Upton, MA

Post Construction Stormwater Management

MS4 Permit Year 5

March 2023

BMP RETROFIT SITE INVESTIGATIONS

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Post Construction Stormwater Management

Upton, MA

MS4 Permit Year 5

BMP RETROFIT SITE INVESTIGATIONS

Prepared by: BETA GROUP, INC.
Prepared for: Town of Upton Department of Public Works

March 2023

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1.0 INTRODUCTION

This report is a follow-up to the previous report sent in June 2022 entitled Nutrient Source Identification Report (NSIR). In accordance with the 2016 MS4 General Permit, permittee-owned properties are required to be reviewed for feasibility to implement Best Management Practices (BMPs) to reduce the frequency, volume, and pollutant loads of stormwater discharges to and from the Town's MS4 system.

This NSIR identified a list of 5 Town-owned properties that potentially could be retrofitted. Since providing this list, BETA added additional locations anticipating some sites may not be suitable following field investigations; BETA also removed some sites because they are not Town-owned. A total of nine sites were considered in this investigation.

BETA conducted site visits for each location listed below in Table 1 on January 6, 2023 and February 2, 2023 to investigate on-the-ground conditions for BMP retrofits, including slopes and stormwater infrastructure connectivity when otherwise unavailable.

Table 1-1. Potential BMP Retrofit Locations

Property	Potential BMPs	Address
Maplewood Cemetery	• Water Quality Swale • Infiltration	Maple Avenue
Town Hall	• Infiltration Chamber/Pipe • Infiltration Basin • Water Quality Swale • Bioretention (rain garden)	1 Main Street
Florence Circle	• Wet Basin	Florence Circle
Upton Fire and EMS Headquarters	• Infiltration Trench • Infiltration Basin • Water Quality Swale • Bioretention (rain garden)	20 Church Street
VFW Post	• Water Quality Swale • Infiltration Basin • Infiltration Trench • Sediment Forebay	15 Milford Street
Lakeview Cemetery	• Infiltration Basin • Water Quality Swale • Vegetated Filter Strip • Sediment Forebay	71 North Main Street
Memorial School	• Infiltration Trench • Leaching CB • Water Quality Swale (with check dams) • Infiltration Basin	69 Main Street
Undeveloped Overflow Parking Lot	• Infiltration Basin • Sediment Forebay • Water Quality Swale • Vegetated Filter Strip	0 Grove Street

2.0 BMP Retrofit Site Investigation Findings

2.1 Maplewood Cemetery

Existing catch basins serve the interior of the cemetery and flow to ponds on the property. An area included in the parcel but outside the cemetery fence line near the intersection of Maple Avenue and Pleasant Street presents an opportunity to install a water quality swale along the east side of Maple Avenue running north from the intersection. Existing catch basins (including 93-14) at the intersection could be rerouted to increase catchment area and infiltration potential, and the swale could overflow to an existing inlet structure that flows underneath Maple Avenue.

An additional inlet and catch basin structure (86-2) was observed north of this area along the cemetery fence line. Opportunities for BMP retrofits are limited in this area due to the cemetery fence and existing grading.

2.1.1 Maplewood Cemetery Site Map

Potential BMP Retrofit Locations
Location: Maplewood Cemetery
Address: Maple Avenue

Interior of site is characterized by steep slopes and it is anticipated that BMPs are generally not desirable adjacent to areas used for plots. There is a limited closed drainage system and runoff is primarily collected and/or directed to the ponds on site. Flows appear to go pond to pond from southeast to northwest.

Curb breaks and swale in this area considered but not feasible without impacts to existing fence.

Roadway low point

Appears to be a minor high point here.

Regularly spaced trees10-15 feet behind guardrail. Don't anticipate any major issues in avoiding with swale

Curb break would be located just upstream of guardrail.

Could provide curb break with paved waterway and discharge to water quality swale/linear infiltration practice. Could also modify existing CB to outlet into grass area with outlet sediment trap (sediment forebay) and then to the swale.There is enough room to provide a foraml ifiltraion basin in the field but may be excessive if water quality volume can be obtained in linear infiltration practice.

Roadway appears banked in this area.

Similar option to the adjacent but grades play more of a factor here. There is a mound at edge of vegetation and and outlet from a CB may be too low to daylight into swale.

FARM STREET
VICTORIA DRIVE
MAPLE AVENUE
FLORENCE CIRCLE
FLORENCE CIRCLE
KNOWLTON CIRCLE
MENDON STREET
PIERCE LANE
West River
West River

Map Legend

- Proposed BMP Retrofit Location

Stormwater Infrastructure

- Existing BMP
- Outfall
- Town-Owned Catch Basin
- State-Owned Catch Basin
- Interconnections
- Town-Owned DMH
- State-Owned DMH
- Curb Inlet
- Inlet
- Culvert
- Pipe
- Conveyance Ditch

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- Rivers: Category 5
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- Lakes, Estuaries: Category 4C
- Lakes, Estuaries: Category 5

Hydrologic Soil Group

- No Rating
- A
- A/D
- B
- B/D
- C
- C/D
- D

Hydrography

- Wetlands
- Hydrologic Connections

BETA

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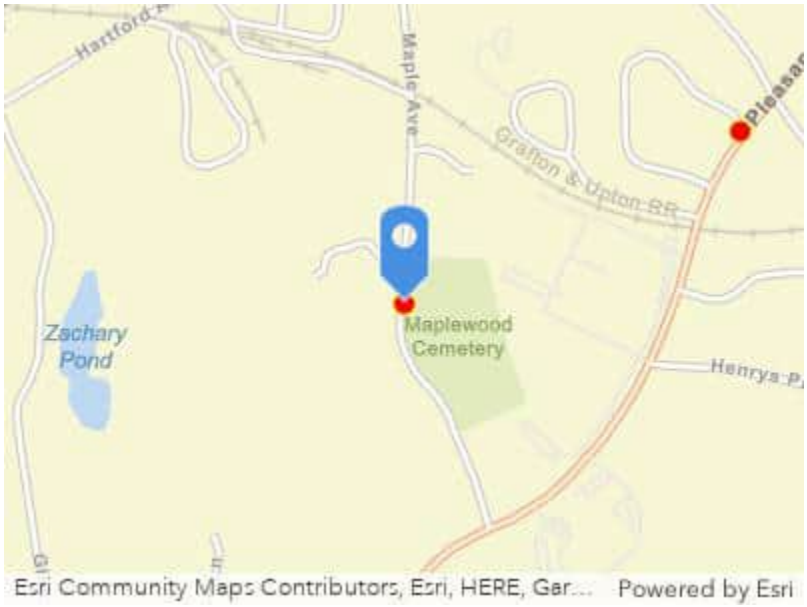
N W E S

2.1.2 Maplewood Cemetery BMP Retrofit Observations Form

Site Name:	Maplewood Cemetery		
Address:	47 Maple Avenue	Date/Time:	January 26, 2023 12:20 PM
Inspector	Leya Strode, Matt Crowley		
Current Weather:	Rainy -- 45 °F		

2.1.2.1 BMP Retrofit Location Map



2.1.2.2 Observation Details

BMP Retrofit(s) Viable: **Yes**

Most Prevalent Soils:	A	Estimated Depth to Water (If Possible):	Test pit required
BMP Options:	Water Quality Swale, Other	If "Other":	Vegetated swale with check dams
Site Observation Notes:	Graves preempt possibility of soil disturbance at interior of site. Unused corner of parcel outside of fenceline close to intersection of Pleasant Street and Maple Ave is not being used as cemetery. Opportunities to reroute catch basins 86-3 and 93-14 to water quality swale or swale with check dams running from the corner of Maple Avenue and Pleasant Street north along Maple Avenue terminating at existing inlet structure. Fence along Maple Avenue obstructs opportunity for swale running south to existing inlet structure.		

2.1.2.3 PHOTOS

	Existing catch basins drain into ponds in center of cemetery, facing southwest.
	Existing inlet structure facing south along Maple Avenue towards intersection of Maple Avenue and Pleasant Street.

	Catch basin 93-14, facing north along Maple Ave.
	Impervious catchment of catch basin 93-14, facing northeast along Pleasant Street.

	Facing south along Maple Ave.
	Facing north along Maple Ave.

	Existing catch basin 86-2 and inlet structure facing south along Maple Ave.
	Facing north along Maple Ave from existing inlet structure.

2.2 TOWN HALL

Stormwater flow from the Town Hall parking lot and Warren Street is captured by two existing catch basins at the front and rear driveways. An existing discharge exits through the retaining wall along the south side of Warren Street into rip rap; overflows from this outlet are likely also captured by the existing catch basins. Existing retaining walls and steep slopes along Warren Street are prohibitive to installing swales on either side of the roadway.

The Town Hall roof is served by gutters in some areas, with at least one retrofitted leader discharging directly onto the ground and buried leaders in other areas. Some sections of roof did not have gutters; there is an opportunity here to install drip edges where the roof drip lines have eroded existing soil. These drip edges could then be routed to a leaching basin, although the presence of an existing HVAC pad may prevent a challenge to installation. Any downspouts discharging directly onto the ground could also be rerouted to a leaching basin but may require cutting of the existing asphalt walkway.

Other BMP retrofit opportunities include routing of parking lot catch basins to a leaching basin or other subsurface infiltration system. This may not be viable due to possible stream flow through the existing drainage manhole and numerous risers on adjacent utility pole.

2.2.1 Town Hall Site Map

Potential BMP Retrofit Locations
Location: Town Hall
Address: 1 Main Street

Would consider redirecting flow from catch basin to leaching basin but may not be viable due to possible stream flow through drainage manhole and numerous risers on adjacent utility pole.

Existing utility pole.

These connections were not verified but are assumed based on GIS mapping.

Could route flows from drip edges to leaching basin.

Existing HVAC equipment. Pad appears to have some undermining at back. Equipment presents challenge to installing drip edge.

Install stone drip edges where no gutters exist. Some evidence of erosion (mild).

Existing downspout with retrofitted leader discharging onto ground. Could direct to leaching basin but would require some cutting of existing HMA walk.

Existing walls and/or steep slopes are prohibitive to installing swales on either side of roadway.

Existing discharge through retaining wall into rip rap.

MILFORD STREET
GROVE STREET
CHURCH STREET
WARREN STREET
TOWN HALL ROAD
MAIN

Map Legend

- Proposed BMP Retrofit Location

Stormwater Infrastructure

- Existing BMP
- Outfall
- Town-Owned Catch Basin
- State-Owned Catch Basin
- Interconnections
- Town-Owned DMH
- State-Owned DMH
- Curb Inlet
- Inlet
- Culvert
- Pipe
- Conveyance Ditch

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Hydrologic Soil Group

- No Rating
- A
- A/D
- B
- B/D
- C
- C/D
- D

Hydrography

- Wetlands
- Hydrologic Connections

BETA

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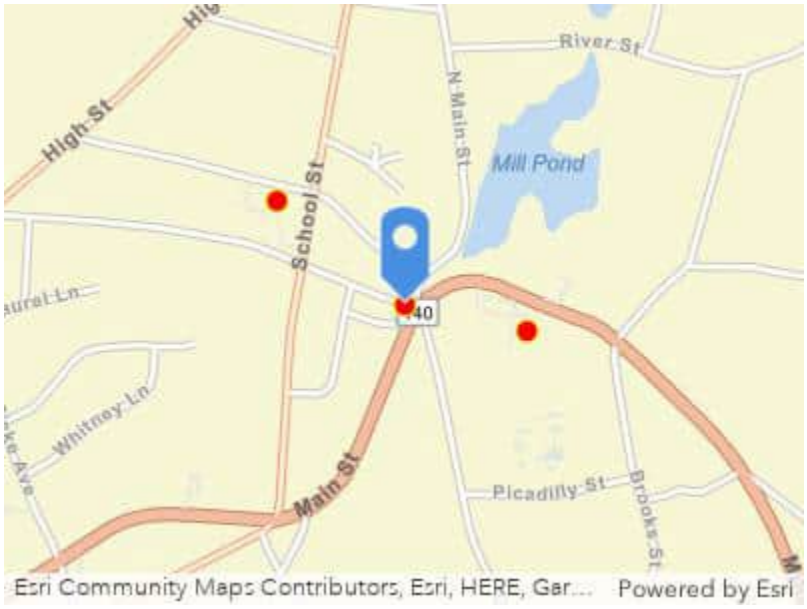
2.2.2 Town Hall BMP Retrofit Observations Form

Site Name:	Town Hall		
Address:	1 Main Street	Date/Time:	January 26, 2023 9:00 AM
Inspector	Leya Strode, Matt Crowley		
Current Weather:	Cloudy -- 45 °F		

2.2.2.1 BMP Retrofit Location Map

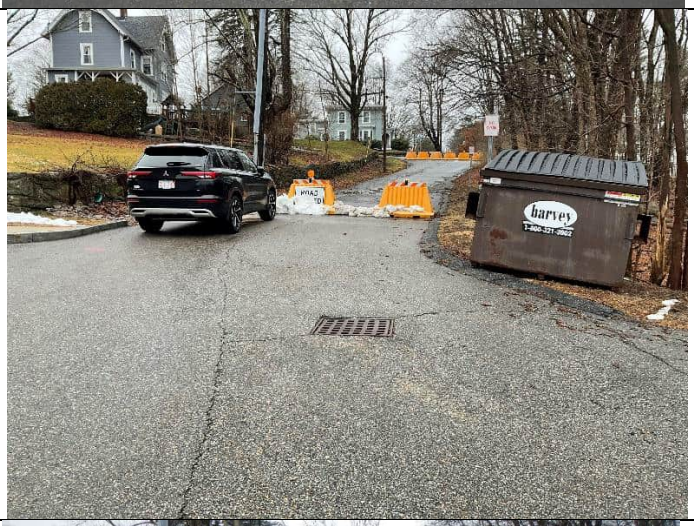


2.2.2.2 Observation Details

BMP Retrofit(s) Viable: **Yes**

Most Prevalent Soils:	A	Estimated Depth to Water (If Possible):	Test pit required
BMP Options:	Infiltration Chamber/Pipe, Infiltration Basin, Water Quality Swale, Bioretention, Other	If "Other":	Rain garden
Site Observation Notes:	Parking lot slopes towards CB near driveway from all sides; additional CB upgradient WNW along blocked ROW. Large pipe deposits into riprap through retaining wall along south edge of blocked ROW. Some roof edges do not have gutters. Potential opportunities for small leaching basin in front of blue sign in front of parking lot, infiltration trench along drip edge around building, subsurface leaching system under lowest CB, or potentially WQS along upstream road.		

2.2.2.3 PHOTOS

	Existing catch basin at parking lot driveway, facing east.
	Existing catch basin 71-9, facing west.
	Roadway leading west from parking lot – opportunities for swales are limited given steep slopes and existing retaining walls.

	Existing discharge through retaining wall into riprap.
	Eroded soil beneath drip edge is beginning to scour existing concrete pad – opportunity to reroute to leaching basin. Equipment presents challenge to installing drip edge.

	Existing downspout discharges to ground – opportunity to discharge to leaching basin, would require cutting and restoration of existing HMA path.

2.3 EMPTY LOT IN RESIDENTIAL AREA

Existing conditions on this undeveloped parcel include two outfalls, one (78-6) that discharges stormwater flow in the north corner to a wet area in the west corner that is retained by an outlet control structure and one (78-5) that was buried under leaves in the east corner of the parcel on the day of the site visit. It is unclear if the existing wet area was designed as a pond or is a natural wetland, although the wet area does appear in the 2005 Wetlands GIS layer published by MassDEP.

An infiltration basin at this site is likely not a good option due to observed standing water and ponding on the day of the site visit – any consideration of an infiltration basin would require a test pit and soil testing. The best option for installation of a BMP retrofit is a wet basin in the eastern corner of the parcel. This would involve installation of an additional catch basin at the northernmost corner of Pleasant Street and Florence Circle, as well as redirecting flows from the upstream Pleasant Street system to maximize catchment to the pond. Any overflow could outlet to the existing drainage channel or back into the closed system after downstream system capacity were considered.

2.3.1 Empty Lot in Residential Area Site Map

Potential BMP Retrofit Locations
Location: Empty Lot in Residential Area
Address: Florence Circle

FLORENCE CIRCLE

MENDON STREET

PLEASANT STREET

FLORENCE CIRCLE

Existing catch basin.

Berm that carries flow flow from outfall to wet/pond area.

Existing outlet control structure. It is unclear if the upstream wet area was designed as a pond or is a natural wetland.

Existing channel.

Existing culvert that is skewed and looks to be directed towards opposite side of street.

Although soils are mapped as A here it generally seems pretty low and wet. There is room to install a pond but would require tree clearing. Any consideration for an infiltration basin would need to have soils confirmed. A wet pond is likely more viable. Recommend installing an additional CB and redirecting flows into basin from Pleasant Street system to maximize catchment to pond. Overflow could be to existing drainage channel or back into closed system after culvert and closed system capacities are considered.

A

B

B/D

A

A

N
W
E
S

Map Legend

Proposed BMP Retrofit Location

Stormwater Infrastructure

- Existing BMP
- Outfall
- Town-Owned Catch Basin
- State-Owned Catch Basin
- Interconnections
- Town-Owned DMH
- State-Owned DMH
- Curb Inlet
- Inlet
- Culvert
- Pipe
- Conveyance Ditch

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- Rivers: Category 4C
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- Lakes, Estuaries: Category 5

Hydrologic Soil Group

- No Rating
- A
- A/D
- B
- B/D
- C
- C/D
- D

Hydrography

- Wetlands
- Hydrologic Connections

BETA

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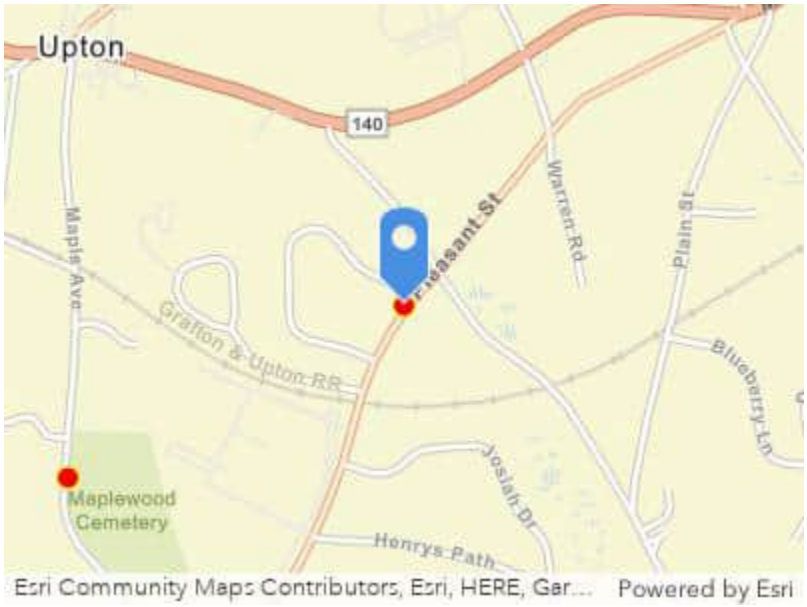
2.3.2 Florence Circle BMP Retrofit Observations Form

Site Name:	Florence Circle Town Property		
Address:	2 Florence Circle	Date/Time:	January 26, 2023 11:55 AM
Inspector	Leya Strode, Matt Crowley		
Current Weather:	Overcast -- 45 °F		

2.3.2.1 BMP Retrofit Location Map



2.3.2.2 Observation Details

BMP Retrofit(s) Viable: **Yes**

Most Prevalent Soils:	A, B/D	Estimated Depth to Water (If Possible):	Test pits required - soil was saturated with pools of standing water throughout the site
BMP Options:	Wet Basin	If "Other":	
Site Observation Notes:	Two outfall structures onsite from adjacent neighborhood (78-6 and 78-5). Outfall 78-6 formed a stream leading to a pond in the W corner of the parcel; an inlet control structure at the SE corner of the pond flowed to an outlet along Pleasant Street. Outfall 78-5 was clogged with leaves and difficult to see. Opportunity for a wet retention basin and installation of an inlet control structure at existing outlet.		

2.3.2.3 PHOTOS

	View of site facing W at corner of Florence Circle and Pleasant Street.
	Outfall 78-6, viewed facing E.

	Outfall 78-5, viewed facing E.
	Existing outlet; opportunity for installation of inlet control structure and wet basin.

	Inlet control structure at W corner of parcel, facing W.

2.4 UPTON FIRE AND EMS HEADQUARTERS

Existing conditions on this site include a subsurface BMP at Upton Fire Headquarters, which is presumed to treat flows from the parking lot, Fire Headquarters roof leaders, and an existing trench drain across the rear garage entrance. If the roof leaders do not discharge to the existing BMP, there may be an opportunity to direct them into a leaching basin located in pervious areas on the property. Additional investigation of as-builts and other Town documents would be required to verify connectivity.

At Upton Police Headquarters, an existing paved waterway captures water from the public parking lot and portions of the driveway from Warren Street. There does not appear to be a formal drainage system downstream of the waterway outlet. There is an opportunity here to redirect flows to a water quality swale which would outlet in a small infiltration area at the corner of Warren Street and School Street.

Additional opportunities for stormwater treatment on this parcel include:

1. Installation of stone infiltration trenches along walkways leading to and around the Fire Headquarters building. Ponding and mud were observed during a visit to this site along walkways.
2. A leaching catch basin could be installed at the driveway entrance to Church Street; however, the catchment would be limited to a small northern section of the parking lot.

2.4.1 Upton Fire and EMS Site Map

Potential BMP Retrofit Locations
Location: Fire and EMS Headquarters
Address: 20 Church Street

Could install CB and direct to leaching basin but would likely be a very limited catchment area.

Stone infiltration trenches could be installed adjacent to walkways.

Catch basins appear to flow towards pervious area, which is assumed to have a BMP that treats flow. It is generally assumed that parking lot flows are treated, although Town should confirm BMP and if roof drains are connected.

Existing trench drain, which is also presumed to drain to BMP.

Roof leaders around building are directed below ground. Unclear where they discharge to. If confirmed they are directed to closed drainage system and no BMP, some could be redirected into leaching basins where located in pervious areas.

Installation of BMP considered here but in consideration of small catchment, slope, and that this area appears to be used for snow storage it was not considered to be viable.

Existing paved waterway with discharge onto Warren Street. Doesn't appear to be any formal drainage system downstream.

Can redirect flows from paved waterway to water quality swale. There is also room to provide a small infiltration area (either a shallow pond or adding a leaching basin or combo) near the corner. Overflow would need to be between HMA berm and sidewalk, which is essentially where the flow from the Warren Street goes anyway.

CHURCH STREET

FIELDSTONE STREET

FIELDSTONE STREET

FIELDSTONE STREET

WARREN STREET

A

D

N

W

E

S

Map Legend

Proposed BMP Retrofit Location

Stormwater Infrastructure

- Existing BMP
- Outfall
- Town-Owned Catch Basin
- State-Owned Catch Basin
- Interconnections
- Town-Owned DMH
- State-Owned DMH
- Curb Inlet
- Inlet
- Culvert
- Pipe
- Conveyance Ditch

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- Rivers: Category 5
- Lakes, Estuaries: Category 4A
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Hydrologic Soil Group

- No Rating
- A
- A/D
- B
- B/D
- C
- C/D
- D

Hydrography

- Wetlands
- Hydrologic Connections

BETA

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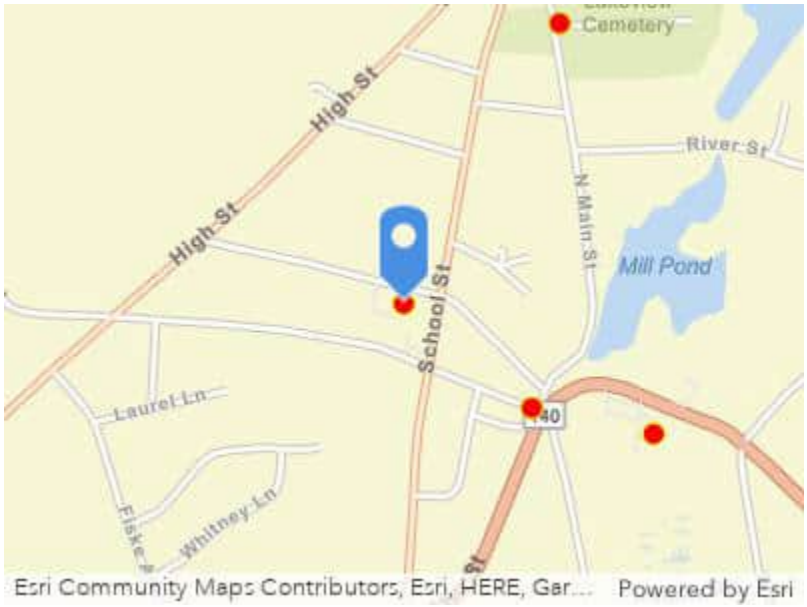
2.4.2 Fire and EMS Headquarters BMP Retrofit Observations Form

Site Name:	Fire and EMS Headquarters		
Address:	20 Church Street	Date/Time:	January 26, 2023 10:40 AM
Inspector	Leya Strode, Matt Crowley		
Current Weather:	Overcast -- 45 °F		

2.4.2.1 BMP Retrofit Location Map



2.4.2.2 Observation Details

BMP Retrofit(s) Viable: **Yes**

Most Prevalent Soils:	A, B	Estimated Depth to Water (If Possible):	Test pit required
BMP Options:	Infiltration Trench, Infiltration Basin, Water Quality Swale, Bioretention	If "Other":	
Site Observation Notes:	Site has existing subsurface BMP, likely linked to existing catch basins in large FD parking lot behind FD building. Unclear where existing roof drains and trench drains flow; existing downspouts are disconnected in front, likely as a result of vehicle impacts. Some drainage from driveway collecting at curb, but impervious catchment area is relatively small. Opportunity for rain garden on		

	north side of walkway leading to main FD entrance indicated by slope of walkway and existing saturated soil/ponding. Back parking area at police station flows towards grassed slope; opportunity for simple infiltration trench, WQS, or rain garden to capture stormwater runoff. In main police parking area, existing paved waterway deposits stormwater onto Warren St. Opportunity to divert paved waterway to WQS with infiltration area at corner of Warren St and School St and overflow curb cut.

2.4.2.3 PHOTOS

	Fire department parking lot driveway facing north towards Church Street.
	Fire department parking lot from Church Street, looking south.

	Fire department building from Church Street, with view of downspouts.
	Disconnected downspout along fire department vehicle bay.

	Saturated low spot along walkway to main fire department building entrance from School Street.
	Back parking lot of police department, looking northwest.

	Front police department parking lot, looking southwest.
	Existing paved waterway from south edge of police station front parking lot along Warren St.

	Flow path of existing paved waterway along north Warren St curb.

2.5 VFW POST

Flow from a large, existing parking lot on site presents most of the opportunity for stormwater treatment. However, this site is not town-owned and any BMPs on site may not count towards the Town's nutrient removal obligations.

One option to capture stormwater flowing north from the existing parking lot would be installation of a linear sediment forebay and shallow infiltration pond or trench along the edge of pavement in the vegetated area along Milford Street, near the VFW flagpole. Another would be to convert the naturally channelized area leading to the rear ballfields into a water quality swale – this may not be desirable due to the lack of formalized access to the playing fields and snack shack.

2.5.1 VFW POST SITE MAP

Potential BMP Retrofit Locations
Location: VFW Post, Parking Lot - NOT TOWN OWNED
Address: 15 Milford Street

Could install a linear sediment forebay along edge of pavement and then a shall infiltration pond or infiltration trench in center of vegetated area.

This lot has been developed with a new community center and is assumed to fully treat stormwater (water quality unit observed).

Naturally channelized location could be converted into water quality swale. May not be desirable here since there is no formalized access to playing fields and snack shack.

WARREN STREET
NORTH
TOWN HALL ROAD
NELSON STREET
MAIN STREET
MILFORD STREET
CHRISTIAN HILL ROAD
ELM STREET
BROOKS STREET
PICCADILLY STREET
Mill Pond
Center Brook

A
B
B/D

N
W
E
S

Map Legend

- Proposed BMP Retrofit Location

Stormwater Infrastructure

- Existing BMP
- Outfall
- Town-Owned Catch Basin
- State-Owned Catch Basin
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- State-Owned DMH
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Hydrologic Soil Group

- No Rating
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- B/D
- C
- C/D
- D

Hydrography

- Wetlands
- Hydrologic Connections

BETA

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2.5.2 VFW Post BMP Retrofit Observations Form

Site Name:	VFW Post & Parking Lot		
Address:	15 Milford Street	Date/Time:	January 26, 2023 9:45 AM
Inspector	Leya Strode, Matt Crowley		
Current Weather:	Overcast -- 45 °F		

2.5.2.1 BMP Retrofit Location Map

2.5.2.2 Observation Details

BMP Retrofit(s) Viable: **Yes**

Most Prevalent Soils:	A, B	Estimated Depth to Water (If Possible):	Test pit required
BMP Options:	Infiltration Basin, Water Quality Swale	If "Other":	
Site Observation Notes:	Precise site was slightly unclear - site address was for VFW-owned parcel with meeting house, ball fields, and snack shack with associated parking lot, but parcel ID was for adjacent town-owned property that is being developed as a new community center. Evidence of stormwater treatment onsite at community center (under construction at time of site visit) includes stormwater quality unit. VFW parcel included opportunities for a sediment forebay and shallow infiltration area near flagpole along Milford St, as well as an existing channelized area leading to ball fields that could be reconstructed as a WQS. Impediments may include a lack of formalized access to fields, and cutting off of access to concessions building. Need to investigate ownership further.		

2.5.2.3 PHOTOS

	Facing southeast from VFW parking lot to sloping area that leads to ballfields - opportunity for WQS along existing channelized area.
	Facing east from VFW parking lot to area near flagpole - opportunity for shallow infiltration area with sediment forebay.

2.6 LAKEVIEW CEMETERY

Land use at this cemetery is primarily devoted to gravesites; resultingly, limited opportunities exist for stormwater treatment. A naturalized swale collects roadway runoff along North Main Street and discharges onto the cemetery property – there is evidence of erosion and sedimentation in several locations. Inside the cemetery, erosion was observed along the shoreline of Pratt Pond, particularly in areas with steep slopes. The area between the shoreline roadway and the pond presents many opportunities for vegetation with a restoration seed mixture and stabilization. Additional opportunities for BMP retrofit installation include:

1. Formalizing the naturalized swale along North Main Street could provide treatment for the roadway runoff currently entering the cemetery. However, this may not be viable due to the existing mature trees, the utility pole, and the existing slope adjacent to the roadway. A linear infiltration practice could be installed along the west edge of the cemetery roads, but a small culvert would be needed to cross the main driveway. Erosion protection would be needed for any discharge into Pratt Pond.
2. The north driveway into the current brush stockpile area could be converted into an infiltration basin with a sediment forebay and vegetated filter strip. This would restrict access to the southern, east-west aligned driveway. The brush area, particularly the north driveway, currently receives stormwater runoff from the paved internal roadways north and northwest of the brush area.

2.6.1 Lakeview Cemetery Site Map

Potential BMP Retrofit Locations
Location: Lakeview Cemetery, Open Land
Address: 71 North Main Street

Sparsely vegetated area with some signs of erosion. Some stabilization provided with rip rap. Consider revegetating and providing a water quality swale if adjacent areas will not be used for future plots.

Hard packed stone/ gravel. Vehicle parked for fishing observed during site visit, so this may be difficult to restore if this is a common use.

There is a bit of a naturalized swale that collects roadway runoff in the upper reaches of this section. Formalizing and continuing swale may not be viable due to existing mature trees, a utility pole, and the slope adjacent to the roadway. Also, flow is currently discharged onto the cemetery property (evidence of erosion and sedimentation in several locations) and providing a BMP without a desirable discharge is generally discouraged. Could provide a linear infiltration practice close to cemetery driveway where slopes are mild. Would need to cross main driveway with small culvert. There is a monument or plot near the northerly limits of property so this could affect the desirability of a swale in this area but may be OK if it stays close to fence line.

Hard packed stone/gravel between driveway and wooded slope (steep). Slope likely too steep to consider a swale but at least a portion could be vegetated with a restoration seed mixture well suited for erosion control. Edge of pavement shows sign of distress, likely from parked vehicles, so may want to provide a stabilized shoulder.

Provide erosion protection for any discharge.

Area currently being used to stockpile brush/leaves/ soil. Could restrict access to this area to southerly drive and convert existing stone/gravel drive on north side to an infiltration basin with sediment forebay. Provide vegetated filter strip to best meet 44% TSS removal if possible.

Some opportunity to provide a swale and small infiltration basin in this area but would impact access to stairs into cemetery and it also looks like this may be used for parking (informally). Any outlet would just discharge back towards street and downstream area has several rip rap berms to keep flows from going over residential property.

Plenty of open space here but it is anticipated that this will be used for future plots.

JAMES ROAD
WESTBORO ROAD
HIGH STREET
SCHOOL STREET
NORTH MAIN STREET
CROSS STREET
MAPLE STREET
Pratt Pond

Map Legend

- Proposed BMP Retrofit Location

Stormwater Infrastructure

- Existing BMP
- Outfall
- Town-Owned Catch Basin
- State-Owned Catch Basin
- Interconnections
- Town-Owned DMH
- State-Owned DMH
- Curb Inlet
- Inlet
- Culvert
- Pipe
- Conveyance Ditch

MassDEP 2018/2020 Integrated List of Waters

- Rivers: Category 4A
- Rivers: Category 4C
- Rivers: Category 5
- Lakes, Estuaries: Category 4A
- Lakes, Estuaries: Category 4C
- Lakes, Estuaries: Category 5

Hydrologic Soil Group

- No Rating
- A
- A/D
- B
- B/D
- C
- C/D
- D

Hydrography

- Wetlands
- Hydrologic Connections

BETA

Issue Date: March 2022
This map is intended for planning purposes only.

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2.6.2 Lakeview Cemetery BMP Retrofit Observations Form

Site Name:	Lakeview Cemetery		
Address:	71 North Main Street	Date/Time:	January 26, 2023 10:20 AM
Inspector	Leya Strode, Matt Crowley		
Current Weather:	Overcast -- 45 °F		

2.6.2.1 BMP Retrofit Location Map

2.6.2.2 Observation Details

BMP Retrofit(s) Viable: **Yes**

Most Prevalent Soils:	A, B/D	Estimated Depth to Water (If Possible):	Test pit required
BMP Options:	Infiltration Basin, Water Quality Swale, Other	If "Other":	Vegetated filter strip, sediment forebay
Site Observation Notes:	Most of site was reserved for graves. Opportunities for BMP installation in rear at brush dump, where two gravel roadways lead down to a local low spot. Erosion from stormwater flowing along both roadways is evident; Town could install a grassed swale with check dams or an infiltration basin. Additional site constraints include steep slopes along Pratt Pond, where erosion was evident. Opportunities for a WQS or vegetated basin near dead tree along existing stormwater runoff channel; additional opportunity at existing riprap outlet protection for swale with basin overflowing to existing riprap. Significant channelized erosion noted along steep slope coming off North Main Street. Adjacent parcel has opportunity for swale and small infiltration basin along School St.		

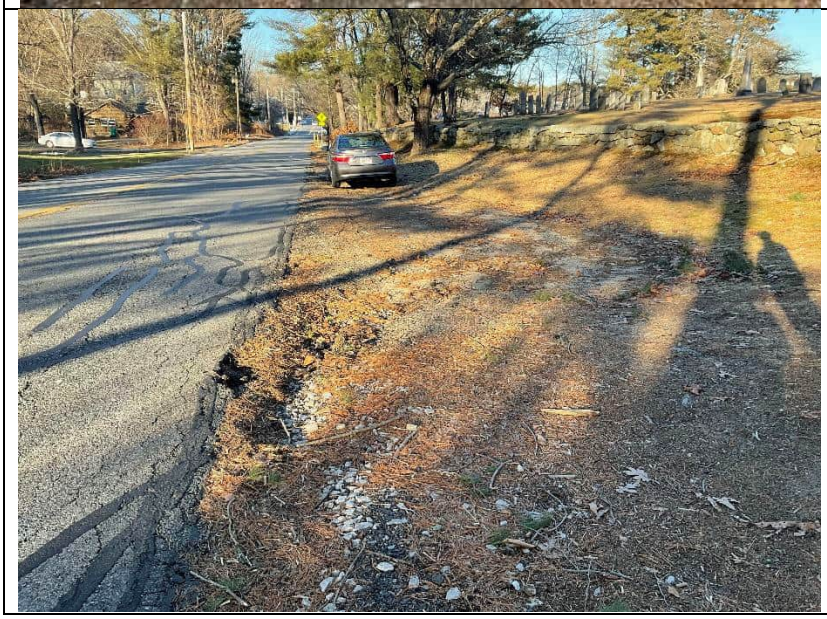
2.6.2.3 PHOTOS

	View to south of existing brush dump area.
	View to north from existing brush dump area.

	View to west-southwest from existing brush dump area.
	Eroded area along perimeter roadway leading to Pratt Pond.

	White car is parked in area where opportunities exist for WQS ending in vegetated basin.
	Existing riprap outlet protection, facing northeast.

	Existing riprap outlet protection, facing southwest.
	Steep slope along North Main Street, looking south.

	Channelized erosion entering site along North Main Street, with deposited sediment visible in background.
	Existing channelized erosion along School St, facing north.

2.7 MEMORIAL SCHOOL

Existing conditions at this site include a network of catch basins for stormwater conveyance throughout parking lots and driveways to Fiske Avenue and Main Street. An additional catch basin is sited behind the school basketball courts. No evidence of existing BMPs or stormwater treatment exists on site.

Some BMP retrofit opportunities were found to be unviable due to poor soils, steep slopes, or existing grading. However, multiple viable options for the installation of retrofitted BMPs were found at Memorial School:

1. There is an opportunity to install a stone infiltration trench with a subdrain connected to the existing catch basin north of the school basketball courts. Ponding was observed on the court playing surface – installation of an infiltration trench along the north edge of the court would capture this water and allow it to infiltrate naturally. Any overflow would outlet to the connected catch basin.
2. Another opportunity exists along the north driveway that exists south of the school building. Currently, the sidewalk along the south parking lot contains 5 empty planting areas. Because the north driveway is banked towards the sidewalk, curbs could be cut to allow stormwater to flow to newly installed tree box filters.
3. The south parking lot channels stormwater flows to an existing catch basin at the east end of the lot. This catch basin currently flows north to a drainage manhole but could be redirected south to a leaching basin or series of leaching basins.
4. The newly constructed concrete patio and walkway present another opportunity for the installation of a stone infiltration trench. The presence of lumber indicates construction is ongoing; if a picnic shelter or other roof structure was constructed, a stone drip edge along the perimeter could also be installed.
5. The sidewalk leading from the school to Fiske Avenue has a slight pitch (0.5%) north and drains downhill towards the street. Existing vegetation along both edges of the sidewalk may be channeling stormwater along the sidewalk itself; there is an opportunity for installation of a water quality swale with check dams along the north edge of this sidewalk to reroute and infiltrate stormwater.

2.7.1 Memorial School Site Map

Potential BMP Retrofit Locations
Location: Memorial School
Address: 69 Main Street

Install stone infiltration trench with subdrain at north end of basketball court. There currently appears to be a grade change to the grass and flow will go over soil to existing catch basin. Subdrain would connect to existing catch basin.

Sidewalk has slight pitch (0.5%) to north and drains toward Fiske Ave. Although soils are HSG C there is opportunity for a water quality swale (including check dams). Pitch of sidewalk may change. Current lip of vegetation of either side may have sidewalk act as the drainage channel with discharge at Fiske Ave. Curl swale away from sidewalk near bottom to prevent flow over sidewalk.

Existing grading presents opportunity to construct a pond. Would need to install berm on south side with possible tree clearing. Overflow could tie back to existing CB. This option is not highly viable due to limited catchment area and poor soils. Could consider a swale, with similar clearing requirements.

Existing catch basin.

Evidence of ponding on basketball court.

Replace empty planting areas with tree box filters (flow from north driveway)

Redirect flow from existing CB to leaching basin or series of leaching basins.

Steep roadway and side slopes. Redirection of flows not viable regardless of soils.

Newly constructed concrete patio and walkway. It appears additional construction may take place (presence of stacked lumber and possible footings). Consider stone infiltration trench along perimeter or stone drip edge if roof constructed.

Existing sidewalk does not have clear cross-slope but drains toward Main Street.

Area provides opportunity to provide a small BMP but is not readily viable due to HSG C soils.

HARTFORD AVENUE NORTH

HAZELTINE ROAD

FISKE AVENUE

WHITNEY LANE

MAIN STREET

MENDON STREET

WARREN ROAD

N W E S

Map Legend

- Proposed BMP Retrofit Location

Stormwater Infrastructure

- Existing BMP
- Outfall
- Town-Owned Catch Basin
- State-Owned Catch Basin
- Interconnections
- Town-Owned DMH
- State-Owned DMH
- Curb Inlet
- Inlet
- Culvert
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- Conveyance Ditch

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Hydrologic Soil Group

- No Rating
- A
- A/D
- B
- B/D
- C
- C/D
- D

Hydrography

- Wetlands
- Hydrologic Connections

BETA

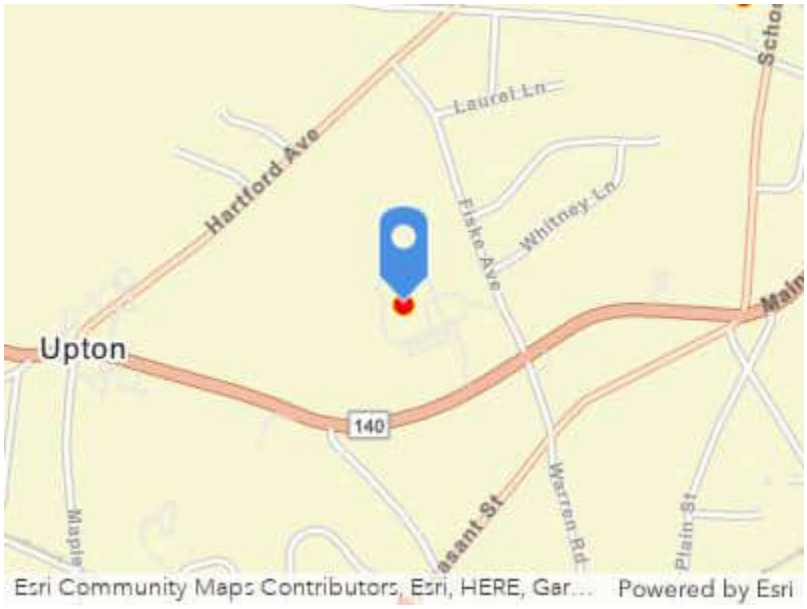
Issue Date: March 2022
This map is intended for planning purposes only.

Document Path: K:\Upton, MA\MS4\0 - Maps\GIS\Projects\BMP_Site_Maps_for_Retrofit_Memo.mxd

2.7.2 Memorial School BMP Retrofit Observations Form

Site Name:	Memorial School		
Address:	69 Main Street	Date/Time:	February 2, 2023 3:30 PM
Inspector	Leya Strode, Matt Crowley		
Current Weather:	Sunny -- 34 °F		

2.7.2.1 BMP Retrofit Location Map



2.7.2.2 Observation Details

BMP Retrofit(s) Viable: **Yes**

Most Prevalent Soils:	B, C	Estimated Depth to Water (If Possible):	Test pit required
BMP Options:	Infiltration Trench, Water Quality Swale, Leaching CB, Infiltration Basin	If "Other":	
Site Observation Notes:	Most of front parking lots are channelized to convey water directly to catch basins. Opportunities for retrofit include leaching subsurface systems fed by diverted catch basins, infiltration basins or swales along accessible path from Main Street, infiltration trenches along path from Fiske Ave or under drip edge of picnic area (currently under construction), and infiltration trench along north edge of basketball courts.		

2.7.2.3 PHOTOS

	South parking area, facing northeast.
	Existing catch basin that captures stormwater from south parking lot, facing south.

	Accessible sidewalk to Main St, facing north.
	Newly constructed concrete patio and walkway, facing southeast.

	Sidewalk to Fiske Ave, facing east.
	Evidence of ponding along back of basketball courts, facing west.

	Grade change and soil accumulation at north end of basketball court, facing west.

2.8 UNDEVELOPED OVERFLOW PARKING LOT

Existing conditions on this parcel include a paved waterway flowing from Grove Street directly to Center Brook, capturing a large impervious catchment from Main Street and the eastern half of Grove St (see Attachment 1 for detail on catchment). Multiple low areas with shallow mud were observed near the east edge of the lot along Center Brook. Most of the surface of this parcel is compacted gravel.

Rerouting the existing paved waterway to a water quality swale with check dams along the south edge of the parcel would provide significant treatment of impervious stormwater runoff. The swale would then outlet to Center Brook with riprap outlet protection. Along the east edge of the parcel, an opportunity exists to install a shallow infiltration basin with a sediment forebay for pretreatment; overflow would flow to Center Brook through a stone spillway.

Restoration of a vegetated filter strip running along the east and south edges of the parcel would provide additional stormwater pretreatment. Existing compacted gravel would need to be excavated; tilling, loam addition, and installation of a restoration seed mixture would complete the restoration.

2.8.1 Undeveloped Parking Lot Site Map

Potential BMP Retrofit Locations
Location: Undeveloped Overflow Parking Lot
Address: 0 Grove Street

GROVE STREET

Flow from street follows gutter and discharges directly to brook from a paved waterway. Watershed to this point includes half of the roadway and is depicted in aerial photo.

North corner of parcel serves as driveway access to rear of adjacent building.

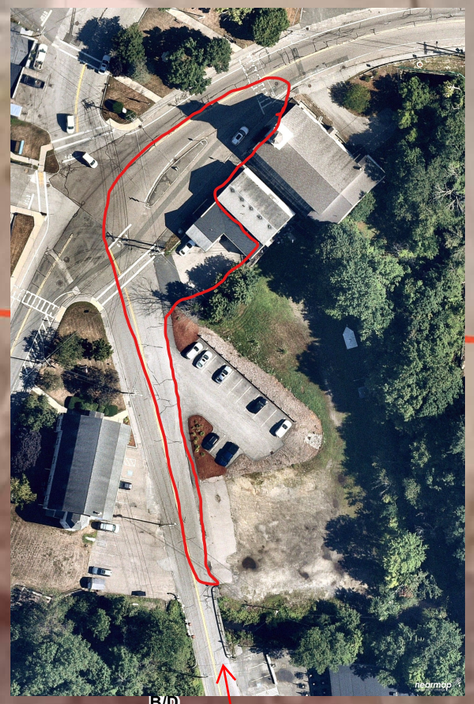
Install a shallow infiltration basin with sediment forebay (red line represents a stone check dam to separate forebay from infiltration area). Overflow through stone spillway to stream.

If parking area is ever paved consider use of porous pavement.

Install wooden guard rail to protect restored area and swale.

Remove compacted gravel, till soil, add loam and a restoration seed mixture to act as a vegetated filter strip. Limits dependent on use of site. Install wooden guardrail in front to protect restored area.

Center Brook



Approximate watershed limits to paved waterway.

Actual brook location and flow direction.

Provide water quality swale (with check dams) or linear infiltration practice. Outlet to stream at southeast corner of parcel with rip rap outlet protection.

N
W E
S

Map Legend

- Proposed BMP Retrofit Location

Stormwater Infrastructure

- Existing BMP
- Outfall
- Town-Owned Catch Basin
- State-Owned Catch Basin
- Interconnections
- Town-Owned DMH
- State-Owned DMH
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- Inlet
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Hydrologic Soil Group

- No Rating
- A
- A/D
- B
- B/D
- C
- C/D
- D

Hydrography

- Wetlands
- Hydrologic Connections

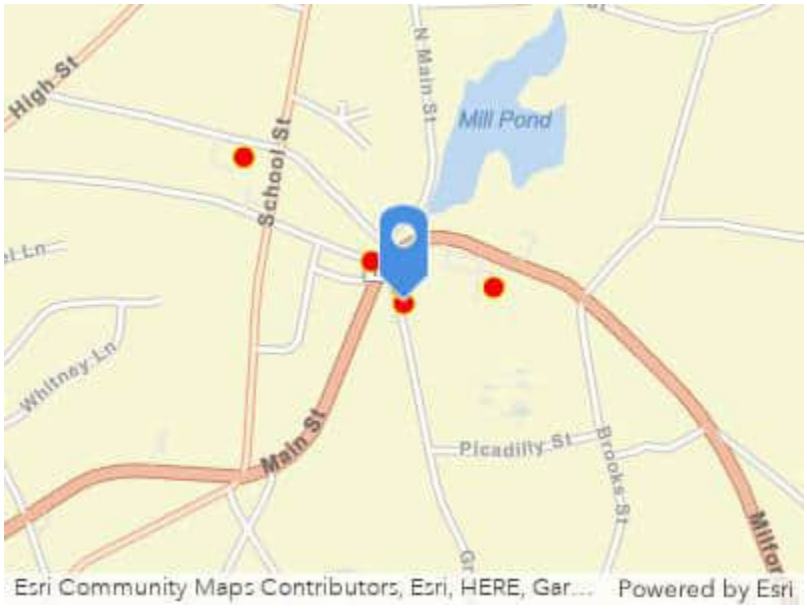
BETA

Issue Date: March 2022
This map is intended for planning purposes only.

2.8.2 Undeveloped Parking Lot BMP Retrofit Observations Form

Site Name:	Undeveloped Overflow Parking Lot		
Address:	0 Grove Street	Date/Time:	February 2, 2023 2:30 PM
Inspector	Leya Strode, Matt Crowley		
Current Weather:	Sunny -- 36 °F		

2.8.2.1 BMP Retrofit Location Map



2.8.2.2 Observation Details

BMP Retrofit(s) Viable: **Yes**

Most Prevalent Soils:	B	Estimated Depth to Water (If Possible):	Test pit required
BMP Options:	Infiltration Basin, Water Quality Swale, Other	If "Other":	Vegetated buffer, sediment forebay
Site Observation Notes:	Runoff from Main Street appears to run down Grove Street and into Center Brook over an existing paved waterway at the western edge of the property. This presents an opportunity for treatment through the installation of a water quality swale along the Brook. Other possibilities at this site include a sediment forebay and shallow infiltration basin along the eastern edge.		

2.8.2.3 PHOTOS

	View of site from northwest corner, facing southeast.
	Stream and adjacent area, facing east towards Grove St.

	Shallow area in rear of parking lot, facing northwest.
	Existing paved waterway from Grove Ave, facing north.

	Shallow area in rear of parking lot, facing southeast.

APPENDIX A

- **Sites Found to be Unviable & Future Work**

Appendix A: Sites Found to be Unviable & Future Work

Nutrient Removal	Address	Ownership		Soil Type[1]		Depth to Water Table[1]		Within a Potential Subsurface Area of Concern[2]		Opportunity for Public Use and Education		Access for Maintenance		Current Stormwater Infrastructure in Area		Receiving Water[3]		Priority Score	Comment
		Owner	Score 0 - 1	Type	Score[4] 0 - 3	Depth (ft)[5]	Score[6] 0 - 3	Yes/No	Score 0 - 1	Yes/No	Score 0 - 1	Yes/No	Score 0 - 1	Yes/No	Score 0 - 1	Yes/No	Score 0 - 1	High Score, High Priority	
Phosphorus	2 Grove Street Parcel: M_191506_880319 Developed Overflow Parking Lot	Town	1	A	3	> 6	3	No	0	Yes	1	Yes	1	Yes	1	No	0	10	This site was found to be unviable - a cleanout was observed while visiting the site, which is typically associated with an underground infiltration system. It is anticipated that this parking area is already fully treated.

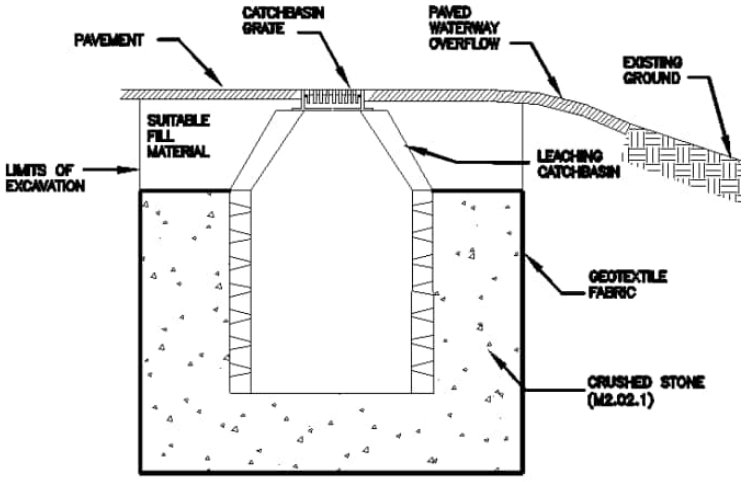
1. Data source: USDA Natural Resources Conservation Service, Web Soil Survey
2. Examples: Contaminated Sites, Zone 2 Watershed Protection Areas. Data source: MassGIS, MassDEP Tier Classified Oil and/or Hazardous Material Sites
3. Control of Discharges to Water Quality Limited Waters, First or Second Order Streams, Public Swimming Beaches, Drinking Water Supply Sources, Shellfish Growing Areas
4. Score breakdown: Hydrologic Soil Group A =3, B = 2, C = 1, D = 0.
5. Depth to water table data unknown, value estimated using MassDEP Energy & Environmental Affairs Data Portal for Well Drillings and best engineering judgement.
6. Score breakdown: Depths of 0 to less than 2 ft = 0, 2 to less than 4 ft = 1, 4 to less than 6 ft = 2, at least 6 ft = 3.

APPENDIX B

- **BMP Retrofit Design Examples**

❑Infiltration Catchbasin/Manhole

- ❖ **Pretreatment difficult, Shorter lifecycle – Can add sump for maintenance & pretreatment**



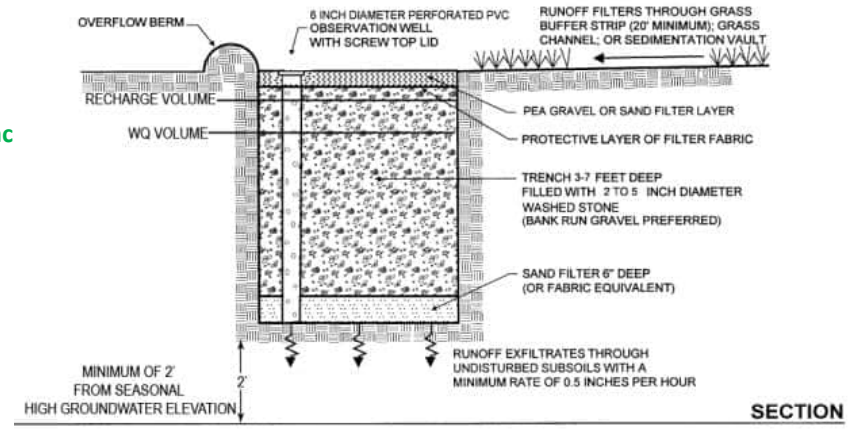
adapted from the MassHighway Department

Addressing

- ✓ Recharge
- ✓ TSS
- ❖ LUHPPL
- ❖ Critical
- ✓ Redevelop
- ✓ Pollutants
- ✓ Maintenance

❑Infiltration Trench

- ➢ **Flexible, Ideal for roadway edge**
- ➢ **Pipe/stone system doubles for conveyanc**



Example of Infiltration Trench

adapted from the University of New Hampshire

Addressing

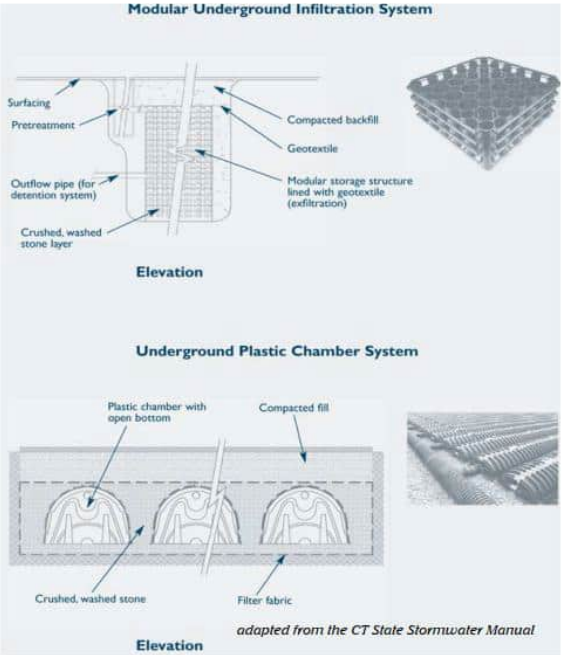
- ✓ Peak Flow
- ✓ Recharge
- ✓ TSS
- ❖ LUHPPL
- ❖ Critical
- ✓ Redevelop
- ✓ Pollutants
- ✓ Maintenance

❑Subsurface Infiltration

- ➢ Flexible options
- ❖ Out of sight, High $, Maintenance

Addressing

- ✓ Peak Flow
- ✓ Recharge
- ✓ TSS
- ❖ LUHPPL
- ❖ Critical
- ✓ Redevelop
- ✓ Pollutants



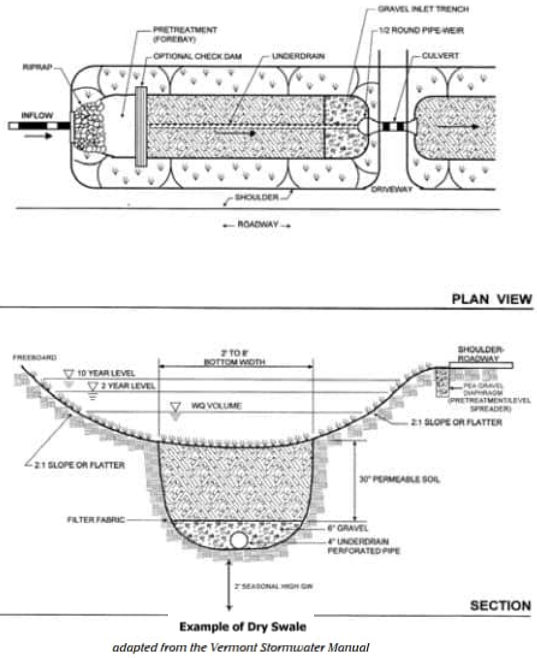
adapted from the CT State Stormwater Manual

❑WATER QUALITY SWALE (DRY)

- ➢ Low maintenance $
- ❖ Little to no peak flow, recharge

Addressing

- ❖ Peak Flow
- ❖ Recharge
- ✓ TSS
- ❖ LUHPPL
- ❖ Critical
- ✓ Redevelop
- ✓ Pollutants
- ✓ Maintenance



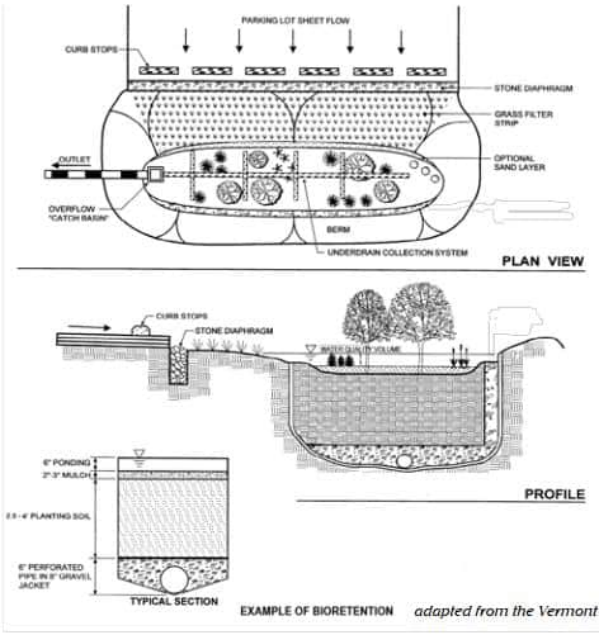
Example of Dry Swale

adapted from the Vermont Stormwater Manual

❑BIORETENTION (RAIN GARDEN)

- ➢ LID, High treatment
- ➢ Option for Poor Soil
- ❖ Landscaping
- ❖ Maintenance
- ❖ For Small Area

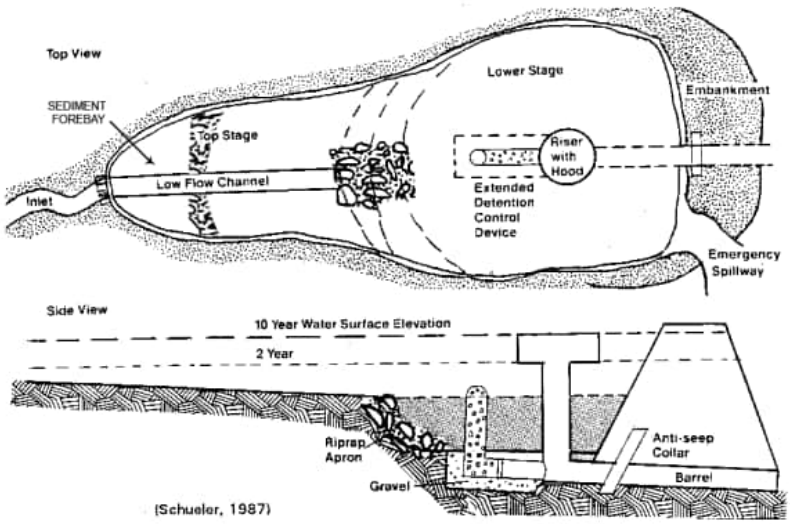
- ❖ Peak Flow
- ❖ Recharge
- ✓ TSS
- ❖ LUHPPL
- ❖ Critical
- ✓ Redevelop
- ✓ Treatment



adapted from the Vermont Stormwater Manual

❑EXTENDED DRY DETENTION BASIN

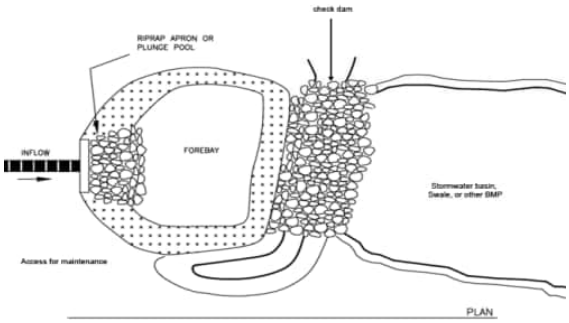
- ❑ Peak flow, some treatment
  - ❖ No recharge credit



adapted from Controlling Urban Runoff, Schueler 1987

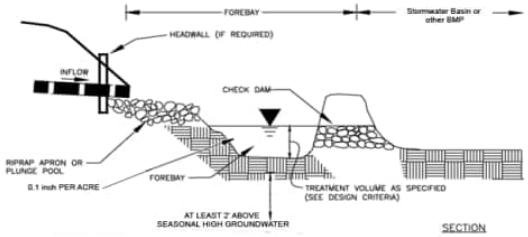
❑Sediment Forebay

- ➢ Low $, Easy to create
- ➢ Consider solid bottom
- ❖ Size 0.1 in/acre of pavement, Lined for LUHPPL



Addressing

- ✓ TSS
- ✓ Maintenance



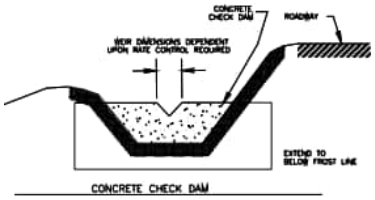
adapted from the Vermont Stormwater Handbook

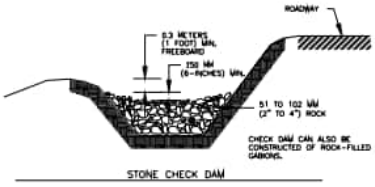
❑Check Dam

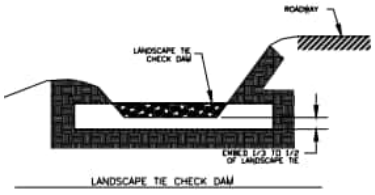
- ➢ Low $
- ➢ Excellent for swales
- ➢ Consider solid bottom

Addressing

- ❖ Recharge
- ✓ TSS
- ✓ Redevelop
- ✓ Maintenance







Examples of Check Dams