DILLIS & ROY
CIVIL DESIGN GROUP

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ENGINEERING LAND SURVEYING WETLAND CONSULTING

October 17th, 2024
#8034

Worcester Planning & Regulatory Services Division
455 Main Street, 4th floor
Worcester, MA 01608

RE: Stormwater Memo
91-93 Alvarado Avenue
Worcester, MA 01604

To Whom it may concern,

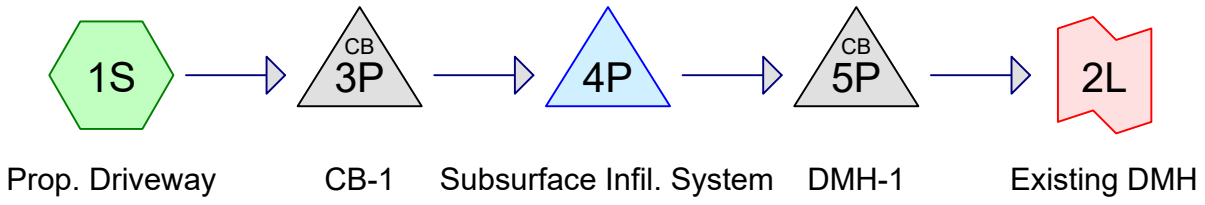
On behalf of the applicant, Specialized Property Group, Dillis & Roy has prepared the attached hydrologic analysis for the stormwater management system proposed for the development at 93 Alvarado Avenue. The existing parcel is currently vacant, with no stormwater infrastructure present at the site.

To accommodate the stormwater runoff associated with the proposed development, a deep-sump and hooded catch basin is included at the low point of the proposed driveway. Stormwater will be discharged via culvert into a subsurface infiltration system to provide storage and infiltration of stormwater runoff. The subsurface system will consist of fourteen Cultec R-150XLHD chambers embedded in crushed stone and wrapped with a geotextile filter fabric (ADS 601 non-woven geotextile or equivalent). The subsurface system has been designed to accommodate the stormwater flows up to and including the 10-year design storm event. For larger storm events, stormwater will be routed to a drain manhole via an outlet culvert which will tie into the municipal drainage system within Alvarado Avenue. The attached hydrologic analysis documents that there is no on-site or off-site flooding during the 100-year design storm event.

We trust this meets your needs at this time. If you have any questions or require any additional information regarding this request, please do not hesitate to contact the undersigned.

Regards,
DILLIS & ROY
CIVIL DESIGN GROUP, INC.

Ryan W. Proctor, E.I.T
Staff Engineer



Subcat Reach Pond Link

Routing Diagram for 8034 - Drainage Analysis

Prepared by {enter your company name here}, Printed 10/21/2024

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Prop. Driveway Runoff Area=2,527 sf 100.00% Impervious Runoff Depth=4.70"
Tc=6.0 min CN=98 Runoff=0.27 cfs 0.023 af

Pond 3P: CB-1 Peak Elev=418.80' Inflow=0.27 cfs 0.023 af
12.0" Round Culvert n=0.013 L=3.0' S=0.0200 '/' Outflow=0.27 cfs 0.023 af

Pond 4P: Subsurface Infil. System Peak Elev=418.39' Storage=542 cf Inflow=0.27 cfs 0.023 af
Discarded=0.01 cfs 0.023 af Primary=0.00 cfs 0.000 af Outflow=0.01 cfs 0.023 af

Pond 5P: DMH-1 Peak Elev=418.44' Inflow=0.00 cfs 0.000 af
12.0" Round Culvert n=0.013 L=46.0' S=0.0696 '/' Outflow=0.00 cfs 0.000 af

Link 2L: Existing DMH Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 0.058 ac Runoff Volume = 0.023 af Average Runoff Depth = 4.70"
0.00% Pervious = 0.000 ac 100.00% Impervious = 0.058 ac

Summary for Subcatchment 1S: Prop. Driveway

Runoff = 0.27 cfs @ 12.09 hrs, Volume= 0.023 af, Depth= 4.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.94"

Area (sf)	CN	Description
2,527	98	Paved parking, HSG C
2,527		100.00% Impervious Area

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

Summary for Pond 3P: CB-1

Inflow Area = 0.058 ac,100.00% Impervious, Inflow Depth = 4.70" for 10-Year event
Inflow = 0.27 cfs @ 12.09 hrs, Volume= 0.023 af
Outflow = 0.27 cfs @ 12.09 hrs, Volume= 0.023 af, Atten= 0%, Lag= 0.0 min
Primary = 0.27 cfs @ 12.09 hrs, Volume= 0.023 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 418.80' @ 12.09 hrs
Flood Elev= 421.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	418.50'	**12.0" Round Culvert** L= 3.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 418.50' / 418.44' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.27 cfs @ 12.09 hrs HW=418.80' (Free Discharge)
1=Culvert (Barrel Controls 0.27 cfs @ 2.02 fps)

Summary for Pond 4P: Subsurface Infil. System

Inflow Area = 0.058 ac,100.00% Impervious, Inflow Depth = 4.70" for 10-Year event
Inflow = 0.27 cfs @ 12.09 hrs, Volume= 0.023 af
Outflow = 0.01 cfs @ 15.05 hrs, Volume= 0.023 af, Atten= 96%, Lag= 178.1 min
Discarded = 0.01 cfs @ 15.05 hrs, Volume= 0.023 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 418.39' @ 15.05 hrs Surf.Area= 596 sf Storage= 542 cf
Flood Elev= 421.50' Surf.Area= 596 sf Storage= 836 cf

Plug-Flow detention time= 474.7 min calculated for 0.023 af (100% of inflow)
Center-of-Mass det. time= 474.5 min (1,222.7 - 748.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	416.90'	452 cf	**8.00'W x 74.50'L x 2.54'H Field A** 1,515 cf Overall - 384 cf Embedded = 1,131 cf x 40.0% Voids
#2A	417.40'	384 cf	**Cultec R-150XLHD** x 14 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 2 rows
		836 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	416.90'	**0.530 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 413.90'
#2	Primary	418.64'	**12.0" Round Culvert** L= 2.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 418.64' / 418.54' S= 0.0500 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Discarded OutFlow Max=0.01 cfs @ 15.05 hrs HW=418.39' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=416.90' (Free Discharge)
↑—**2=Culvert** (Controls 0.00 cfs)

Summary for Pond 5P: DMH-1

Inflow Area = 0.058 ac,100.00% Impervious, Inflow Depth = 0.00" for 10-Year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 418.44' @ 0.00 hrs
Flood Elev= 424.20'

Device	Routing	Invert	Outlet Devices
#1	Primary	418.44'	**12.0" Round Culvert** L= 46.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 418.44' / 415.24' S= 0.0696 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=418.44' (Free Discharge)
↑—**1=Culvert** (Controls 0.00 cfs)

Summary for Link 2L: Existing DMH

Inflow Area = 0.058 ac,100.00% Impervious, Inflow Depth = 0.00" for 10-Year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Prop. Driveway Runoff Area=2,527 sf 100.00% Impervious Runoff Depth=7.45"
Tc=6.0 min CN=98 Runoff=0.43 cfs 0.036 af

Pond 3P: CB-1 Peak Elev=418.89' Inflow=0.43 cfs 0.036 af
12.0" Round Culvert n=0.013 L=3.0' S=0.0200 '/' Outflow=0.43 cfs 0.036 af

Pond 4P: Subsurface Infil. System Peak Elev=418.85' Storage=694 cf Inflow=0.43 cfs 0.036 af
Discarded=0.01 cfs 0.028 af Primary=0.14 cfs 0.008 af Outflow=0.16 cfs 0.036 af

Pond 5P: DMH-1 Peak Elev=418.64' Inflow=0.14 cfs 0.008 af
12.0" Round Culvert n=0.013 L=46.0' S=0.0696 '/' Outflow=0.14 cfs 0.008 af

Link 2L: Existing DMH Inflow=0.14 cfs 0.008 af
Primary=0.14 cfs 0.008 af

Total Runoff Area = 0.058 ac Runoff Volume = 0.036 af Average Runoff Depth = 7.45"
0.00% Pervious = 0.000 ac 100.00% Impervious = 0.058 ac

Summary for Subcatchment 1S: Prop. Driveway

Runoff = 0.43 cfs @ 12.09 hrs, Volume= 0.036 af, Depth= 7.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.69"

Area (sf)	CN	Description
2,527	98	Paved parking, HSG C
2,527		100.00% Impervious Area

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

Summary for Pond 3P: CB-1

Inflow Area = 0.058 ac,100.00% Impervious, Inflow Depth = 7.45" for 100-Year event
Inflow = 0.43 cfs @ 12.09 hrs, Volume= 0.036 af
Outflow = 0.43 cfs @ 12.09 hrs, Volume= 0.036 af, Atten= 0%, Lag= 0.0 min
Primary = 0.43 cfs @ 12.09 hrs, Volume= 0.036 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 418.89' @ 12.09 hrs
Flood Elev= 421.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	418.50'	**12.0" Round Culvert** L= 3.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 418.50' / 418.44' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.42 cfs @ 12.09 hrs HW=418.89' (Free Discharge)
1=Culvert (Barrel Controls 0.42 cfs @ 2.21 fps)

Summary for Pond 4P: Subsurface Infil. System

[81] Warning: Exceeded Pond 3P by 0.15' @ 12.55 hrs

Inflow Area = 0.058 ac,100.00% Impervious, Inflow Depth = 7.45" for 100-Year event
Inflow = 0.43 cfs @ 12.09 hrs, Volume= 0.036 af
Outflow = 0.16 cfs @ 12.35 hrs, Volume= 0.036 af, Atten= 64%, Lag= 15.9 min
Discarded = 0.01 cfs @ 12.35 hrs, Volume= 0.028 af
Primary = 0.14 cfs @ 12.35 hrs, Volume= 0.008 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 418.85' @ 12.35 hrs Surf.Area= 596 sf Storage= 694 cf
Flood Elev= 421.50' Surf.Area= 596 sf Storage= 836 cf

Plug-Flow detention time= 433.9 min calculated for 0.036 af (100% of inflow)

Center-of-Mass det. time= 434.3 min (1,176.0 - 741.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	416.90'	452 cf	**8.00'W x 74.50'L x 2.54'H Field A** 1,515 cf Overall - 384 cf Embedded = 1,131 cf x 40.0% Voids
#2A	417.40'	384 cf	**Cultec R-150XLHD** x 14 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 2 rows
		836 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	416.90'	**0.530 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 413.90'
#2	Primary	418.64'	**12.0" Round Culvert** L= 2.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 418.64' / 418.54' S= 0.0500 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Discarded OutFlow Max=0.01 cfs @ 12.35 hrs HW=418.85' (Free Discharge)
1=Exfiltration (Controls 0.01 cfs)

Primary OutFlow Max=0.14 cfs @ 12.35 hrs HW=418.85' (Free Discharge)
2=Culvert (Inlet Controls 0.14 cfs @ 1.22 fps)

Summary for Pond 5P: DMH-1

[79] Warning: Submerged Pond 4P Primary device # 2 OUTLET by 0.10'

Inflow Area = 0.058 ac,100.00% Impervious, Inflow Depth = 1.61" for 100-Year event
Inflow = 0.14 cfs @ 12.35 hrs, Volume= 0.008 af
Outflow = 0.14 cfs @ 12.35 hrs, Volume= 0.008 af, Atten= 0%, Lag= 0.0 min
Primary = 0.14 cfs @ 12.35 hrs, Volume= 0.008 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 418.64' @ 12.35 hrs
Flood Elev= 424.20'

Device	Routing	Invert	Outlet Devices
#1	Primary	418.44'	**12.0" Round Culvert** L= 46.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 418.44' / 415.24' S= 0.0696 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.14 cfs @ 12.35 hrs HW=418.64' (Free Discharge)
1=Culvert (Inlet Controls 0.14 cfs @ 1.22 fps)

Summary for Link 2L: Existing DMH

Inflow Area = 0.058 ac,100.00% Impervious, Inflow Depth = 1.61" for 100-Year event
Inflow = 0.14 cfs @ 12.35 hrs, Volume= 0.008 af
Primary = 0.14 cfs @ 12.35 hrs, Volume= 0.008 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs