STORMWATER DESIGN NARRATIVE

PREPARED November 21, 2022

APPLICANT:

HARSH REALTY LLC

248 Atlantic Ave, Hull, MA 02045

PROJECT:

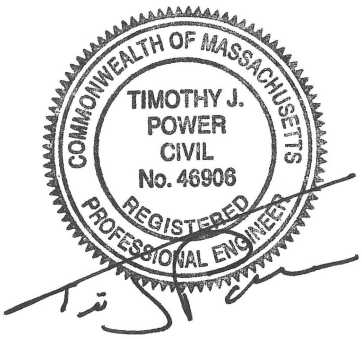
248 ATLANTIC AVE

248 Atlantic Ave, Hull, MA 02045

PREPARED BY:

PVI SITE DESIGN, LLC

18 GLENDALE ROAD, NORWOOD, MA 02062



PVI SITE DESIGN

SECTION 1 – PROJECT OVERVIEW

1.1 INTRODUCTION

The applicant, Harsh Realty LLC, is proposing to redevelop the commercial property located at 248 Atlantic Ave, Hull, MA, parcel ID 49-078. This lot is currently developed with a two-story mixed-use building with a coffee shop on the ground floor and residential above. The total lot area is 4,025 sf (0.092 acres) and is in the Business zone.

The project proposes to demolish the existing building and replace it with a new building with a similar footprint. The project will result in an increase of impervious area. In accordance with Hull Zoning By-Law section 410-4-1.D.1.g, the project shall address the prevention of pollution of surface and groundwater, soil erosion, increased runoff and flooding. This will be achieved with the implementation of Best Management Practices (BMPs) such as porous pavement and an underground infiltration trench, as further described in this report.

1.2 LOCATION, TOPOGRAPHY, AND SOILS

LOCATION:

The project site is located at 248 Atlantic Ave, Hull, MA. The property has frontage on Atlantic Ave. There are no existing curb cuts and no on-site parking. The property sits at the intersection of Atlantic and School Streets, across the street from Town Hall.

TOPOGRAPHY

The topography within the subject site slopes generally from the southwest to the northeast, or from the front left corner on Atlantic Ave to the back right corner at the abutting property line. Elevations range from 51 feet to 47 feet. Slopes are gentle across the front two-thirds of the site, with the rear of the site reaching slopes of 10%. The proposed design aims to maintain the existing topography.

SOILS

The underlying soils have been obtained from the Natural Resources Conservation Service as made available by the Web Soil Survey website and are generally consistent across the site. The soil types are as follows:

TABLE 1.1 – NRCS SOIL TYPES

NRCS MAP UNIT	MAP UNIT NAME	HYDROLOGIC SOIL GROUP
635	Canton-Urban Land	A

A copy of the NRCS Web Soil Survey maps is included in the Appendix of this report.

1.3 WATERSHED DESCRIPTIONS

The Development Area consists of two watershed areas for the purpose of this stormwater analysis. Below is a discussion of the watersheds. Refer to Figure 2 and Figure 3 for Existing and Proposed Watershed Plans respectively. Watershed plans provide information on total area, Curve Numbers, and Time of Concentration for each watershed.

1.3.1 EXISTING CONDITIONS

WATERSHED EX-1

The northern portion of the site drains to the northeast corner where runoff discharges to the abutter's rear yard. Runoff from portions of the building, pavement, and landscape areas, totaling 2,622 sf, contributes to this design point. For the purposes of the analysis, the property line will be considered the Design Point, DP-1.

WATERSHED EX-2

The southern portion of the site drains to the southeast corner where runoff discharges to the gutter line in Atlantic Ave. This watershed also includes portions of the building, pavement, and landscape areas. This watershed is comprised of 1,403 sf. For the purposes of the analysis, the property line will be considered the Design Point, DP-2.

1.3.2 PROPOSED CONDITIONS

The proposed project includes replacing the existing building with a new building of a similar footprint. As in the existing condition, paved walkways will provide access to the building. The remaining site area will be landscaped.

WATERSHED PW-1

The proposed site design reduces the size of the watershed discharging to DP-1, thereby reducing stormwater runoff to the abutting property to the northeast. The design reduces the amount of roof area contributing to this watershed and uses porous pavement to further reduce stormwater runoff. This watershed is comprised of 2,138 sf. For the purposes of the analysis, the property line will be considered the Design Point, DP-1.

WATERSHED PW-2

The proposed site design increases the size of the watershed discharging to DP-2, including an increase to impervious area. This watershed is comprised of 1,887 sf. The increase of runoff to this design point is mitigated by collecting and infiltrating runoff from paved areas in front of the building. Runoff not collected will discharge to the gutter line in Atlantic Ave. For the purposes of the analysis, the property line will be considered the Design Point, DP-1.

1.4 METHODOLOGY

The peak rate of runoff and sizing of retention BMP's was determined using techniques and data found in the following:

1. Urban Hydrology for Small Watersheds – Technical Release 55 by the United States Department of Agriculture Soils Conservation Service, June 1986. Runoff curve numbers and 24-hour precipitation values were obtained from this reference.
2. HydroCAD© Stormwater Modeling System by HydroCAD Software Solutions LLC, version 10.0. The HydroCAD program was used to generate the runoff hydrographs for the watershed areas, to determine discharge/stage/storage characteristics for the infiltration systems, to perform drainage routing and to combine the results of the runoff hydrographs. This software is based on the Soil Conservation Service (SCS) TR-20 program.

SECTION 2 – MITIGATION MEASURES – BEST MANAGEMENT PRACTICES

Best Management Practices were selected as appropriate to provide a drainage system compliant with the Hull Zoning Code.

2.1 PEAK RATE ATTENUATION

The proposed system has been designed to mitigate increase in runoff leaving the property due to increased impervious areas. The following table summarizes the results of the calculations:

TABLE 2 – RUNOFF FLOW COMPARISON

Design Point		2-YEAR	10-YEAR	100-YEAR
DP-1	*Existing*	*0.07*	*0.16*	*0.39*
	Proposed	**0.06**	**0.13**	**0.32**
DP-2	*Existing*	*010*	*0.15*	*0.28*
	Proposed	**0.10**	**0.15**	**0.26**

Detailed HydroCAD calculations are provided in the appendix.

2.2 ANNUAL RECHARGE TO GROUNDWATER

Annual recharge is based on soil type for the project. As previously noted, the soil type falls within Hydrologic Soil Group A. Following the standard set by MassDEP, for this soil type a recharge rate of 0.60-inch x the Total Impervious Area. The Required Recharge Volume (RRv) for the increase in impervious area for the property is as follows:

RRv = 296 SF x 0.60 / 12 = 15 Cubic Feet

The infiltration trench has been designed to hold and infiltrate a static volume, below the lowest outlet, of 242 cf, far exceeding the 15 cf required.

SECTION 3 – OPERATION & MAINTENANCE PLAN

All stormwater BMPs require on-going maintenance. The following is a brief description for recommended maintenance for the BMP's outlined in this report:

Downspouts:

Building downspouts should be inspected annually towards the end of the fall season to ensure not leaf or other debris has collected and limits flow. Both the top of the downspout, and the connection to the underground pipes should be inspected. Any debris should be removed.

Permeable Pavers:

Inspection: Inspect parking area after precipitation events at a minimum of four times per year to ensure proper drainage. Inspection should preferably occur during extended precipitation events, high-intensity rainfall, and/or rain-on-snow events. If standing water remains on surface of pavers more than 30 minutes after rainfall has ended, cleaning of porous pavers is recommended.

Cleaning: In Clogged areas power wash aggregate between joints to a minimum of 1" below paver surface. Refill joints with clean ASTM NO. 8 aggregate material.

Winter Maintenance: Salting of the permeable pavers is permitted. **No winter sanding shall be allowed on the permeable paver area, as sand will clog the porous pavement surface.** To prevent aesthetic damage to the paver surface (e.g. scarring), shovel area by hand (not with snowblower).

Underground Infiltration Trenches:

During first year visually inspect after each major storm (>1.5") and again 72 hours later to verify exfiltration is occurring as designed. Note if water remains in basin after 72 hours. After first year visually inspect twice per year. Infiltration Systems shall be inspected for accumulation of silt, sediment, standing water, or debris on an annual basis. Debris and sediment shall be removed.

The inspection port is a 6" PVC riser. Removing the inspection port cover will provide access to the Chamber below. From the surface, through this access, the sediment depth may be measured. A stadia rod may be used to measure the depth of sediment. If the depth of sediment is in excess of 3 inches, then this row should be cleaned with high pressure water through a culvert cleaning nozzle. This would be carried out through an upstream structure. CCTV inspection of this row can be deployed through this access port to determine if any sediment has accumulated in the inlet row.

Landscaped Areas:

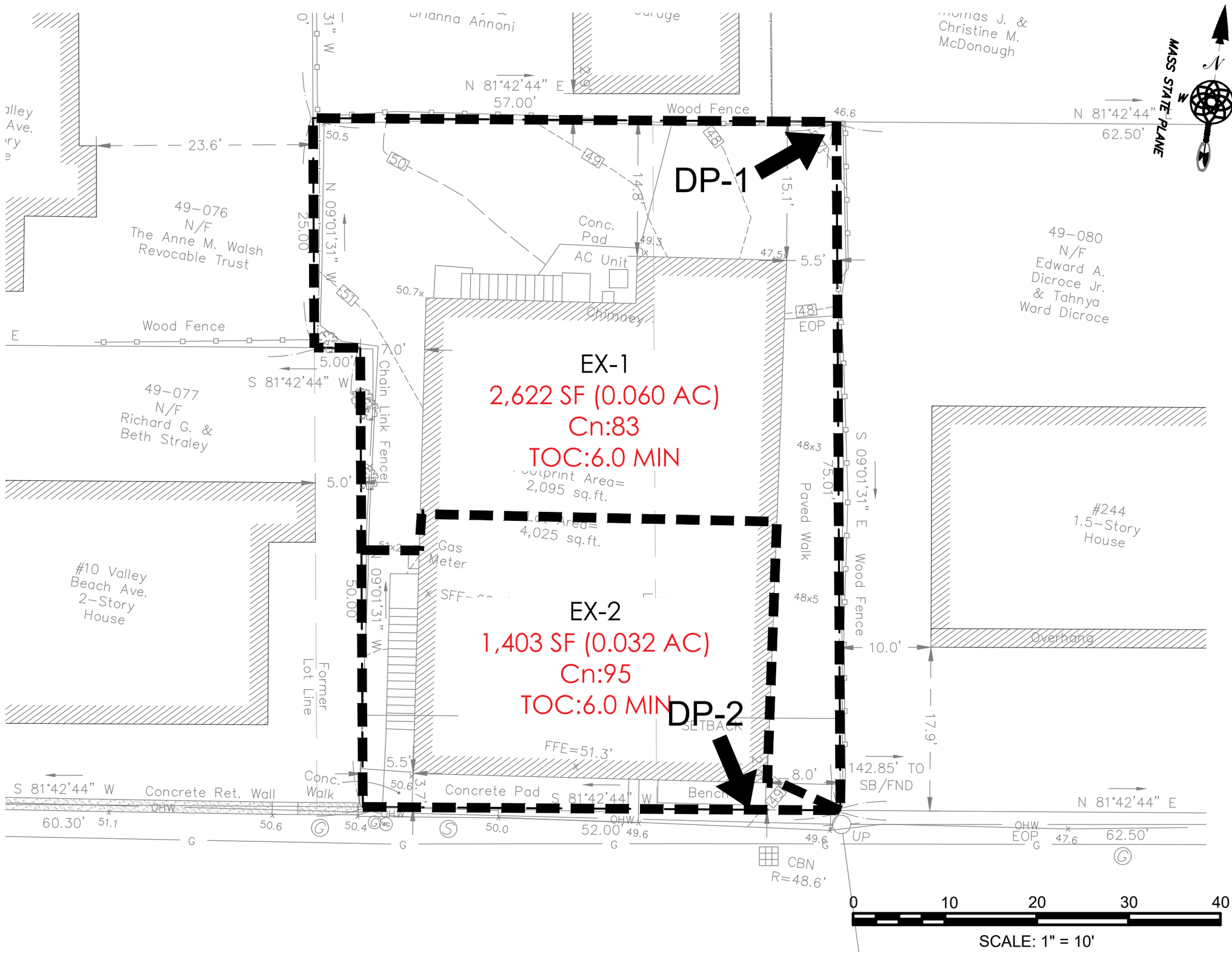
Landscaped areas shall be inspected and maintained on a regular basis. Areas that may be subject to erosion will be stabilized and reseeded immediately. Inspect soil and repair eroded areas monthly. Re-plant void areas as needed. Remove litter and debris monthly. Remove and replace dead vegetation twice per year in spring and fall. Replace soil media if ponding is witnessed more than 48 hours after rainfall event

For further information about the design of the system and on-going maintenance, contact the Engineer of Record:

PVI Site Design, LLC
Attn: Timothy Power, PE

18 Glendale Road
Norwood, MA 02062
tpower@PVIsitedesign.com
339.206.1030

APPENDIX A
Watershed Plans



CIVIL ENGINEER:

PVI SITE DESIGN

PVI Site Design, LLC
Civil Engineering - Land Entitlements
Master Planning - Project Management
339-206-1030

PROJECT:
248 ATLANTIC AVE
248 ATLANTIC AVE, HULL, MA 02045

OWNER::
HARSH REALTY LLC
248 ATLANTIC AVE, HULL, MA 02045

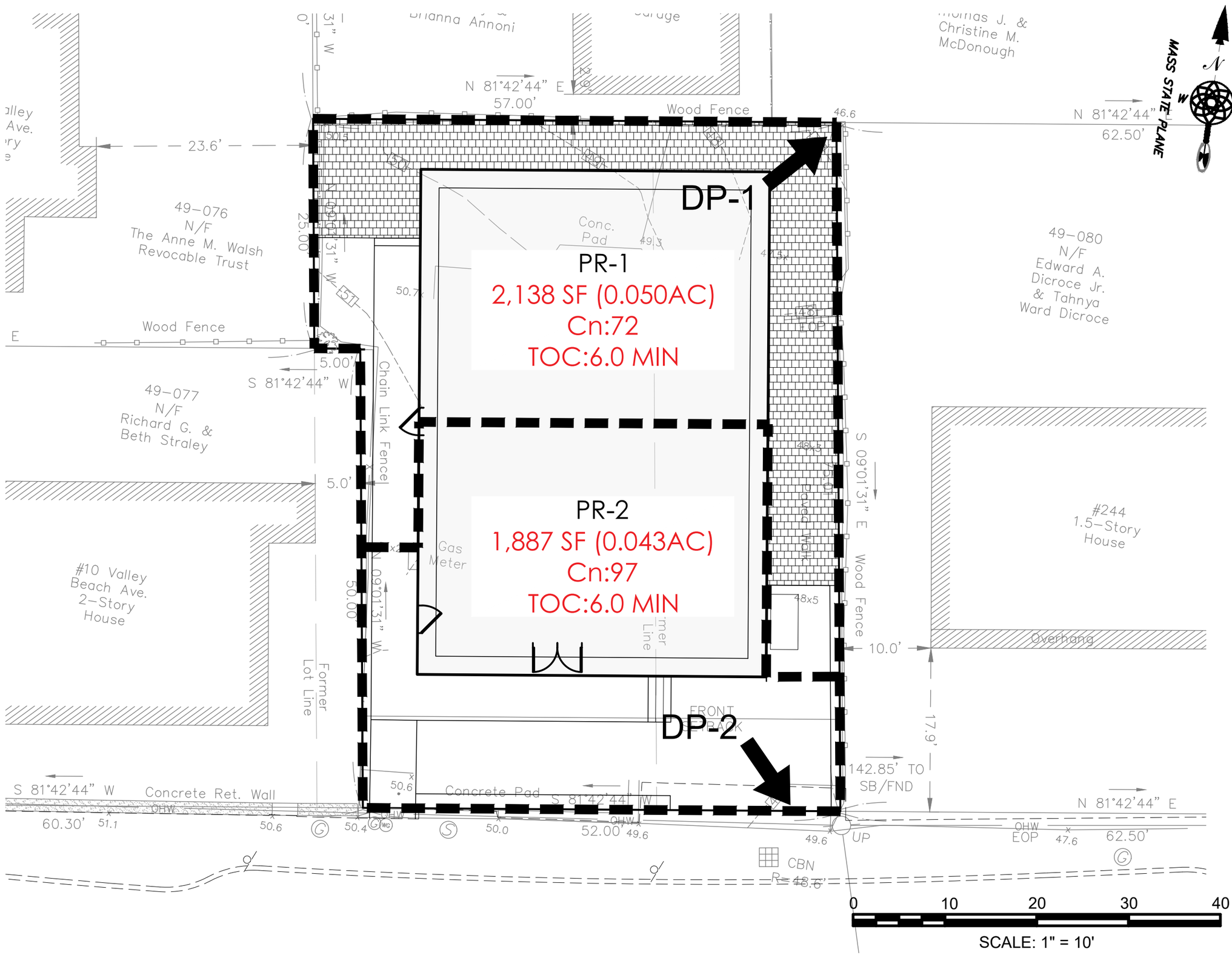
TITLE:
EXISTING WATERSHED PLAN

ISSUED:	11-18-2022
REV:	
REV:	
REV:	
REV:	
REV:	

SCALE:	AS NOTED
PROJECT:	22-016
FILE:	22-016 WATERSHED-EC.dwg
DRAWN:	RLB
CHECKED:	TJP

SHEET NO:

WS-1



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TITLE:
PROPOSED
WATERSHED PLAN

ISSUED:	11-18-2022
REV:	
REV:	
REV:	
REV:	
REV:	

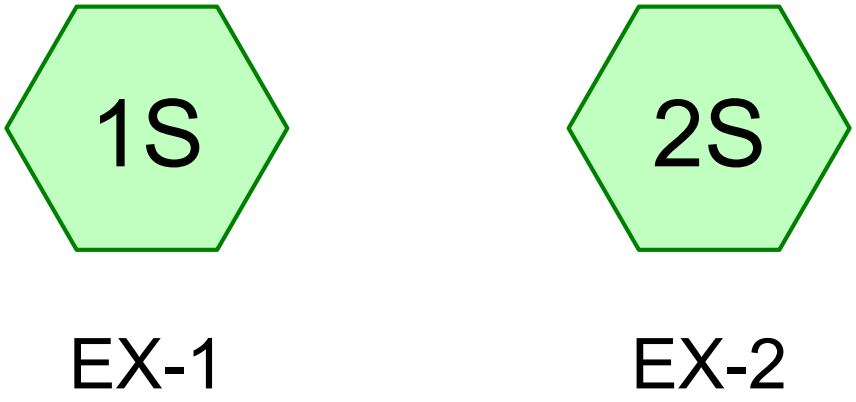
SCALE:	AS NOTED
PROJECT:	22-016
FILE:	22-016 WATERSHED-PR.dwg
DRAWN:	RLB
CHECKED:	TJP
SHEET NO:	

WS-2

APPENDIX B

HydroCAD Calculations

- ***Existing Conditions***
- ***Proposed Conditions***
- ***Infiltration System Stage-Storage Table***



Subcat Reach Pond Link

Routing Diagram for Existing Conditions
Prepared by PVI Site Design, LLC, Printed 11/21/2022

Summary for Subcatchment 1S: EX-1

Runoff = 0.07 cfs @ 12.14 hrs, Volume= 223 cf, Depth> 1.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.35"

Area (sf)	CN	Description
997	98	Roofs, HSG A
455	98	Paved parking, HSG A
1,170	39	>75% Grass cover, Good, HSG A
2,622	72	Weighted Average
1,170		44.62% Pervious Area
1,452		55.38% Impervious Area

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

Summary for Subcatchment 2S: EX-2

Runoff = 0.10 cfs @ 12.13 hrs, Volume= 326 cf, Depth> 2.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.35"

Area (sf)	CN	Description
1,096	98	Roofs, HSG A
225	98	Paved parking, HSG A
82	39	>75% Grass cover, Good, HSG A
1,403	95	Weighted Average
82		5.84% Pervious Area
1,321		94.16% Impervious Area

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

Summary for Subcatchment 1S: EX-1

Runoff = 0.16 cfs @ 12.13 hrs, Volume= 471 cf, Depth> 2.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.95"

Area (sf)	CN	Description
997	98	Roofs, HSG A
455	98	Paved parking, HSG A
1,170	39	>75% Grass cover, Good, HSG A
2,622	72	Weighted Average
1,170		44.62% Pervious Area
1,452		55.38% Impervious Area

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

Summary for Subcatchment 2S: EX-2

Runoff = 0.15 cfs @ 12.13 hrs, Volume= 510 cf, Depth> 4.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.95"

Area (sf)	CN	Description
1,096	98	Roofs, HSG A
225	98	Paved parking, HSG A
82	39	>75% Grass cover, Good, HSG A
1,403	95	Weighted Average
82		5.84% Pervious Area
1,321		94.16% Impervious Area

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

Summary for Subcatchment 1S: EX-1

Runoff = 0.39 cfs @ 12.13 hrs, Volume= 1,156 cf, Depth> 5.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=8.68"

Area (sf)	CN	Description
997	98	Roofs, HSG A
455	98	Paved parking, HSG A
1,170	39	>75% Grass cover, Good, HSG A
2,622	72	Weighted Average
1,170		44.62% Pervious Area
1,452		55.38% Impervious Area

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

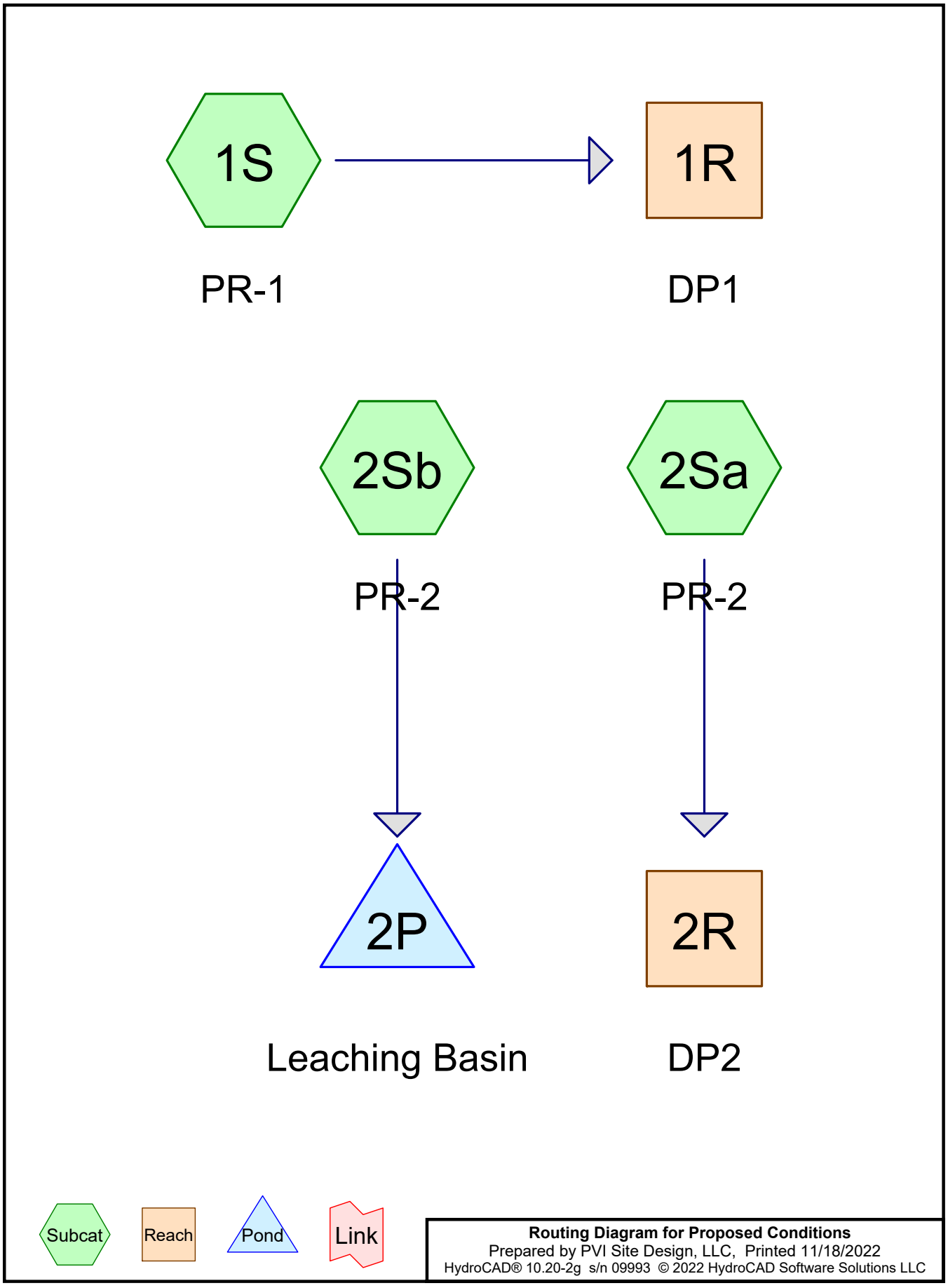
Summary for Subcatchment 2S: EX-2

Runoff = 0.28 cfs @ 12.13 hrs, Volume= 944 cf, Depth> 8.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=8.68"

Area (sf)	CN	Description
1,096	98	Roofs, HSG A
225	98	Paved parking, HSG A
82	39	>75% Grass cover, Good, HSG A
1,403	95	Weighted Average
82		5.84% Pervious Area
1,321		94.16% Impervious Area

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



Routing Diagram for Proposed Conditions
Prepared by PVI Site Design, LLC, Printed 11/18/2022

Summary for Subcatchment 1S: PR-1

Runoff = 0.06 cfs @ 12.14 hrs, Volume= 182 cf, Depth> 1.02"
Routed to Reach 1R : DP1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
	1,044	98	Roofs, HSG A
	168	98	Paved parking, HSG A
*	738	39	>75% Permeable Pavers, Good, HSG A
	188	39	>75% Grass cover, Good, HSG A
	2,138	72	Weighted Average
	926		43.31% Pervious Area
	1,212		56.69% Impervious Area

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

Summary for Subcatchment 2Sa: PR-2

Runoff = 0.10 cfs @ 12.13 hrs, Volume= 329 cf, Depth> 3.00"
Routed to Reach 2R : DP2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.35"

Area (sf)	CN	Description
1,044	98	Roofs, HSG A
244	98	Paved parking, HSG A
28	39	>75% Grass cover, Good, HSG A
1,316	97	Weighted Average
28		2.13% Pervious Area
1,288		97.87% Impervious Area

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

Summary for Subcatchment 2Sb: PR-2

Runoff = 0.04 cfs @ 12.13 hrs, Volume= 148 cf, Depth> 3.11"
Routed to Pond 2P : Leaching Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
	256	98	Paved parking, HSG A
*	315	98	Patio, HSG A
	571	98	Weighted Average
	571		100.00% Impervious Area

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

Summary for Reach 1R: DP1

Inflow Area = 2,138 sf, 56.69% Impervious, Inflow Depth > 1.02" for 2-Year event
Inflow = 0.06 cfs @ 12.14 hrs, Volume= 182 cf
Outflow = 0.06 cfs @ 12.14 hrs, Volume= 182 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Summary for Reach 2R: DP2

Inflow Area = 1,316 sf, 97.87% Impervious, Inflow Depth > 3.00" for 2-Year event
Inflow = 0.10 cfs @ 12.13 hrs, Volume= 329 cf
Outflow = 0.10 cfs @ 12.13 hrs, Volume= 329 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Summary for Pond 2P: Leaching Basin

Inflow Area = 571 sf,100.00% Impervious, Inflow Depth > 3.11" for 2-Year event
Inflow = 0.04 cfs @ 12.13 hrs, Volume= 148 cf
Outflow = 0.00 cfs @ 11.55 hrs, Volume= 148 cf, Atten= 88%, Lag= 0.0 min
Discarded = 0.00 cfs @ 11.55 hrs, Volume= 148 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 45.13' @ 12.81 hrs Surf.Area= 90 sf Storage= 43 cf

Plug-Flow detention time= 54.6 min calculated for 148 cf (100% of inflow)
Center-of-Mass det. time= 53.7 min (810.5 - 756.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	44.00'	109 cf	**6.40'W x 14.00'L x 5.00'H Field A** 448 cf Overall - 177 cf Embedded = 271 cf x 40.0% Voids
#2A	45.00'	133 cf	**Concrete Galley 4x4x4** x 3 Inside #1 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf
		242 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	44.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.00 cfs @ 11.55 hrs HW=44.05' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Summary for Subcatchment 1S: PR-1

Runoff = 0.13 cfs @ 12.13 hrs, Volume= 384 cf, Depth> 2.16"
Routed to Reach 1R : DP1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.95"

	Area (sf)	CN	Description
	1,044	98	Roofs, HSG A
	168	98	Paved parking, HSG A
*	738	39	>75% Permeable Pavers, Good, HSG A
	188	39	>75% Grass cover, Good, HSG A
	2,138	72	Weighted Average
	926		43.31% Pervious Area
	1,212		56.69% Impervious Area

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

Summary for Subcatchment 2Sa: PR-2

Runoff = 0.15 cfs @ 12.13 hrs, Volume= 504 cf, Depth> 4.59"
Routed to Reach 2R : DP2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.95"

Area (sf)	CN	Description
1,044	98	Roofs, HSG A
244	98	Paved parking, HSG A
28	39	>75% Grass cover, Good, HSG A
1,316	97	Weighted Average
28		2.13% Pervious Area
1,288		97.87% Impervious Area

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

Summary for Subcatchment 2Sb: PR-2

Runoff = 0.06 cfs @ 12.13 hrs, Volume= 224 cf, Depth> 4.71"
Routed to Pond 2P : Leaching Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.95"

	Area (sf)	CN	Description
	256	98	Paved parking, HSG A
*	315	98	Patio, HSG A
	571	98	Weighted Average
	571		100.00% Impervious Area

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

Summary for Reach 1R: DP1

Inflow Area = 2,138 sf, 56.69% Impervious, Inflow Depth > 2.16" for 10-Year event
Inflow = 0.13 cfs @ 12.13 hrs, Volume= 384 cf
Outflow = 0.13 cfs @ 12.13 hrs, Volume= 384 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Summary for Reach 2R: DP2

Inflow Area = 1,316 sf, 97.87% Impervious, Inflow Depth > 4.59" for 10-Year event
Inflow = 0.15 cfs @ 12.13 hrs, Volume= 504 cf
Outflow = 0.15 cfs @ 12.13 hrs, Volume= 504 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Summary for Pond 2P: Leaching Basin

Inflow Area = 571 sf,100.00% Impervious, Inflow Depth > 4.71" for 10-Year event
Inflow = 0.06 cfs @ 12.13 hrs, Volume= 224 cf
Outflow = 0.00 cfs @ 11.10 hrs, Volume= 224 cf, Atten= 92%, Lag= 0.0 min
Discarded = 0.00 cfs @ 11.10 hrs, Volume= 224 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 45.78' @ 13.23 hrs Surf.Area= 90 sf Storage= 79 cf

Plug-Flow detention time= 110.4 min calculated for 224 cf (100% of inflow)
Center-of-Mass det. time= 109.6 min (858.6 - 749.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	44.00'	109 cf	**6.40'W x 14.00'L x 5.00'H Field A** 448 cf Overall - 177 cf Embedded = 271 cf x 40.0% Voids
#2A	45.00'	133 cf	**Concrete Galley 4x4x4** x 3 Inside #1 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf
		242 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	44.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.00 cfs @ 11.10 hrs HW=44.05' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Summary for Subcatchment 1S: PR-1

Runoff = 0.32 cfs @ 12.13 hrs, Volume= 943 cf, Depth> 5.29"
Routed to Reach 1R : DP1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=8.68"

	Area (sf)	CN	Description
	1,044	98	Roofs, HSG A
	168	98	Paved parking, HSG A
*	738	39	>75% Permeable Pavers, Good, HSG A
	188	39	>75% Grass cover, Good, HSG A
	2,138	72	Weighted Average
	926		43.31% Pervious Area
	1,212		56.69% Impervious Area

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

Summary for Subcatchment 2Sa: PR-2

Runoff = 0.26 cfs @ 12.13 hrs, Volume= 912 cf, Depth> 8.31"
Routed to Reach 2R : DP2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=8.68"

Area (sf)	CN	Description
1,044	98	Roofs, HSG A
244	98	Paved parking, HSG A
28	39	>75% Grass cover, Good, HSG A
1,316	97	Weighted Average
28		2.13% Pervious Area
1,288		97.87% Impervious Area

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

Summary for Subcatchment 2Sb: PR-2

Runoff = 0.11 cfs @ 12.13 hrs, Volume= 401 cf, Depth> 8.43"
Routed to Pond 2P : Leaching Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=8.68"

	Area (sf)	CN	Description
	256	98	Paved parking, HSG A
*	315	98	Patio, HSG A
	571	98	Weighted Average
	571		100.00% Impervious Area

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

Summary for Reach 1R: DP1

Inflow Area = 2,138 sf, 56.69% Impervious, Inflow Depth > 5.29" for 100-Year event
Inflow = 0.32 cfs @ 12.13 hrs, Volume= 943 cf
Outflow = 0.32 cfs @ 12.13 hrs, Volume= 943 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Summary for Reach 2R: DP2

Inflow Area = 1,316 sf, 97.87% Impervious, Inflow Depth > 8.31" for 100-Year event
Inflow = 0.26 cfs @ 12.13 hrs, Volume= 912 cf
Outflow = 0.26 cfs @ 12.13 hrs, Volume= 912 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Summary for Pond 2P: Leaching Basin

Inflow Area = 571 sf,100.00% Impervious, Inflow Depth > 8.43" for 100-Year event
Inflow = 0.11 cfs @ 12.13 hrs, Volume= 401 cf
Outflow = 0.00 cfs @ 10.05 hrs, Volume= 320 cf, Atten= 96%, Lag= 0.0 min
Discarded = 0.00 cfs @ 10.05 hrs, Volume= 320 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 47.59' @ 14.29 hrs Surf.Area= 90 sf Storage= 179 cf

Plug-Flow detention time= 234.6 min calculated for 319 cf (80% of inflow)
Center-of-Mass det. time= 149.5 min (889.9 - 740.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	44.00'	109 cf	**6.40'W x 14.00'L x 5.00'H Field A** 448 cf Overall - 177 cf Embedded = 271 cf x 40.0% Voids
#2A	45.00'	133 cf	**Concrete Galley 4x4x4** x 3 Inside #1 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf
		242 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	44.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.00 cfs @ 10.05 hrs HW=44.05' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Stage-Area-Storage for Pond 2P: Leaching Basin

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
44.00	**90**	0
44.05	90	2
44.10	90	4
44.15	90	5
44.20	90	7
44.25	90	9
44.30	90	11
44.35	90	13
44.40	90	14
44.45	90	16
44.50	90	18
44.55	90	20
44.60	90	22
44.65	90	23
44.70	90	25
44.75	90	27
44.80	90	29
44.85	90	30
44.90	90	32
44.95	90	34
45.00	90	36
45.05	90	39
45.10	90	41
45.15	90	44
45.20	90	47
45.25	90	49
45.30	90	52
45.35	90	55
45.40	90	58
45.45	90	61
45.50	90	63
45.55	90	66
45.60	90	69
45.65	90	72
45.70	90	75
45.75	90	77
45.80	90	80
45.85	90	83
45.90	90	86
45.95	90	88
46.00	90	91
46.05	90	94
46.10	90	97
46.15	90	100
46.20	90	102
46.25	90	105
46.30	90	108
46.35	90	111
46.40	90	113
46.45	90	116
46.50	90	119
46.55	90	122
46.60	90	125
46.65	90	127
46.70	90	130
46.75	90	133
46.80	90	136
46.85	90	138
46.90	90	141
46.95	90	144
47.00	90	147
47.05	90	150
47.10	90	152
47.15	90	155
47.20	90	158
47.25	90	161
47.30	90	163
47.35	90	166
47.40	90	169
47.45	90	172
47.50	90	174
47.55	90	177
47.60	90	180
47.65	90	183
47.70	90	185
47.75	90	188
47.80	90	191
47.85	90	194
47.90	90	196
47.95	90	199
48.00	90	202
48.05	90	205
48.10	90	207
48.15	90	210
48.20	90	213
48.25	90	216
48.30	90	218
48.35	90	221
48.40	90	224
48.45	90	227
48.50	90	229
48.55	90	232
48.60	90	234
48.65	90	235
48.70	90	236
48.75	90	237
48.80	90	238
48.85	90	239
48.90	90	240
48.95	90	241
49.00	90	**242**

APPENDIX C
NRCS Soils Report

Soil Map—Plymouth County, Massachusetts
(248 Atlantic Ave)

Map Scale: 1:1,650 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 20 40 80 120

Feet
0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Plymouth County, Massachusetts
Survey Area Data: Version 15, Sep 9, 2022

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
110E	Canton-Chatfield-Rock outcrop complex, 15 to 35 percent slopes, very stony	1.1	9.8%
635C	Canton - Urban land - Rock outcrop complex, 3 to 15 percent slopes	10.2	90.2%
Totals for Area of Interest		**11.3**	**100.0%**

Plymouth County, Massachusetts

635C—Canton - Urban land - Rock outcrop complex, 3 to 15 percent slopes

Map Unit Setting

National map unit symbol: 9y4x
Elevation: 0 to 400 feet
Mean annual precipitation: 41 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Canton and similar soils: 35 percent
Rock outcrop: 30 percent
Urban land: 25 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Canton

Setting

Landform: Till plains, ridges, hills
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Coarse-loamy eolian deposits over sandy and gravelly supraglacial meltout till

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: very fine sandy loam
E - 3 to 4 inches: very fine sandy loam
Bw1 - 4 to 5 inches: very fine sandy loam
Bw2 - 5 to 15 inches: very fine sandy loam
Bw3 - 15 to 24 inches: fine sandy loam
BC - 24 to 28 inches: gravelly loamy sand
2C1 - 28 to 49 inches: gravelly coarse sand
2C2 - 49 to 73 inches: gravelly loamy coarse sand

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: 20 to 36 inches to strongly contrasting textural stratification
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)

Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Description of Rock Outcrop

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s

Minor Components

Gloucester

Percent of map unit: 5 percent
Landform: Hills, ground moraines
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Udorthents, loamy

Percent of map unit: 5 percent
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Data Source Information

Soil Survey Area: Plymouth County, Massachusetts
Survey Area Data: Version 15, Sep 9, 2022