Energy Storage System Ordinance with the overlay district of Hilldale Ave as drafted.

**MUNICIPAL ORDINANCE CHAPTER 255 Zoning**

## AN ORDINANCE RELATING TO AMENDING CHAPTER 255, ZONING BY ADDING A NEW SECTION 7.9 BATTERY ENTERGY STORAGE SYSTEMS

**BE IT ORDAINED by the City Council of the City of Haverhill that Chapter 255, Zoning, of the Code of the City of Haverhill, as amended, being and is hereby further amended as follows by inserting the following new section 7.9 entitled "Battery Energy Storage Systems";**

§7.9 BATTERY ENERGY STORAGE SYSTEMS

§7.9.1. Purpose.

The purpose of this Section is to advance and protect the public health, safety, welfare, and quality of life by creating regulations for the installation and use of free-standing battery energy storage systems ("BESS"), with the following objectives:

A. To provide a regulatory scheme for the location, construction and operation of free-standing BESS consistent with best practices and safety protocols;
B. To ensure compatible land uses in the vicinity of the areas affected by BESS and to mitigate any potential impacts on abutting and nearby properties; and
C. To mitigate the impacts of BESS on environmental resources such as agricultural lands, forests, wildlife, wetlands and other natural resources.

This Section shall be construed to be consistent with state law, including but not limited to the provisions of General Laws chapter 40A, section 3, and state regulations, including but not limited to the provisions of the State Building Code, State Fire Code, and State Electrical Code. In the event of any conflict between the provisions of this section and the provisions of state law or regulations, the state law and regulations shall prevail.

§7.9.2. Establishment of the BESS Overlay District
The BESS Overlay District is an overlay district superimposed over the underlying district set forth in this Zoning Ordinance. Within the BESS, the requirements of the underlying district continue to apply, except when the following uses are proposed then the following provisions of this section 7.9 shall apply:

Tier 1 BESS

Tier 2 BESS and

Tier 3 BESS

§7.9.3 Applicability.

A. The requirements of this ordinance shall apply to BESS permitted, installed, decommissioned or modified after the effective date of this ordinance, excluding general maintenance and repair. BESS subject to this ordinance are only those that exceed the following capacities:

- Lead-acid with a capacity of greater than 70 kW
- Nickel with a capacity of greater than 70 kW
- Lithium-ion with a capacity of greater than 30 kW
- Sodium nickel chloride with a capacity of greater than 20 kW
- Flow with a capacity of greater than 20 kW
- Other battery technologies with a capacity of greater than 20 kW

B. Only BESS that meet the criteria herein shall be permitted under this ordinance. BESS permitted under and subject to this ordinance shall be classified either as a Tier 1, Tier 2 or Tier 3 BESS as set forth herein. All sizes noted in this section shall include the total capacity of the proposed facility and not refer solely as a limitation on total export. For avoidance of doubt, a proposed system which has an export capacity of 50 MW but has a total storage or redundance capacity of 100 MW shall be treated as a 100 MW system.

1. Tier 1 BESS have an aggregate energy capacity less than or equal to 500 kWh, derive 51% or more of their power from Solar Energy Systems as defined herein, and, if in a room or enclosed area, consist of only a single energy storage system technology.

2. Tier 2 BESS consist of those which meet one or more of the following criteria;

    a. have an aggregate energy capacity greater than 500kWh and less than 10 MWh, but no greater than 10 MWh;

    b. are comprised of more than one storage battery facility in a room or enclosed area;

    c. derive less than 51% of their power from Solar Energy Systems as defined herein.

3. Tier 3 BESS consist of those which meet one or more of the following criteria;

    a. have an aggregate energy capacity greater than 10 MWh, but no greater than 350MWh;

    b. are comprised of more than one storage battery facility in a room or enclosed area;

c. derive less than 51% of their power from Solar Energy Systems as defined herein.

§ 7.9.4. General Requirements

A. All permits required by state codes, including but not limited to building permit, an electrical permit, and a fire department permit shall be required for installation of all BESS.

B. All BESS, all Dedicated Use Buildings, and all other buildings or structures that (a) contain or are otherwise associated with a battery energy storage system; and (b) subject to the requirements of the State Building Code, shall be designed, erected, and installed in accordance with all applicable provisions of the State Building Code 780 CMR, State Fire Code 527 CMR 1.00, and State Electrical Code 527 CMR 12.00. All BESS shall comply with NFPA 855, Standard for the Installation of Stationary Energy Storage Systems or subsequent standard.

C. Energy storage system capacities, including array capacity and separation, are limited to the thresholds contained in NFPA 855 or subsequent standard.

§ 7.9.5. Permitting Requirements for Tier 1 BESS

Tier 1 BESS are allowed by right in all zoning districts, including the BESS Overlay District, subject to applicable provisions of the State Building Code, Electrical Code, Fire Code, and other applicable codes, and are subject to site plan review in accordance with section 10.8 hereof and such provisions of this ordinance as are applicable.

Tier 1 BESS and appurtenances shall be prohibited in the Zone A and Zone 1 public water supply protection areas.

§ 7.9.6. Permitting Requirements for, Tier 2 and Tier 3 BESS shall be permitted by Special Permit in the BESS Overlay District in accordance with the requirements below.

§ 7.9.6.1 Special Permit Required. Tier 2 and Tier 3 BESS subject to this ordinance require the issuance of a Special Permit in the BESS Overlay District and are subject to Major Site Plan Review pursuant to Section 10.8. Tier 2 and Tier 3 BESS shall comply with the applicable requirements set forth in this ordinance including the General Special Permit Criteria set forth in section 10.4.2, as well as this Section 7.9 , and the Haverhill General Ordinances. The City Council shall be the Special Permit Granting Authority ("SPGA"). The Applicant shall be required to submit all materials required in accordance with the SPGA Rules and Regulations, in addition to any other materials necessary or as may be required in order to support that the Application meets the Design Requirements set forth in section 7.9.6.2 herein.

§ 7.9.6.1.1 Development Review Required As Part of Hearing Process: For the purpose of a Special Permit filed hereunder, the Applicant shall be required to submit a complete application for a Special Permit in accordance with the Requirements hereunder. Following the opening of the Public Hearing by the SPGA, the Application shall be referred to the Development Review Committee as set forth in

§10.1.4 hereof. The Development Review Committee shall meet with the Applicant who shall be required to provide any additional information as the Committee may reasonably request and the Development Review Committee shall provide the SPGA with its recommendations within ninety (90) days of the date upon which the application was thereto referred.

§ 7.9.6.1.2 Prohibitions: Notwithstanding the foregoing, Tier 2 and Tier 3 BESS and appurtenances shall be prohibited in the Zone A and Zone I public water supply protection areas.

§ 7.9.6.2 Design Requirements. The following requirements apply to all BESS subject to this ordinance, except where it is specifically noted to apply only to Tier 2 or Tier 3BESS:

A. Site Plan Drawings. The Applicant shall provide a full set of Site Drawings stamped by a Massachusetts Registered Professional Engineer inclusive of items set forth in section 7.9.7.K.1 hereof.

B. Utility Lines and Electrical Circuitry. All on-site utility lines shall be placed underground to the extent feasible and as permitted by the serving utility, with the exception of the main service connection at the utility company right-of-way and any new interconnection equipment, including without limitation any poles.

C. Signage. Signage shall comply with the requirements of Section 6.2 of this Zoning Ordinance and the following additional requirements; in the event of a conflict between the provisions of Section 6.2 and this section, the requirements of this section shall control.

    1. The signage shall be in compliance with ANSI Z535 and shall include the type of technology associated with the BESS, any special hazards associated, the type of suppression system installed in the area of BESS, and 24-hour emergency contact information, including reach-back phone number.

    2. As required by the state electrical code, disconnect and other emergency shutoff information shall be clearly displayed on a light reflective surface. A clearly visible warning sign concerning voltage shall be placed at the base of all pad-mounted transformers and substations.

    3. Signage compliant with ANSI Z535 shall be provided on doors to rooms, entrances to BESS facilities, and on BESS outdoor containers.

D. Lighting. Lighting of the BESS shall be limited to that minimally required for safety, security and operational purposes, shall be shielded from abutting properties, shall be directed downward, shall incorporate full cut-off fixtures to reduce light pollution and shall otherwise be consistent with local, state and federal law. A photometric plan shall be required.

E. Vegetation and tree cutting. Areas within ten feet on each side of Tier 2 and Tier 3 BESS shall be cleared of combustible vegetation and other combustible growth. Single specimens of trees, shrubbery, or cultivated ground cover such as green grass, ivy, succulents, or similar plants used as ground covers shall be permitted provided that they do not form a means of readily transmitting fire. Removal of trees should be minimized to the extent possible. No tree or vegetation clearing shall be permitted within the Setbacks as noted below except for the

purposes of the area of ingress and egress to the site. Vegetation control in the Water Supply Protection Overlay District (WSPOD) shall be by mowing or other mechanical means. The use of synthetic pesticides, herbicides, and fertilizers shall be prohibited for BESS facilities within the WSPOD.

F. Setbacks. Tier 2 and Tier 3 BESS shall be set back a minimum of 150 feet from all side, rear, and front lot lines; except that Tier 2 and Tier 3 BESS shall be set back a minimum of 300 feet from side, rear, and front lot lines that abut or are across a street from residential zoning districts or existing single, two-family, or multi-family structures. The minimum setback areas shall include a Buffer Area at least fifty feet wide along all property lines. Access drives and parking are allowed in the setback areas, except emergency access as noted below, but shall not intrude into the required setback areas except where necessary to provide access or egress to the property. In addition, a minimum of 50 feet must be maintained between BESS components and all buildings, stored combustible materials, hazardous materials, high-piled storage, personnel means of egress, and other exposure hazards not associated with electrical grid infrastructure. The Special Permit Granting Authority may waive these setback requirements so long as the approved setbacks protect the health and safety of nearby abutters.

G. Emergency Access: There shall be a 60-foot-wide paved emergency access road around the complete perimeter of the facility but inside the required setback area which may not exceed a 7% grade at any time. Ongoing maintenance of the access road including snow removal after 3 inches of snow shall be included as part of the Operations and Maintenance Plan required herein.

H. Lot Size. The minimum lot size for Tier 1 BESS shall not be less than 1 acre. The minimum lot size for a Tier 2 BESS shall be not less than 10 acres and the minimum lot size for a Tier 3 BESS shall be no less than 20.

I. Dimensional. All BESS shall comply with the dimensional limitations for principal structures of the underlying zoning district as provided in Appendix B, Table 2, of this Zoning Ordinance, unless otherwise provided in this ordinance. No BESS shall exceed 15 feet in height and there shall be no vertical stacking of BESS units.

J. Fencing Requirements. Tier 2 and Tier 3 BESS, including all mechanical equipment, shall be enclosed by a minimum eight-foot high fence with a self-locking gate to prevent unauthorized access unless housed in a dedicated-use building. All gates shall accomodate a knox box or other accessible means to allow access to public safety personnel. Security barriers, fences, landscaping, and other enclosures must not inhibit required air flow to or exhaust from the BESS and components. Electrical equipment greater than 1,000V require a separate and additional means to restrict access. NFPA 855 requires specialty safety systems to be provided based on the BESS chemistry and installed location.

K. Screening and Visibility. Tier 2 and Tier 3 BESS shall have views minimized from adjacent properties to the extent reasonably practicable using architectural features, earth berms, landscaping, or other screening methods that will harmonize with the character of the property and surrounding area. Such features may not inhibit required air flow to or exhaust from the BESS and components and must comply with the setbacks established in paragraph G above.

L. Failure Protection. All Tier 2 and Tier 3 BESS shall include an impenetrable layer beneath the

surface and no closer than four (4) feet to the closest water table which will cause any discharge to flow into a basin located on site which will then capture and/or treat any runoff as a result of a failed battery or fire or other destruction. The Application shall include details of the proposed catchment system along with a detailed stormwater report and stamped detailed engineering plans from a Massachusetts Registered Professional Engineer depicting the stormwater system. All BESS facilities located within the WSPOD shall have full containment to capture all releases, either intentionally from maintenance or accidental in nature. Release and runoff shall not be allowed.

M. Batteries. Failed battery cells and modules shall not be stored on the site and shall be removed no later than 30 days after deemed failed by the BESS operator or cell/module manufacturer. The operator shall notify the Haverhill Fire Chief in advance if the type of battery or batteries used onsite is to be changed. All failed battery cells and modules shall not be stored outdoors and must be protected from further damage and potential release of contaminants to the environment.

N. Storage. No equipment or hazardous materials, in liquid, dry, or gas form, shall be stored onsite of the BESS other than those items in quantities necessary for the proper operation of the facility. Any storage for materials deemed necessary shall be properly labeled, covered and contained to protect from release to the environment.

O. Acoustical Impacts. No system shall cause an increase in acoustical levels over ambient at the Property line. An acoustical study prepared by a Massachusetts Registered Acoustical Engineer shall be provided.

P. Water Source. A municipal water source shall be provided including a FDC within 100 feet before the entrance to the Hazard Area on the Property. The Applicant shall present evidence including a hydraulic analysis in accordance to the City standard to support that there is adequate volume and pressure for fire suppression on the Property and not have a detrimental impact on the surrounding neighborhood. The applicant shall be required to make any related offsite improvement to achieve the required standard to alleviate any impact on the adjacent users.

Q. Stormwater Management. The applicant shall submit a stormwater management plan consistent with the Massachusetts Stormwater Management Policy.

R. Decommissioning Plan. The applicant shall submit with its application a decommissioning plan for all BESS to be implemented upon abandonment and/or in conjunction with removal of the facility. The owner or operator of the BESS shall notify the Building Commissioner in writing at least twenty days prior to when a BESS will be decommissioned. Decommissioning of an abandoned or discontinued BESS shall be completed within six months after the facility ceases operation. The decommissioning plan shall include:

1. A narrative description of the activities to be accomplished, including who will perform that activity and at what point in time, for complete physical removal of all BESS components, structures, equipment, security barriers, and transmission lines from the site;

2. Disposal of all solid and hazardous waste in accordance with local, state, and

federal waste disposal regulations;

3. The anticipated life of the BESS;

4. The estimated decommissioning costs and how said estimate was determined, including an allowance for annual cost of living increases or increases due to inflation;

5. The method of ensuring that funds will be available for decommissioning and restoration;

6. The method by which the decommissioning cost will be kept current;

7. The manner in which the site will be restored, including a description of how any changes to the surrounding areas and other systems adjacent to the BESS, such as, but not limited to, structural elements, building penetrations, means of egress, and required fire detection suppression systems, will be protected during decommissioning and confirmed as being acceptable after the system is removed; and

8. A listing of any contingencies for removing an intact operational energy storage system from service, and for removing an energy storage system from service that has been damaged by a fire or other event.

S. Decommissioning Fund. The owner and/or operator of the energy storage system, shall continuously maintain a fund or other surety acceptable to the City, in a form approved by the City Council and City Solicitor, for the removal of the BESS, in an amount to be determined by the City, and which includes the City as loss payee, for the period of the life of the facility. All costs of the financial security shall be borne by the Applicant.

T. Proof of Liability Insurance. The applicant or property owner shall provide evidence of commercial liability insurance in an amount and type generally acceptable in the industry and approved by the Planning Board prior to the issuance of a building permit, and shall continue such insurance in effect until such facility has been decommissioned, removed, and the site restored in accordance with this ordinance.

§ 7.9.6.3 Special Permit Criteria. In addition to the general Special Permit criteria set forth in section 10.4.2 of this Ordinance, an application for Tier 2 or Tier 3 BESS shall meet the following criteria:

A. The project protects the ground water and surrounding properties from catastrophic failure of one or more of the batteries or cells by implementing appropriate catchment and filtration systems for water run off or run off from the system.

B. The project appropriately attenuates sound intrusion beyond the property lines onto adjacent properties so that there is no change in ambient sound after construction and during operations of the system.

C. The project includes only dark sky compliant down lighting which does not intrude beyond the property lines onto adjacent properties.

D. The project is secure and addresses possible trespass or other intrusion by individuals not affiliated with the project.

E. The project meets the public safety needs of the City.

F. The project minimizes visual impacts from utility infrastructure for interconnection.

F. The project is minimally visible from adjacent properties.

§ 7.9.7. Site Plan application.

For all BESS the Site Plan application shall include the following information, in addition to that required by Section 10.8 of this Zoning Ordinance and the applicable Planning Board requirements governing Site Plan Applications:

A. Utility Infrastructure information requirements:

1. A one- or three-line electrical diagram detailing the BESS layout, associated components, and electrical interconnection methods, with all State Electrical Code compliant disconnects and over current devices.

2. The Applicant shall provide certified verification that there is a fully executed Interconnection Services Agreement ("ISA") with the local utility distribution company. Said certification shall include the cover and signature pages of the ISA.

3. If the ISA has not been issued, the Applicant shall be required to provide a full copy of the Application for Interconnection filed with the local utility distribution company.

B. Preliminary equipment specification sheets that document the proposed BESS components, inverters and associated electrical equipment that are to be installed. A final equipment specification sheet shall be submitted prior to the issuance of building permit.

C. Name, address, and contact information of proposed or potential system installer and the owner and/or operator of the BESS. Such information of the final system installer shall be submitted prior to the issuance of building permit.

D. Large-scale fire test data, evaluation information, and calculations, and modeling data. For any of the following, UL 9540A fire test data must be made available to the Planning Board for review:

- BESS systems with a capacity of greater than 50 kW
- BESS systems with spacing between arrays of less than 3 feet

E. Commissioning Plan. The system installer or commissioning agent shall prepare a commissioning plan prior to the start of commissioning. Such plan shall be compliant with NFPA 855 and document and verify that the system and its associated controls and safety

systems are in proper working condition per requirements set forth in applicable state codes. Where commissioning is required by the Building Code, BESS commissioning shall be conducted by a Massachusetts Licensed Professional Engineer after the installation is complete but prior to final inspection and approval. A corrective action plan shall be developed for any open or continuing issues that are allowed to be continued after commissioning. A report describing the results of the system commissioning and including the results of the initial acceptance testing required by applicable state codes shall be provided to Zoning Enforcement Officer prior to final inspection and approval and maintained at an approved on-site location.

F. Fire Safety Compliance Plan. Such plan shall document and verify that the system and its associated controls and safety systems are in compliance with state codes, including documentation that BESS components comply with the safety standards set forth in subsection 7.9.9. Such plan shall also include a detailed training plan for public safety personnel.

G. Operation and Maintenance Manual. Such plan shall describe continuing BESS maintenance and property upkeep, as well as design, construction, installation, testing and commissioning information and shall meet all requirements set forth state codes and NFPA 855. Maintenance provisions will be driven by manufacturer requirements for the specific listed system. It shall address maintenance of the access and perimeter roadways, perimeter fencing, and shall include a snow removal plan and 24 hours access requirements by public safety officials. There shall be an annual; acoustical review to assure ongoing compliance with the requirement of no change from ambient at the property line and fire department inspection.

H. Depending on the location of the BESS in relation to and its interaction with the electrical grid, interconnection will be completed per 527 CMR 12.00. System interconnections into utility grids shall be in accordance with NFPA 855 and the local distribution company standards for interconnection of distributed energy resources. An accessible disconnect is required per 527 CMR 12.00.

I. Prior to the issuance of the building permit, As Built engineering documents must be signed and sealed by a Massachusetts Licensed Professional Engineer and provided to the Building Commissioner and Planning Department .

J. Emergency Operations Plan. An Emergency Operations Plan compliant with NFPA 855 is required. A copy of the approved Emergency Operations Plan shall be given to the system operator, the local fire department, local fire code official and police department. For so long as the BESS is operational, the operator shall provide the Fire Department, Police Department, Building Commissioner, and Mayor's office with contact information for personnel that can be reached 24 hours per day every day, and this contact information shall be updated by the operator whenever there is a change in the information. The operator shall also be required to have an official representative be present onsite not later than two hours after notification by the Fire Chief, Police Chief, or their designee. A permanent copy shall also be placed in an approved location to be accessible to facility personnel, fire code officials, and emergency responders. The emergency operations plan shall include the following information:

1. Procedures for safe shutdown, de-energizing, or isolation of equipment and systems under emergency conditions to reduce the risk of fire, electric shock, and personal injuries, and for safe start-up following cessation of emergency conditions.

2. Procedures for inspection and testing of associated alarms, interlocks, and controls, including time intervals for inspection and testing.

3. Procedures to be followed in response to notifications from the Battery Energy Storage Management System, when provided, that could signify potentially dangerous conditions, including shutting down equipment, summoning service and repair personnel, and providing agreed upon notification to fire department personnel for potentially hazardous conditions in the event of a system failure.

4. Emergency procedures to be followed in case of fire, explosion, release of liquids or vapors, damage to critical moving parts, or other potentially dangerous conditions. Procedures can include sounding the alarm, notifying the fire department, evacuating personnel, de-energizing equipment, and controlling and extinguishing the fire.

5. Response considerations similar to a safety data sheet (SDS) that will address response safety concerns and extinguishment when an SDS is not required.

6. Procedures for safe disposal of BESS equipment damaged in a fire or other emergency event, including maintaining contact information for personnel qualified to safely remove damaged BESS equipment from the facility.

7. Other procedures as determined necessary by the City to provide for the safety of occupants, neighboring properties, and emergency responders.

8. Procedures and schedules for conducting drills of these procedures and for training local first responders on the contents of the plan and appropriate response procedures.

K. Each Application shall be accompanied by the following information:

1. A certified plot plan at a minimum scale of one inch equals 40 feet and a maximum scale of one inch equals 20 feet. The site plan shall contain:
   a. Date of site plan with all revisions noted and dated. Title of development, North arrow, scale, map and lot number, name and address of record owner, name and address of person preparing the site plan.
   b. The names of all owners of record of adjacent properties, and the map and lot number of the properties and all buildings.
   c. Zoning district boundaries and flood zone boundaries shall be shown as they affect the property including limits of the WSPOD and public water supply Zone A and Zone I on the overall site plan.
   d. Boundaries of the property and lines of existing street, lots, easements and

areas dedicated to public use, including rights of way.

e. A locus map showing the location of the property with reference to surrounding area.
f. A table indicating all calculations necessary to determine conformance to Bylaw regulations including current required and proposed regulations.
g. Square footage of property to the nearest 10 square feet.

2. All plans must include the location of existing and proposed buildings, walls, fences, culverts, parking areas, loading areas, walkways and driveways.

   a. Location and dimensions of utilities, gas, telephone, electrical, communications, water drainage, sewer and other waste disposal.

   b. Location, type and dimensions of landscaping and screening.

   c. Location of existing rock outcroppings, high points, vistas, ponds, depressions, wetlands, major trees (twelve-inch caliper and over) and any other significant existing features.

   d. Two-foot contours where slopes are less than 15% and five-foot contours when 15% or more. Existing contours shall be indicated by dashed line. Proposed contours shall be indicated by solid line.

   e. Dimensioned schematic drawings of all proposed buildings. Scale shall not exceed ¼ inch equals one foot nor less than 1/8 inch equals one foot.

   f. A narrative describing the proposal and addressing the foregoing requirements.

   g. Location of street numbers indicated on the schematic drawings and/or site plan.

   h. Surface and water pollution. A report on the impact of Stormwater runoff on adjacent and downstream surface water bodies, subsurface groundwater and the water table.

   i. Soils. The potential dangers of erosion and sedimentation caused by the operation and maintenance of the proposed development.

   j. General environmental impact. A report on the relationship of the proposed development of the major botanical, zoological, geological and hydrological resources of the site, and compatibility of the proposed development with adjacent or surrounding land uses and neighborhoods.

   k. Traffic impact. A report on existing street capacities, estimated average

daily traffic generation, composition, peak hour levels and directional flows resulting from the proposed development, proposed methods to mitigate the estimated traffic impact and methodology and sources used to derive existing data and estimations.

l. Renderings showing the proposed project in relationship to its surroundings.

§ 7.9.8. Ownership Changes.

If the owner of the BESS changes or the owner of the property changes, the Special Permit shall remain in effect, provided that the successor owner or operator assumes in writing all of the obligations of the Special Permit, Site Plan approval, and decommissioning plan. A new owner or operator of the BESS shall notify the Building Commissioner of such change in ownership or operator within 14 days of the ownership change. A new owner or operator must provide such notification to the Building Commissioner in writing.

§ 7.9.9. Safety

System Certification. BESS and equipment shall be listed by a Nationally Recognized Testing Laboratory to UL 9540 (Standard for BESS and Equipment) or approved equivalent, with subcomponents meeting each of the following standards as applicable:

A. UL 1973 (Standard for Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail Applications),
B. UL 1642 (Standard for Lithium Batteries),
C. UL 1741 or UL 62109 (Inverters and Power Converters),
D. Certified under the applicable electrical, building, and fire prevention codes as required.
E. Alternatively, field evaluation by an approved testing laboratory for compliance with UL 9540 (or approved equivalent) and applicable codes, regulations and safety standards may be used to meet system certification requirements.

Site Access. BESS shall be maintained in good working order and in accordance with industry standards. Site access shall be maintained, including snow removal at a level acceptable to the local fire department.

BESS, components, and associated ancillary equipment shall have required working space clearances, and electrical circuitry shall be within weatherproof enclosures marked with the environmental rating suitable for the type of exposure in compliance with NFPA 70.

§ 7.9.11. Abandonment

The BESS shall be considered abandoned when it ceases to operate consistently for more than one year. If the owner and/or operator fails to comply with decommissioning upon any abandonment, the City may, after compliance with any applicable state and federal constitutional requirements, enter the property and utilize the available bond and/or security for the removal of any BESS and restoration of the site in accordance with the decommissioning plan.

**And further add the following new definition to § 11.1 of Chapter 255**

§ 11.1

AGGREGATE ENERGY CAPACITY: Total amount of energy stored that can be stored in all batteries that are a part of the BESS measured in kilowatt-hours (kWh) or megawatt-hours (MWh).

BATTERY or BATTERIES: A single cell or group of cells connected electrically in series, in parallel, or combination of both, which can charge, discharge and store energy electrochemically. For the purpose of this Ordinance, batteries utilized in consumer products are excluded from these requirements.

BATTERY ENERGY STORAGE SYSTEM ("BESS") – A system containing one of more battery modules for storing electrical energy, any equipment needed to support the safe and proper function or usage of the battery modules, and one or moe physical container(s) providing secondary containment to any of the above. It may be a primary use or an Accessory Use to a solar generating facility, power generation facility, electrical substation, or other similar uses. For the purposes of this bylaw, BESS are comprised of three (3) types as further described in § 7.9.3.B. of this bylaw; Tier 1 BESS, Tier 2 BESS and Tier 3 BESS.

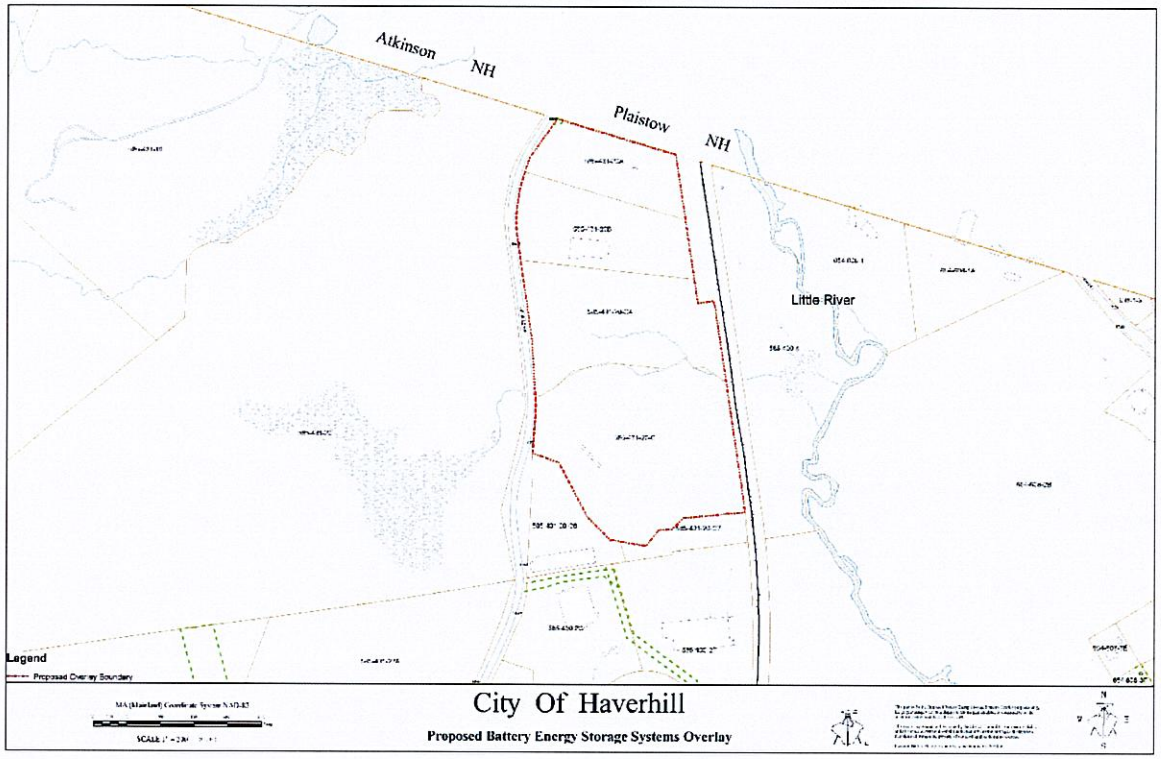
**And further to amend section 3.1.3, Table of Use and Parking regulations by allowing Tier 1, Tier 2 and Tier 3 BESS in the districts as follows:**

BESS Overlay District - OD

| | RS | RR | RL | RM | RH | RU | CN | CH | CG | CC | CM | OP | BG | BP | BESS OD | PC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **I. MISCELLANEOUS COMMERCIAL USES (cont'd)** | | | | | | | | | | | | | | | | |
| 22. Kennel or veterinary hospital in which all animals, fowl or other forms of life are completely enclosed in pens or other structures | BA | BA | N | N | N | N | N | BA | N | N | N | N | N | N | | D |
| 23. Commercial communications and/or television tower, provided that it shall be at least 500 feet from any R District | BA | N | N | N | N | N | N | BA | BA | BA | N | BA | BA | BA | | None |
| **24. Battery Energy Storage Systems: Tier 1** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **N** | **Y** | **Y** | **Y** | **None** |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **25. Battery Energy Storage Systems: Tier 2** | N | N | N | N | N | N | N | N | N | N | N | N | N | N | CC | None |
| **26. Battery Energy Storage Systems: Tier 3** | N | N | N | N | N | N | N | N | N | N | N | N | N | N | CC | None |

**And further to amend the City of Haverhill Zoning Map to include the BESS Overlay District as set forth below:**



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**CITY OF HAVERHILL**

HAVERHILL, MASSACHUSETTS 01830-5843

September 9, 2026

TO: President and Members of the City Council

Vice President Michitson submits the summary of minutes and recommendations of the Planning and Development Committee held on August 24, 2026 for acceptance and approval.

John A. Michitson

Vice President John Michitson

SEP 10 PM 1:49
HAVCITYCLERK

(Meeting: 9.15.26)

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# CITY OF HAVERHILL

HAVERHILL, MASSACHUSETTS 01830-5843

MINUTES/SUMMARY OF THE PLANNING AND DEVELOPMENT COMMITTEE MEETING

August 24, 2026

A Planning and Development Committee Meeting was held on Monday, August 24, 2026 at 6:00 PM in the City Council Chambers, Room 202

Committee Members Present: Committee Chair, John Michitson, Councilor Melissa Lewandowski, Councilor Devan Ferreira and Councilor Daniel Diodati

Committee Members Absent: Councilor Catherine Rogers

Councilors Present: Councilor LePage

City Officials: Mayor Melinda Barrett, Robert Moore, Conservation Department, Jacki Byerley, Planning Director, City Solicitor Lisa Mead, Fire Chief Chris Cesati

The following items were discussed:

- Doc. 21-B Motion by Councilor Sullivan to send for further discussion Chapter 255-Zoning Ordinance and Zoning Map – Battery Energy Storage Systems Overlay District (BESS) (review the objective site comparison before selecting a battery energy system overlay to understand how each candidate area performs from the perspective of public safety, environmental protections, infrastructure capacity, emergency response, water resources, surrounding land usage and municipal operations)

Planning Director Jacki Byerley presented maps and departmental reviews of potential Battery Energy Storage System (BESS) zoning areas, including Computer Drive, Hilldale Avenue, Neck Road, Groveland Road, Amesbury Road, and Cross Road. She explained that departments applied the evaluation criteria differently based on their operational needs, so the scores were not directly comparable. Conservation favored Hilldale Avenue, while Engineering and Water/Wastewater favored Computer Drive, followed by Hilldale Avenue and Neck Road. Planning identified Amesbury Road as the strongest option among the business districts, and the Fire Department supported Amesbury Road for zoning purposes. Councilor Ferreira and City Solicitor Lisa Mead discussed whether clean energy projects could instead be addressed through special permit requirements, with City Solicitor Mead explaining that a zoning framework would provide the Council greater control over where projects are located. Councilor Lewandowski discussed the favorable characteristics of Hilldale Avenue, while Fire Chief Cesati noted concerns regarding site size, water flow, and access requirements. Chief Cesati stated that larger parcels would help avoid stacking and that all sites would require adequate fire access and water availability. Resident Christine Kwitchoff (14 Colby's Lane) clarified the minimum lot sizes for the three BESS tiers, and Conservation Agent Robert Moore discussed the potential to include the NETTS property with the Hilldale Avenue site. Rob Moore

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also raised environmental and water-supply concerns regarding Amesbury Road, including Blanding's turtle habitat, wetlands, and its proximity to Kenoza Lake and the Millvale Reservoir. Councilor Diodati expressed concerns about locating the district at the airport and the Groveland Road site due to new fields, while Councilor Lewandowski discussed the possibility of including the tractor-trailer facility with Hilldale Avenue to meet the 20-acre requirement.

Corey O'Neill (Haverhill resident) questioned whether October 1 is a deadline for the City to establish a BESS overlay district. City Solicitor Lisa Mead clarified that the City is not required to create an overlay, but without zoning in place, BESS facilities could potentially be proposed anywhere in the City. Corey O'Neill stated that he believed additional time was needed to review the proposed locations, departmental assessments. He expressed concern about rushing the decision and raised questions regarding potential agreements between companies and City officials. Corey O'Neill stated that he is not opposed to BESS technology but wants the City to find a balance that protects residents and the community.

Christine Kwitchoff, 14 Colby's Lane, thanked the City departments for conducting the additional site reviews. She stated that it was a significant oversight at the May 19 meeting to present only one potential site and expressed appreciation for the opportunity for further public review.

Anita Toscano, Corliss Hill Road, asked about the potential impacts of BESS facilities on the City's natural resources. She raised concerns regarding the amount of water that may be needed to address a battery fire and the potential environmental impacts and cleanup requirements in the event of a battery leak.

City Solicitor Lisa Mead explained that BESS facilities do not require water for normal operations, but water is needed for emergency fire response, and the zoning ordinance requires an impervious catchment area beneath the facility. Fire Chief Cesati stated that battery fires require significant amounts of water to cool the batteries and prevent the fire from spreading, noting that a runaway battery must ultimately discharge its energy. Councilor Ferreira expressed support for the Hilldale Avenue site and suggested reducing the minimum acreage from 20 to 15 acres. She also asked about potential host agreements or PILOT payments. City Solicitor Mead explained that such agreements could be pursued but could not be made a special permit requirement. Councilor Lewandowski asked about additional Fire Department training and equipment, and Chief Cesati stated that some equipment would need upgrading, training would be required and funded by the developer, and the department would meet applicable NFPA standards. Councilor Diodati discussed including the tractor-trailer facility with the Hilldale Avenue site to maintain the 20-acre requirement. City Solicitor Mead confirmed that the City Council's role is to ensure the use is permitted somewhere, not to determine whether a specific amount of available acreage exists. Chair Michitson stated that the committee could move forward with one site, recommend multiple sites, or seek additional information before making a decision.

*Motion by Councilor Lewandowski to propose Hilldale Avenue as the recommended site for the district. Second by Councilor Diodati.*

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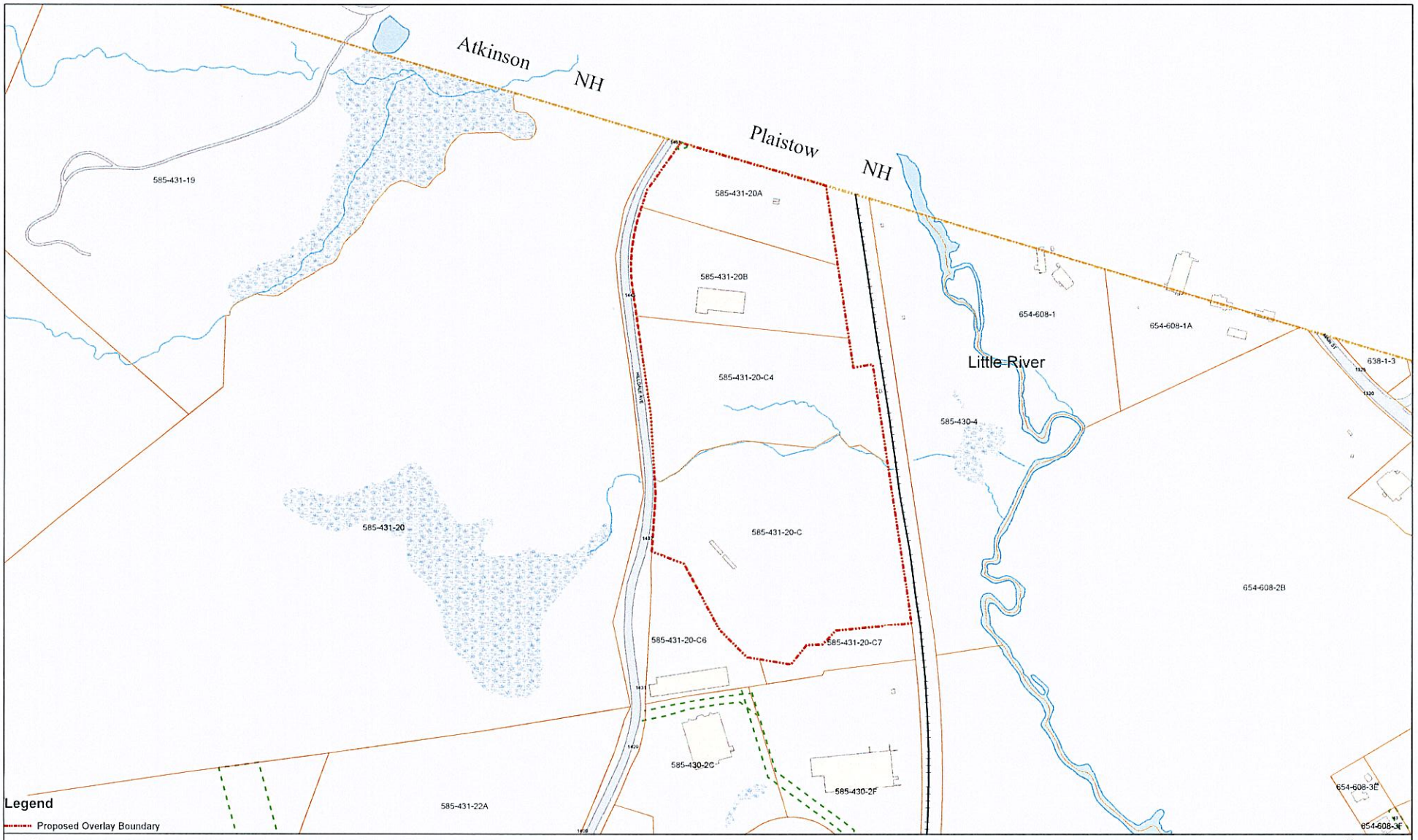
Jacki Byerley stated would you want a change made to the regulations requiring it to be 15 acres or do you want us to work on adding it so the total acreage of the area is 20 or more. Councilor Diodati stated I would like to see 20 acres. Jacki stated I will work with our GIS department. Chair Michitson stated that is part of the motion. Councilor Lewandowski stated sure.

*Motion by Councilor Lewandowski to propose Hilldale Avenue as the recommended site for the district. The total acreage of the area will be 20 acres. Second by Councilor Diodati.*
*PASSED* *4 YEAS, 0 NAYS*

City Solicitor Mead stated when you do bring it up, we will have to readvertise so the sooner you bring it up the better. It's a 21-day advertisement period.

*Motion by Councilor Diodati to adjourn. Second by Councilor Lewandowski.*
*PASSED* *4 YEAS, 0 NAYS*

Respectfully submitted,
John A. Michitson
John A. Michitson
Chairperson




MA (Mainland) Coordinate System NAD-83

200 100 0 200 400 600 800 Feet

SCALE 1" = 200' (1:2,400)

# City Of Haverhill

## Proposed Battery Energy Storage Systems Overlay

This plan is for the Proposed Battery Energy Storage Systems Overlay purposes only. the graphic images and data displayed on this plan shall not be construed to be the actual metes and bounds locations of such.

This map was prepared and formatted by the City Of Haverhill – Engineering Division and all rights and ownership of all intellectual information and logos displayed on this plan shall remain the property of same. All applicable rights reserved.

Proposed Battery Energy Storage Systems Overlay 08/26/2020

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**MUNICIPAL ORDINANCE CHAPTER 255 Zoning**

## AN ORDINANCE RELATING TO AMENDING CHAPTER 255, ZONING BY ADDING A NEW SECTION 7.9 BATTERY ENTERGY STORAGE SYSTEMS

**BE IT ORDAINED by the City Council of the City of Haverhill that Chapter 255, Zoning, of the Code of the City of Haverhill, as amended, being and is hereby further amended as follows by inserting the following new section 7.9 entitled "Battery Energy Storage Systems";**

§7.9 BATTERY ENERGY STORAGE SYSTEMS

§7.9.1. Purpose.

The purpose of this Section is to advance and protect the public health, safety, welfare, and quality of life by creating regulations for the installation and use of free-standing battery energy storage systems ("BESS"), with the following objectives:

A. To provide a regulatory scheme for the location, construction and operation of free-standing BESS consistent with best practices and safety protocols;
B. To ensure compatible land uses in the vicinity of the areas affected by BESS and to mitigate any potential impacts on abutting and nearby properties; and
C. To mitigate the impacts of BESS on environmental resources such as agricultural lands, forests, wildlife, wetlands and other natural resources.

This Section shall be construed to be consistent with state law, including but not limited to the provisions of General Laws chapter 40A, section 3, and state regulations, including but not limited to the provisions of the State Building Code, State Fire Code, and State Electrical Code. In the event of any conflict between the provisions of this section and the provisions of state law or regulations, the state law and regulations shall prevail.

§7.9.2. Establishment of the BESS Overlay District
The BESS Overlay District is an overlay district superimposed over the underlying district set forth in this Zoning Ordinance. Within the BESS, the requirements of the underlying district continue to apply, except when the following uses are proposed then the following provisions of this section 7.9 shall apply:

Tier 1 BESS

Tier 2 BESS and

Tier 3 BESS

§7.9.3 Applicability.

A. The requirements of this ordinance shall apply to BESS permitted, installed, decommissioned or modified after the effective date of this ordinance, excluding general maintenance and repair. BESS subject to this ordinance are only those that exceed the following capacities:

- Lead-acid with a capacity of greater than 70 kW
- Nickel with a capacity of greater than 70 kW
- Lithium-ion with a capacity of greater than 30 kW
- Sodium nickel chloride with a capacity of greater than 20 kW
- Flow with a capacity of greater than 20 kW
- Other battery technologies with a capacity of greater than 20 kW

B. Only BESS that meet the criteria herein shall be permitted under this ordinance. BESS permitted under and subject to this ordinance shall be classified either as a Tier 1, Tier 2 or Tier 3 BESS as set forth herein. All sizes noted in this section shall include the total capacity of the proposed facility and not refer solely as a limitation on total export. For avoidance of doubt, a proposed system which has an export capacity of 50 MW but has a total storage or redundance capacity of 100 MW shall be treated as a 100 MW system.

1. Tier 1 BESS have an aggregate energy capacity less than or equal to 500 kWh, derive 51% or more of their power from Solar Energy Systems as defined herein, and, if in a room or enclosed area, consist of only a single energy storage system technology.

2. Tier 2 BESS consist of those which meet one or more of the following criteria;

    a. have an aggregate energy capacity greater than 500kWh and less than 10 MWh, but no greater than 10 MWh;

    b. are comprised of more than one storage battery facility in a room or enclosed area;

    c. derive less than 51% of their power from Solar Energy Systems as defined herein.

3. Tier 3 BESS consist of those which meet one or more of the following criteria;

    a. have an aggregate energy capacity greater than 10 MWh, but no greater than 350MWh;

    b. are comprised of more than one storage battery facility in a room or enclosed area;

c. derive less than 51% of their power from Solar Energy Systems as defined herein.

§ 7.9.4. General Requirements

A. All permits required by state codes, including but not limited to building permit, an electrical permit, and a fire department permit shall be required for installation of all BESS.

B. All BESS, all Dedicated Use Buildings, and all other buildings or structures that (a) contain or are otherwise associated with a battery energy storage system; and (b) subject to the requirements of the State Building Code, shall be designed, erected, and installed in accordance with all applicable provisions of the State Building Code 780 CMR, State Fire Code 527 CMR 1.00, and State Electrical Code 527 CMR 12.00. All BESS shall comply with NFPA 855, Standard for the Installation of Stationary Energy Storage Systems or subsequent standard.

C. Energy storage system capacities, including array capacity and separation, are limited to the thresholds contained in NFPA 855 or subsequent standard.

§ 7.9.5. Permitting Requirements for Tier 1 BESS

Tier 1 BESS are allowed by right in all zoning districts, including the BESS Overlay District, subject to applicable provisions of the State Building Code, Electrical Code, Fire Code, and other applicable codes, and are subject to site plan review in accordance with section 10.8 hereof and such provisions of this ordinance as are applicable.

Tier 1 BESS and appurtenances shall be prohibited in the Zone A and Zone 1 public water supply protection areas.

§ 7.9.6. Permitting Requirements for, Tier 2 and Tier 3 BESS shall be permitted by Special Permit in the BESS Overlay District in accordance with the requirements below.

§ 7.9.6.1 Special Permit Required. Tier 2 and Tier 3 BESS subject to this ordinance require the issuance of a Special Permit in the BESS Overlay District and are subject to Major Site Plan Review pursuant to Section 10.8. Tier 2 and Tier 3 BESS shall comply with the applicable requirements set forth in this ordinance including the General Special Permit Criteria set forth in section 10.4.2, as well as this Section 7.9 , and the Haverhill General Ordinances. The City Council shall be the Special Permit Granting Authority ("SPGA"). The Applicant shall be required to submit all materials required in accordance with the SPGA Rules and Regulations, in addition to any other materials necessary or as may be required in order to support that the Application meets the Design Requirements set forth in section 7.9.6.2 herein.

§ 7.9.6.1.1 Development Review Required As Part of Hearing Process: For the purpose of a Special Permit filed hereunder, the Applicant shall be required to submit a complete application for a Special Permit in accordance with the Requirements hereunder. Following the opening of the Public Hearing by the SPGA, the Application shall be referred to the Development Review Committee as set forth in

§10.1.4 hereof. The Development Review Committee shall meet with the Applicant who shall be required to provide any additional information as the Committee may reasonably request and the Development Review Committee shall provide the SPGA with its recommendations within ninety (90) days of the date upon which the application was thereto referred.

§ 7.9.6.1.2 Prohibitions: Notwithstanding the foregoing, Tier 2 and Tier 3 BESS and appurtenances shall be prohibited in the Zone A and Zone I public water supply protection areas.

§ 7.9.6.2 Design Requirements. The following requirements apply to all BESS subject to this ordinance, except where it is specifically noted to apply only to Tier 2 or Tier 3BESS:

A. Site Plan Drawings. The Applicant shall provide a full set of Site Drawings stamped by a Massachusetts Registered Professional Engineer inclusive of items set forth in section 7.9.7.K.1 hereof.

B. Utility Lines and Electrical Circuitry. All on-site utility lines shall be placed underground to the extent feasible and as permitted by the serving utility, with the exception of the main service connection at the utility company right-of-way and any new interconnection equipment, including without limitation any poles.

C. Signage. Signage shall comply with the requirements of Section 6.2 of this Zoning Ordinance and the following additional requirements; in the event of a conflict between the provisions of Section 6.2 and this section, the requirements of this section shall control.

    1. The signage shall be in compliance with ANSI Z535 and shall include the type of technology associated with the BESS, any special hazards associated, the type of suppression system installed in the area of BESS, and 24-hour emergency contact information, including reach-back phone number.

    2. As required by the state electrical code, disconnect and other emergency shutoff information shall be clearly displayed on a light reflective surface. A clearly visible warning sign concerning voltage shall be placed at the base of all pad-mounted transformers and substations.

    3. Signage compliant with ANSI Z535 shall be provided on doors to rooms, entrances to BESS facilities, and on BESS outdoor containers.

D. Lighting. Lighting of the BESS shall be limited to that minimally required for safety, security and operational purposes, shall be shielded from abutting properties, shall be directed downward, shall incorporate full cut-off fixtures to reduce light pollution and shall otherwise be consistent with local, state and federal law. A photometric plan shall be required.

E. Vegetation and tree cutting. Areas within ten feet on each side of Tier 2 and Tier 3 BESS shall be cleared of combustible vegetation and other combustible growth. Single specimens of trees, shrubbery, or cultivated ground cover such as green grass, ivy, succulents, or similar plants used as ground covers shall be permitted provided that they do not form a means of readily transmitting fire. Removal of trees should be minimized to the extent possible. No tree or vegetation clearing shall be permitted within the Setbacks as noted below except for the

purposes of the area of ingress and egress to the site. Vegetation control in the Water Supply Protection Overlay District (WSPOD) shall be by mowing or other mechanical means. The use of synthetic pesticides, herbicides, and fertilizers shall be prohibited for BESS facilities within the WSPOD.

F. Setbacks. Tier 2 and Tier 3 BESS shall be set back a minimum of 150 feet from all side, rear, and front lot lines; except that Tier 2 and Tier 3 BESS shall be set back a minimum of 300 feet from side, rear, and front lot lines that abut or are across a street from residential zoning districts or existing single, two-family, or multi-family structures. The minimum setback areas shall include a Buffer Area at least fifty feet wide along all property lines. Access drives and parking are allowed in the setback areas, except emergency access as noted below, but shall not intrude into the required setback areas except where necessary to provide access or egress to the property. In addition, a minimum of 50 feet must be maintained between BESS components and all buildings, stored combustible materials, hazardous materials, high-piled storage, personnel means of egress, and other exposure hazards not associated with electrical grid infrastructure. The Special Permit Granting Authority may waive these setback requirements so long as the approved setbacks protect the health and safety of nearby abutters.

G. Emergency Access: There shall be a 60-foot-wide paved emergency access road around the complete perimeter of the facility but inside the required setback area which may not exceed a 7% grade at any time. Ongoing maintenance of the access road including snow removal after 3 inches of snow shall be included as part of the Operations and Maintenance Plan required herein.

H. Lot Size. The minimum lot size for Tier 1 BESS shall not be less than 1 acre. The minimum lot size for a Tier 2 BESS shall be not less than 10 acres and the minimum lot size for a Tier 3 BESS shall be no less than 20.

I. Dimensional. All BESS shall comply with the dimensional limitations for principal structures of the underlying zoning district as provided in Appendix B, Table 2, of this Zoning Ordinance, unless otherwise provided in this ordinance. No BESS shall exceed 15 feet in height and there shall be no vertical stacking of BESS units.

J. Fencing Requirements. Tier 2 and Tier 3 BESS, including all mechanical equipment, shall be enclosed by a minimum eight-foot high fence with a self-locking gate to prevent unauthorized access unless housed in a dedicated-use building. All gates shall accomodate a knox box or other accessible means to allow access to public safety personnel. Security barriers, fences, landscaping, and other enclosures must not inhibit required air flow to or exhaust from the BESS and components. Electrical equipment greater than 1,000V require a separate and additional means to restrict access. NFPA 855 requires specialty safety systems to be provided based on the BESS chemistry and installed location.

K. Screening and Visibility. Tier 2 and Tier 3 BESS shall have views minimized from adjacent properties to the extent reasonably practicable using architectural features, earth berms, landscaping, or other screening methods that will harmonize with the character of the property and surrounding area. Such features may not inhibit required air flow to or exhaust from the BESS and components and must comply with the setbacks established in paragraph G above.

L. Failure Protection. All Tier 2 and Tier 3 BESS shall include an impenetrable layer beneath the

surface and no closer than four (4) feet to the closest water table which will cause any discharge to flow into a basin located on site which will then capture and/or treat any runoff as a result of a failed battery or fire or other destruction. The Application shall include details of the proposed catchment system along with a detailed stormwater report and stamped detailed engineering plans from a Massachusetts Registered Professional Engineer depicting the stormwater system. All BESS facilities located within the WSPOD shall have full containment to capture all releases, either intentionally from maintenance or accidental in nature. Release and runoff shall not be allowed.

M. Batteries. Failed battery cells and modules shall not be stored on the site and shall be removed no later than 30 days after deemed failed by the BESS operator or cell/module manufacturer. The operator shall notify the Haverhill Fire Chief in advance if the type of battery or batteries used onsite is to be changed. All failed battery cells and modules shall not be stored outdoors and must be protected from further damage and potential release of contaminants to the environment.

N. Storage. No equipment or hazardous materials, in liquid, dry, or gas form, shall be stored onsite of the BESS other than those items in quantities necessary for the proper operation of the facility. Any storage for materials deemed necessary shall be properly labeled, covered and contained to protect from release to the environment.

O. Acoustical Impacts. No system shall cause an increase in acoustical levels over ambient at the Property line. An acoustical study prepared by a Massachusetts Registered Acoustical Engineer shall be provided.

P. Water Source. A municipal water source shall be provided including a FDC within 100 feet before the entrance to the Hazard Area on the Property. The Applicant shall present evidence including a hydraulic analysis in accordance to the City standard to support that there is adequate volume and pressure for fire suppression on the Property and not have a detrimental impact on the surrounding neighborhood. The applicant shall be required to make any related offsite improvement to achieve the required standard to alleviate any impact on the adjacent users.

Q. Stormwater Management. The applicant shall submit a stormwater management plan consistent with the Massachusetts Stormwater Management Policy.

R. Decommissioning Plan. The applicant shall submit with its application a decommissioning plan for all BESS to be implemented upon abandonment and/or in conjunction with removal of the facility. The owner or operator of the BESS shall notify the Building Commissioner in writing at least twenty days prior to when a BESS will be decommissioned. Decommissioning of an abandoned or discontinued BESS shall be completed within six months after the facility ceases operation. The decommissioning plan shall include:

1. A narrative description of the activities to be accomplished, including who will perform that activity and at what point in time, for complete physical removal of all BESS components, structures, equipment, security barriers, and transmission lines from the site;

2. Disposal of all solid and hazardous waste in accordance with local, state, and

federal waste disposal regulations;

3. The anticipated life of the BESS;

4. The estimated decommissioning costs and how said estimate was determined, including an allowance for annual cost of living increases or increases due to inflation;

5. The method of ensuring that funds will be available for decommissioning and restoration;

6. The method by which the decommissioning cost will be kept current;

7. The manner in which the site will be restored, including a description of how any changes to the surrounding areas and other systems adjacent to the BESS, such as, but not limited to, structural elements, building penetrations, means of egress, and required fire detection suppression systems, will be protected during decommissioning and confirmed as being acceptable after the system is removed; and

8. A listing of any contingencies for removing an intact operational energy storage system from service, and for removing an energy storage system from service that has been damaged by a fire or other event.

S. Decommissioning Fund. The owner and/or operator of the energy storage system, shall continuously maintain a fund or other surety acceptable to the City, in a form approved by the City Council and City Solicitor, for the removal of the BESS, in an amount to be determined by the City, and which includes the City as loss payee, for the period of the life of the facility. All costs of the financial security shall be borne by the Applicant.

T. Proof of Liability Insurance. The applicant or property owner shall provide evidence of commercial liability insurance in an amount and type generally acceptable in the industry and approved by the Planning Board prior to the issuance of a building permit, and shall continue such insurance in effect until such facility has been decommissioned, removed, and the site restored in accordance with this ordinance.

§ 7.9.6.3 Special Permit Criteria. In addition to the general Special Permit criteria set forth in section 10.4.2 of this Ordinance, an application for Tier 2 or Tier 3 BESS shall meet the following criteria:

A. The project protects the ground water and surrounding properties from catastrophic failure of one or more of the batteries or cells by implementing appropriate catchment and filtration systems for water run off or run off from the system.

B. The project appropriately attenuates sound intrusion beyond the property lines onto adjacent properties so that there is no change in ambient sound after construction and during operations of the system.

C. The project includes only dark sky compliant down lighting which does not intrude beyond the property lines onto adjacent properties.

D. The project is secure and addresses possible trespass or other intrusion by individuals not affiliated with the project.

E. The project meets the public safety needs of the City.

F. The project minimizes visual impacts from utility infrastructure for interconnection.

F. The project is minimally visible from adjacent properties.

§ 7.9.7. Site Plan application.

For all BESS the Site Plan application shall include the following information, in addition to that required by Section 10.8 of this Zoning Ordinance and the applicable Planning Board requirements governing Site Plan Applications:

A. Utility Infrastructure information requirements:

1. A one- or three-line electrical diagram detailing the BESS layout, associated components, and electrical interconnection methods, with all State Electrical Code compliant disconnects and over current devices.

2. The Applicant shall provide certified verification that there is a fully executed Interconnection Services Agreement ("ISA") with the local utility distribution company. Said certification shall include the cover and signature pages of the ISA.

3. If the ISA has not been issued, the Applicant shall be required to provide a full copy of the Application for Interconnection filed with the local utility distribution company.

B. Preliminary equipment specification sheets that document the proposed BESS components, inverters and associated electrical equipment that are to be installed. A final equipment specification sheet shall be submitted prior to the issuance of building permit.

C. Name, address, and contact information of proposed or potential system installer and the owner and/or operator of the BESS. Such information of the final system installer shall be submitted prior to the issuance of building permit.

D. Large-scale fire test data, evaluation information, and calculations, and modeling data. For any of the following, UL 9540A fire test data must be made available to the Planning Board for review:

- BESS systems with a capacity of greater than 50 kW
- BESS systems with spacing between arrays of less than 3 feet

E. Commissioning Plan. The system installer or commissioning agent shall prepare a commissioning plan prior to the start of commissioning. Such plan shall be compliant with NFPA 855 and document and verify that the system and its associated controls and safety

systems are in proper working condition per requirements set forth in applicable state codes. Where commissioning is required by the Building Code, BESS commissioning shall be conducted by a Massachusetts Licensed Professional Engineer after the installation is complete but prior to final inspection and approval. A corrective action plan shall be developed for any open or continuing issues that are allowed to be continued after commissioning. A report describing the results of the system commissioning and including the results of the initial acceptance testing required by applicable state codes shall be provided to Zoning Enforcement Officer prior to final inspection and approval and maintained at an approved on-site location.

F. Fire Safety Compliance Plan. Such plan shall document and verify that the system and its associated controls and safety systems are in compliance with state codes, including documentation that BESS components comply with the safety standards set forth in subsection 7.9.9. Such plan shall also include a detailed training plan for public safety personnel.

G. Operation and Maintenance Manual. Such plan shall describe continuing BESS maintenance and property upkeep, as well as design, construction, installation, testing and commissioning information and shall meet all requirements set forth state codes and NFPA 855. Maintenance provisions will be driven by manufacturer requirements for the specific listed system. It shall address maintenance of the access and perimeter roadways, perimeter fencing, and shall include a snow removal plan and 24 hours access requirements by public safety officials. There shall be an annual; acoustical review to assure ongoing compliance with the requirement of no change from ambient at the property line and fire department inspection.

H. Depending on the location of the BESS in relation to and its interaction with the electrical grid, interconnection will be completed per 527 CMR 12.00. System interconnections into utility grids shall be in accordance with NFPA 855 and the local distribution company standards for interconnection of distributed energy resources. An accessible disconnect is required per 527 CMR 12.00.

I. Prior to the issuance of the building permit, As Built engineering documents must be signed and sealed by a Massachusetts Licensed Professional Engineer and provided to the Building Commissioner and Planning Department .

J. Emergency Operations Plan. An Emergency Operations Plan compliant with NFPA 855 is required. A copy of the approved Emergency Operations Plan shall be given to the system operator, the local fire department, local fire code official and police department. For so long as the BESS is operational, the operator shall provide the Fire Department, Police Department, Building Commissioner, and Mayor's office with contact information for personnel that can be reached 24 hours per day every day, and this contact information shall be updated by the operator whenever there is a change in the information. The operator shall also be required to have an official representative be present onsite not later than two hours after notification by the Fire Chief, Police Chief, or their designee. A permanent copy shall also be placed in an approved location to be accessible to facility personnel, fire code officials, and emergency responders. The emergency operations plan shall include the following information:

1. Procedures for safe shutdown, de-energizing, or isolation of equipment and systems under emergency conditions to reduce the risk of fire, electric shock, and personal injuries, and for safe start-up following cessation of emergency conditions.

2. Procedures for inspection and testing of associated alarms, interlocks, and controls, including time intervals for inspection and testing.

3. Procedures to be followed in response to notifications from the Battery Energy Storage Management System, when provided, that could signify potentially dangerous conditions, including shutting down equipment, summoning service and repair personnel, and providing agreed upon notification to fire department personnel for potentially hazardous conditions in the event of a system failure.

4. Emergency procedures to be followed in case of fire, explosion, release of liquids or vapors, damage to critical moving parts, or other potentially dangerous conditions. Procedures can include sounding the alarm, notifying the fire department, evacuating personnel, de-energizing equipment, and controlling and extinguishing the fire.

5. Response considerations similar to a safety data sheet (SDS) that will address response safety concerns and extinguishment when an SDS is not required.

6. Procedures for safe disposal of BESS equipment damaged in a fire or other emergency event, including maintaining contact information for personnel qualified to safely remove damaged BESS equipment from the facility.

7. Other procedures as determined necessary by the City to provide for the safety of occupants, neighboring properties, and emergency responders.

8. Procedures and schedules for conducting drills of these procedures and for training local first responders on the contents of the plan and appropriate response procedures.

K. Each Application shall be accompanied by the following information:

1. A certified plot plan at a minimum scale of one inch equals 40 feet and a maximum scale of one inch equals 20 feet. The site plan shall contain:
   a. Date of site plan with all revisions noted and dated. Title of development, North arrow, scale, map and lot number, name and address of record owner, name and address of person preparing the site plan.
   b. The names of all owners of record of adjacent properties, and the map and lot number of the properties and all buildings.
   c. Zoning district boundaries and flood zone boundaries shall be shown as they affect the property including limits of the WSPOD and public water supply Zone A and Zone I on the overall site plan.
   d. Boundaries of the property and lines of existing street, lots, easements and

areas dedicated to public use, including rights of way.

e. A locus map showing the location of the property with reference to surrounding area.
f. A table indicating all calculations necessary to determine conformance to Bylaw regulations including current required and proposed regulations.
g. Square footage of property to the nearest 10 square feet.

2. All plans must include the location of existing and proposed buildings, walls, fences, culverts, parking areas, loading areas, walkways and driveways.

   a. Location and dimensions of utilities, gas, telephone, electrical, communications, water drainage, sewer and other waste disposal.

   b. Location, type and dimensions of landscaping and screening.

   c. Location of existing rock outcroppings, high points, vistas, ponds, depressions, wetlands, major trees (twelve-inch caliper and over) and any other significant existing features.

   d. Two-foot contours where slopes are less than 15% and five-foot contours when 15% or more. Existing contours shall be indicated by dashed line. Proposed contours shall be indicated by solid line.

   e. Dimensioned schematic drawings of all proposed buildings. Scale shall not exceed ¼ inch equals one foot nor less than 1/8 inch equals one foot.

   f. A narrative describing the proposal and addressing the foregoing requirements.

   g. Location of street numbers indicated on the schematic drawings and/or site plan.

   h. Surface and water pollution. A report on the impact of Stormwater runoff on adjacent and downstream surface water bodies, subsurface groundwater and the water table.

   i. Soils. The potential dangers of erosion and sedimentation caused by the operation and maintenance of the proposed development.

   j. General environmental impact. A report on the relationship of the proposed development of the major botanical, zoological, geological and hydrological resources of the site, and compatibility of the proposed development with adjacent or surrounding land uses and neighborhoods.

   k. Traffic impact. A report on existing street capacities, estimated average

daily traffic generation, composition, peak hour levels and directional flows resulting from the proposed development, proposed methods to mitigate the estimated traffic impact and methodology and sources used to derive existing data and estimations.

l. Renderings showing the proposed project in relationship to its surroundings.

§ 7.9.8. Ownership Changes.

If the owner of the BESS changes or the owner of the property changes, the Special Permit shall remain in effect, provided that the successor owner or operator assumes in writing all of the obligations of the Special Permit, Site Plan approval, and decommissioning plan. A new owner or operator of the BESS shall notify the Building Commissioner of such change in ownership or operator within 14 days of the ownership change. A new owner or operator must provide such notification to the Building Commissioner in writing.

§ 7.9.9. Safety

System Certification. BESS and equipment shall be listed by a Nationally Recognized Testing Laboratory to UL 9540 (Standard for BESS and Equipment) or approved equivalent, with subcomponents meeting each of the following standards as applicable:

A. UL 1973 (Standard for Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail Applications),
B. UL 1642 (Standard for Lithium Batteries),
C. UL 1741 or UL 62109 (Inverters and Power Converters),
D. Certified under the applicable electrical, building, and fire prevention codes as required.
E. Alternatively, field evaluation by an approved testing laboratory for compliance with UL 9540 (or approved equivalent) and applicable codes, regulations and safety standards may be used to meet system certification requirements.

Site Access. BESS shall be maintained in good working order and in accordance with industry standards. Site access shall be maintained, including snow removal at a level acceptable to the local fire department.

BESS, components, and associated ancillary equipment shall have required working space clearances, and electrical circuitry shall be within weatherproof enclosures marked with the environmental rating suitable for the type of exposure in compliance with NFPA 70.

§ 7.9.11. Abandonment

The BESS shall be considered abandoned when it ceases to operate consistently for more than one year. If the owner and/or operator fails to comply with decommissioning upon any abandonment, the City may, after compliance with any applicable state and federal constitutional requirements, enter the property and utilize the available bond and/or security for the removal of any BESS and restoration of the site in accordance with the decommissioning plan.

**And further add the following new definition to § 11.1 of Chapter 255**

§ 11.1

AGGREGATE ENERGY CAPACITY: Total amount of energy stored that can be stored in all batteries that are a part of the BESS measured in kilowatt-hours (kWh) or megawatt-hours (MWh).

BATTERY or BATTERIES: A single cell or group of cells connected electrically in series, in parallel, or combination of both, which can charge, discharge and store energy electrochemically. For the purpose of this Ordinance, batteries utilized in consumer products are excluded from these requirements.

BATTERY ENERGY STORAGE SYSTEM ("BESS") – A system containing one of more battery modules for storing electrical energy, any equipment needed to support the safe and proper function or usage of the battery modules, and one or moe physical container(s) providing secondary containment to any of the above. It may be a primary use or an Accessory Use to a solar generating facility, power generation facility, electrical substation, or other similar uses. For the purposes of this bylaw, BESS are comprised of three (3) types as further described in § 7.9.3.B. of this bylaw; Tier 1 BESS, Tier 2 BESS and Tier 3 BESS.

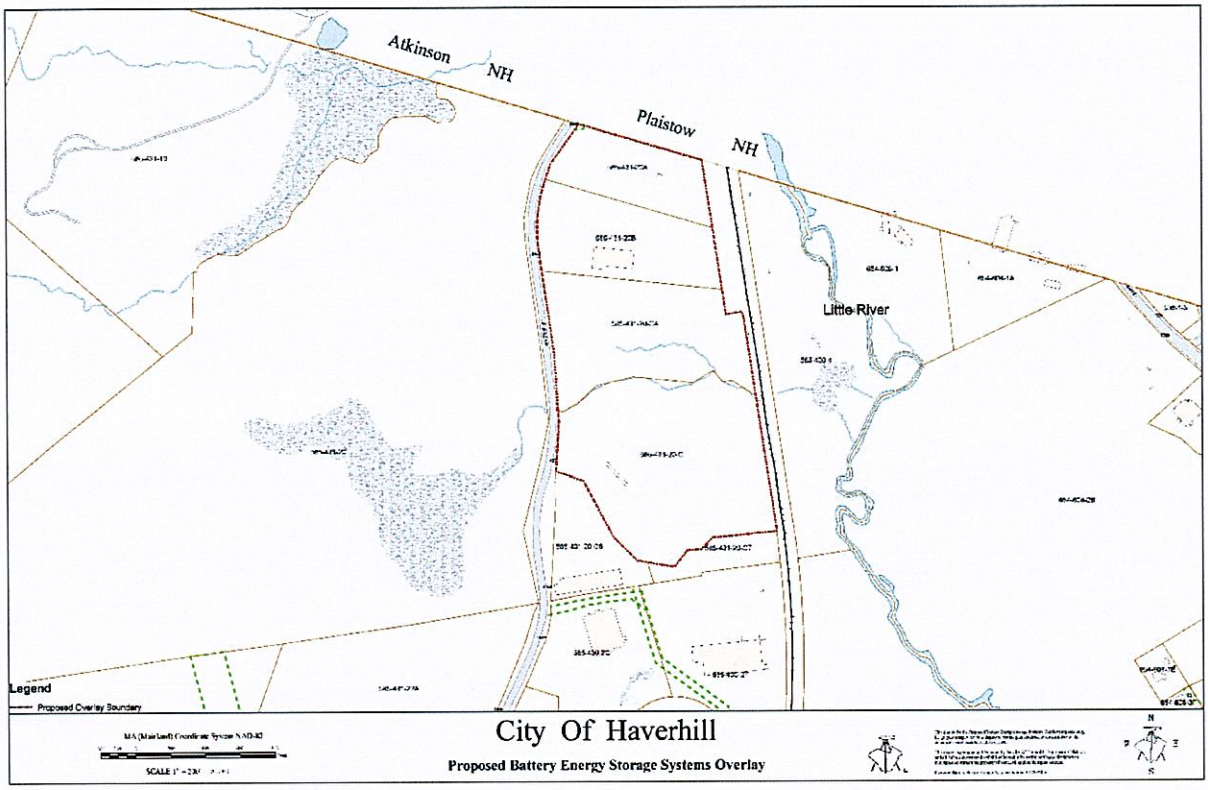
**And further to amend section 3.1.3, Table of Use and Parking regulations by allowing Tier 1, Tier 2 and Tier 3 BESS in the districts as follows:**

BESS Overlay District - OD

| | RS | RR | RL | RM | RH | RU | CN | CH | CG | CC | CM | OP | BG | BP | BESS OD | PC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **I. MISCELLANEOUS COMMERCIAL USES (cont'd)** | | | | | | | | | | | | | | | | |
| 22. Kennel or veterinary hospital in which all animals, fowl or other forms of life are completely enclosed in pens or other structures | BA | BA | N | N | N | N | N | BA | N | N | N | N | N | N | | D |
| 23. Commercial communications and/or television tower, provided that it shall be at least 500 feet from any R District | BA | N | N | N | N | N | N | BA | BA | BA | N | BA | BA | BA | | None |
| **24. Battery Energy Storage Systems: Tier 1** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **N** | **Y** | **Y** | **Y** | **None** |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25. Battery Energy Storage Systems: Tier 2 | N | N | N | N | N | N | N | N | N | N | N | N | N | N | CC | None |
| 26. Battery Energy Storage Systems: Tier 3 | N | N | N | N | N | N | N | N | N | N | N | N | N | N | CC | None |

**And further to amend the City of Haverhill Zoning Map to include the BESS Overlay District as set forth below:**



Outlook

## Thank you for placing your order with us.

**From** North of Boston <noreply@wave2adportal.com>
**Date** Thu 9/17/2026 8:25 AM
**To** CityClerk <cityclerk@haverhillma.gov>
**Cc** cmacdonald@northofboston.com <cmacdonald@northofboston.com>; Kaitlin Wright Esposito <kwright@haverhillma.gov>; Natalia Hernandez <NHernandez@HaverhillMa.gov>

Warning! External Email. Exercise caution when opening attachments or clicking on any links.

## THANK YOU for your notice submission!

This is your confirmation that your order has been submitted. Below are the details of your transaction. Please save this confirmation for your records.

### Job Details

| | |
|---|---|
| Order Number: | W0147713 |
| Business Type: | All Other Public Notices |
| Notice Size: | Public Notices |
| Notice Estimate: | $57.69 |
| Referral Code: | Battery Energy Storage Ord. |

### Account Details

Haverhill Clerk
4 SUMMER ST STE 118
HAVERHILL, MA ◆ 01830
978-374-2312
cityclerk@cityofhaverhill.com
HAVERHILL CITY CLERK

### Schedule for notice number W01477130

**Thu Sep 24, 2026**

**Haverhill Gazette Public** *All Zones*

**Notices**

**CITY OF HAVERHILL**
**In Municipal Council**
**ORDERED:**
**Municipal Ordinance**
**Chapter 255 Zoning**

An Ordinance Relating to Amending Chapter 255, Zoning by adding a new section 7.9 Battery Energy Storage Systems

Since this Ordinance exceeds in length eight octavo pages of ordinary book print, in lieu of advertising, it is published by the City Council in a municipal bulletin, placed on file in the City Clerk's Office, and posted on the municipal bulletin in City Hall.

PLACED ON FILE for at least 10 days Attest:

Kaitlin M. Wright Esposito, CMC, City Clerk
HG - Publication Dates

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*The North of Boston Media Group reserves the right to alter, edit and omit any notice to meet our editorial guidelines. Any additional charges or credits as a result of this process will be the responsibility of the individual or company submitting the notice.*

*This is an automated message, please do not reply to this e-mail. If you have any questions or concerns you may contact us toll-free at 800-681-6248.*

City of Haverhill, MA

12.6.14.1

October 21, 2026

## Record No: GOLD-26-4

Buy and Sell Old Gold License

Status: Active

Submitted On: 10/15/2026

### Primary Location

741 SOUTH MAIN ST Unit
Unit 1
Bradford, MA 01835

### Owner

THE THOMAS J. MOORE SEPARATE PROPERTY TRUST
MOORE THOMAS J TR
MILLIKAN AVE 16782 IRVINE, CA 92606

### Applicant


freddy rodriguez
978-914-7753
freddy3343@outlook.com
741 south main street unit 1
haverhill, Massachusetts 01835


## Business Information

OCT 21 PM1:55
HAVCITYCLERK

**Name of Business***

Javier's Jewelry Repair

**Type of Business***

Jewelers

**Address of Business***

741 south main street unit 1

**Type of Application***

Renewal

## Owner Information

**Owner's Name***

Freddy Rodriguez

**Owner Home Address***

16 mary lou street methuen, MA

**SSN***

028087468

**Phone Number**

516-688-4020

## Signatures and Dates

**Print Applicant Name***

Freddy Rodriguez

**Applicant's Signature***

Freddy Rodriguez

**Date**

10/15/2026

13.1

MELINDA E. BARRETT
MAYOR

CITY OF HAVERHILL
MASSACHUSETTS

CITY HALL, ROOM 100
FOUR SUMMER STREET
HAVERHILL, MA 01830
PHONE 978-374-2300
FAX 978-373-7544
MAYOR@HAVERHILLMA.GOV
WWW.HAVERHILLMA.GOV

October 22, 2026

To: City Council President Timothy J. Jordan and Members of the Haverhill City Council

From: Mayor Melinda E. Barrett

**RE: FY25 Bills**

Dear Mr. President and Members of the Haverhill City Council:

Attached, please find an order to pay bills from the previous fiscal year:

| Vendor | Amount | Account |
|---|---|---|
| WB Mason | $133.23 | Police |
| WB Mason | $133.23 | Police |
| | Total: $266.46 | |

I recommend approval.

Sincerely,

**Melinda E. Barrett**
Mayor
MEB/em

Document

CITY OF HAVERHILL

In Municipal Council

OCT 22 PM3:06
HAVCITYCLERK

Ordered:

That in accordance with General Laws, Chapter 44, Section 64, authorize the payment of bill(s) of the previous years and to further authorize the payment from current year departmental appropriations as listed below:

| Vendor | Amount | Account |
|---|---|---|
| WB Mason | $133.23 | Police |
| WB Mason | $133.23 | Police |
| | $266.46 | |

PM(P)

W.B.MASON CO., INC.
59 Centre St
Brockton, MA 02301

Address Service Requested
888-WB-MASON www.wbmason.com

| Invoice Number | 261560296 |
|---|---|
| Customer Number | C1016545 |
| Invoice Date | 04/27/2026 |
| Due Date | 05/27/2026 |
| PO Number | police Dept. |
| Order Date | 04/23/2026 |
| Order Number | S161460948 |
| Order Method | WEB |

Wendy Duff
40 Bailey Blvd
Haverhill MA 01830

**Delivery Address**
Haverhill-Police HQ
Attn.: Wendy Duff
40 Bailey Blvd
Haverhill MA 01830

W.B. Mason Federal ID #: 04-2455641

## Important Messages

IMPORTANT UPDATE REGARDING W.B. MASON RETURNS POLICY:

Unopened items must be returned within 30 days. Missing, damaged, defective or expired items must be reported within 14 days. Visit www.wbmason.com to view our entire Return Policy

Thank you for your business! We encourage you to visit www.wbmason.com/Payment for 24/7 access to your account. We offer the ability to pay online, and view or download invoices.

| ITEM NUMBER | DESCRIPTION | QTY | U/M | UNIT PRICE | EXT PRICE |
|---|---|---|---|---|---|
| WBM97200 | PAPER,8.5X11,98BRT,20 LB,WHITE,5000/CT | 3 | CT | 44.41 | 133.23 |

| | |
|---|---|
| SUBTOTAL: | 133.23 |
| TAX & BOTTLE DEPOSITS TOTAL: | 0.00 |
| ORDER TOTAL: | 133.23 |
| Total Due: | 133.23 |

To ensure proper credit, please detach and return below portion with your payment

*W.B. MASON CO., INC.*
*PO BOX 981101*
*BOSTON, MA 02298-1101*

| Remittance Section | |
|---|---|
| Customer Number | C1016545 |
| Invoice Number | 261560296 |
| Invoice Date | 04/27/2026 |
| Terms | Net 30 |
| **Total Due** | **133.23** |

PLEASE REFERENCE INVOICE NUMBER WHEN MAKING PAYMENT. PAY ON OUR WEBSITE OR SEND PAYMENT TO:

Wendy Duff
40 Bailey Blvd
Haverhill MA 01830

W.B. MASON CO., INC.
PO BOX 981101
BOSTON, MA 02298-1101

C101654526156029626156029600000000133238

PM(P)

W.B.MASON CO., INC.
59 Centre St
Brockton, MA 02301

Address Service Requested
888-WB-MASON www.wbmason.com

| | |
|---|---|
| **Invoice Number** | **262529993** |
| Customer Number | C1016545 |
| Invoice Date | 06/11/2026 |
| Due Date | 07/11/2026 |
| PO Number | police dept. |
| Order Date | 06/10/2026 |
| Order Number | S162615419 |
| Order Method | WEB |

Wendy Duff
40 Bailey Blvd
Haverhill MA 01830

**Delivery Address**
Haverhill-Police HQ
Attn.: Wendy Duff
40 Bailey Blvd
Haverhill MA 01830

W.B. Mason Federal ID #: 04-2455641

## Important Messages

IMPORTANT UPDATE REGARDING W.B. MASON RETURNS POLICY:

Unopened items must be returned within 30 days. Missing, damaged, defective or expired items must be reported within 14 days. Visit www.wbmason.com to view our entire Return Policy

Thank you for your business! We encourage you to visit www.wbmason.com/Payment for 24/7 access to your account. We offer the ability to pay online, and view or download invoices.

| ITEM NUMBER | DESCRIPTION | QTY | U/M | UNIT PRICE | EXT PRICE |
|---|---|---|---|---|---|
| WBM97200 | PAPER,8.5X11,98BRT,20 LB,WHITE,5000/CT | 3 | CT | 44.41 | 133.23 |

| | |
|---|---|
| SUBTOTAL: | 133.23 |
| TAX & BOTTLE DEPOSITS TOTAL: | 0.00 |
| ORDER TOTAL: | 133.23 |
| Total Due: | 133.23 |

To ensure proper credit, please detach and return below portion with your payment

*W.B. MASON CO., INC.*
*PO BOX 981101*
*BOSTON, MA 02298-1101*

| **Remittance Section** | |
|---|---|
| Customer Number | C1016545 |
| Invoice Number | 262529993 |
| Invoice Date | 06/11/2026 |
| Terms | Net 30 |
| **Total Due** | **133.23** |

PLEASE REFERENCE INVOICE NUMBER WHEN MAKING PAYMENT. PAY ON OUR WEBSITE OR SEND PAYMENT TO:

Wendy Duff
40 Bailey Blvd
Haverhill MA 01830

W.B. MASON CO., INC.
PO BOX 981101
BOSTON, MA 02298-1101

C101654526252999326252999300000000133238

File 10 days

14.1

# Haverhill

Lisa E. DeMeo, City Engineer
Phone: 978-374-2335
ldemeo@haverhillma.gov

OCT 22 PM2:24
HAVCITYCLERK

October 22, 2026

**MEMO TO: CITY COUNCIL PRESIDENT TIMOTHY JORDAN AND MEMBERS OF THE CITY COUNCIL**

Subject: ***Park Street #20 – HPS-26-21 - Add Handicap Parking***

As requested, attached is the subject Ordinance to add handicap parking.

Please contact me if you have any questions.

Sincerely,

Lisa E DeMeo

Lisa E. DeMeo, P.E.
City Engineer

C: Mayor Barrett, Lt. Lynch, K. Wright, R. Kimball, L. Mead

DOCUMENT

# CITY OF HAVERHILL

In Municipal Council

ORDERED:

## AN ORDINANCE RELATING TO VEHICLES AND TRAFFIC

**BE IT ORDAINED by the City Council of the City of Haverhill that the Code of the City of Haverhill, Chapter 240, §85, Schedule B: Parking Restrictions and Prohibitions, as amended, is hereby further amended by ADDING the following:**

| | | |
|---|---|---|
| **Park Street:**<br>**In front of #20** | **No Parking**<br>**(except for 1 24-hour handicap parking space)** | **24 hours** |

APPROVED AS TO LEGALITY

_____

City Solicitor

Outlook

## Thank you for placing your order with us.

**From** North of Boston <noreply@wave2adportal.com>
**Date** Thu 10/22/2026 3:27 PM
**To** CityClerk <cityclerk@haverhillma.gov>
**Cc** cmacdonald@northofboston.com <cmacdonald@northofboston.com>; Kaitlin Wright Esposito <kwright@haverhillma.gov>; Natalia Hernandez <NHernandez@HaverhillMa.gov>

Warning! External Email. Exercise caution when opening attachments or clicking on any links.

## THANK YOU for your notice submission!

This is your confirmation that your order has been submitted. Below are the details of your transaction. Please save this confirmation for your records.

### Job Details

| | |
|---|---|
| Order Number: | **W0148741** |
| Business Type: | All Other Public Notices |
| Notice Size: | Public Notices |
| Notice Estimate: | $83.89 |
| Referral Code: | **20 Park Street Parking Ord.** |

### Account Details

Haverhill Clerk
4 SUMMER ST STE 118
HAVERHILL, MA ◆ 01830
978-374-2312
cityclerk@cityofhaverhill.com
HAVERHILL CITY CLERK

### Schedule for notice number W01487410

**Thu Oct 29, 2026**
**Haverhill Gazette Public** *All Zones*
**Notices**

**City of Haverhill**
**In Municipal Council**

**ORDERED:**

AN ORDINANCE RELATING TO VEHICLES AND TRAFFIC

BE IT ORDAINED by the City Council of the City of Haverhill that the Code of the City of Haverhill, Chapter 240, §85, Schedule B: Parking Restrictions and Prohibitions, as amended, is hereby further amended by ADDING the following:

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| Park Street: In front of #20 | No Parking (except for 1 24-hour handicap parking space) | 24 hours |

HG - Publication Dates

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*This is an automated message, please do not reply to this e-mail. If you have any questions or concerns you may contact us toll-free at 800-681-6248.*

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**John A. Michitson,** *Vice President*
**Thomas J. Sullivan**
**Colin F. LePage**
**Melissa J. Lewandowski**
**Catherine P. Rogers**
**Shaun P. Toohey**
**Michael S. McGonagle**
**Daniel R. Diodati**
**Devan Ferreira**
**Ralph T. Basiliere**

15.1

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4 SUMMER STREET
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# CITY OF HAVERHILL

HAVERHILL, MASSACHUSETTS 01830-5843

October 15, 2026

OCT 15 PM3:39
HAVCITYCLERK

TO: President and Members of the City Council

Councilors Lewandowski and Ferreira request update from Mayor on snow plan for season including services for senior population and snowplow contractor staffing.

Melissa J. Lewandowski

Councilor Melissa J. Lewandowski

Devan Ferreira

Councilor Devan Ferreira

(Meeting: 10.20.26)

15.2

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**CITY OF HAVERHILL**

HAVERHILL, MASSACHUSETTS 01830-5843

October 20, 2026

TO: President and Members of the City Council

Vice President Michitson wishes to announce a Planning and Development Committee meeting on Monday, November 9, 2026 at 6PM in Room 202, City Council Chambers.

John A. Michitson

Vice President John A. Michitson

OCT 20 AM9:30
HAVCITYCLERK

(10.27.26)

**CITY COUNCIL**
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# CITY OF HAVERHILL

HAVERHILL, MASSACHUSETTS 01830-5843

October 15, 2026

TO: Kaitlin M. Wright, City Clerk

RE: Planning and Development Committee Meeting -
**Monday, November 9, 2026, 6:00 PM**

Dear Ms. Wright:

Please be advised, I have scheduled a Planning and Development Committee meeting for **Monday, November 9, 2026, at 6:00 PM in the City Council Chambers, Room 202, City Hall, 4 Summer Street.**

The purpose of the meeting is to discuss and review the following:

**Doc.85-e:** **Motion by Councilor Michitson to send Judi Barrett's progress report on the fiscal impact analysis prepared for the City Council for further discussion**

**Doc. 44-a** **Motion by Councilor Ferreira to send information regarding the consolidation of the city's existing medical marijuana overlay district and licensed marijuana establishment overlay zone for review and discussion**

You can also join the meeting remotely by using the link: https://meet.google.com/zup-rexj-kja

Sincerely,
John A. Michitson
John A. Michitson, Chairperson
Planning and Development Committee

JAM/lar

C: P&D Committee Members, City Council, Mayor Melinda E. Barrett, DPW Department, Water/Wastewater Department, Engineering Department, Economic Development and Planning Department, Judi Barrett, City Solicitor

## Lori Robertson

**From:** Erinn Scott <escott@haverhillcommunitytv.org>
**Sent:** Wednesday, October 14, 2026 8:40 AM
**To:** Lori Robertson; Matt Belfiore; Dave Shultz; Lindsay Paris; cbowden; cellson; Escott@haverhillcommunitytv.org
**Subject:** Planning & Development Meeting - Monday, November 9, 2026, at 6PM

Warning! External Email. Exercise caution when opening attachments or clicking on any links. .
Warning! External Email. Exercise caution when opening attachments or clicking on any links.
Good morning!

Here is the Google link to join the Planning & Development meeting schedule for Monday, November 9, 2026, at 6PM.

https://meet.google.com/zup-rexj-kja

Or open Meet and enter this code: zup-rexj-kja

Dial in (audio only): (US) +1 276-738-2671 PIN: 993 427 387#

Erinn E. Scott, Office Manager
escott@haverhillcommunitytv.org
HC Media
60 Elm St.
Haverhill, MA 01830
(978) 372-8070 Ex. 202

Received C
Mtg 12/9/25

# Fiscal Impact: Mixed-Use Development

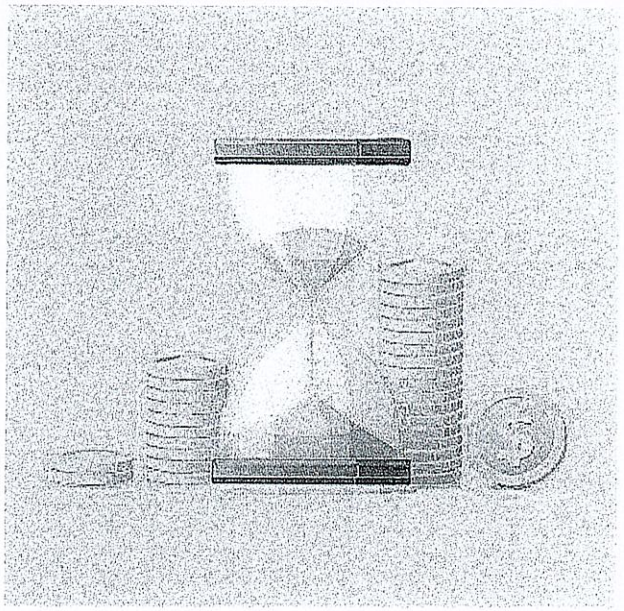
Presentation to Haverhill City Council
December 9, 2025

Prepared for the City of Haverhill
Barrett Planning Group

BARRETT
PLANNING GROUP LLC

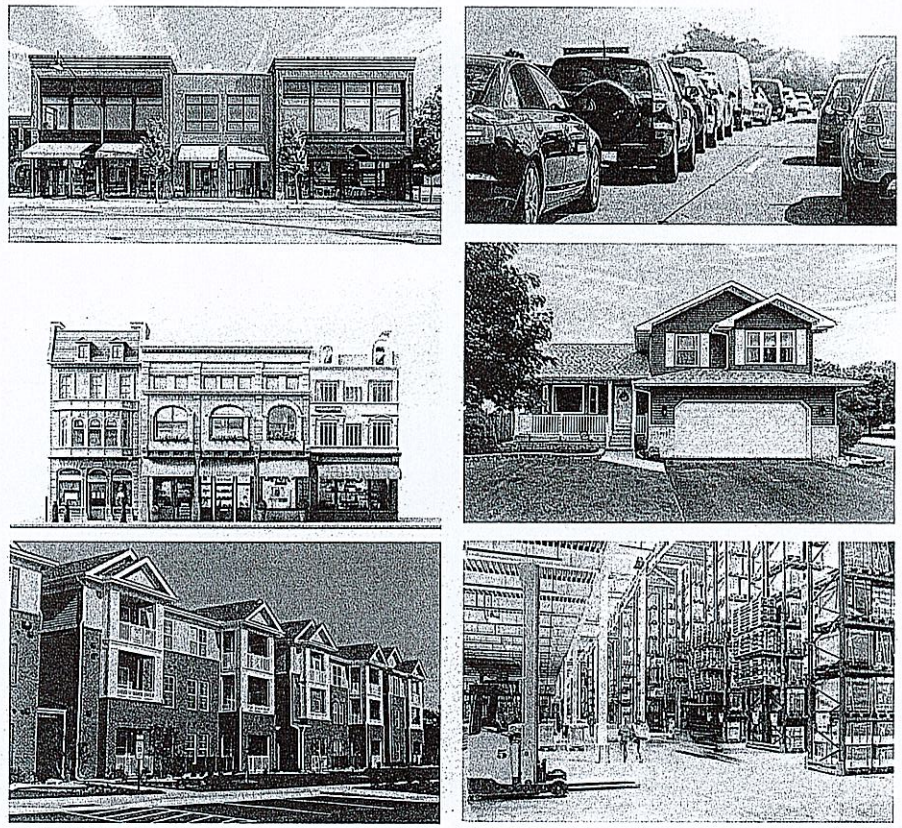
# What is Fiscal Impact?

- Projection of local government *operating revenue* generated by new growth and *directly attributable, incremental costs,* expressed in current dollars.
- Expressed as *net revenue* dollars and a *cost-revenue ratio*.
- Fiscal impact studies usually focus on an actual proposed development, where the following factors are known:
  - Land use
  - Location
  - Size/scale
  - New construction, reconstruction, adaptive reuse
  - Applicant
  - Existing condition of streets, public utilities, surrounding land uses
  - Zoning



# Haverhill Scope

- Looking city-wide … what is the City's *incremental cost* to provide services to new residential and nonresidential development?
  - Any type of location
  - Development of any scale or type
  - Any zoning district



# Assumptions

- Current Dollars (FY 2025)
- Allocation of residential and nonresidential cost of city services: "proportional valuation"
- Costs and revenues assume a new development is fully occupied
- Fiscal impact focuses on municipal and school service costs and General Fund revenue, and excludes services operated on an enterprise basis
- Household and employment growth do not cause all City expenditures to increase across the board … not all costs are "growth-sensitive"
- Challenge: identify growth-sensitive costs

# Incremental Municipal Cost Assumptions

| Budget Category | Total Exp 2025 | Incremental Cost | % Incremental |
|---|---|---|---|
| General Government | $5,442,915 | $276,369 | 5% |
| Community Development | $2,108,742 | $210,123 | 10% |
| Police | $15,935,113 | $10,821,641 | 68% |
| Fire | $14,078,122 | $10,115,405 | 72% |
| Education* | $189,112,509 | $106,685,915 | 77% |
| Public Works | $12,151,399 | $3,871,058 | 32% |
| Human Services | $3,266,365 | $355,487 | 11% |
| Debt Service | $5,651,601 | $0 | 0% |
| Employee Benefits | $52,260,423 | $4,180,834 | 8% |
| Other | $13,718,051 | $137,181 | 1% |

# Net Fiscal Impact: Mixed-Use Building

| | | Operating Revenue | | | |
|---|---|---|---|---|---|
| | Units/ Commercial Space | Revenue | Excise Tax | Chapter 70 | Total |
| Mixed-Use/Residential | 10 Dus 7,500 sq. ft. | $24,357 | $6,250 | $4,266 | $34,873 |

| | Incremental Costs | | | | |
|---|---|---|---|---|---|
| | Municipal | Est. K-12 Students | School | Total | Net Revenue |
| Mixed-Use/Residential | $10,369 | <1 | $5,191 | $15,560 | $19,313 |
| Mixed-Use/Retail | $2,625 | N/A | N/A | $2,625 | $2,625 |

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# CITY OF HAVERHILL

HAVERHILL, MASSACHUSETTS 01830-5843

SEP 25 AM8:30
HAVCITYCLERK

## DOCUMENTS REFERRED TO COMMITTEE STUDY

| Document Number | Motion Details | Committee | Date Sent |
|---|---|---|---|
| 103-HH | Motion by Councilor Michitson to send the Home Rule Petition – *An Act Establishing Guidelines for the Installation and Use of Electric Vehicle Charging Stations in the City of Haverhill* to committee in order to coordinate with condominium associations. | A&F | 12/23/23 |
| 40 | Motion by Councilor Lewandowski to send updated *Cannabis Social Equity Best Practices* for the Cannabis Control Commission to A&F for further review. | A&F | 4/2/24 |
| 12-S | Motion by Councilor Ferreira to send the City's Swimming Ordinance (Chapter 193, Article III) and related items at Lake Saltonstall (Plug Pond) to NRPP for further discussion. | NRPP | 6/18/24 |
| 33-F | Motion by Councilor Basiliere to send resident winter parking concerns and offer suggestions for improvements to the Public Health & Safety Committee. | Public Health & Safety | 3/11/25 |
| 33-L | Motion by Councilor Lewandowski to send Bill 3360 (vacancy tax on residential properties) for review, along with further review of the Massachusetts Vacant Storefront Program (MVSP). | Planning & Development | 6/24/25 |
| 33-P | Motion by Councilor Ferreira to send for review the City's local strategies regarding traffic and safety, including evaluation of intersections at Amesbury Line Road and Merrimac Road for public safety improvements. | Public Health & Safety | 9/16/25 |
| 94-B | Motion by Councilor Ferreira to review and update standards of Chapter 250, Article VI of the Haverhill Zoning Code regarding water use restrictions established in 2016. | Planning & Development | 9/16/25 |
| 33-T | Motion by Councilor Lewandowski to establish a working group, as previously discussed, to implement a control management plan for vegetation in Riverside Park / Edible Avenue along the river. | NRPP | 9/30/25 |
| 85-E | Motion by Councilor Michitson to send Judi Barrett's progress report on the fiscal impact analysis prepared for the Council for further discussion. | Planning & Development | 12/9/25 |
| 1-F | Motion by Councilor Lewandowski to send for discussion the establishment or formalization of an ordinance regarding a water conservation program. | Planning & Development | 1/27/26 |
| 1-Q / 1-QQ | Motion by Councilor Lewandowski to send for further discussion amendments to Chapter 216 – Snow and Ice Removal, including changes to Sections 1-16, Article 1, Chapter 1 (General Provisions), to increase fines for violations. | Public Health & Safety | 3/17/26 |

Updated: September 24, 2026

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# CITY OF HAVERHILL

HAVERHILL, MASSACHUSETTS 01830-5843

| Document Number | Motion Details | Committee | Date Sent |
|---|---|---|---|
| 21-B | Motion by Councilor Sullivan to send for further discussion Chapter 255-Zoning Ordinance and Zoning Map – Battery Energy Storage Systems Overlay District (BESS) | Planning & Development | 5/19/26 |
| 32-C | Motion by Councilor McGonagle to send for further discussion fixed vendor locations | NRPP | 6/16/26 |
| 33-F | Motion by Councilor Lewandowski to refer matter of e-bike safety for further review and discussion | Public Safety | 6/30/26 |
| 32-K | Motion by Vice President Michitson to work the Administration and appropriate departments on initial risk based assessment of the city's critical infrastructure beginning with Wastewater and Drinking water systems | Planning & Development | 7/14/26 |
| 32-l | Motion by Councilor Ferreira to send Flock Cameras to Public Safety committee for further discussion and recommendation back to council. | Public Safety | 8/11/26 |
| 31-a | Motion by Councilor Ferreira to send for review the city's vegetation management plan | NRPP | 8/25/26 |
| 44-a | Motion by Councilor Ferreira to send information regarding the consolidation of the city's existing medical marijuana overlay district and Licensed marijuana establishment overlay zone for review and discussion | Planning and Development | 9/22/26 |

Updated: September 24, 2026