

Proposed Redevelopment

1400 West Main Road
Middletown, Rhode Island

PREPARED FOR

Carpionato Group, LLC
1414 Atwood Avenue
Johnston, Rhode Island 02919

PREPARED BY



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May 2019

Revised August 2020



List of Appendices

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Project Description

Existing Conditions

The Project Site ("the Site") is an existing development located at 1400 West Main Road in Middletown, Rhode Island. The approximately 11.16 acre Site operates as a retail development with multiple buildings and parking; a lumberyard occupies the West/rear portion of the Site, while the front/East end of the Site consists of a currently unoccupied retail building. The Site is heavily developed with approximately 80% impervious surface coverage and is generally flat, sloping from the middle of the site to the front and rear.

Stormwater runoff for the Site is collected via at-grade discharge locations and/or catch basins and is piped east to a stormwater management basin (the Basin) at the northeast corner of the property. There are four known existing connections to the Basin. The Basin discharges to the RI DOT owned and operated closed drainage system in West Main Road that empties into Bailey's Brook. Bailey's Brook has a TMDL for Enterococcus. It is also impaired for lead and total phosphorus. The Site is located within the Aquidneck Island – Frontal Atlantic Ocean watershed.

Refer to Figure 2 for more information.

Proposed Conditions

The redevelopment project involves the renovation of one of the existing buildings (BLDG B), the renovation and extension of another building (Building C), the construction of three new buildings (Buildings A, D, and E), and the demolition of one existing building. The project also includes modifications to the driveways and parking areas, landscaping, stormwater infrastructure including at-grade and subsurface, and utilities. Low impact development (LID) and other best management practices (BMPs) have been proposed to mitigate the impact of this activity. Existing drainage patterns were maintained to the maximum extent practicable in the proposed design.

Stormwater discharge quantity from the Site is waived from RIDEM review because it is a redevelopment. Peak flow and volume calculations and summaries are provided below and in Appendices for local and RI DOT review.

Site Ground Cover Conditions

Existing Conditions		Proposed Conditions	
Impervious Area	387,234 SF	Impervious Area	355,800 SF
Pervious Area	99,026 SF	Pervious Area	130,460 SF

Design Point 1 On-Site Stormwater Management Basin (Discharges to RI DOT Drainage System, ultimately to Bailey's Brook)

Peak Runoff Rate-24-hour storm event

Existing Conditions		Proposed Conditions	
1-year:	19.0 CFS	1-year:	17.3 CFS
2-year:	22.3 CFS	2-year:	20.7 CFS
10-year:	32.6 CFS	10-year:	31.4 CFS
25-year:	40.2 CFS	25-year:	39.4 CFS
100-year:	55.9 CFS	100-year:	55.8 CFS

Discharge Volume

Existing Conditions		Proposed Conditions	
10-year:	164,509 CF	10-year:	159,573 CF
100-year:	305,179 CF	100-year:	299,274 CF

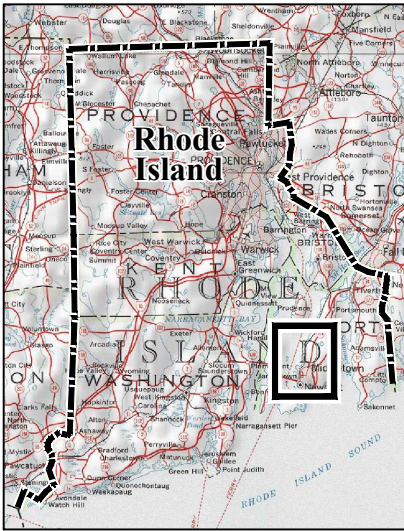
Post-development peak discharge rates from the 1, 2, 10, 25 and 100-year frequency storm are below pre-development rates.

Peak flow and discharge volume to the existing detention basin are reduced under proposed conditions in the 10 and 100-year storm event to below pre-development conditions values because of an overall decrease in impervious surface.

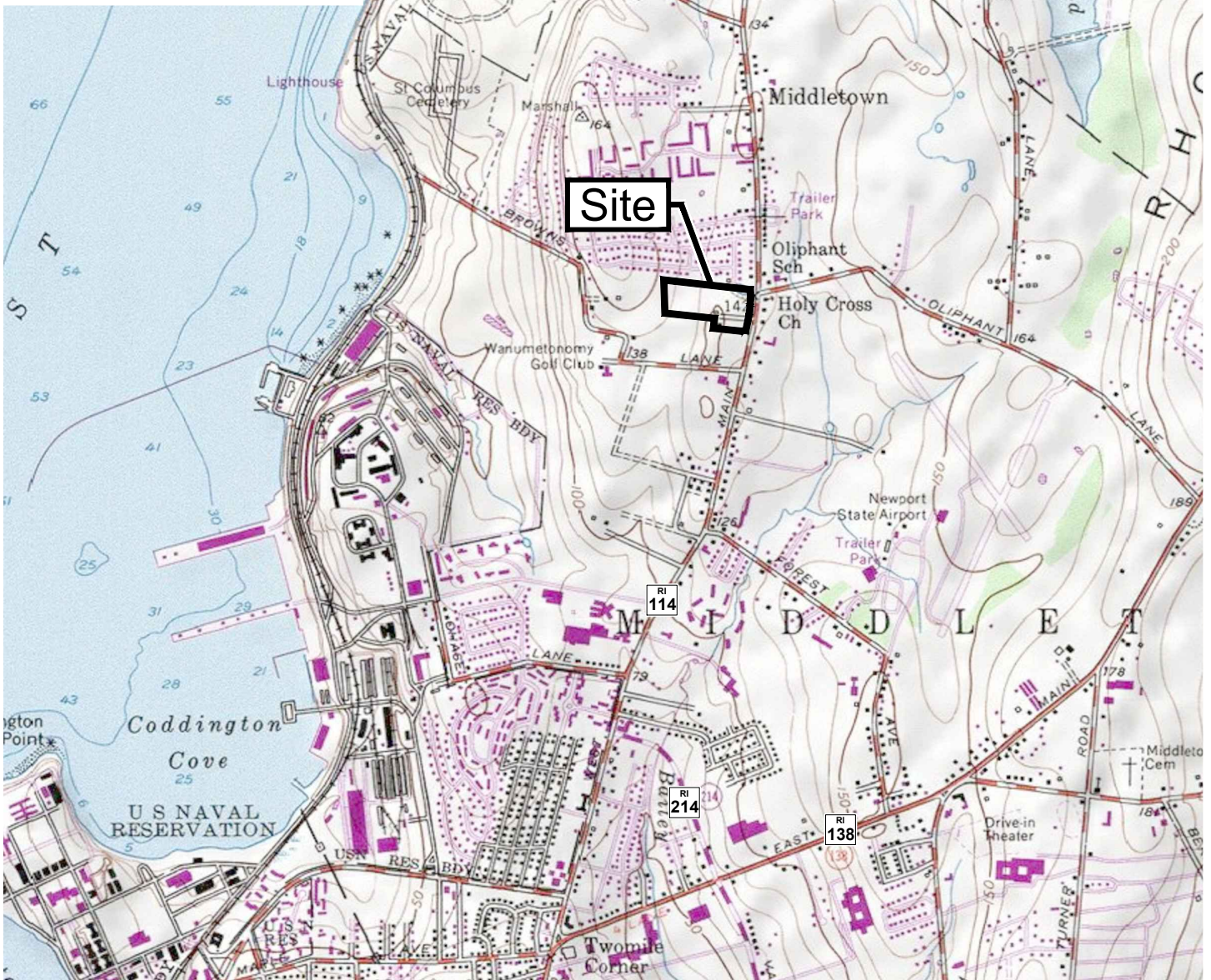
The proposed design resulted in the modification to a portion of the existing detention basin. The design ensures existing pond volumes were maintained. Calculations are provided in Appendix B.

The proposed stormwater conveyance system has been designed to accommodate a 25-year storm event in accordance with the Town of Middletown Stormwater Ordinance.

Refer to Figure 3 for more information.



Project Location Key



Source: USGS Quadrangles



Project Location Map
Proposed Development
1400 West Main Street
Middletown, Rhode Island

Figure 1



0 1000 2000 Feet



1 Cedar Street
Suite 400
Providence, RI 02903
401.272.8100

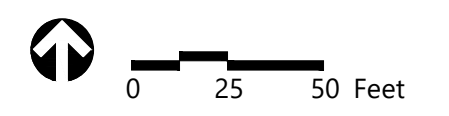
Legend

SYMBOLS

- DESIGN POINT
- DRAINAGE AREA DESIGNATION
- POND
- LINETYPES**
- DRAINAGE AREA BOUNDARY
- TIME OF CONCENTRATION FLOW LINE
- SOIL TYPE BOUNDARY
- FLOW DIRECTION

SCS SOIL CLASSIFICATIONS

- NEWPORT-URBAN LAND COMPLEX, HSG C
- PITTSVILLE SILT LOAM, 3 TO 8 PERCENT SLOPES, HSG C
- URBAN LAND



Proposed Redevelopment

1400 West Main Road
Middletown, Rhode Island

No.	Revision	Date	Appd.

Designed by	Checked by
Issued for	Date

May 28, 2019

State Permits

Drawing Title
**Figure 2
Existing Drainage Areas**

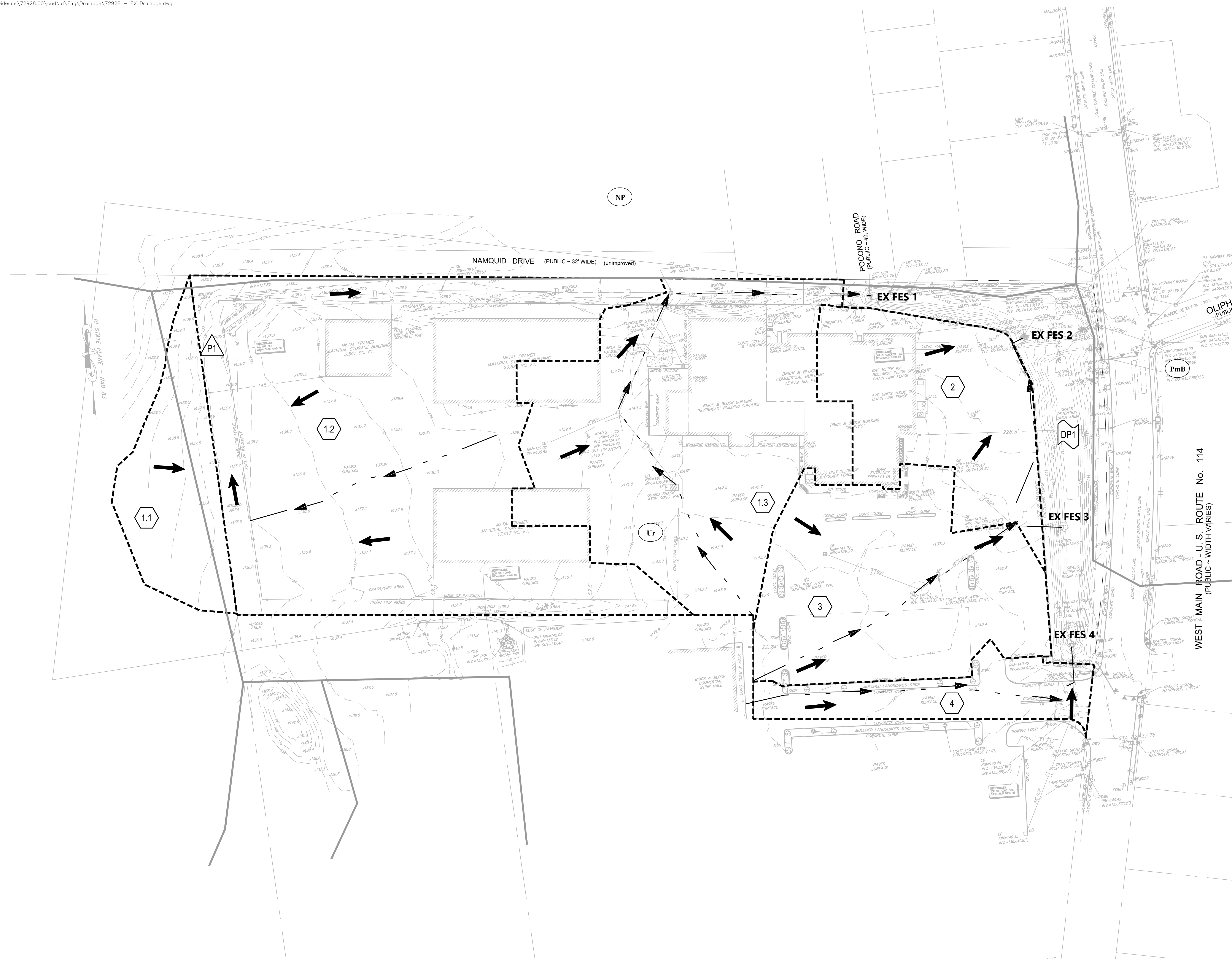
Drawing Number

FIG-2

Sheet of
1 1

Project Number
72928.00

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1 Cedar Street
Suite 400
Providence, RI 02903
401.272.8100

Legend

SYMBOLS

- DESIGN POINT
- DRAINAGE AREA DESIGNATION
- POND
- DRY SWALE SEGMENT
- PIPE SEGMENT

LINETYPES

- DRAINAGE AREA BOUNDARY
- TIME OF CONCENTRATION FLOW LINE
- SOIL TYPE BOUNDARY
- FLOW DIRECTION

SCS SOIL CLASSIFICATIONS

- NEWPORT-URBAN LAND COMPLEX, HSG C
- PITTSFORD SILT LOAM, 3 TO 8 PERCENT SLOPES, HSG C
- URBAN LAND

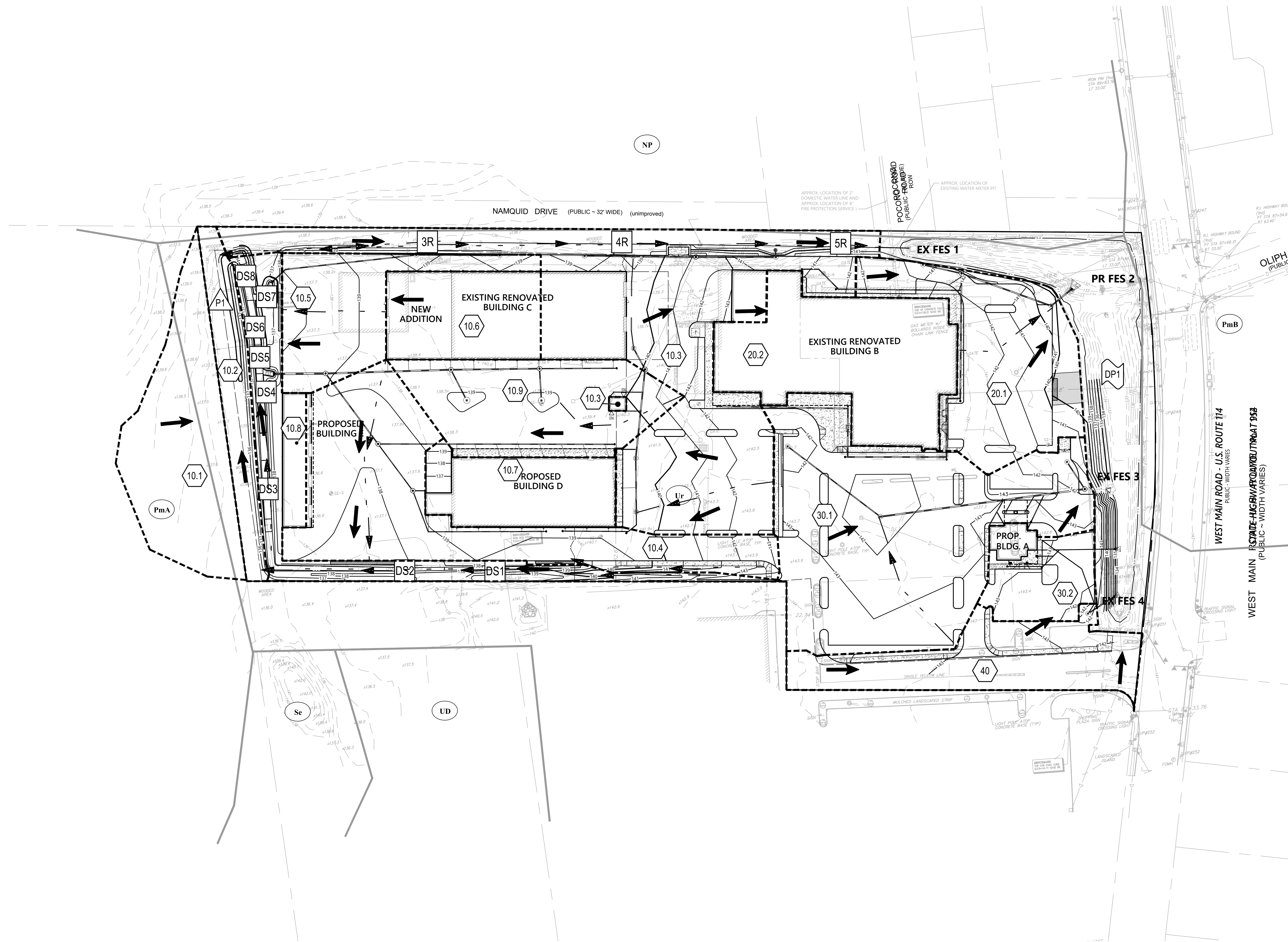


Proposed Redevelopment
1400 West Main Road
Middletown, Rhode Island

No.	Revision	Date	App'd.

Designed by: SAP Checked by: AEC
Issued for: Date: April 18, 2022

Permits
Drawing Title: **Figure 3 Proposed Drainage Areas**
Drawing Number: **FIG-3**



Appendix A –RIDEM Stormwater Management Checklist and LID Planning Report

APPENDIX A: STORMWATER MANAGEMENT PLAN CHECKLIST AND LID PLANNING REPORT – STORMWATER DESIGN SUMMARY

PROJECT NAME Proposed Redevelopment	(RIDEM USE ONLY)
TOWN Middletown, Rhode Island	STW/WQC File #:
BRIEF PROJECT DESCRIPTION: Redevelopment of retail plaza. This is a Modification to RIDEM PERMIT No. RIR101913.	Date Received:

Stormwater Management Plan (SMP) Elements – Minimum Standards

When submitting a SMP,¹ submit **four separately bound** documents: Appendix A Checklist; Stormwater Site Planning, Analysis and Design Report with Plan Set/Drawings; Soil Erosion and Sediment Control (SESC) Plan, and Post Construction Operations and Maintenance (O&M) Plan. Please refer to [Suggestions to Promote Brevity](#).

Note: All stormwater construction projects **must create** a Stormwater Management Plan (SMP). However, not every element listed below is required per the [RIDEM Stormwater Rules](#) and the [RIPDES Construction General Permit \(CGP\)](#). This checklist will help identify the required elements to be submitted with an Application for Stormwater Construction Permit & Water Quality Certification.

PART 1. PROJECT AND SITE INFORMATION

PROJECT TYPE (Check all that apply)

<input type="checkbox"/> Residential	<input checked="" type="checkbox"/> Commercial	<input type="checkbox"/> Federal	<input type="checkbox"/> Retrofit	<input type="checkbox"/> Restoration
<input type="checkbox"/> Road	<input type="checkbox"/> Utility	<input type="checkbox"/> Fill	<input type="checkbox"/> Dredge	<input type="checkbox"/> Mine
<input type="checkbox"/> Other (specify):				

SITE INFORMATION

Vicinity Map

INITIAL DISCHARGE LOCATION(S): The WQv discharges to: (You may choose more than one answer if several discharge points are associated with the project.)

<input type="checkbox"/> Groundwater	<input type="checkbox"/> Surface Water	<input checked="" type="checkbox"/> MS4
<input type="checkbox"/> GAA	<input type="checkbox"/> Isolated Wetland	<input checked="" type="checkbox"/> RIDOT
<input type="checkbox"/> GA	<input type="checkbox"/> Named Waterbody	<input type="checkbox"/> RIDOT Alteration Permit is Approved
<input type="checkbox"/> GB	<input type="checkbox"/> Unnamed Waterbody Connected to Named Waterbody	<input type="checkbox"/> Town
		<input type="checkbox"/> Other (specify):

ULTIMATE RECEIVING WATERBODY LOCATION(S): Include pertinent information that applies to both WQv and flow from larger storm events including overflows. Choose all that apply, and repeat table for each waterbody.

<input type="checkbox"/> Groundwater or Disconnected Wetland	<input type="checkbox"/> SRWP
<input checked="" type="checkbox"/> Waterbody Name: Bailey’s Brook	<input type="checkbox"/> Coldwater <input checked="" type="checkbox"/> Warmwater <input type="checkbox"/> Unassessed
<input checked="" type="checkbox"/> Waterbody ID: RI0007035R-01	<input type="checkbox"/> 4 th order stream of pond 50 acres or more
<input checked="" type="checkbox"/> TMDL for: Enterococcus	<input type="checkbox"/> Watershed of flood prone river (e.g., Pocasset River)
<input type="checkbox"/> Contributes to a priority outfall listed in the TMDL	<input type="checkbox"/> Contributes stormwater to a public beach
<input checked="" type="checkbox"/> 303(d) list – Impairment(s) for: enterococcus, phosphorus, lead	<input type="checkbox"/> Contributes to shellfishing grounds

¹ Applications for a Construction General Permit that do not require any other permits from RIDEM and will disturb less than 5 acres over the entire course of the project do not need to submit a SMP. The Appendix A checklist must still be submitted.

PROJECT HISTORY		
<input type="checkbox"/> RIDEM Pre- Application Meeting	Meeting Date:	<input type="checkbox"/> Minutes Attached
<input type="checkbox"/> Municipal Master Plan Approval	Approval Date:	<input type="checkbox"/> Minutes Attached
<input type="checkbox"/> Subdivision Suitability Required	Approval #:	
<input type="checkbox"/> Previous Enforcement Action has been taken on the property	Enforcement #:	
FLOODPLAIN & FLOODWAY See Guidance Pertaining to Floodplain and Floodways		
<input type="checkbox"/> Riverine 100-year floodplain: FEMA FLOODPLAIN FIRMETTE has been reviewed and the 100-year floodplain is on site		
<input type="checkbox"/> Delineated from FEMA Maps		
NOTE: Per Rule 250-RICR-150-10-8-1.1(B)(5)(d)(3), provide volumetric floodplain compensation calculations for cut and fill/displacement calculated by qualified professional		
<input type="checkbox"/> Calculated by Professional Engineer		
<input type="checkbox"/> Calculations are provided for cut vs. fill/displacement volumes proposed within the 100-year floodplain	Amount of Fill (CY):	
	Amount of Cut (CY):	
<input type="checkbox"/> Restrictions or modifications are proposed to the flow path or velocities in a floodway		
<input type="checkbox"/> Floodplain storage capacity is impacted		
<input checked="" type="checkbox"/> Project area is not within 100-year floodplain as defined by RIDEM		

CRMC JURISDICTION
<input type="checkbox"/> CRMC Assent required
<input type="checkbox"/> Property subject to a Special Area Management Plan (SAMP). If so, specify which SAMP:
<input type="checkbox"/> Sea level rise mitigation has been designed into this project

LUHPPL IDENTIFICATION - MINIMUM STANDARD 8:		
1. OFFICE OF Land Revitalization and Sustainable Materials Management (OLRSMM)		
<input type="checkbox"/> Known or suspected releases of HAZARDOUS MATERIAL are present at the site (Hazardous Material is defined in Rule 1.4(A)(33) of 250-140-30-1 of the RIDEM Rules and Regulations for Investigation and Remediation of Hazardous Materials (the Remediation Regulations))		RIDEM CONTACT:
<input type="checkbox"/> Known or suspected releases of PETROLEUM PRODUCT are present at the site (Petroleum Product as defined in Rule 1.5(A)(84) of 250-140-25-1 of the RIDEM Rules and Regulations for Underground Storage Facilities Used for Regulated Substances and Hazardous Materials)		
<input type="checkbox"/> This site is identified on the RIDEM Environmental Resources Map as one of the following regulated facilities		SITE ID#:
<input type="checkbox"/> CERCLIS/Superfund (NPL)		
<input type="checkbox"/> State Hazardous Waste Site (SHWS)		
<input type="checkbox"/> Environmental Land Usage Restriction (ELUR)		
<input type="checkbox"/> Leaking Underground Storage Tank (LUST)		
<input type="checkbox"/> Closed Landfill		
Note: If any boxes in 1 above are checked, the applicant must contact the RIDEM OLRSM Project Manager associated with the Site to determine if subsurface infiltration of stormwater is allowable for the project. Indicate if the infiltration corresponds to “Red,” “Yellow” or “Green” as described in Section 3.2.8 of the RISDISM Guidance (Subsurface Contamination Guidance). Also, note and reference approval in PART 3, Minimum Standard 2: Groundwater Recharge/Infiltration.		
2. PER MINIMUM STANDARD 8 of RICR 8.14.C.1-6 “LUHPPLS,” THE SITE IS/HAS:		
<input type="checkbox"/> Industrial Site with RIPDES MSGP, except where No Exposure Certification exists. http://www.dem.ri.gov/programs/water/permits/ripdes/stormwater/status.php		
<input type="checkbox"/> Auto Fueling Facility (e.g., gas station)		
<input type="checkbox"/> Exterior Vehicles Service, Maintenance, or Equipment Cleaning Area		

Stormwater Management, Design, and Installation Rules (250-RICR-150-10-8)

<input type="checkbox"/>	Road Salt Storage and Loading Areas (exposed to rainwater)	
<input type="checkbox"/>	Outdoor Storage and Loading/Unloading of Hazardous Substances	
3. STORMWATER INDUSTRIAL PERMITTING		
<input type="checkbox"/>	The site is associated with existing or proposed activities that are considered Land Uses with Higher Potential Pollutant Loads (LUHPPLS) (see RICR 8.14.C)	Activities: Sector:
<input type="checkbox"/>	Construction is proposed on a site that is subject to THE MULTI-SECTOR GENERAL PERMIT (MSGP) UNDER RULE 31(B)15 OF THE RIPDES REGULATIONS.	MSGP permit #
<input type="checkbox"/>	Additional stormwater treatment is required by the MSGP Explain:	

REDEVELOPMENT STANDARD – MINIMUM STANDARD 6		
<input checked="" type="checkbox"/> Pre Construction Impervious Area		
<input type="checkbox"/>	Total Pre-Construction Impervious Area (TIA) 8.89 ac	
<input type="checkbox"/>	Total Site Area (TSA) 11.16 ac	
<input type="checkbox"/>	Jurisdictional Wetlands (JW) 0 ac	
<input type="checkbox"/>	Conservation Land (CL) 0 ac	
<input checked="" type="checkbox"/> Calculate the Site Size (defined as contiguous properties under same ownership)		
<input type="checkbox"/>	Site Size (SS) = (TSA) – (JW) – (CL) 11.16 – 0 – 0 = 11.16 ac	
<input type="checkbox"/>	(TIA) / (SS) = 8.89 / 11.16 = 0.80	<input checked="" type="checkbox"/> (TIA) / (SS) >0.4?
<input checked="" type="checkbox"/> YES, Redevelopment		

PART 2. LOW IMPACT DEVELOPMENT ASSESSMENT – MINIMUM STANDARD 1
(NOT REQUIRED FOR REDEVELOPMENT OR RETROFITS)
This section may be deleted if not required.

PART 3. SUMMARY OF REMAINING STANDARDS

GROUNDWATER RECHARGE – MINIMUM STANDARD 2		
YES	NO	
<input type="checkbox"/>	<input checked="" type="checkbox"/>	The project has been designed to meet the groundwater recharge standard.
<input type="checkbox"/>	<input checked="" type="checkbox"/>	If “No,” the justification for groundwater recharge criterion waiver has been explained in the Narrative (e.g., threat of groundwater contamination or physical limitation), if applicable (see RICR 8.8.D);
<input type="checkbox"/>	<input type="checkbox"/>	Your waiver request has been explained in the Narrative, if applicable.
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Is this site identified as a Regulated Facility in Part 1, Minimum Standard 8: LUHPPL Identification?
<input type="checkbox"/>	<input type="checkbox"/>	If “Yes,” has approval for infiltration by the OLRSM Site Project Manager, per Part 1, Minimum Standard 8, been requested?

TABLE 2-1: Summary of Recharge (see RISDISM Section 3.3.2) (Add or Subtract Rows as Necessary)					
Design Point	Impervious Area Treated (sq ft)	Total Re _v Required (cu ft)	LID Stormwater Credits (see RISDISM Section 4.6.1)	Recharge Required by Remaining BMPs (cu ft)	Recharge Provided by BMPs (cu ft)

Stormwater Management, Design, and Installation Rules (250-RICR-150-10-8)

			Portion of Re_v directed to a QPA (cu ft)		
DP-1:	130,680	2,723	0	2,723	0
TOTALS:					
Notes: 1. Only BMPs listed in RISDISM Table 3-5 “List of BMPs Acceptable for Recharge” may be used to meet the recharge requirement. 2. Recharge requirement must be satisfied for each waterbody ID.					
1 <input checked="" type="checkbox"/> Indicate where the pertinent calculations and/or information for the above items are provided (i.e., name of report/document, page numbers, appendices, etc.): GEOTECHNICAL INVESTIGATION SHOWS LOW-PERMEABILITY SOIL (GLACIAL TILL) IN ALL BORING TEST LOGS. REFER TO APPENDIX G					

Stormwater Management, Design, and Installation Rules (250-RICR-150-10-8)

WATER QUALITY – MINIMUM STANDARD 3		
YES	NO	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Does this project meet or exceed the required water quality volume WQv (see RICR 8.9.E-I)?
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Is the proposed final impervious cover greater than 20% of the disturbed area (see RICR 8.9.E-I)?
<input checked="" type="checkbox"/>	<input type="checkbox"/>	If “Yes,” either the Modified Curve Number Method or the Split Pervious/Impervious method in Hydro-CAD was used to calculate WQv; or,
<input type="checkbox"/>	<input type="checkbox"/>	If “Yes,” either TR-55 or TR-20 was used to calculate WQv; and,
<input type="checkbox"/>	<input type="checkbox"/>	If “No,” the project meets the minimum WQv of 0.2 watershed inches over the entire disturbed area.
<input type="checkbox"/>	<input type="checkbox"/>	Not Applicable
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Does this project meet or exceed the ability to treat required water quality flow WQf (see RICR 8.9.I.1-3)?
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Does this project propose an increase of impervious cover to a receiving water body with impairments? If “Yes,” please indicate below the method that was used to address the water quality requirements of no further degradation to a low-quality water.
<input type="checkbox"/>	<input checked="" type="checkbox"/>	RICR 8.36. A Pollutant Loading Analysis is needed and has been completed.
<input type="checkbox"/>	<input checked="" type="checkbox"/>	The Water Quality Guidance Document (Water Quality Goals and Pollutant Loading Analysis Guidance for Discharges to Impaired Waters) has been followed as applicable.
<input type="checkbox"/>	<input checked="" type="checkbox"/>	BMPs are proposed that are on the approved technology list . If “Yes,” please provide all required worksheets from the manufacturer.
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Additional pollutant-specific requirements and/or pollutant removal efficiencies are applicable to the site as the result of a TMDL, SAMP, or other watershed-specific requirements. If “Yes,” please describe:

TABLE 3-1: Summary of Water Quality (see RICR 8.9)					
Design Point and WB ID	Impervious area treated (ac)	Total WQv Required (ac ft)	LID Stormwater Credits (see RICR 8.18)	Water Quality Treatment Remaining (ac ft)	Water Quality Provided by BMPs (ac ft)
			WQv directed to a QPA (ac ft)		
DP-1:	2.8	0.230	0.001	0.229	0.234
TOTALS:	2.8	0.230	0.001	0.229	0.234
Notes:					
1. Only BMPs listed in RICR 8.20 and 8.25 or the Approved Technologies List of BMPs is Acceptable for Water Quality treatment.					
2. For each Design Point, the Water Quality Volume Standard must be met for each Waterbody ID.					
<input checked="" type="checkbox"/> YES	This project has met the setback requirements for each BMP.				
<input type="checkbox"/> NO	If “No,” please explain:				
<input checked="" type="checkbox"/>	Indicate where the pertinent calculations and/or information for the above items are provided (i.e., name of report/document, page numbers, appendices, etc.):				
REFER TO APPENDIX B FOR WATER QUALITY CALCULATIONS.					

Stormwater Management, Design, and Installation Rules (250-RICR-150-10-8)

CONVEYANCE AND NATURAL CHANNEL PROTECTION (RICR 8.10) – MINIMUM STANDARD 4		
YES	NO	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Is this standard waived? If “Yes,” please indicate one or more of the reasons below:
		<input type="checkbox"/> The project directs discharge to a large river (i.e., 4th-order stream or larger. See RISDISM Appendix I for State-wide list and map of stream orders), bodies of water >50.0 acres in surface area (i.e., lakes, ponds, reservoirs), or tidal waters. <input type="checkbox"/> The project is a small facility with impervious cover of less than or equal to 1 acre. <input type="checkbox"/> The project has a post-development peak discharge rate from the facility that is less than 2 cfs for the 1-year, 24-hour Type III design storm event (prior to any attenuation). (<u>Note</u> : LID design strategies can greatly reduce the peak discharge rate). The project is a redevelopment.
<input type="checkbox"/>	<input type="checkbox"/>	Conveyance and natural channel protection for the site have been met. If “No,” explain why:

TABLE 4-1: Summary of Channel Protection Volumes (see RICR 8.10)

Design Point	Receiving Water Body Name	Coldwater Fishery? (Y/N)	Total CPv Required (cu ft)	Total CPv Provided (cu ft)	Average Release Rate Modeled in the 1-yr storm (cfs)
DP-1:					
TOTALS:					
<u>Note</u> : The Channel Protection Volume Standard must be met in each waterbody ID.					
<input type="checkbox"/> YES <input type="checkbox"/> NO	The CPv is released at roughly a uniform rate over a 24-hour duration (see examples of sizing calculations in Appendix D of the RISDISM).				
<input type="checkbox"/> YES <input type="checkbox"/> NO	Do additional design restrictions apply resulting from any discharge to cold-water fisheries; If “Yes,” please indicate restrictions and solutions below.				
<input type="checkbox"/> Indicate below where the pertinent calculations and/or information for the above items are provided (i.e., name of report/document, page numbers, appendices, etc.).					

Stormwater Management, Design, and Installation Rules (250-RICR-150-10-8)

OVERBANK FLOOD PROTECTION (RICR 8.11) AND OTHER POTENTIAL HIGH FLOWS – MINIMUM STANDARD 5		
YES	NO	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Is this standard waived? If yes, please indicate one or more of the reasons below:
		<input type="checkbox"/> The project directs discharge to a large river (i.e., 4th-order stream or larger. See Appendix I for state-wide list and map of stream orders), bodies of water >50.0 acres in surface area (i.e., lakes, ponds, reservoirs), or tidal waters. <input type="checkbox"/> A Downstream Analysis (see RICR 8.11.D and E) indicates that peak discharge control would not be beneficial or would exacerbate peak flows in a downstream tributary of a particular site (e.g., through coincident peaks). The project is a redevelopment. Hydrologic and hydraulic analysis is included for RIDOT and local review.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Does the project flow to an MS4 system or subject to other stormwater requirements? If “Yes,” indicate as follows:
		<input checked="" type="checkbox"/> RIDOT <input type="checkbox"/> Other (specify):
<p><u>Note:</u> The project could be approved by RIDEM but not meet RIDOT or Town standards. RIDOT’s regulations indicate that post-volumes must be less than pre-volumes for the 10-yr storm at the design point entering the RIDOT system. If you have not already received approval for the discharge to an MS4, please explain below your strategy to comply with RIDEM and the MS4.</p>		
		Indicate below which model was used for your analysis. <input checked="" type="checkbox"/> TR-55 <input type="checkbox"/> TR-20 <input checked="" type="checkbox"/> HydroCAD <input type="checkbox"/> Bentley/Haestad <input type="checkbox"/> Intellisolve <input type="checkbox"/> Other (Specify):
YES	NO	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Does the drainage design demonstrate that flows from the 100-year storm event through a BMP will safely manage and convey the 100-year storm? If “No,” please explain briefly below and reference where in the application further documentation can be found (i.e., name of report/document, page numbers, appendices, etc.):
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Do off-site areas contribute to the sub-watersheds and design points? If “Yes,”
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Are the areas modeled as “present condition” for both pre- and post-development analysis?
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Are the off-site areas shown on the subwatershed maps? Design point is RIDOT pond, reduced peaks and volumes so did not analyze entire area to existing pond
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Does the drainage design confirm safe passage of the 100-year flow through the site for off-site runoff?
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Is a Downstream Analysis required (see RICR 8.11.E.1)?
<input type="checkbox"/>	<input type="checkbox"/>	Calculate the following:
		<input checked="" type="checkbox"/> Area of disturbance within the sub-watershed (areas) 9.3
		<input checked="" type="checkbox"/> Impervious cover (%) 74
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Is a dam breach analysis required (earthen embankments over six (6) feet in height, or a capacity of 15 acre-feet or more, and contributes to a significant or high hazard dam)?
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Does this project meet the overbank flood protection standard?

Stormwater Management, Design, and Installation Rules (250-RICR-150-10-8)

Table 5-1 Hydraulic Analysis Summary

Subwatershed (Design Point)	1.2" Peak Flow (cfs) **		1-yr Peak Flow (cfs)		10-yr Peak Flow (cfs)		100-yr Peak Flow (cfs)	
	Pre (cfs)	Post (cfs)	Pre (cfs)	Post (cfs)	Pre (cfs)	Post (cfs)	Pre (cfs)	Post (cfs)
DP-1:	7.6	6.3	19.0	17.3	32.6	31.4	55.9	55.8
TOTALS:	7.6	6.3	19.0	17.3	32.6	31.4	55.9	55.8
** Utilize modified curve number method or split pervious /impervious method in HydroCAD.								
<u>Note:</u> The hydraulic analysis must demonstrate no impact to each individual subwatershed DP unless each DP discharges to the same wetland or water resource.								
Indicate as follows where the pertinent calculations and/or information for the items above are provided						Name of report/document, page numbers, appendices, etc.		
Existing conditions analysis for each subwatershed, including curve numbers, times of concentration, runoff rates, volumes, and water surface elevations showing methodologies used and supporting calculations.						Refer to Appendix D for existing conditions hydrologic calculations.		
Proposed conditions analysis for each subwatershed, including curve numbers, times of concentration, runoff rates, volumes, water surface elevations, and routing showing the methodologies used and supporting calculations.						Refer to Appendix D for proposed conditions hydrologic calculations.		
Final sizing calculations for structural stormwater BMPs, including contributing drainage area, storage, and outlet configuration.						Refer to Appendix D for proposed conditions hydraulic calculations.		
Stage-storage, inflow and outflow hydrographs for storage facilities (e.g., detention, retention, or infiltration facilities).						Refer to Appendix D for proposed conditions hydraulic calculations.		

Table 5-2 Summary of Best Management Practices

BMP ID	DP #	BMP Type (e.g., bioretention, tree filter)	BMP Functions					Bypass Type External (E) Internal (I) or NA	Horizontal Setback Criteria are met per RICR 8.21.B.10, 8.22.D.11, and 8.35.B.4		
			Pre-Treatment (Y/N/NA)	Re _v	WQ _v	CP _v (Y/N/NA)	Overbank Flood Reduction (Y/N/NA)		Yes/No	Technical Justification (Design Report page number)	Distance Provided
DS	1	Dry Swale	Y	0	10,179	NA	N	N/A	N/A	N/A	N/A
SD101	1	Stone Diaphragm	Y	0	0	NA	N	N/A	N/A	N/A	N/A
SD102	1	Stone Diaphragm	Y	0	0	NA	N	N/A	N/A	N/A	N/A
SD103	1	Stone Diaphragm	Y	0	0	NA	N	N/A	N/A	N/A	N/A
CB105	1	Deep-Sump Hooded Catch Basin	Y	0	0	NA	N	N/A	N/A	N/A	N/A
CB106	1	Deep-Sump Hooded Catch Basin	Y	0	0	NA	N	N/A	N/A	N/A	N/A
CB108	1	Deep-Sump Hooded Catch Basin	Y	0	0	NA	N	N/A	N/A	N/A	N/A

Stormwater Management, Design, and Installation Rules (250-RICR-150-10-8)

Table 5-2 Summary of Best Management Practices											
BMP ID	DP #	BMP Type (e.g., bioretention, tree filter)	BMP Functions					Bypass Type External (E) Internal (I) or NA	Horizontal Setback Criteria are met per RICR 8.21.B.10, 8.22.D.11, and 8.35.B.4		
			Pre-Treatment (Y/N/NA)	Re _v	WQ _v	CP _v (Y/N/NA)	Overbank Flood Reduction (Y/N/NA)		Yes/No	Technical Justification (Design Report page number)	Distance Provided
CB109	1	Deep-Sump Hooded Catch Basin	Y	0	0	NA	N	N/A	N/A	N/A	N/A
		TOTALS:									

Table 5.3 Summary of Soils to Evaluate Each BMP										
DP #	BMP ID	BMP Type (e.g., bioretention, tree filter)	Soils Analysis for Each BMP							Exfiltration Rate Applied (in/hr)
			Test Pit ID# and Ground Elevation		SHWT Elevation (ft)	Bottom of Practice Elevation* (ft)	Separation Distance Provided (ft)	Hydrologic Soil Group (A, B, C, D)		
			Primary	Secondary						
1	DS	Dry Swale	GZ-2		127+/- Observed	134	7	Ur- assumed Group C based on surrounding Soil groups	none	
1	DS	Dry Swale	GZ-4		130+/- Observed	138	8	Ur- assumed Group C based on surrounding Soil groups	none	
		TOTALS:								

* For underground infiltration systems (UICs) bottom equals bottom of stone, for surface infiltration basins bottom equals bottom of basin, for filters bottom equals interface of storage and top of filter layer

LAND USES WITH HIGHER POTENTIAL POLLUTANTS LOADS (LUHPPLs) – MINIMUM STANDARD 8			
YES	NO	N/A	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Describe any LUHPPLs identified in Part 1, Minimum Standard 8, Section 2. If not applicable, continue to Minimum Standard 9.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Are these activities already covered under an MSGP? If “No,” please explain if you have applied for an MSGP or intend to do so?
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	List the specific BMPs that are proposed for this project that receive stormwater from LUHPPL drainage areas. These BMP types must be listed in RISDISM Table 3-3, “Acceptable BMPs for Use at LUHPPLs.” Please list BMPs:

Stormwater Management, Design, and Installation Rules (250-RICR-150-10-8)

<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Additional BMPs, or additional pretreatment BMP's if any, that meet RIPDES MSGP requirements; Please list BMPs:
			Indicate below where the pertinent calculations and/or information for the above items are provided (i.e., name of report/document, page numbers, appendices, etc.).

ILLICIT DISCHARGES – MINIMUM STANDARD 9			
Illicit discharges are defined as unpermitted discharges to Waters of the State that do not consist entirely of stormwater or uncontaminated groundwater, except for certain discharges identified in the RIPDES Phase II Stormwater General Permit.			
YES	NO	N/A	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Have you checked for illicit discharges?
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Have any been found and/or corrected? If “Yes,” please identify.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Does your report explain preventative measures that keep non-stormwater discharges out of the Waters of the State (during and after construction)?

SOIL EROSION AND SEDIMENT CONTROL (SESC) – MINIMUM STANDARD 10			
YES	NO	N/A	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Have you included a Soil Erosion and Sediment Control Plan Set and/or Complete Construction Plan Set?
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Have you provided a separately-bound document based upon the SESC Template ? If yes, proceed to Minimum Standard 11 (the following items can be assumed to be addressed).
			If “No,” include a document with your submittal that addresses the following elements of an SESC Plan:
<input type="checkbox"/>			Soil Erosion and Sediment Control Plan Project Narrative, including a description of how the fifteen (15) Performance Criteria have been met:
<input type="checkbox"/>			Provide Natural Buffers and Maintain Existing Vegetation
<input type="checkbox"/>			Minimize Area of Disturbance
<input type="checkbox"/>			Minimize the Disturbance of Steep Slopes
<input type="checkbox"/>			Preserve Topsoil
<input type="checkbox"/>			Stabilize Soils
<input type="checkbox"/>			Protect Storm Drain Inlets
<input type="checkbox"/>			Protect Storm Drain Outlets
<input type="checkbox"/>			Establish Temporary Controls for the Protection of Post-Construction Stormwater Control Measures
<input type="checkbox"/>			Establish Perimeter Controls and Sediment Barriers
<input type="checkbox"/>			Divert or Manage Run-On from Up-Gradient Areas
<input type="checkbox"/>			Properly Design Constructed Stormwater Conveyance Channels
<input type="checkbox"/>			Retain Sediment On-Site
<input type="checkbox"/>			Control Temporary Increases in Stormwater Velocity, Volume, and Peak Flows
<input type="checkbox"/>			Apply Construction Activity Pollution Prevention Control Measures
<input type="checkbox"/>			Install, Inspect, and Maintain Control Measures and Take Corrective Actions
<input type="checkbox"/>			Qualified SESC Plan Preparer’s Information and Certification
<input type="checkbox"/>			Operator’s Information and Certification; if not known at the time of application, the Operator must certify the SESC Plan upon selection and prior to initiating site activities
<input type="checkbox"/>			Description of Control Measures, such as Temporary Sediment Trapping and Conveyance Practices, including design calculations and supporting documentation, as required

STORMWATER MANAGEMENT SYSTEM OPERATION, MAINTENANCE, AND POLLUTION PREVENTION
--

Stormwater Management, Design, and Installation Rules (250-RICR-150-10-8)

PLAN – MINIMUM STANDARDS 7 AND 9		
Operation and Maintenance Section		
YES	NO	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Have you minimized all sources of pollutant contact with stormwater runoff, to the maximum extent practicable?
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Have you provided a separately-bound Operation and Maintenance Plan for the site and for all of the BMPs, and does it address each element of RICR 8.17 and RISDISM Appendix C and E?
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Lawn, Garden, and Landscape Management meet the requirements of RISDISM Section G.7? If “No,” why not?
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Is the property owner or homeowner’s association responsible for the stormwater maintenance of all BMP’s? If “No,” you must provide a legally binding and enforceable maintenance agreement (see RISDISM Appendix E, page 26) that identifies the entity that will be responsible for maintenance of the stormwater. Indicate where this agreement can be found in your report (i.e., name of report/document, page numbers, appendices, etc.).
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Do you anticipate that you will need legal agreements related to the stormwater structures? (e.g. off-site easements, deed restrictions, covenants, or ELUR per the Remediation Regulations). If “Yes,” have you obtained them? Or please explain your plan to obtain them:
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Is stormwater being directed from public areas to private property? If “Yes,” note the following: <u>Note:</u> This is not allowed unless a funding mechanism is in place to provide the finances for the long-term maintenance of the BMP and drainage, or a funding mechanism is demonstrated that can guarantee the long-term maintenance of a stormwater BMP by an individual homeowner.
Pollution Prevention Section		
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Designated snow stockpile locations?
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Trash racks to prevent floatables, trash, and debris from discharging to Waters of the State?
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Asphalt-only based sealants?
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Pet waste stations? (<u>Note:</u> If a receiving water has a bacterial impairment, and the project involves housing units, then this could be an important part of your pollution prevention plan).
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Regular sweeping? Please describe:
<input checked="" type="checkbox"/>	<input type="checkbox"/>	De-icing specifications, in accordance with RISDISM Appendix G. (NOTE: If the groundwater is GAA, or this area contributes to a drinking water supply, then this could be an important part of your pollution prevention plan).
<input checked="" type="checkbox"/>	<input type="checkbox"/>	A prohibition of phosphate-based fertilizers? (<u>Note:</u> If the site discharges to a phosphorus impaired waterbody, then this could be an important part of your pollution prevention plan).

PART 4. SUBWATERSHED MAPPING AND SITE-PLAN DETAILS

Existing and Proposed Subwatershed Mapping (REQUIRED)		
YES	NO	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Existing and proposed drainage area delineations
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Locations of all streams and drainage swales
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Drainage flow paths, mapped according to the DEM <i>Guidance for Preparation of Drainage Area Maps</i> (included in RISDISM Appendix K)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Complete drainage area boundaries; include off-site areas in both mapping and analyses, as applicable
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Logs of borings and/or test pit investigations along with supporting soils/geotechnical report
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Mapped seasonal high-water-table test pit locations
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Mapped locations of the site-specific borings and/or test pits and soils information from the test pits at the

Stormwater Management, Design, and Installation Rules (250-RICR-150-10-8)

		locations of the BMPs
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Mapped locations of the BMPs, with the BMPs consistently identified on the Site Construction Plans
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Mapped bedrock outcrops adjacent to any infiltration BMP
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Soils were logged by a:
	<input type="checkbox"/>	DEM-licensed Class IV soil evaluator Name:
	<input type="checkbox"/>	RI-registered P.E. Name:

Subwatershed and Impervious Area Summary				
Subwatershed (area to each design point)	First Receiving Water ID or MS4	Area Disturbed (ac)	Existing Impervious (sf)	Proposed Impervious (sf)
DP-1:	RIDOT	9.3	387,234	360,521
TOTALS:			387,234	360,521

Site Construction Plans (Indicate that the following applicable specifications are provided)		
YES	NO	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Existing and proposed plans (scale not greater than 1" = 40') with North arrow
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Existing and proposed site topography (with 1 or 2-foot contours); 10-foot contours accepted for off-site areas
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Boundaries of existing predominant vegetation and proposed limits of clearing
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Site Location clarification
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Location and field-verified boundaries of resource protection areas such as: <ul style="list-style-type: none"> ▶ freshwater and coastal wetlands, including lakes and ponds ▶ coastal shoreline features Perennial and intermittent streams, in addition to Areas Subject to Storm Flowage (ASSFs) N/A
<input checked="" type="checkbox"/>	<input type="checkbox"/>	All required setbacks (e.g., buffers, water-supply wells, septic systems)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Representative cross-section and profile drawings, and notes and details of structural stormwater management practices and conveyances (i.e., storm drains, open channels, swales, etc.), which include: <ul style="list-style-type: none"> ▶ Location and size of the stormwater treatment practices (type of practice, depth, area). Stormwater treatment practices (BMPs) must have labels that correspond to RISDISM Table 5-2; ▶ Design water surface elevations (applicable storms); ▶ Structural details of outlet structures, embankments, spillways, stilling basins, grade-control structures, conveyance channels, etc.; ▶ Existing and proposed structural elevations (e.g., inverts of pipes, manholes, etc.); ▶ Location of floodplain and, if applicable, floodway limits and relationship of site to upstream and downstream properties or drainage that could be affected by work in the floodplain; ▶ Planting plans for structural stormwater BMPs, including species, size, planting methods, and maintenance requirements of proposed planting
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Logs of borings and/or test pit investigations along with supporting soils/geotechnical report and corresponding water tables
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Mapping of any OLRSM-approv ed remedial actions/systems (including ELURs)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Location of existing and proposed roads, buildings, and other structures including limits of disturbance; <ul style="list-style-type: none"> ▶ Existing and proposed utilities (e.g., water, sewer, gas, electric) and easements; ▶ Location of existing and proposed conveyance systems, such as grass channels, swales, and storm drains, and location(s) of final discharge point(s) (wetland, waterbody, etc.); ▶ Cross sections of roadways, with edge details such as curbs and sidewalks; ▶ Location and dimensions of channel modifications, such as bridge or culvert crossings
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Locations, cross sections, and profiles of all stream or wetland crossings and their method of stabilization Not applicable

Appendix B – Minimum Standard 3 – Water Quality Calculations

- › Calculations for Water Quality Treatment and Pretreatment
- › Pond Compensation Calculations

Water Quality Volume Calculation WorkSheet

This worksheet is designed to assist the project engineer with a determination of the required water quality treatment area. The worksheet leads the designer through redevelopment applicability first and then receiving water requirements. This tool is intended to compliment to the Redevelopment Criteria Guidance and the Water Quality Guidance and assist both the designer and the permit application reviewer towards consistent results. Enter information into only the **YELLOW** Boxes.

[Redevelopment Criteria Guidance](#)

[Water Quality Goals "Stormwater Compensation Method"](#)

Step 1 - Determine which office in OWR you are applying to: [Application Guidance](#)

Step 2 - Site Information value/calculation units

Total Site Area (total area of project parcels)	TS	11.16	acres
Total Jurisdictional Wetlands and/or floodplain within the above TSA	JW1	0.00	acres
Existing impervious also within the Jurisdictional Wetlands	-JW2	0.00	acres
Conservation Land within the TSA		0.00	acres
Site Size = (TSA)-(JW1-JW2)-CL	SS=	11.16	acres

Step 3 - Redevelopment Applicability

Total Impervious Area (pre-construction)	TIA=	8.89	acres
% Impervious (if ≥40% - redevelopment standard 3.2.6 applies)		0.80	

REPEAT IF NECESSARY Steps 4, 5 and 6 for EACH Waterbody ID (RIVER-ID as found in the GIS Map Server)

Step 4 - Receiving waterbody information

Waterbody ID or RIVER ID from GIS Map Server	
Waterbody Name from GIS Map Server	
Name the sub-watersheds (design-points) contributing to this Waterbody ID	
Is this Waterbody Impaired/TMDL for any Phosphorus, Metals or Bacteria?	YES
Is this Waterbody Impaired for Nitrogen?	NO

Step 5 - Pre-Post Construction Conditions to the Waterbody

Total Pre-Construction Impervious Surface to this Waterbody ID	8.89	acres
Total Disturbed Existing Impervious (DI)	6.84	acres
Total Post-Construction Impervious to this Waterbody ID	8.28	acres
Net Increased Impervious (NII)	-0.61	acres

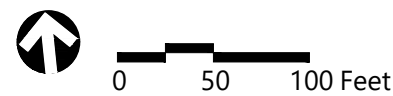
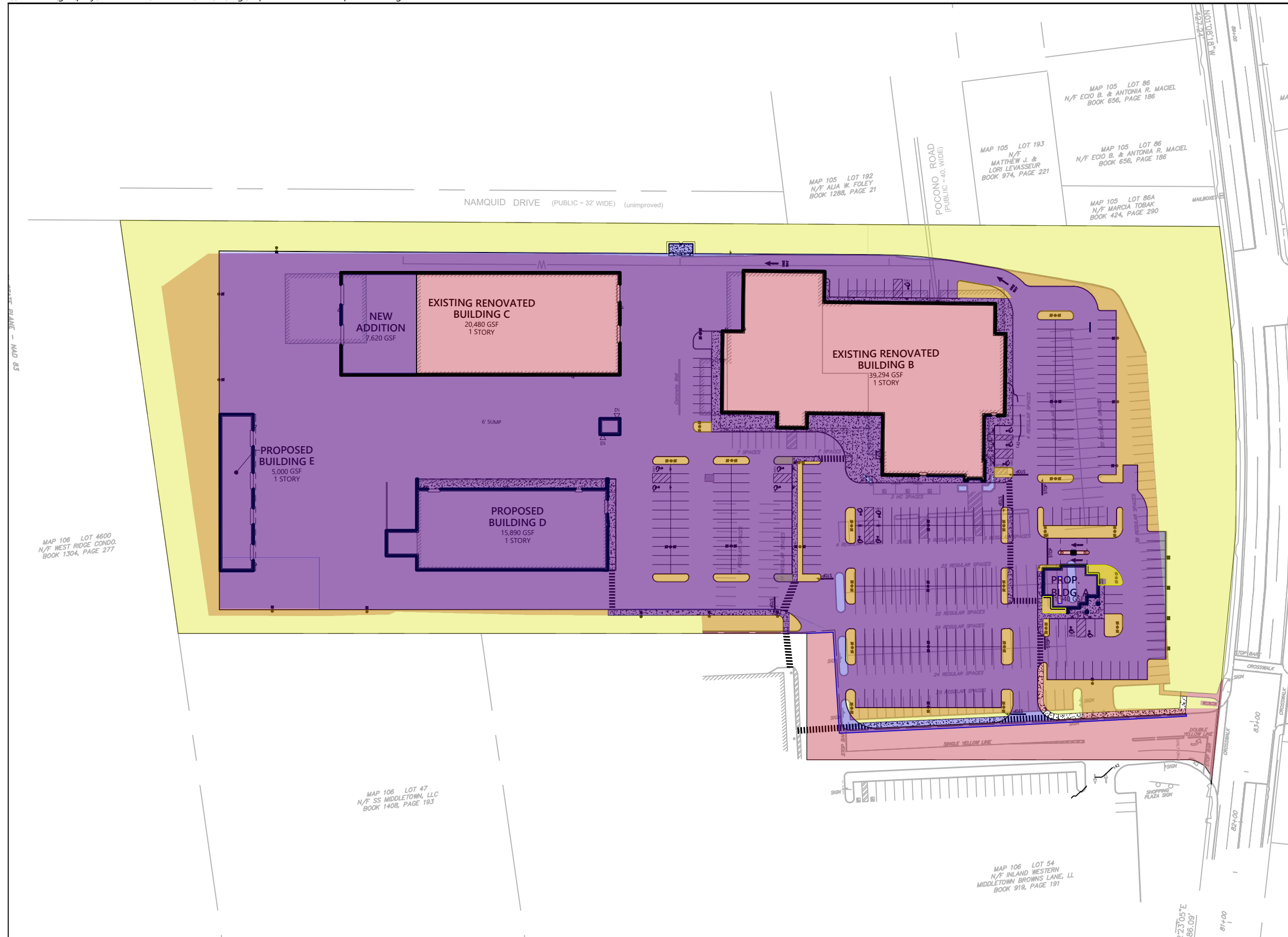
Step 6 - Infiltration and BMP information - Note: Increasing infiltration will likely decrease stormwater treatment area for Metals, Bacteria and Phosphorus

I am proposing to infiltrate this percentage WQv to this WBID	0%	%
I am proposing this number of BMP's	1	#

RESULTS - Select the Larger Number of the 2 numbers provided

Applicable Condition	Min Water Quality Treatment Area	Min Treatment w/o WQ consideration
No Impairment or TMDL - New Development		
No Impairment or TMDL - Redevelopment		
Only Phosphorus, Metals or Bacteria Impairment - New Development		
Only Phosphorus, Metals or Bacteria Impairment - Redevelopment	-1.22	2.81
Nitrogen Impairment - New Development		
Nitrogen Impairment - Redevelopment		
REQUIRED STORMWATER TREATMENT AREA	2.8	acres

* Enter the name of the STP (both type and label) which has been designed to treat this particular Rev or Rea.





Computations

Project:	<u>Middletown Redevelopment</u>	Project #	<u>72928.00</u>
Location:	<u>Middletown, RI</u>	Sheet	<u>1 of 1</u>
Calculated by:	<u>AEC</u>	Date:	<u>4/5/2022</u>
Checked by:		Date:	
Title	<u>Water Quality Treatment Summary</u>		

Section 3.3.3 Water Quality Volume (WQv)

Stormwater Treatment Area Required:

Required Stormwater Treatment Area = 2.8 acres = **121,968** sf

Refer to Appendix E - Redevelopment and Infil Calculations

Water Quality Volume = Treatment Area * 1" = 121,968 sf * 1 ft/12 in = 10,164 cf

Stormwater Treatment Area Provided:

Area Contributes to	Impervious Area (sf)	WQv (cf)
SD101	13,165	1,097
SD102	32,846	2,737
SD103	17,451	1,454
FES192	41,000	3,417
FES193	12,844	1,070
BLDG E TO SWALE	4,267	356
QPA1	575	48

Total Stormwater Treatment Area Provided **122,148** > 121,968 sf Stormwater Treatment Area Required

Total Water Quality Volume Provided **10,179** > 10,164 cf Water Quality Volume Required



Computations

Project:	Middletown Redevelopment	Project #	72928.00
Location:	Middletown, RI	Sheet	1 of 1
Calculated by:	AEC	Date:	4/5/2022
Checked by:		Date:	
Title	Water Quality Treatment for impervious area contributing to SD101		

Dry Swale Filter Design Criteria

Section 5.7.1 Feasibility

- Maximum drainage area of 5 acres draining to any one inlet. **Drainage Area = 0.30 acres**
- Maximum longitudinal slope of 4% without checkdams. **Slope = 0.5%**
- Bottom of swale shall be at or above seasonal high groundwater. **Requirement met**
- Minimum 3' separation between top of swale and seasonal high groundwater. **Requirement met**

Section 5.7.2 Conveyance

- Maximum allowable temporary ponding time shall be less than 48 hours. **Ponding time < 48 hours.**
- Peak velocity for the 1-year storm must be non-erosive (3.5-5.0 fps). **Peak velocity = 1.49 fps**
- Open channels shall be designed to safely convey the 10-year storm. **Requirement met.**
- Channels shall be designed with moderate side slopes (flatter than 2:1). **Side slope = 2.5:1**

Section 5.7.3 Pretreatment

$$WQV = 1 \text{ in} * (1 \text{ in}/12 \text{ ft}) * 13165 \text{ sf} = 1098 \text{ cf}$$

Pretreatment for Paved Areas is provided by Stone Diaphragm 101 (See Calculation Sheet)

Section 5.7.4 Treatment

- Minimum bottom width of 2', maximum bottom width of 8' **Bottom width = 2' min, 8' max**

$$\text{Bottom Area} = A_f = \frac{(WQV)(d_f)}{[(k)(h_f + d_f)(t_f)]} = 392.1 \text{ sf}$$

Where:

- df = Filter Bed Depth = 2.5 ft
- k = Coeff. of perm. filter media = 1 ft/day
- hf = Ave. height of water above surface = 1 ft
- tf = Drain Downtime (2 days max) = 2 day(s)

Area provided = 4813 sf (> required 392.1 sf)

Area is provided in Dry Swale Segments 1, 2, 3, 4, 5, 6, and 8



Computations

Project:	Middletown Redevelopment	Project #	72928.00
Location:	Middletown, RI	Sheet	1 of 1
Calculated by:	AEC	Date:	4/5/2022
Checked by:		Date:	
Title	Water Quality Treatment for impervious area contributing to SD102		

Dry Swale Filter Design Criteria

Section 5.7.1 Feasibility

- Maximum drainage area of 5 acres draining to any one inlet. **Drainage Area = 0.75 acres**
- Maximum longitudinal slope of 4% without checkdams. **Slope = 0.5%**
- Bottom of swale shall be at or above seasonal high groundwater. **Requirement met**
- Minimum 3' separation between top of swale and seasonal high groundwater. **Requirement met**

Section 5.7.2 Conveyance

- Maximum allowable temporary ponding time shall be less than 48 hours. **Ponding time < 48 hours.**
- Peak velocity for the 1-year storm must be non-erosive (3.5-5.0 fps). **Peak velocity = 1.49 fps**
- Open channels shall be designed to safely convey the 10-year storm. **Requirement met.**
- Channels shall be designed with moderate side slopes (flatter than 2:1). **Side slope = 2.5:1**

Section 5.7.3 Pretreatment

$$WQV = 1 \text{ in} * (1 \text{ in}/12 \text{ ft}) * 32846 \text{ sf} = 2738 \text{ cf}$$

Pretreatment for Paved Areas is provided by Stone Diaphragm 102 (See Calculation Sheet)

Section 5.7.4 Treatment

- Minimum bottom width of 2', maximum bottom width of 8' **Bottom width = 2' min, 8' max**

$$\text{Bottom Area} = A_f = \frac{(WQV)(d_f)}{[(k)(h_f + d_f)(t_f)]} = 977.9 \text{ sf}$$

Where:

- df = Filter Bed Depth = 2.5 ft
- k = Coeff. of perm. filter media = 1 ft/day
- hf = Ave. height of water above surface = 1 ft
- tf = Drain Downtime (2 days max) = 2 day(s)

Area provided = 4376 sf (> required 977.9 sf)

Area is provided in Dry Swale Segments 2, 3, 4, 5, 6, and 8



Computations

Project:	Middletown Redevelopment	Project #	72928.00
Location:	Middletown, RI	Sheet	1 of 1
Calculated by:	AEC	Date:	4/15/2022
Checked by:		Date:	
Title	Water Quality Treatment for impervious area contributing to Part of BLDG E		

Dry Swale Filter Design Criteria

Section 5.7.1 Feasibility

- Maximum drainage area of 5 acres draining to any one inlet. **Drainage Area = 0.19 acres**
- Maximum longitudinal slope of 4% without checkdams. **Slope = 0.5% - 0.6%**
- Bottom of swale shall be at or above seasonal high groundwater. **Requirement met**
- Minimum 3' separation between top of swale and seasonal high groundwater. **Requirement met**

Section 5.7.2 Conveyance

- Maximum allowable temporary ponding time shall be less than 48 hours. **Ponding time < 48 hours.**
- Peak velocity for the 1-year storm must be non-erosive (3.5-5.0 fps). **Peak velocity = 1.85 fps**
- Open channels shall be designed to safely convey the 10-year storm. **Requirement met.**
- Channels shall be designed with moderate side slopes (flatter than 2:1). **Side slope = 2.5:1**

Section 5.7.3 Pretreatment

$$WQV = 1 \text{ in} * (1 \text{ in}/12 \text{ ft}) * 2133.5 \text{ sf} = 178 \text{ cf}$$

Pretreatment not required for Rooftop Runoff

Section 5.7.4 Treatment

- Minimum bottom width of 2', maximum bottom width of 8' **Bottom width = 2' min, 8' max**

$$\text{Bottom Area} = A_f = \frac{(WQV)(d_f)}{[(k)(h_f + d_f)(t_f)]} = 63.6 \text{ sf}$$

Where:

- df = Filter Bed Depth = 2.5 ft
- k = Coeff. of perm. filter media = 1 ft/day
- hf = Ave. height of water above surface = 1 ft
- tf = Drain Downtime (2 days max) = 2 day(s)

Area provided = 3001 sf (> required 63.6 sf)

Area is provided in Dry Swale Segments 3, 4, 5, 6, and 8



Computations

Project:	Middletown Redevelopment	Project #	72928.00
Location:	Middletown, RI	Sheet	1 of 1
Calculated by:	AEC	Date:	4/5/2022
Checked by:		Date:	
Title	Water Quality Treatment for impervious area contributing to DS 104 (Part of Bldg E)		

Dry Swale Filter Design Criteria

Section 5.7.1 Feasibility

- Maximum drainage area of 5 acres draining to any one inlet. **Drainage Area = 0.05 acres**
- Maximum longitudinal slope of 4% without checkdams. **Slope = 0.5% - 0.6%**
- Bottom of swale shall be at or above seasonal high groundwater. **Requirement met**
- Minimum 3' separation between top of swale and seasonal high groundwater. **Requirement met**

Section 5.7.2 Conveyance

- Maximum allowable temporary ponding time shall be less than 48 hours. **Ponding time < 48 hours.**
- Peak velocity for the 1-year storm must be non-erosive (3.5-5.0 fps). **Peak velocity = 1.85 fps**
- Open channels shall be designed to safely convey the 10-year storm. **Requirement met.**
- Channels shall be designed with moderate side slopes (flatter than 2:1). **Side slope = 2.5:1**

Section 5.7.3 Pretreatment

$$WQV = 1 \text{ in} * (1 \text{ in}/12 \text{ ft}) * 2133.5 \text{ sf} = 178 \text{ cf}$$

Pretreatment not required for Rooftop Runoff

Section 5.7.4 Treatment

- Minimum bottom width of 2', maximum bottom width of 8' **Bottom width = 2' min, 8' max**

$$\text{Bottom Area} = A_f = \frac{(WQV)(d_f)}{[(k)(h_f + d_f)(t_f)]} = 63.6 \text{ sf}$$

Where:

- df = Filter Bed Depth = 2.5 ft
- k = Coeff. of perm. filter media = 1 ft/day
- hf = Ave. height of water above surface = 1 ft
- tf = Drain Downtime (2 days max) = 2 day(s)

Area provided = 2385 sf (> required 63.6 sf)

Area is provided in Dry Swale Segments 4, 5, 6, and 8



Computations

Project:	Middletown Redevelopment	Project #	72928.00
Location:	Middletown, RI	Sheet	1 of 1
Calculated by:	AEC	Date:	4/15/2022
Checked by:		Date:	
Title	Water Quality Treatment for impervious area contributing to FES192		

Dry Swale Filter Design Criteria

Section 5.7.1 Feasibility

- Maximum drainage area of 5 acres draining to any one inlet. **Drainage Area = 0.65 acres**
- Maximum longitudinal slope of 4% without checkdams. **Slope = 0.5% - 0.6%**
- Bottom of swale shall be at or above seasonal high groundwater. **Requirement met**
- Minimum 3' separation between top of swale and seasonal high groundwater. **Requirement met**

Section 5.7.2 Conveyance

- Maximum allowable temporary ponding time shall be less than 48 hours. **Ponding time < 48 hours.**
- Peak velocity for the 1-year storm must be non-erosive (3.5-5.0 fps). **Peak velocity = 1.85 fps**
- Open channels shall be designed to safely convey the 10-year storm. **Requirement met.**
- Channels shall be designed with moderate side slopes (flatter than 2:1). **Side slope = 2.5:1**

Section 5.7.3 Pretreatment

WQV = 1 in * (1 in/12 ft) * 41000 sf = 3417 cf (Treating 41,000 sf of total impervious area directed to swale)

Pretreatment not required for Rooftop Runoff

Pretreatment for Paved Areas is provided in Deep-Sump Hooded Catch Basins (See Calculation Sheet)

Section 5.7.4 Treatment

- Minimum bottom width of 2', maximum bottom width of 8' **Bottom width = 2' min, 8' max**

$$\text{Bottom Area} = A_f = \frac{(WQV)(d_f)}{[(k)(h_f + d_f)(t_f)]} = 1220.4 \text{ sf}$$

Where:

df = Filter Bed Depth = 2.5 ft

k = Coeff. of perm. filter media = 1 ft/day

hf = Ave. height of water above surface = 1 ft

tf = Drain Downtime (2 days max) = 2 day(s)

Area provided = 1240 sf (> required 1220.4 sf)

Area is provided in Dry Swale Segments 5, 6, and 8



Computations

Project:	Middletown Redevelopment	Project #	72928.00
Location:	Middletown, RI	Sheet	1 of 1
Calculated by:	AEC	Date:	4/5/2022
Checked by:		Date:	
Title	Water Quality Treatment for impervious area contributing to SD103		

Dry Swale Filter Design Criteria

Section 5.7.1 Feasibility

- Maximum drainage area of 5 acres draining to any one inlet. **Drainage Area = 0.40 acres**
- Maximum longitudinal slope of 4% without checkdams. **Slope = 0.5% - 0.6%**
- Bottom of swale shall be at or above seasonal high groundwater. **Requirement met**
- Minimum 3' separation between top of swale and seasonal high groundwater. **Requirement met**

Section 5.7.2 Conveyance

- Maximum allowable temporary ponding time shall be less than 48 hours. **Ponding time < 48 hours.**
- Peak velocity for the 1-year storm must be non-erosive (3.5-5.0 fps). **Peak velocity = 1.85 fps**
- Open channels shall be designed to safely convey the 10-year storm. **Requirement met.**
- Channels shall be designed with moderate side slopes (flatter than 2:1). **Side slope = 2.5:1**

Section 5.7.3 Pretreatment

$$WQV = 1 \text{ in} * (1 \text{ in}/12 \text{ ft}) * 17451 \text{ sf} = 1455 \text{ cf}$$

Pretreatment for Paved Areas is provided by Stone Diaphragm 103 (See Calculation Sheet)

Section 5.7.4 Treatment

- Minimum bottom width of 2', maximum bottom width of 8' **Bottom width = 2' min, 8' max**

$$\text{Bottom Area} = A_f = \frac{(WQV)(d_f)}{[(k)(h_f + d_f)(t_f)]} = 519.6 \text{ sf}$$

Where:

- df = Filter Bed Depth = 2.5 ft
- k = Coeff. of perm. filter media = 1 ft/day
- hf = Ave. height of water above surface = 1 ft
- tf = Drain Downtime (2 days max) = 2 day(s)

Area provided = 802 sf (> required 519.6 sf)

Area is provided in Dry Swale Segments 6, and 8



Computations

Project:	Middletown Redevelopment	Project #	72928.00
Location:	Middletown, RI	Sheet	1 of 1
Calculated by:	AEC	Date:	4/5/2022
Checked by:		Date:	
Title	Water Quality Treatment for impervious area contributing to FES193		

Dry Swale Filter Design Criteria

Section 5.7.1 Feasibility

- Maximum drainage area of 5 acres draining to any one inlet. **Drainage Area = 0.29 acres**
- Maximum longitudinal slope of 4% without checkdams. **Slope = 0.5% - 0.6%**
- Bottom of swale shall be at or above seasonal high groundwater. **Requirement met**
- Minimum 3' separation between top of swale and seasonal high groundwater. **Requirement met**

Section 5.7.2 Conveyance

- Maximum allowable temporary ponding time shall be less than 48 hours. **Ponding time < 48 hours.**
- Peak velocity for the 1-year storm must be non-erosive (3.5-5.0 fps). **Peak velocity = 1.85 fps**
- Open channels shall be designed to safely convey the 10-year storm. **Requirement met.**
- Channels shall be designed with moderate side slopes (flatter than 2:1). **Side slope = 2.5:1**

Section 5.7.3 Pretreatment

$$WQV = 1 \text{ in} * (1 \text{ in}/12 \text{ ft}) * 12844 \text{ sf} = 1071 \text{ cf}$$

Pretreatment not required for Rooftop Runoff

Pretreatment for Paved Areas is provided in Deep-Sump Hooded Catch Basins (See Calculation Sheet)

Section 5.7.4 Treatment

- Minimum bottom width of 2', maximum bottom width of 8' **Bottom width = 2' min, 8' max**

$$\text{Bottom Area} = A_f = \frac{(WQV)(d_f)}{[(k)(h_f + d_f)(t_f)]} = 382.5 \text{ sf}$$

Where:

df = Filter Bed Depth = 2.5 ft

k = Coeff. of perm. filter media = 1 ft/day

hf = Ave. height of water above surface = 1 ft

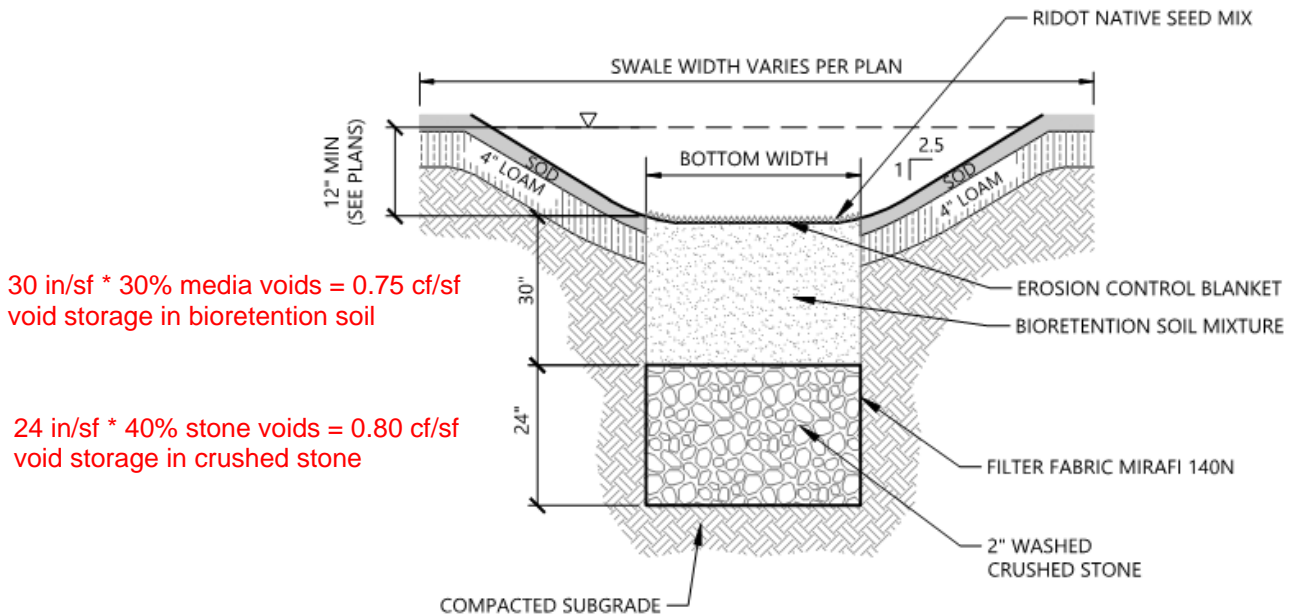
tf = Drain Downtime (2 days max) = 2 day(s)

Area provided = 566 sf (> required 382.5 sf)

Area is provided in Dry Swale Segments 7 and 8

Dry Swale Drawdown Calculations and Support

August 2019



Dry Swale

N.T.S.

Source: VHB

1/16

REV LD_354

The total void storage of the bioretention media is provided in an additional 24" crushed stone reservoir course below the filter. During a large storm event, the majority of stormwater exits the dry swale via the surface channel, leaving only the saturated filter media below. The area-based drawdown calculations provided within this report shows that the filter media is capable of completely draining to the reservoir course within 48 hours, leaving the full volume of the filter available should a second storm event occur.

72928 PR Drainage

Prepared by VHB

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Proposed Redevelopment
Type III 24-hr 1.2" Rainfall=1.20"

Printed 4/18/2022

Page 1

Summary for Reach DS 1_2: Dry Swale - Segments 1 and 2

Inflow Area = 48,459 sf, 94.79% Impervious, Inflow Depth = 0.94" for 1.2" event
Inflow = 1.1 cfs @ 12.12 hrs, Volume= 3,786 cf
Outflow = 0.9 cfs @ 12.17 hrs, Volume= 3,786 cf, Atten= 14%, Lag= 3.4 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.12 fps, Min. Travel Time= 6.1 min
Avg. Velocity = 0.30 fps, Avg. Travel Time= 22.6 min

Peak Storage= 333 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.30' , Surface Width= 3.48'
Bank-Full Depth= 1.00' Flow Area= 4.5 sf, Capacity= 9.8 cfs

2.00' x 1.00' deep channel, n= 0.035 High grass
Side Slope Z-value= 2.5 ' / ' Top Width= 7.00'
Length= 412.0' Slope= 0.0051 ' / '
Inlet Invert= 138.00', Outlet Invert= 135.90'



Summary for Reach DS 3_8: Dry Swale - Segments 3-8

Inflow Area = 159,226 sf, 84.33% Impervious, Inflow Depth = 0.84" for 1.2" event
Inflow = 2.9 cfs @ 12.10 hrs, Volume= 11,158 cf
Outflow = 2.7 cfs @ 12.14 hrs, Volume= 11,158 cf, Atten= 8%, Lag= 2.7 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.17 fps, Min. Travel Time= 4.3 min
Avg. Velocity = 0.30 fps, Avg. Travel Time= 16.9 min

Peak Storage= 684 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.26' , Surface Width= 9.32'
Bank-Full Depth= 1.50' Flow Area= 17.6 sf, Capacity= 56.3 cfs

8.00' x 1.50' deep channel, n= 0.035 High grass
Side Slope Z-value= 2.5 ' / ' Top Width= 15.50'
Length= 300.0' Slope= 0.0050 ' / '
Inlet Invert= 135.40', Outlet Invert= 133.90'



‡



Computations

Project:	<u>Middletown Redevelopment</u>	Project #	<u>72928.00</u>
Location:	<u>Middletown, RI</u>	Sheet	<u>1 of 1</u>
Calculated by:	<u>SAP</u>	Date:	<u>4/5/2022</u>
Checked by:		Date:	
Title	<u>Stone Diaphragm 101</u>		<u>SD 101</u>

Pretreatment: Stone Diaphragm

The diaphragm shall be sized to contain a percent of the WQV as well as the required sediment volume.

Percent Required = 10%

Sediment Volume $SV = \{(76.6 \times RA \times TE) + (5.3 \times DA \times TE)\} \times T$

RA = area of roadway or parking lots = 0.3023 acres

TE = basin trap efficiency (80% standard) = 80%

DA = contributing land use area = 0.359 acres

T = time in years = 1 year(s)

$$SV = 21 \text{ cf}$$

For % WQV refer to Chapter 5, for pretreatment requirements for each BMP used.

WQV % Required = 10%

WQV = 1097.349 cf Based on contributing Impervious Area to SD 101.

Pretreatment Volume Required = 110 cf

SV Required = 21 cf

Total volume required = 110 cf + 21 cf = 131 cf

Volume provided = 133.65 cf (> required 131 cf) 45-feet long x 3-feet wide x 3-feet deep, 33% voids



Computations

Project:	<u>Middletown Redevelopment</u>	Project #	<u>72928.00</u>
Location:	<u>Middletown, RI</u>	Sheet	<u>1 of 1</u>
Calculated by:	<u>SAP</u>	Date:	<u>4/5/2022</u>
Checked by:		Date:	
Title	<u>Stone Diaphragm 102</u>		<u>SD 102</u>

Pretreatment: Stone Diaphragm

The diaphragm shall be sized to contain a percent of the WQV as well as the required sediment volume.

Percent Required = 10%

Sediment Volume $SV = \{(76.6 \times RA \times TE) + (5.3 \times DA \times TE)\} \times T$

RA = area of roadway or parking lots = 0.7541 acres

TE = basin trap efficiency (80% standard) = 80%

DA = contributing land use area = 0.755 acres

T = time in years = 1 year(s)

$$SV = 50 \text{ cf}$$

For % WQV refer to Chapter 5, for pretreatment requirements for each BMP used.

WQV % Required = 10%

WQV = 2737.383 cf Based on contributing Impervious Area from Subarea 10.9.

Pretreatment Volume Required = 274 cf

SV Required = 50 cf

Total volume required = 274 cf + 50 cf = 324 cf

Volume provided = 336.6 cf (> required 324 cf)

85-feet long x 4-feet wide x 3-feet deep, 33% voids



Computations

Project:	Middletown Redevelopment	Project #	72928.00
Location:	Middletown, RI	Sheet	1 of 1
Calculated by:	SAP	Date:	4/5/2022
Checked by:		Date:	
Title	Stone Diaphragm 103		SD 103

Pretreatment: Stone Diaphragm

The diaphragm shall be sized to contain a percent of the WQV as well as the required sediment volume.

Percent Required = 10%

Sediment Volume $SV = \{(76.6 \times RA \times TE) + (5.3 \times DA \times TE)\} \times T$

RA = area of roadway or parking lots = 0.401 acres

TE = basin trap efficiency (80% standard) = 80%

DA = contributing land use area = 0.401 acres

T = time in years = 1 year(s)

$$SV = 27 \text{ cf}$$

For % WQV refer to Chapter 5, for pretreatment requirements for each BMP used.

WQV % Required = 10%

WQV = 1455.63 cf Based on contributing Impervious Area from Subarea 10.5.

Pretreatment Volume Required = 146 cf

SV Required = 27 cf

Total volume required = 146 cf + 27 cf = 173 cf

Volume provided = 178.2 cf (> required 173 cf) 45-feet long x 4-feet wide x 3-feet deep, 33% voids



Computations

Project:	<u>Middletown Redevelopment</u>	Project #	<u>72928.00</u>
Location:	<u>Middletown, RI</u>	Sheet	<u>1 of 1</u>
Calculated by:	<u>SAP</u>	Date:	<u>4/5/2022</u>
Checked by:		Date:	
Title	<u>Stone Diaphragm 104</u>		<u>SD 104</u>

Pretreatment: Stone Diaphragm

The diaphragm shall be sized to contain a percent of the WQV as well as the required sediment volume.

Percent Required = 10%

Sediment Volume $SV = \{(76.6 \times RA \times TE) + (5.3 \times DA \times TE)\} \times T$

RA = area of roadway or parking lots = 0.401 acres

TE = basin trap efficiency (80% standard) = 80%

DA = contributing land use area = 0.401 acres

T = time in years = 1 year(s)

$$SV = 27 \text{ cf}$$

For % WQV refer to Chapter 5, for pretreatment requirements for each BMP used.

WQV % Required = 10%

WQV = 1218 cf

Based on contributing Impervious Area from Subarea 10.5.

Pretreatment Volume Required = 122 cf

SV Required = 27 cf

Total volume required = 122 cf + 27 cf = 149 cf

Volume provided = 154 cf (> required 149 cf)

26-feet long x 6-feet wide x 3-feet deep, 33% voids



Computations

Project:	Middletown Redevelopment	Project #	72928.00
Location:	Middletown, RI	Sheet	1 of 1
Calculated by:	AEC	Date:	4/18/2022
Checked by:		Date:	
Title	Deep Sump Hooded Catch Basin		105

Section 6.4 Sediment Forebay

$$As = 5,750 \times Q$$

Where:

Q = Discharge from drainage area (CFS) = % WQV / 86,400 sec = 1 cfs

As = Sedimentation surface area (SF) = 2 sf

Area provided = 50.8 sf (> required 2 sf)

The forebay shall be sized to contain a percent of the WQv as well as the required sediment volume.

Percent Required = 10%

Sediment Volume $SV = \{(76.6 \times RA \times TE) + (5.3 \times DA \times TE)\} \times T$

RA = area of roadway or parking lots = 0.045 acres

TE = basin trap efficiency (80% standard) = 80%

DA = contributing land use area = 0.16 acres

T = time in years = 1 year(s)

$$SV = 4 \text{ cf}$$

For % WQV refer to Chapter 5, for pretreatment requirements for each BMP used.

WQV % Required = 10%

WQV = 163.35 cf

WQV Required = 17 cf

SV Required = 4 cf

Total volume required = 17 cf + 4 cf = 21 cf

Volume provided = 50.28 cf (> required 21 cf)

Pretreatment volume provided in 48" diameter Catch Basin: Area = 12.57 sf, depth = 4-feet.



Computations

Project:	Middletown Redevelopment	Project #	72928.00
Location:	Middletown, RI	Sheet	1 of 1
Calculated by:	AEC	Date:	4/18/2022
Checked by:		Date:	
Title	Deep Sump Hooded Catch Basin		106

Section 6.4 Sediment Forebay

$$As = 5,750 \times Q$$

Where:

Q = Discharge from drainage area (CFS) = % WQV / 86,400 sec = 1 cfs

As = Sedimentation surface area (SF) = 2 sf

Area provided = 50.8 sf (> required 2 sf)

The forebay shall be sized to contain a percent of the WQv as well as the required sediment volume.

Percent Required = 10%

$$\text{Sediment Volume SV} = \{(76.6 \times \text{RA} \times \text{TE}) + (5.3 \times \text{DA} \times \text{TE})\} \times \text{T}$$

RA = area of roadway or parking lots = 0.043 acres

TE = basin trap efficiency (80% standard) = 80%

DA = contributing land use area = 0.135 acres

T = time in years = 1 year(s)

$$SV = 4 \text{ cf}$$

For % WQV refer to Chapter 5, for pretreatment requirements for each BMP used.

WQV % Required = 10%

WQV = 156.09 cf

WQV Required = 16 cf

SV Required = 4 cf

Total volume required = 16 cf + 4 cf = 20 cf

Volume provided = 50.28 cf (> required 20 cf)

Pretreatment volume provided in 48" diameter Catch Basin: Area = 12.57 sf, depth = 4-feet.



Computations

Project:	Middletown Redevelopment	Project #	72928.00
Location:	Middletown, RI	Sheet	1 of 1
Calculated by:	AEC	Date:	4/18/2022
Checked by:		Date:	
Title	Deep Sump Hooded Catch Basin		108

Section 6.4 Sediment Forebay

$$As = 5,750 \times Q$$

Where:

Q = Discharge from drainage area (CFS) = % WQV / 86,400 sec = 1 cfs

As = Sedimentation surface area (SF) = 9 sf

Area provided = 50.8 sf (> required 9 sf)

The forebay shall be sized to contain a percent of the WQv as well as the required sediment volume.

Percent Required = 10%

$$\text{Sediment Volume SV} = \{(76.6 \times \text{RA} \times \text{TE}) + (5.3 \times \text{DA} \times \text{TE})\} \times \text{T}$$

RA = area of roadway or parking lots = 0.36 acres

TE = basin trap efficiency (80% standard) = 80%

DA = contributing land use area = 0.39 acres

T = time in years = 1 year(s)

$$\text{SV} = 24 \text{ cf}$$

For % WQV refer to Chapter 5, for pretreatment requirements for each BMP used.

WQV % Required = 10%

WQV = 1306.8 cf

WQV Required = 131 cf

SV Required = 24 cf

Total volume required = 131 cf + 24 cf = 155 cf

Volume provided = 169.6 cf (> required 155 cf)

Pretreatment volume provided in 70" diameter Catch Basin: Area = 28.27 sf, depth = 6-feet.



Computations

Project:	Middletown Redevelopment	Project #	72928.00
Location:	Middletown, RI	Sheet	1 of 1
Calculated by:	AEC	Date:	4/18/2022
Checked by:		Date:	
Title	Deep Sump Hooded Catch Basin		109

Section 6.4 Sediment Forebay

$$As = 5,750 \times Q$$

Where:

Q = Discharge from drainage area (CFS) = % WQV / 86,400 sec = 1 cfs

As = Sedimentation surface area (SF) = 7 sf

Area provided = 50.8 sf (> required 7 sf)

The forebay shall be sized to contain a percent of the WQv as well as the required sediment volume.

Percent Required = 10%

Sediment Volume SV = $\{(76.6 \times RA \times TE) + (5.3 \times DA \times TE)\} \times T$

RA = area of roadway or parking lots = 0.26 acres

TE = basin trap efficiency (80% standard) = 80%

DA = contributing land use area = 0.28 acres

T = time in years = 1 year(s)

$$SV = 18 \text{ cf}$$

For % WQV refer to Chapter 5, for pretreatment requirements for each BMP used.

WQV % Required = 10%

WQV = 943.8 cf

WQV Required = 95 cf

SV Required = 18 cf

Total volume required = 95 cf + 18 cf = 113 cf

Volume provided = 113.1 cf (> required 113 cf)

Pretreatment volume provided in 72" diameter (A= Catch Basin: Area = 28.27 sf, depth = 4-feet.



Computations

Project: Proposed Redevelopment Project # 72955
 Location: Middletown, RI Sheet: 1 of 1
 Calculated By: AEC Date: 04-06-2022
 Checked By: RLC Date: 04-06-2022
 Title: Compensatory Pond Storage Volume Analysis

Existing stormwater detention ponds are located in the eastern portion of the site. The Redevelopment results in a modification to the lower detention pond. As a result, grading was analyzed to ensure the volume of the pond was maintained at all elevations to 139.

The following calculations utilize the Average End Area method to demonstrate that no detention pond storage will be lost as a result of the redevelopment.

Existing Pond Storage Volumes within Project Limits					
Elevation	Average Area			Storage Volume (CF)	Storage Volume (CY)
133 to 134	(3488+7127)	/2	x1'	= 5,307.5	= 196.5
134 to 135	(7127+2923)	/2	x1'	= 8,210	= 304.1
135 to 136	(2,923+11,351)	/2	x1'	= 10,322	=382.3
136 to 137	(11,351+13512)	/2	x1'	=12,431.5	= 460.4
137 to 138	(13,512+15,543)	/2	x1'	=14,527.5	= 538.0
138 to 139	(15,543+17,596)	/2	x1'	= 16,569.5	= 613.7

Proposed Flood Storage Volumes within Project Limits					
Elevation	Average Area			Storage Volume (CF)	Storage Volume (CY)
133 to 134	(3,488+7,170)	/2	x1'	= 5,329	= 197.3
134 to 135	(7,170+9,360)	/2	x1'	= 8,265	= 306.1
135 to 136	(9,360+11,465)	/2	x1'	= 10,412.5	= 385.6
136 to 137	(11,465+13,584)	/2	x1'	=12,524.5	=463.8
137 to 138	(13,584+15,584)	/2	x1'	=14,584	=540.1
138 to 139	(15,584+17,616)	/2	x1'	= 16,600	= 614.8

Elevation	Existing Flood Storage Volume (CY)	Proposed Flood Storage Volume (CY)	Net Increase in Flood Storage Volume (CY)	Cumulative Increase in Flood Storage Volume (CY)
133 to 134	196.5	197.3	0.8	0.8
134 to 135	304.1	306.1	2.0	2.8
135 to 136	382.3	385.6	3.4	6.2
136 to 137	460.4	463.8	3.4	9.6
137 to 138	538.0	540.1	2.1	11.7
138 to 139	613.7	614.8	1.1	12.8

Appendix C – Minimum Standard 4 – Conveyance and Natural Channel Protection Calculations

- › Hydraulic Pipe Calculations
- › Riprap Outlet Protection Sizing
- › Dry Swale Conveyance – 1-Year Storm Event
- › Dry Swale Conveyance – 10-Year Storm Event

Hydraulic Pipe Calculations

Proposed Redevelopment - Middletown, Rhode Island
 Standard 3.2.4 - Minimum Standard 4: Conveyance and Natural Channel Protection

April 18, 2022
 Hydraulic Pipe Calculations: 25-Year Storm Event

VHB, Inc.

Start Node	Stop Node	System Intensity (in/h)	Capacity (Full Flow) (cfs)	Manning's n	Diameter (in)	Material	Slope (%)	Flow (cfs)	Velocity (ft/s)	Length (ft)	Rim Elevation (ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Cover (ft)
101	RDB1 CO	7.009	4.26	0.012	12	HDPE	1.22	0.83	4.21	57.5	140.10	136.10	135.40	3.00
102	152	7.032	4.64	0.012	12	HDPE	1.44	1.17	4.93	27.7	139.30	134.90	134.50	3.40
103	152	6.788	4.87	0.012	15	HDPE	0.48	4.17	4.46	103.1	139.10	135.00	134.50	2.85
104	151	6.954	4.54	0.012	12	HDPE	1.39	2.19	5.73	72.2	138.80	134.90	133.90	2.90
105	106	7.032	3.05	0.012	12	HDPE	0.62	1.02	3.50	96.2	138.60	135.90	135.30	1.70
106	155	6.891	2.80	0.012	12	HDPE	0.53	1.84	3.81	151.7	138.65	135.30	134.50	2.35
107	103	6.866	2.90	0.012	12	HDPE	0.56	2.17	4.05	62.0	139.10	135.35	135.00	2.75
108	154	7.032	3.27	0.012	12	HDPE	0.72	1.80	4.27	41.7	138.80	135.80	135.50	2.00
109	162	7.032	2.85	0.012	12	HDPE	0.54	2.51	4.09	36.7	138.80	136.20	136.00	1.60
110	104	7.032	3.46	0.012	12	HDPE	0.80	0.88	3.68	56.1	138.65	135.45	135.00	2.20
111	101	7.027	0.63	0.012	6	HDPE	1.06	0.17	2.70	9.4	138.30	136.30	136.20	1.50
151	EX CB 108	6.539	24.82	0.012	24	RCP	1.03	8.44	7.14	15.6	141.10	132.30	132.14	6.80
152	151	6.669	21.35	0.012	24	RCP	0.76	5.23	5.62	141.0	140.10	134.37	133.30	3.73
153	FES 192	6.44	15.58	0.012	24	HDPE	0.40	7.76	4.95	59.4	138.90	134.90	134.66	2.00
154	153	6.802	7.33	0.012	18	HDPE	0.41	6.16	4.65	144.6	139.40	135.50	134.90	2.40
155	FES 193	6.686	2.71	0.012	12	HDPE	0.49	1.79	3.68	20.3	138.10	134.50	134.40	2.60
160	161	6.708	0.94	0.012	8	HDPE	0.52	0.93	2.66	67.5	138.50	135.75	135.40	2.08
161	153	6.578	2.71	0.012	12	HDPE	0.49	1.97	3.77	101.1	138.50	135.40	134.90	2.10
162	154	6.922	4.89	0.012	15	HDPE	0.49	3.67	4.38	102.2	139.40	136.00	135.50	2.15
201	FES 2	6.32	7.47	0.012	15	HDPE	1.14	6.98	6.92	30.7	139.80	134.85	134.50	3.70
203	250	7.032	4.46	0.012	12	HDPE	1.33	0.66	3.97	45.0	140.70	136.40	135.80	3.30
250	201	6.415	6.49	0.012	15	HDPE	0.86	5.86	5.98	110.6	141.90	135.80	134.85	4.85
301	FES 5	7.032	5.56	0.012	12	HDPE	2.08	1.62	6.14	33.7	141.40	137.20	136.50	3.20
303	EX FES 3	6.628	13.05	0.012	18	RCP	1.31	9.95	8.13	25.1	142.40	135.25	134.92	5.65
305	RDA1-INT	6.85	8.58	0.012	18	HDPE	0.57	8.40	5.53	190.0	141.30	136.60	135.52	3.20
306	305	7.032	2.69	0.012	12	HDPE	0.49	2.10	3.78	134.0	141.70	137.35	136.70	3.35
307	303	7.032	4.46	0.012	12	HDPE	1.33	1.76	5.34	37.5	141.60	138.50	138.00	2.10
CO	107	6.902	1.29	0.012	8	HDPE	0.97	0.48	3.31	22.6	139.30	135.90	135.68	2.73
EX CB 107	EX CB 108	8.222	51.84	0.012	36	RCP	0.51	14.80	6.32	277.8	139.67	133.57	132.14	3.10
EX CB 108	FES 1	6.528	27.63	0.012	36	RCP	0.15	23.23	4.38	239.3	138.89	132.14	131.79	3.75
FES at Ditch	EX CB 107	7.026	24.73	0.012	36	RCP	0.12	14.80	3.66	247.5	136.86	133.86	133.57	0.00
RDA1-INT	303	6.673	8.53	0.012	18	HDPE	0.56	8.35	5.50	48.0	143.00	135.52	135.25	5.98
RDA2	FES 6	7.032	0.27	0.012	4	HDPE	1.70	0.13	2.55	88.0	142.80	137.50	136.00	4.97

Start Node	Stop Node	System Intensity (in/h)	Capacity (Full Flow) (cfs)	Manning's n	Diameter (in)	Material	Slope (%)	Flow (cfs)	Velocity (ft/s)	Length (ft)	Rim Elevation (ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Cover (ft)
RDB1	RDB1 CO	7.032	1.94	0.012	6	HDPE	10.14	0.51	8.29	14.8	142.00	137.00	135.50	4.50
RDB1 CO	151	6.938	4.15	0.012	12	HDPE	1.16	1.33	4.70	34.6	141.30	135.40	135.00	4.90
RDB1&2-INT	250	6.434	5.46	0.012	15	HDPE	0.61	5.27	5.07	18.7	142.50	135.91	135.80	5.34
RDB2	RDB1&2-INT	6.976	2.30	0.012	10	HDPE	0.94	1.62	4.07	192.0	141.60	137.70	135.90	3.07
RDB3	RDB1&2-INT	6.565	5.10	0.012	15	HDPE	0.53	3.85	4.92	527.0	143.25	138.70	135.90	3.30
RDC6	162	7.032	2.14	0.012	10	HDPE	0.81	1.22	4.04	86.4	139.40	136.70	136.00	1.87
RDD1A	RDD-INT	7.032	0.93	0.012	8	HDPE	0.50	0.73	2.94	133.0	139.40	136.70	136.03	2.03
RDD1B	CO	7.032	1.28	0.012	8	HDPE	0.95	0.49	3.31	84.0	139.40	136.70	135.90	2.03
RDD2	161	7.032	1.73	0.012	10	HDPE	0.53	1.13	3.39	273.0	139.50	136.85	135.40	1.82
RDD-INT	160	6.8	0.90	0.013	8	HDPE	0.55	0.70	2.85	50.6	139.00	136.03	135.75	2.30

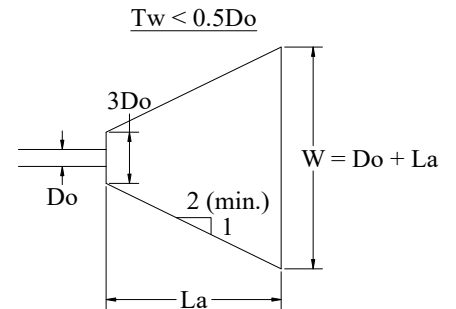
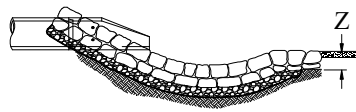
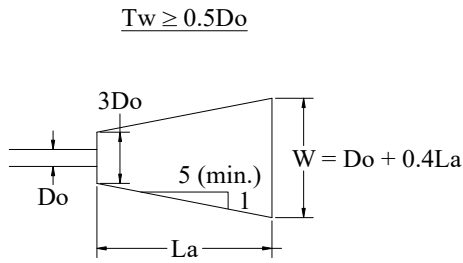
RDXX= RD Building Letter (See Site Plans) and roof drain #
RDXX-INT= Intersection of RD and pipe

Riprap Outlet Protection Sizing



Outfall Riprap Sizing and Velocity Calculations

Project	Proposed Redevelopment	Project #	72928.00
Calculated by	AEC	Date	4/6/2022
Checked by		Date	



OUTLET DESCRIPTION:

		192	193	2	5	6
Design Storm (yr)		25	25	25	25	25
Flow / Discharge (Q) (cfs)		9.7	2.7	8.3	2.0	0.2
Defined Channel ?	-	YES	YES	NO	NO	NO
Defined Channel Width (ft)		4	4	0	0	0
Outlet Pipe Diameter (D _O) (in)		24	12	15	6	6
Tailwater Condition (T _w) (ft)		TW ≥ 0.5D	TW ≥ 0.5D	TW < 0.5D	TW < 0.5D	TW < 0.5D
Apron Length (L _A) (ft)		8.5	4	11	6	6
Apron Width at Outlet (3D _O) (ft)		4	4	3.75	1.5	1.5
Apron Width at End (W) (ft)		4	4	12.25	6.5	6.5
Median Stone Diameter (in)		6	6	6	6	6
Largest Stone Diameter (in)		9	9	9	9	9
Apron Depth (in)		13.5	13.5	13.5	13.5	13.5

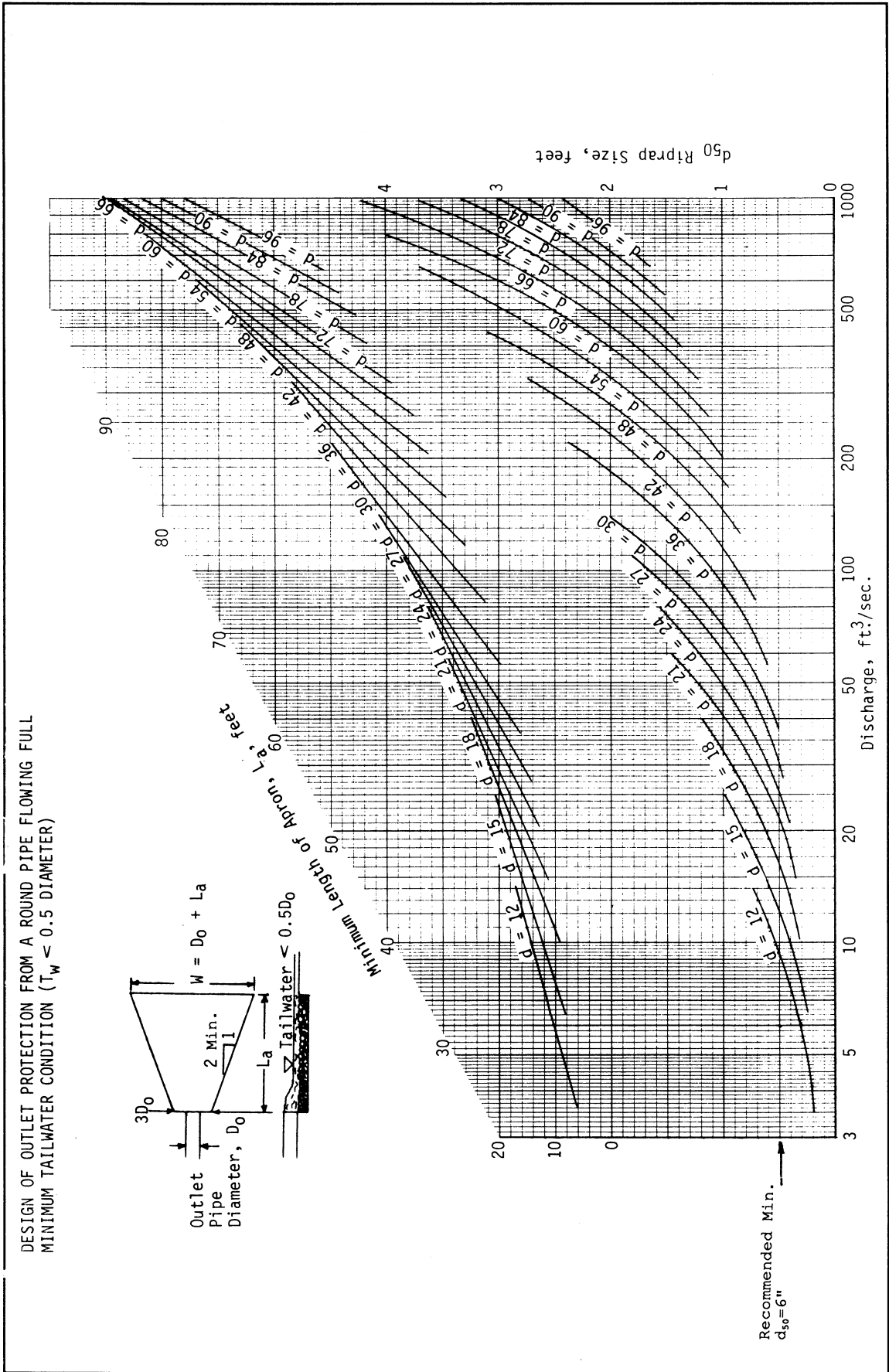
Apron Length (L_A): Length = From Virginia DCR Handbook - Plate 3.18-3 if T_w < 0.5D
 Length = From Virginia DCR Handbook - Plate 3.18-4 if T_w ≥ 0.5D

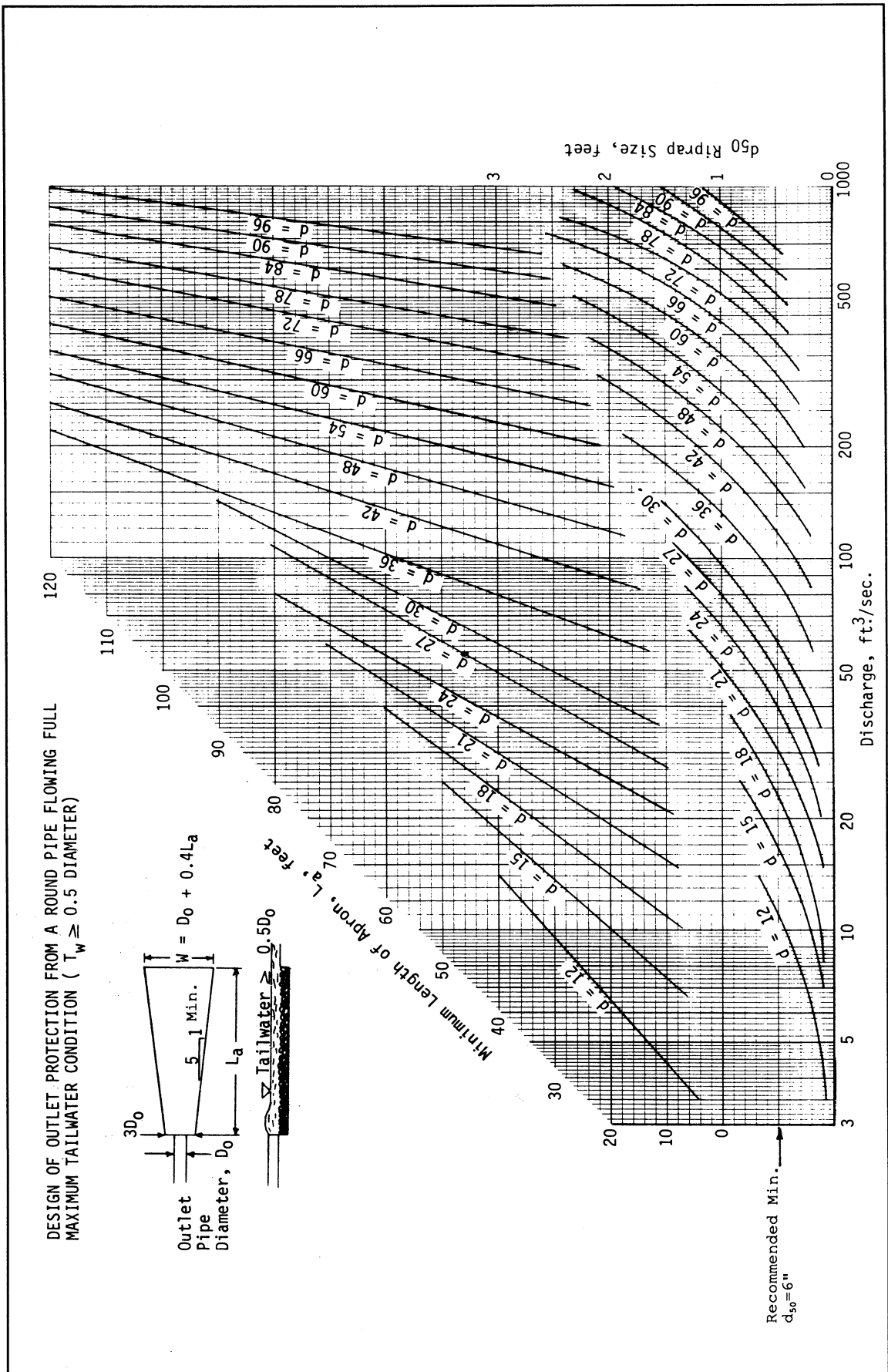
Apron Width at Outlet (3D_O): Width = 3 x pipe dia. (or width of channel)

Apron Width at End (W): Width = dia. + apron length if T_w < 0.5D
 Width = dia. + 0.4 x apron length if T_w ≥ 0.5D
 or apron width = channel width if a well defined channel exists

Rock Riprap: Median Diameter (d₅₀) = From Virginia DCR Handbook - Plate 3.18-3 or 4
 Largest stone dia = 1.5 x d₅₀

Apron Depth: 6" or 1.5 x largest stone dia





Dry Swale Conveyance – 1-Year Storm Event

72928 PR Drainage

Prepared by VHB

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Proposed Redevelopment
Type III 24-hr 1-Year Rainfall=2.80"

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Reach DS 1_2: Dry Swale - Segments 1 Avg. Flow Depth=0.50' Max Vel=1.49 fps Inflow=2.7 cfs 10,000 cf
n=0.035 L=412.0' S=0.0051 '/' Capacity=9.8 cfs Outflow=2.4 cfs 10,000 cf

Reach DS 3_8: Dry Swale - Segments 3-8 Avg. Flow Depth=0.47' Max Vel=1.66 fps Inflow=7.6 cfs 30,379 cf
n=0.035 L=300.0' S=0.0050 '/' Capacity=56.3 cfs Outflow=7.2 cfs 30,379 cf

Non-erosive velocity

Non-erosive velocity

Dry Swale Conveyance – 10-Year Storm Event

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Proposed Redevelopment
Type III 24-hr 10-Year Rainfall=4.90"

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. — Non-erosive velocity
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Reach DS 1_2: Dry Swale - Segments 1 Avg. Flow Depth=0.68' Max Vel=1.76 fps Inflow=4.8 cfs 18,331 cf
n=0.035 L=412.0' S=0.0051 '/' Capacity=9.8 cfs Outflow=4.4 cfs 18,331 cf

Reach DS 3_8: Dry Swale - Segments Avg. Flow Depth=0.68' Max Vel=2.05 fps Inflow=14.0 cfs 56,933 cf
n=0.035 L=300.0' S=0.0050 '/' Capacity=56.3 cfs Outflow=13.5 cfs 56,933 cf

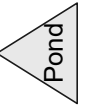
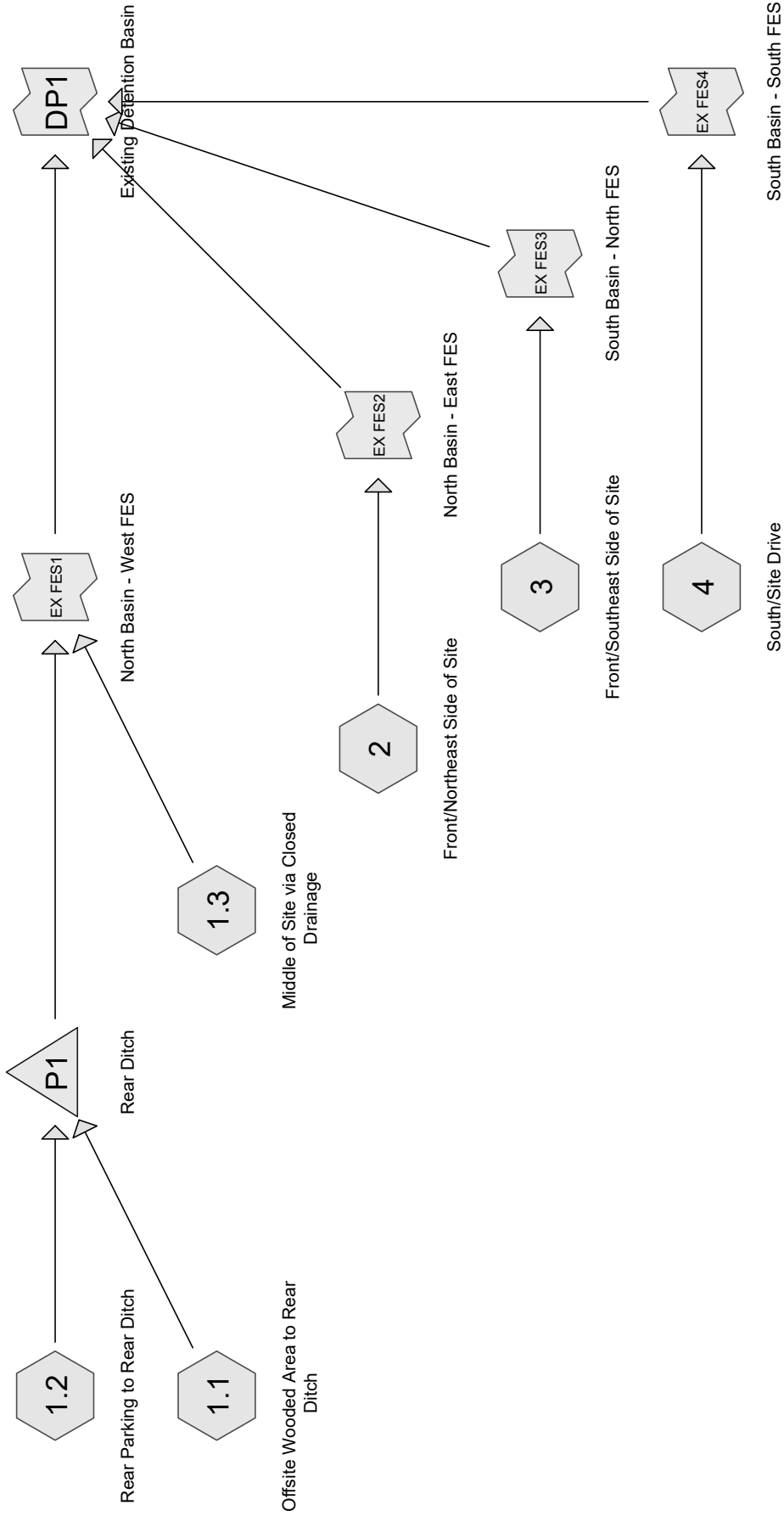
— Non-erosive velocity

Appendix D – Minimum Standard 5 – Overbank Flood Protection – HydroCAD Calculations

Provided for local and RIDOT review

- › Existing Conditions - HydroCAD Model
 - WQv Storm Event
 - 1-Year Storm Event
 - 2-Year Storm Event
 - 10-Year Storm Event
 - 25-Year Storm Event
 - 100-Year Storm Event
- › Proposed Conditions – HydroCAD Model
 - WQv Storm Event
 - 1-Year Storm Event
 - 2-Year Storm Event
 - 10-Year Storm Event
 - 25-Year Storm Event
 - 100-Year Storm Event

Existing Conditions – HydroCAD Model



WQv Storm Event

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Type III 24-hr 1.2" Rainfall=1.20"

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Summary for Subcatchment 1.1: Offsite Wooded Area to Rear Ditch

Runoff = 0.0 cfs @ 14.88 hrs, Volume= 67 cf, Depth= 0.03"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1.2" Rainfall=1.20"

Area (sf)	CN	Description
31,628	70	Woods, Good, HSG C
31,628	70	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	40	0.0550	0.10		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.39"
0.2	45	0.0550	3.78		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
6.9	85	Total			

Summary for Subcatchment 1.2: Rear Parking to Rear Ditch

Runoff = 3.5 cfs @ 12.08 hrs, Volume= 11,368 cf, Depth= 0.77"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1.2" Rainfall=1.20"

Area (sf)	CN	Description
4,357	74	>75% Grass cover, Good, HSG C
103,688	98	Paved parking, HSG C
33,682	98	Roofs, HSG C
35,666	70	Woods, Good, HSG C
177,392	92	Weighted Average
40,023	70	22.56% Pervious Area
137,370	98	77.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	50	0.0040	0.65		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.39"
1.0	140	0.0146	2.45		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.5	100	0.0050	3.21	2.52	Pipe Channel, 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.5	160	0.0050	5.09	16.00	Pipe Channel, 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
0.6	240	0.0050	6.67	47.16	Pipe Channel, 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75'

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Type III 24-hr 1.2" Rainfall=1.20"

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n= 0.013

3.9 690 Total, Increased to minimum Tc = 6.0 min

Summary for Subcatchment 1.3: Middle of Site via Closed Drainage

Runoff = 2.0 cfs @ 12.22 hrs, Volume= 8,885 cf, Depth= 0.93"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1.2" Rainfall=1.20"

Area (sf)	CN	Description
1,487	74	>75% Grass cover, Good, HSG C
71,082	98	Paved parking, HSG C
36,848	98	Roofs, HSG C
5,597	70	Woods, Good, HSG C
115,013	96	Weighted Average
7,084	71	6.16% Pervious Area
107,930	98	93.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	50	0.0200	0.07		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.39"
1.6	220	0.0200	2.28		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
2.8	770	0.0020	4.57	32.31	Pipe Channel, 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.012
16.4	1,040	Total			

Summary for Subcatchment 2: Front/Northeast Side of Site

Runoff = 1.3 cfs @ 12.08 hrs, Volume= 4,275 cf, Depth= 0.98"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1.2" Rainfall=1.20"

Area (sf)	CN	Description
464	74	>75% Grass cover, Good, HSG C
35,754	98	Paved parking, HSG C
16,259	98	Roofs, HSG C
52,477	98	Weighted Average
464	74	0.88% Pervious Area
52,013	98	99.12% Impervious Area

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Type III 24-hr 1.2" Rainfall=1.20"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0160	1.13		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.39"
1.3	150	0.0093	1.96		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.0	15	0.0600	11.11	8.73	Pipe Channel, 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
2.0	215	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment 3: Front/Southeast Side of Site

Runoff = 1.8 cfs @ 12.08 hrs, Volume= 5,859 cf, Depth= 0.97"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1.2" Rainfall=1.20"

Area (sf)	CN	Description
1,351	74	>75% Grass cover, Good, HSG C
71,251	98	Paved parking, HSG C
72,602	98	Weighted Average
1,351	74	1.86% Pervious Area
71,251	98	98.14% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	50	0.0080	0.85		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.39"
2.2	235	0.0080	1.82		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.4	135	0.0139	6.21	7.62	Pipe Channel, 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
0.2	55	0.0095	5.79	10.24	Pipe Channel, 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
3.8	475	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment 4: South/Site Drive

Runoff = 0.5 cfs @ 12.08 hrs, Volume= 1,554 cf, Depth= 0.82"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1.2" Rainfall=1.20"

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Type III 24-hr 1.2" Rainfall=1.20"

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Area (sf)	CN	Description
3,977	74	>75% Grass cover, Good, HSG C
18,670	98	Paved parking, HSG C
22,647	94	Weighted Average
3,977	74	17.56% Pervious Area
18,670	98	82.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	50	0.0070	0.81		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.39"
3.0	350	0.0090	1.93		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.1	45	0.0084	8.65	61.13	Pipe Channel, 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013
4.1	445	Total, Increased to minimum Tc = 6.0 min			

Summary for Pond P1: Rear Ditch

Inflow Area = 209,020 sf, 65.72% Impervious, Inflow Depth = 0.66" for 1.2" event
 Inflow = 3.5 cfs @ 12.08 hrs, Volume= 11,435 cf
 Outflow = 2.8 cfs @ 12.14 hrs, Volume= 11,435 cf, Atten= 19%, Lag= 3.5 min
 Primary = 2.8 cfs @ 12.14 hrs, Volume= 11,435 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Peak Elev= 134.72' @ 12.14 hrs Surf.Area= 2,170 sf Storage= 789 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
 Center-of-Mass det. time= 2.5 min (788.3 - 785.8)

Volume	Invert	Avail.Storage	Storage Description
#1	134.00'	51,675 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
134.00	15	0	0
135.00	3,000	1,508	1,508
136.00	21,030	12,015	13,523
137.00	55,275	38,153	51,675

Device	Routing	Invert	Outlet Devices
#1	Primary	133.86'	36.0" Round Culvert L= 250.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 133.86' / 133.57' S= 0.0012 ' / Cc= 0.900 n= 0.012, Flow Area= 7.07 sf

Primary OutFlow Max=2.8 cfs @ 12.14 hrs HW=134.72' TW=0.00' (Dynamic Tailwater)
 ↑1=Culvert (Barrel Controls 2.8 cfs @ 2.49 fps)

72928 EX Drainage

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Type III 24-hr 1.2" Rainfall=1.20"

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Summary for Link DP1: Existing Detention Basin

Inflow Area = 471,760 sf, 82.08% Impervious, Inflow Depth = 0.81" for 1.2" event
Inflow = 7.6 cfs @ 12.11 hrs, Volume= 32,007 cf
Primary = 7.6 cfs @ 12.11 hrs, Volume= 32,007 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link EX FES1: North Basin - West FES

Inflow Area = 324,034 sf, 75.70% Impervious, Inflow Depth = 0.75" for 1.2" event
Inflow = 4.6 cfs @ 12.17 hrs, Volume= 20,319 cf
Primary = 4.6 cfs @ 12.17 hrs, Volume= 20,319 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link EX FES2: North Basin - East FES

Inflow Area = 52,477 sf, 99.12% Impervious, Inflow Depth = 0.98" for 1.2" event
Inflow = 1.3 cfs @ 12.08 hrs, Volume= 4,275 cf
Primary = 1.3 cfs @ 12.08 hrs, Volume= 4,275 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link EX FES3: South Basin - North FES

Inflow Area = 72,602 sf, 98.14% Impervious, Inflow Depth = 0.97" for 1.2" event
Inflow = 1.8 cfs @ 12.08 hrs, Volume= 5,859 cf
Primary = 1.8 cfs @ 12.08 hrs, Volume= 5,859 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link EX FES4: South Basin - South FES

Inflow Area = 22,647 sf, 82.44% Impervious, Inflow Depth = 0.82" for 1.2" event
Inflow = 0.5 cfs @ 12.08 hrs, Volume= 1,554 cf
Primary = 0.5 cfs @ 12.08 hrs, Volume= 1,554 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

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72928 Proposed Redevelopment
Type III 24-hr 1.2" Rainfall=1.20"

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1.1: Offsite Wooded Area to Runoff Area=31,628 sf 0.00% Impervious Runoff Depth=0.03"
Flow Length=85' Slope=0.0550 '/ Tc=6.9 min CN=70/0 Runoff=0.0 cfs 67 cf

Subcatchment 1.2: Rear Parking to Rear Runoff Area=177,392 sf 77.44% Impervious Runoff Depth=0.77"
Flow Length=690' Tc=6.0 min CN=70/98 Runoff=3.5 cfs 11,368 cf

Subcatchment 1.3: Middle of Site via Runoff Area=115,013 sf 93.84% Impervious Runoff Depth=0.93"
Flow Length=1,040' Tc=16.4 min CN=71/98 Runoff=2.0 cfs 8,885 cf

Subcatchment 2: Front/Northeast Side of Runoff Area=52,477 sf 99.12% Impervious Runoff Depth=0.98"
Flow Length=215' Tc=6.0 min CN=74/98 Runoff=1.3 cfs 4,275 cf

Subcatchment 3: Front/Southeast Side of Runoff Area=72,602 sf 98.14% Impervious Runoff Depth=0.97"
Flow Length=475' Tc=6.0 min CN=74/98 Runoff=1.8 cfs 5,859 cf

Subcatchment 4: South/Site Drive Runoff Area=22,647 sf 82.44% Impervious Runoff Depth=0.82"
Flow Length=445' Tc=6.0 min CN=74/98 Runoff=0.5 cfs 1,554 cf

Pond P1: Rear Ditch Peak Elev=134.72' Storage=789 cf Inflow=3.5 cfs 11,435 cf
36.0" Round Culvert n=0.012 L=250.0' S=0.0012 '/ Outflow=2.8 cfs 11,435 cf

Link DP1: Existing Detention Basin Inflow=7.6 cfs 32,007 cf
Primary=7.6 cfs 32,007 cf

Link EX FES1: North Basin - West FES Inflow=4.6 cfs 20,319 cf
Primary=4.6 cfs 20,319 cf

Link EX FES2: North Basin - East FES Inflow=1.3 cfs 4,275 cf
Primary=1.3 cfs 4,275 cf

Link EX FES3: South Basin - North FES Inflow=1.8 cfs 5,859 cf
Primary=1.8 cfs 5,859 cf

Link EX FES4: South Basin - South FES Inflow=0.5 cfs 1,554 cf
Primary=0.5 cfs 1,554 cf

Total Runoff Area = 471,760 sf Runoff Volume = 32,007 cf Average Runoff Depth = 0.81"
17.92% Pervious = 84,526 sf 82.08% Impervious = 387,234 sf

1-Year Storm Event

72928 EX Drainage

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72928 Proposed Redevelopment
Type III 24-hr 1-Year Rainfall=2.80"

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1.1: Offsite Wooded Area to Runoff Area=31,628 sf 0.00% Impervious Runoff Depth=0.61"
Flow Length=85' Slope=0.0550 '/ Tc=6.9 min CN=70/0 Runoff=0.4 cfs 1,597 cf

Subcatchment 1.2: Rear Parking to Rear Runoff Area=177,392 sf 77.44% Impervious Runoff Depth=2.13"
Flow Length=690' Tc=6.0 min CN=70/98 Runoff=9.1 cfs 31,432 cf

Subcatchment 1.3: Middle of Site via Runoff Area=115,013 sf 93.84% Impervious Runoff Depth=2.45"
Flow Length=1,040' Tc=16.4 min CN=71/98 Runoff=5.0 cfs 23,490 cf

Subcatchment 2: Front/Northeast Side of Runoff Area=52,477 sf 99.12% Impervious Runoff Depth=2.55"
Flow Length=215' Tc=6.0 min CN=74/98 Runoff=3.2 cfs 11,166 cf

Subcatchment 3: Front/Southeast Side of Runoff Area=72,602 sf 98.14% Impervious Runoff Depth=2.54"
Flow Length=475' Tc=6.0 min CN=74/98 Runoff=4.5 cfs 15,343 cf

Subcatchment 4: South/Site Drive Runoff Area=22,647 sf 82.44% Impervious Runoff Depth=2.26"
Flow Length=445' Tc=6.0 min CN=74/98 Runoff=1.2 cfs 4,257 cf

Pond P1: Rear Ditch Peak Elev=135.21' Storage=2,553 cf Inflow=9.5 cfs 33,029 cf
36.0" Round Culvert n=0.012 L=250.0' S=0.0012 '/ Outflow=6.9 cfs 33,029 cf

Link DP1: Existing Detention Basin Inflow=19.0 cfs 87,285 cf
Primary=19.0 cfs 87,285 cf

Link EX FES1: North Basin - West FES Inflow=11.8 cfs 56,519 cf
Primary=11.8 cfs 56,519 cf

Link EX FES2: North Basin - East FES Inflow=3.2 cfs 11,166 cf
Primary=3.2 cfs 11,166 cf

Link EX FES3: South Basin - North FES Inflow=4.5 cfs 15,343 cf
Primary=4.5 cfs 15,343 cf

Link EX FES4: South Basin - South FES Inflow=1.2 cfs 4,257 cf
Primary=1.2 cfs 4,257 cf

Total Runoff Area = 471,760 sf Runoff Volume = 87,285 cf Average Runoff Depth = 2.22"
17.92% Pervious = 84,526 sf 82.08% Impervious = 387,234 sf

2-Year Storm Event

72928 EX Drainage

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72928 Proposed Redevelopment
Type III 24-hr 2-Year Rainfall=3.30"

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1.1: Offsite Wooded Area to Runoff Area=31,628 sf 0.00% Impervious Runoff Depth=0.89"
Flow Length=85' Slope=0.0550 '/' Tc=6.9 min CN=70/0 Runoff=0.7 cfs 2,338 cf

Subcatchment 1.2: Rear Parking to Rear Runoff Area=177,392 sf 77.44% Impervious Runoff Depth=2.58"
Flow Length=690' Tc=6.0 min CN=70/98 Runoff=11.0 cfs 38,069 cf

Subcatchment 1.3: Middle of Site via Runoff Area=115,013 sf 93.84% Impervious Runoff Depth=2.94"
Flow Length=1,040' Tc=16.4 min CN=71/98 Runoff=6.0 cfs 28,140 cf

Subcatchment 2: Front/Northeast Side of Runoff Area=52,477 sf 99.12% Impervious Runoff Depth=3.05"
Flow Length=215' Tc=6.0 min CN=74/98 Runoff=3.8 cfs 13,337 cf

Subcatchment 3: Front/Southeast Side of Runoff Area=72,602 sf 98.14% Impervious Runoff Depth=3.03"
Flow Length=475' Tc=6.0 min CN=74/98 Runoff=5.3 cfs 18,336 cf

Subcatchment 4: South/Site Drive Runoff Area=22,647 sf 82.44% Impervious Runoff Depth=2.72"
Flow Length=445' Tc=6.0 min CN=74/98 Runoff=1.5 cfs 5,138 cf

Pond P1: Rear Ditch Peak Elev=135.32' Storage=3,380 cf Inflow=11.6 cfs 40,406 cf
36.0" Round Culvert n=0.012 L=250.0' S=0.0012 '/' Outflow=8.0 cfs 40,406 cf

Link DP1: Existing Detention Basin Inflow=22.3 cfs 105,357 cf
Primary=22.3 cfs 105,357 cf

Link EX FES1: North Basin - West FES Inflow=13.9 cfs 68,547 cf
Primary=13.9 cfs 68,547 cf

Link EX FES2: North Basin - East FES Inflow=3.8 cfs 13,337 cf
Primary=3.8 cfs 13,337 cf

Link EX FES3: South Basin - North FES Inflow=5.3 cfs 18,336 cf
Primary=5.3 cfs 18,336 cf

Link EX FES4: South Basin - South FES Inflow=1.5 cfs 5,138 cf
Primary=1.5 cfs 5,138 cf

Total Runoff Area = 471,760 sf Runoff Volume = 105,357 cf Average Runoff Depth = 2.68"
17.92% Pervious = 84,526 sf 82.08% Impervious = 387,234 sf

10-Year Storm Event

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72928 Proposed Redevelopment
Type III 24-hr 10-Year Rainfall=4.90"

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1.1: Offsite Wooded Area to Runoff Area=31,628 sf 0.00% Impervious Runoff Depth=1.96"
Flow Length=85' Slope=0.0550 '/ Tc=6.9 min CN=70/0 Runoff=1.6 cfs 5,172 cf

Subcatchment 1.2: Rear Parking to Rear Runoff Area=177,392 sf 77.44% Impervious Runoff Depth=4.05"
Flow Length=690' Tc=6.0 min CN=70/98 Runoff=17.2 cfs 59,929 cf

Subcatchment 1.3: Middle of Site via Runoff Area=115,013 sf 93.84% Impervious Runoff Depth=4.50"
Flow Length=1,040' Tc=16.4 min CN=71/98 Runoff=9.0 cfs 43,148 cf

Subcatchment 2: Front/Northeast Side of Runoff Area=52,477 sf 99.12% Impervious Runoff Depth=4.64"
Flow Length=215' Tc=6.0 min CN=74/98 Runoff=5.8 cfs 20,301 cf

Subcatchment 3: Front/Southeast Side of Runoff Area=72,602 sf 98.14% Impervious Runoff Depth=4.62"
Flow Length=475' Tc=6.0 min CN=74/98 Runoff=7.9 cfs 27,946 cf

Subcatchment 4: South/Site Drive Runoff Area=22,647 sf 82.44% Impervious Runoff Depth=4.25"
Flow Length=445' Tc=6.0 min CN=74/98 Runoff=2.3 cfs 8,012 cf

Pond P1: Rear Ditch Peak Elev=135.61' Storage=6,694 cf Inflow=18.7 cfs 65,101 cf
36.0" Round Culvert n=0.012 L=250.0' S=0.0012 '/ Outflow=11.3 cfs 65,101 cf

Link DP1: Existing Detention Basin Inflow=32.6 cfs 164,509 cf
Primary=32.6 cfs 164,509 cf

Link EX FES1: North Basin - West FES Inflow=20.3 cfs 108,249 cf
Primary=20.3 cfs 108,249 cf

Link EX FES2: North Basin - East FES Inflow=5.8 cfs 20,301 cf
Primary=5.8 cfs 20,301 cf

Link EX FES3: South Basin - North FES Inflow=7.9 cfs 27,946 cf
Primary=7.9 cfs 27,946 cf

Link EX FES4: South Basin - South FES Inflow=2.3 cfs 8,012 cf
Primary=2.3 cfs 8,012 cf

Total Runoff Area = 471,760 sf Runoff Volume = 164,509 cf Average Runoff Depth = 4.18"
17.92% Pervious = 84,526 sf 82.08% Impervious = 387,234 sf

25-Year Storm Event

72928 EX Drainage

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72928 Proposed Redevelopment
Type III 24-hr 25-Year Rainfall=6.10"

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1.1: Offsite Wooded Area to Runoff Area=31,628 sf 0.00% Impervious Runoff Depth=2.88"
Flow Length=85' Slope=0.0550 '/' Tc=6.9 min CN=70/0 Runoff=2.4 cfs 7,603 cf

Subcatchment 1.2: Rear Parking to Rear Runoff Area=177,392 sf 77.44% Impervious Runoff Depth=5.19"
Flow Length=690' Tc=6.0 min CN=70/98 Runoff=21.9 cfs 76,724 cf

Subcatchment 1.3: Middle of Site via Runoff Area=115,013 sf 93.84% Impervious Runoff Depth=5.68"
Flow Length=1,040' Tc=16.4 min CN=71/98 Runoff=11.4 cfs 54,480 cf

Subcatchment 2: Front/Northeast Side of Runoff Area=52,477 sf 99.12% Impervious Runoff Depth=5.84"
Flow Length=215' Tc=6.0 min CN=74/98 Runoff=7.2 cfs 25,534 cf

Subcatchment 3: Front/Southeast Side of Runoff Area=72,602 sf 98.14% Impervious Runoff Depth=5.81"
Flow Length=475' Tc=6.0 min CN=74/98 Runoff=9.9 cfs 35,173 cf

Subcatchment 4: South/Site Drive Runoff Area=22,647 sf 82.44% Impervious Runoff Depth=5.41"
Flow Length=445' Tc=6.0 min CN=74/98 Runoff=2.9 cfs 10,203 cf

Pond P1: Rear Ditch Peak Elev=135.80' Storage=9,695 cf Inflow=24.3 cfs 84,327 cf
36.0" Round Culvert n=0.012 L=250.0' S=0.0012 '/' Outflow=13.7 cfs 84,327 cf

Link DP1: Existing Detention Basin Inflow=40.2 cfs 209,717 cf
Primary=40.2 cfs 209,717 cf

Link EX FES1: North Basin - West FES Inflow=25.0 cfs 138,807 cf
Primary=25.0 cfs 138,807 cf

Link EX FES2: North Basin - East FES Inflow=7.2 cfs 25,534 cf
Primary=7.2 cfs 25,534 cf

Link EX FES3: South Basin - North FES Inflow=9.9 cfs 35,173 cf
Primary=9.9 cfs 35,173 cf

Link EX FES4: South Basin - South FES Inflow=2.9 cfs 10,203 cf
Primary=2.9 cfs 10,203 cf

Total Runoff Area = 471,760 sf Runoff Volume = 209,717 cf Average Runoff Depth = 5.33"
17.92% Pervious = 84,526 sf 82.08% Impervious = 387,234 sf

100-Year Storm Event

72928 EX Drainage

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72928 Proposed Redevelopment
Type III 24-hr 100-Year Rainfall=8.60"

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1.1: Offsite Wooded Area to Runoff Area=31,628 sf 0.00% Impervious Runoff Depth=4.98"
Flow Length=85' Slope=0.0550 '/' Tc=6.9 min CN=70/0 Runoff=4.1 cfs 13,136 cf

Subcatchment 1.2: Rear Parking to Rear Runoff Area=177,392 sf 77.44% Impervious Runoff Depth=7.60"
Flow Length=690' Tc=6.0 min CN=70/98 Runoff=32.0 cfs 112,322 cf

Subcatchment 1.3: Middle of Site via Runoff Area=115,013 sf 93.84% Impervious Runoff Depth=8.16"
Flow Length=1,040' Tc=16.4 min CN=71/98 Runoff=16.2 cfs 78,203 cf

Subcatchment 2: Front/Northeast Side of Runoff Area=52,477 sf 99.12% Impervious Runoff Depth=8.33"
Flow Length=215' Tc=6.0 min CN=74/98 Runoff=10.2 cfs 36,446 cf

Subcatchment 3: Front/Southeast Side of Runoff Area=72,602 sf 98.14% Impervious Runoff Depth=8.31"
Flow Length=475' Tc=6.0 min CN=74/98 Runoff=14.0 cfs 50,253 cf

Subcatchment 4: South/Site Drive Runoff Area=22,647 sf 82.44% Impervious Runoff Depth=7.85"
Flow Length=445' Tc=6.0 min CN=74/98 Runoff=4.2 cfs 14,818 cf

Pond P1: Rear Ditch Peak Elev=136.14' Storage=16,931 cf Inflow=36.0 cfs 125,459 cf
36.0" Round Culvert n=0.012 L=250.0' S=0.0012 '/' Outflow=18.3 cfs 125,459 cf

Link DP1: Existing Detention Basin Inflow=55.9 cfs 305,179 cf
Primary=55.9 cfs 305,179 cf

Link EX FES1: North Basin - West FES Inflow=34.4 cfs 203,662 cf
Primary=34.4 cfs 203,662 cf

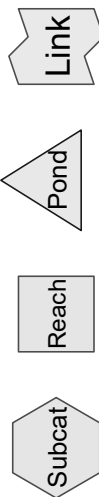
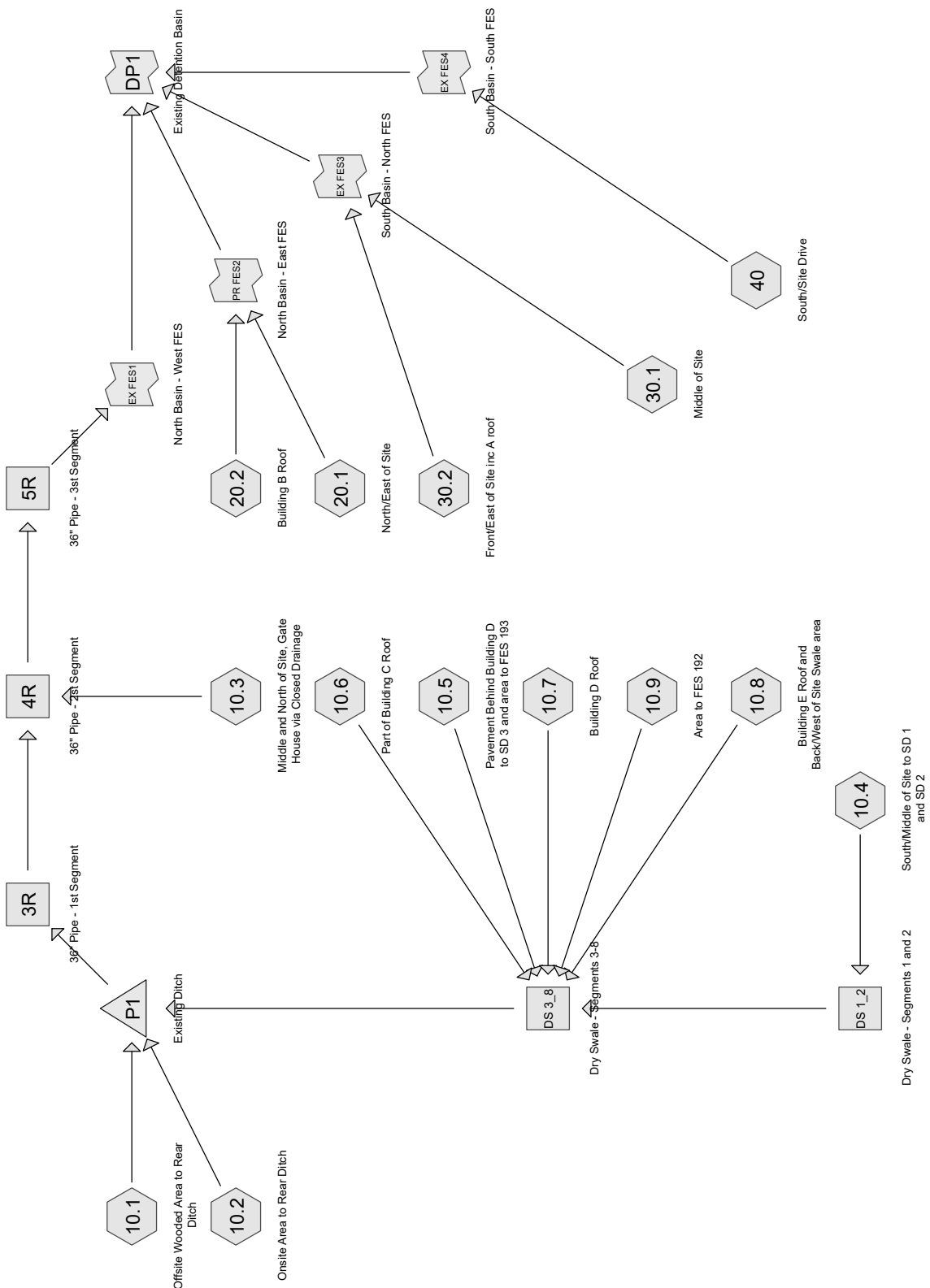
Link EX FES2: North Basin - East FES Inflow=10.2 cfs 36,446 cf
Primary=10.2 cfs 36,446 cf

Link EX FES3: South Basin - North FES Inflow=14.0 cfs 50,253 cf
Primary=14.0 cfs 50,253 cf

Link EX FES4: South Basin - South FES Inflow=4.2 cfs 14,818 cf
Primary=4.2 cfs 14,818 cf

Total Runoff Area = 471,760 sf Runoff Volume = 305,179 cf Average Runoff Depth = 7.76"
17.92% Pervious = 84,526 sf 82.08% Impervious = 387,234 sf

Proposed Conditions – HydroCAD Model



Routing Diagram for 72928 PR Drainage
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WQv Storm Event

72928 PR Drainage

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Proposed Redevelopment
Type III 24-hr 1.2" Rainfall=1.20"

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Summary for Subcatchment 10.1: Offsite Wooded Area to Rear Ditch

Runoff = 0.0 cfs @ 14.88 hrs, Volume= 67 cf, Depth= 0.03"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1.2" Rainfall=1.20"

Area (sf)	CN	Description
31,628	70	Woods, Good, HSG C
31,628	70	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	40	0.0550	0.10		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.39"
0.2	45	0.0550	3.78		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
6.9	85	Total			

Summary for Subcatchment 10.2: Onsite Area to Rear Ditch

Runoff = 0.0 cfs @ 14.58 hrs, Volume= 36 cf, Depth= 0.03"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1.2" Rainfall=1.20"

Area (sf)	CN	Description
4,053	74	>75% Grass cover, Good, HSG C
8,990	70	Woods, Good, HSG C
13,043	71	Weighted Average
13,043	71	100.00% Pervious Area

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

Summary for Subcatchment 10.3: Middle and North of Site, Gate House via Closed Drainage

Runoff = 1.2 cfs @ 12.22 hrs, Volume= 5,432 cf, Depth= 0.74"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1.2" Rainfall=1.20"

72928 PR Drainage

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Type III 24-hr 1.2" Rainfall=1.20"

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Area (sf)	CN	Description
1,271	74	>75% Grass cover, Good, HSG C
49,503	98	Paved parking, HSG C
15,740	98	Roofs, HSG C
20,860	70	Woods, Good, HSG C
320	98	Roofs, HSG A
87,694	91	Weighted Average
22,131	70	25.24% Pervious Area
65,563	98	74.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	50	0.0200	0.07		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.39"
1.6	220	0.0200	2.28		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
2.8	770	0.0020	4.57	32.31	Pipe Channel, 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.012
16.4	1,040	Total			

Summary for Subcatchment 10.4: South/Middle of Site to SD 1 and SD 2

Runoff = 1.1 cfs @ 12.12 hrs, Volume= 3,786 cf, Depth= 0.94"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1.2" Rainfall=1.20"

Area (sf)	CN	Description
2,523	74	>75% Grass cover, Good, HSG C
45,004	98	Paved parking, HSG C
932	98	Roofs, HSG C
48,459	97	Weighted Average
2,523	74	5.21% Pervious Area
45,936	98	94.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	50	0.0250	0.11		Sheet Flow, Grass: Dense n= 0.240 P2= 3.39"
1.3	200	0.0250	2.55		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
8.6	250	Total			

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Type III 24-hr 1.2" Rainfall=1.20"

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Summary for Subcatchment 10.5: Pavement Behind Building D to SD 3 and area to FES 193

Runoff = 0.5 cfs @ 12.08 hrs, Volume= 1,744 cf, Depth= 0.99"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1.2" Rainfall=1.20"

Area (sf)	CN	Description
21,235	98	Paved parking, HSG C
21,235	98	100.00% Impervious Area

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

Summary for Subcatchment 10.6: Part of Building C Roof

Runoff = 0.5 cfs @ 12.08 hrs, Volume= 1,488 cf, Depth= 0.99"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1.2" Rainfall=1.20"

Area (sf)	CN	Description
0	98	Paved parking, HSG C
18,120	98	Roofs, HSG C
18,120	98	Weighted Average
18,120	98	100.00% Impervious Area

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

Summary for Subcatchment 10.7: Building D Roof

Runoff = 0.4 cfs @ 12.08 hrs, Volume= 1,182 cf, Depth= 0.99"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1.2" Rainfall=1.20"

Area (sf)	CN	Description
1,693	98	Paved parking, HSG C
12,699	98	Roofs, HSG C
14,392	98	Weighted Average
14,392	98	100.00% Impervious Area

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Proposed Redevelopment
Type III 24-hr 1.2" Rainfall=1.20"

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

Summary for Subcatchment 10.8: Building E Roof and Back/West of Site Swale area

Runoff = 0.1 cfs @ 12.17 hrs, Volume= 537 cf, Depth= 0.23"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1.2" Rainfall=1.20"

Area (sf)	CN	Description
20,293	74	>75% Grass cover, Good, HSG C
955	98	Paved parking, HSG C
4,185	98	Roofs, HSG C
2,128	70	Woods, Good, HSG C
27,561	78	Weighted Average
22,422	74	81.35% Pervious Area
5,140	98	18.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	50	0.0250	0.11		Sheet Flow, Grass: Dense n= 0.240 P2= 3.39"
1.0	150	0.0250	2.55		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
4.5	450	0.0050	1.68	2.53	Channel Flow, Area= 1.5 sf Perim= 4.5' r= 0.33' n= 0.030
12.8	650	Total			

Summary for Subcatchment 10.9: Area to FES 192

Runoff = 0.7 cfs @ 12.08 hrs, Volume= 2,420 cf, Depth= 0.99"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1.2" Rainfall=1.20"

Area (sf)	CN	Description
29,459	98	Paved parking, HSG C
29,459	98	100.00% Impervious Area

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

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Type III 24-hr 1.2" Rainfall=1.20"

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Summary for Subcatchment 20.1: North/East of Site

Runoff = 0.7 cfs @ 12.08 hrs, Volume= 2,320 cf, Depth= 0.81"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1.2" Rainfall=1.20"

Area (sf)	CN	Description
6,710	74	>75% Grass cover, Good, HSG C
27,831	98	Paved parking, HSG C
34,541	93	Weighted Average
6,710	74	19.43% Pervious Area
27,831	98	80.57% Impervious Area

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

Summary for Subcatchment 20.2: Building B Roof

Runoff = 0.9 cfs @ 12.08 hrs, Volume= 3,028 cf, Depth= 0.99"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1.2" Rainfall=1.20"

Area (sf)	CN	Description
1	98	Paved parking, HSG C
36,866	98	Roofs, HSG C
36,867	98	Weighted Average
36,867	98	100.00% Impervious Area

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

Summary for Subcatchment 30.1: Middle of Site

Runoff = 1.6 cfs @ 12.08 hrs, Volume= 5,300 cf, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1.2" Rainfall=1.20"

Area (sf)	CN	Description
6,614	74	>75% Grass cover, Good, HSG C
64,107	98	Paved parking, HSG C
70,721	96	Weighted Average
6,614	74	9.35% Pervious Area
64,107	98	90.65% Impervious Area

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Type III 24-hr 1.2" Rainfall=1.20"

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

Summary for Subcatchment 30.2: Front/East of Site inc A roof

Runoff = 0.3 cfs @ 12.08 hrs, Volume= 972 cf, Depth= 0.93"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1.2" Rainfall=1.20"

Area (sf)	CN	Description
784	74	>75% Grass cover, Good, HSG C
9,841	98	Paved parking, HSG C
1,940	98	Roofs, HSG C
12,565	97	Weighted Average
784	74	6.24% Pervious Area
11,781	98	93.76% Impervious Area

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

Summary for Subcatchment 40: South/Site Drive

Runoff = 0.5 cfs @ 12.08 hrs, Volume= 1,678 cf, Depth= 0.79"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1.2" Rainfall=1.20"

Area (sf)	CN	Description
5,384	74	>75% Grass cover, Good, HSG C
20,091	98	Paved parking, HSG C
25,475	93	Weighted Average
5,384	74	21.14% Pervious Area
20,091	98	78.86% Impervious Area

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

Summary for Reach 3R: 36" Pipe - 1st Segment

Inflow Area = 203,898 sf, 65.86% Impervious, Inflow Depth = 0.66" for 1.2" event
Inflow = 2.5 cfs @ 12.17 hrs, Volume= 11,260 cf
Outflow = 2.5 cfs @ 12.20 hrs, Volume= 11,260 cf, Atten= 1%, Lag= 1.6 min

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Type III 24-hr 1.2" Rainfall=1.20"

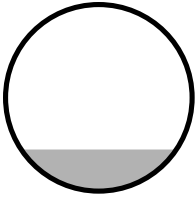
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Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.12 fps, Min. Travel Time= 1.9 min
Avg. Velocity = 0.68 fps, Avg. Travel Time= 6.1 min

Peak Storage= 289 cf @ 12.20 hrs
Average Depth at Peak Storage= 0.67' , Surface Width= 2.49'
Bank-Full Depth= 3.00' Flow Area= 7.1 sf, Capacity= 22.9 cfs

36.0" Round Pipe
n= 0.013
Length= 247.0' Slope= 0.0012 '/'
Inlet Invert= 133.86', Outlet Invert= 133.57'



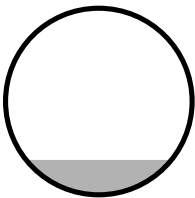
Summary for Reach 4R: 36" Pipe - 2st Segment

Inflow Area =	291,592 sf, 68.54% Impervious, Inflow Depth = 0.69" for 1.2" event
Inflow =	3.7 cfs @ 12.20 hrs, Volume= 16,692 cf
Outflow =	3.7 cfs @ 12.22 hrs, Volume= 16,692 cf, Atten= 0%, Lag= 0.9 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.00 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 1.29 fps, Avg. Travel Time= 3.6 min

Peak Storage= 255 cf @ 12.22 hrs
Average Depth at Peak Storage= 0.56' , Surface Width= 2.34'
Bank-Full Depth= 3.00' Flow Area= 7.1 sf, Capacity= 47.8 cfs

36.0" Round Pipe
n= 0.013
Length= 278.0' Slope= 0.0051 '/'
Inlet Invert= 133.57', Outlet Invert= 132.14'



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Type III 24-hr 1.2" Rainfall=1.20"

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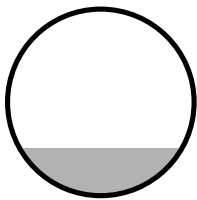
Summary for Reach 5R: 36" Pipe - 3st Segment

Inflow Area = 291,592 sf, 68.54% Impervious, Inflow Depth = 0.69" for 1.2" event
Inflow = 3.7 cfs @ 12.22 hrs, Volume= 16,692 cf
Outflow = 3.6 cfs @ 12.24 hrs, Volume= 16,692 cf, Atten= 1%, Lag= 1.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.57 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 0.81 fps, Avg. Travel Time= 4.9 min

Peak Storage= 334 cf @ 12.24 hrs
Average Depth at Peak Storage= 0.76' , Surface Width= 2.61'
Bank-Full Depth= 3.00' Flow Area= 7.1 sf, Capacity= 25.7 cfs

36.0" Round Pipe
n= 0.013
Length= 236.0' Slope= 0.0015 '/'
Inlet Invert= 132.14', Outlet Invert= 131.79'



Summary for Reach DS 1_2: Dry Swale - Segments 1 and 2

Inflow Area = 48,459 sf, 94.79% Impervious, Inflow Depth = 0.94" for 1.2" event
Inflow = 1.1 cfs @ 12.12 hrs, Volume= 3,786 cf
Outflow = 0.9 cfs @ 12.17 hrs, Volume= 3,786 cf, Atten= 14%, Lag= 3.4 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.12 fps, Min. Travel Time= 6.1 min
Avg. Velocity = 0.30 fps, Avg. Travel Time= 22.6 min

Peak Storage= 333 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.30' , Surface Width= 3.48'
Bank-Full Depth= 1.00' Flow Area= 4.5 sf, Capacity= 9.8 cfs

2.00' x 1.00' deep channel, n= 0.035 High grass
Side Slope Z-value= 2.5 '/' Top Width= 7.00'
Length= 412.0' Slope= 0.0051 '/'
Inlet Invert= 138.00', Outlet Invert= 135.90'

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Type III 24-hr 1.2" Rainfall=1.20"

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Summary for Reach DS 3_8: Dry Swale - Segments 3-8

Inflow Area = 159,226 sf, 84.33% Impervious, Inflow Depth = 0.84" for 1.2" event
Inflow = 2.9 cfs @ 12.10 hrs, Volume= 11,158 cf
Outflow = 2.7 cfs @ 12.14 hrs, Volume= 11,158 cf, Atten= 8%, Lag= 2.7 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.17 fps, Min. Travel Time= 4.3 min
Avg. Velocity = 0.30 fps, Avg. Travel Time= 16.9 min

Peak Storage= 684 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.26' , Surface Width= 9.32'
Bank-Full Depth= 1.50' Flow Area= 17.6 sf, Capacity= 56.3 cfs

8.00' x 1.50' deep channel, n= 0.035 High grass
Side Slope Z-value= 2.5 '/' Top Width= 15.50'
Length= 300.0' Slope= 0.0050 '/'
Inlet Invert= 135.40', Outlet Invert= 133.90'



Summary for Pond P1: Existing Ditch

Inflow Area = 203,898 sf, 65.86% Impervious, Inflow Depth = 0.66" for 1.2" event
Inflow = 2.7 cfs @ 12.14 hrs, Volume= 11,260 cf
Outflow = 2.5 cfs @ 12.17 hrs, Volume= 11,260 cf, Atten= 6%, Lag= 1.7 min
Primary = 2.5 cfs @ 12.17 hrs, Volume= 11,260 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 134.65' @ 12.19 hrs Surf.Area= 690 sf Storage= 241 cf

Plug-Flow detention time= 1.4 min calculated for 11,260 cf (100% of inflow)
Center-of-Mass det. time= 1.2 min (803.9 - 802.7)

Volume	Invert	Avail.Storage	Storage Description
#1	133.80'	17,850 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

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Type III 24-hr 1.2" Rainfall=1.20"

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Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
133.80	5	0	0
134.00	40	4	4
135.00	1,045	543	547
136.00	9,280	5,163	5,710
137.00	15,000	12,140	17,850

Device	Routing	Invert	Outlet Devices
#1	Primary	133.86'	36.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.5 cfs @ 12.17 hrs HW=134.64' TW=134.52' (Dynamic Tailwater)

↑**1=Orifice/Grate** (Orifice Controls 2.5 cfs @ 1.67 fps)

Summary for Link DP1: Existing Detention Basin

Inflow Area = 471,760 sf, 76.42% Impervious, Inflow Depth = 0.76" for 1.2" event
Inflow = 6.3 cfs @ 12.11 hrs, Volume= 29,990 cf
Primary = 6.3 cfs @ 12.11 hrs, Volume= 29,990 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link EX FES1: North Basin - West FES

Inflow Area = 291,592 sf, 68.54% Impervious, Inflow Depth = 0.69" for 1.2" event
Inflow = 3.6 cfs @ 12.24 hrs, Volume= 16,692 cf
Primary = 3.6 cfs @ 12.24 hrs, Volume= 16,692 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link EX FES3: South Basin - North FES

Inflow Area = 83,286 sf, 91.12% Impervious, Inflow Depth = 0.90" for 1.2" event
Inflow = 1.9 cfs @ 12.08 hrs, Volume= 6,271 cf
Primary = 1.9 cfs @ 12.08 hrs, Volume= 6,271 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link EX FES4: South Basin - South FES

Inflow Area = 25,475 sf, 78.86% Impervious, Inflow Depth = 0.79" for 1.2" event
Inflow = 0.5 cfs @ 12.08 hrs, Volume= 1,678 cf
Primary = 0.5 cfs @ 12.08 hrs, Volume= 1,678 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

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Type III 24-hr 1.2" Rainfall=1.20"

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Summary for Link PR FES2: North Basin - East FES

Inflow Area = 71,408 sf, 90.60% Impervious, Inflow Depth = 0.90" for 1.2" event
Inflow = 1.6 cfs @ 12.08 hrs, Volume= 5,349 cf
Primary = 1.6 cfs @ 12.08 hrs, Volume= 5,349 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

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Type III 24-hr 1.2" Rainfall=1.20"

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 10.1: Offsite Wooded Area to Runoff Area=31,628 sf 0.00% Impervious Runoff Depth=0.03"
Flow Length=85' Slope=0.0550 '/' Tc=6.9 min CN=70/0 Runoff=0.0 cfs 67 cf

Subcatchment 10.2: Onsite Area to Rear Runoff Area=13,043 sf 0.00% Impervious Runoff Depth=0.03"
Tc=6.0 min CN=71/0 Runoff=0.0 cfs 36 cf

Subcatchment 10.3: Middle and North of Runoff Area=87,694 sf 74.76% Impervious Runoff Depth=0.74"
Flow Length=1,040' Tc=16.4 min CN=70/98 Runoff=1.2 cfs 5,432 cf

Subcatchment 10.4: South/Middle of Site Runoff Area=48,459 sf 94.79% Impervious Runoff Depth=0.94"
Flow Length=250' Slope=0.0250 '/' Tc=8.6 min CN=74/98 Runoff=1.1 cfs 3,786 cf

Subcatchment 10.5: Pavement Behind Runoff Area=21,235 sf 100.00% Impervious Runoff Depth=0.99"
Tc=6.0 min CN=0/98 Runoff=0.5 cfs 1,744 cf

Subcatchment 10.6: Part of Building C Runoff Area=18,120 sf 100.00% Impervious Runoff Depth=0.99"
Tc=6.0 min CN=0/98 Runoff=0.5 cfs 1,488 cf

Subcatchment 10.7: Building D Roof Runoff Area=14,392 sf 100.00% Impervious Runoff Depth=0.99"
Tc=6.0 min CN=0/98 Runoff=0.4 cfs 1,182 cf

Subcatchment 10.8: Building E Roof and Runoff Area=27,561 sf 18.65% Impervious Runoff Depth=0.23"
Flow Length=650' Tc=12.8 min CN=74/98 Runoff=0.1 cfs 537 cf

Subcatchment 10.9: Area to FES 192 Runoff Area=29,459 sf 100.00% Impervious Runoff Depth=0.99"
Tc=6.0 min CN=0/98 Runoff=0.7 cfs 2,420 cf

Subcatchment 20.1: North/East of Site Runoff Area=34,541 sf 80.57% Impervious Runoff Depth=0.81"
Tc=6.0 min CN=74/98 Runoff=0.7 cfs 2,320 cf

Subcatchment 20.2: Building B Roof Runoff Area=36,867 sf 100.00% Impervious Runoff Depth=0.99"
Tc=6.0 min CN=0/98 Runoff=0.9 cfs 3,028 cf

Subcatchment 30.1: Middle of Site Runoff Area=70,721 sf 90.65% Impervious Runoff Depth=0.90"
Tc=6.0 min CN=74/98 Runoff=1.6 cfs 5,300 cf

Subcatchment 30.2: Front/East of Site inc Runoff Area=12,565 sf 93.76% Impervious Runoff Depth=0.93"
Tc=6.0 min CN=74/98 Runoff=0.3 cfs 972 cf

Subcatchment 40: South/Site Drive Runoff Area=25,475 sf 78.86% Impervious Runoff Depth=0.79"
Tc=6.0 min CN=74/98 Runoff=0.5 cfs 1,678 cf

Reach 3R: 36" Pipe - 1st Segment Avg. Flow Depth=0.67' Max Vel=2.12 fps Inflow=2.5 cfs 11,260 cf
36.0" Round Pipe n=0.013 L=247.0' S=0.0012 '/' Capacity=22.9 cfs Outflow=2.5 cfs 11,260 cf

Reach 4R: 36" Pipe - 2st Segment Avg. Flow Depth=0.56' Max Vel=4.00 fps Inflow=3.7 cfs 16,692 cf
36.0" Round Pipe n=0.013 L=278.0' S=0.0051 '/' Capacity=47.8 cfs Outflow=3.7 cfs 16,692 cf

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Proposed Redevelopment
Type III 24-hr 1.2" Rainfall=1.20"

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Reach 5R: 36" Pipe - 3st Segment Avg. Flow Depth=0.76' Max Vel=2.57 fps Inflow=3.7 cfs 16,692 cf
36.0" Round Pipe n=0.013 L=236.0' S=0.0015 '/' Capacity=25.7 cfs Outflow=3.6 cfs 16,692 cf

Reach DS 1_2: Dry Swale - Segments 1 Avg. Flow Depth=0.30' Max Vel=1.12 fps Inflow=1.1 cfs 3,786 cf
n=0.035 L=412.0' S=0.0051 '/' Capacity=9.8 cfs Outflow=0.9 cfs 3,786 cf

Reach DS 3_8: Dry Swale - Segments 3-8 Avg. Flow Depth=0.26' Max Vel=1.17 fps Inflow=2.9 cfs 11,158 cf
n=0.035 L=300.0' S=0.0050 '/' Capacity=56.3 cfs Outflow=2.7 cfs 11,158 cf

Pond P1: Existing Ditch Peak Elev=134.65' Storage=241 cf Inflow=2.7 cfs 11,260 cf
Outflow=2.5 cfs 11,260 cf

Link DP1: Existing Detention Basin Inflow=6.3 cfs 29,990 cf
Primary=6.3 cfs 29,990 cf

Link EX FES1: North Basin - West FES Inflow=3.6 cfs 16,692 cf
Primary=3.6 cfs 16,692 cf

Link EX FES3: South Basin - North FES Inflow=1.9 cfs 6,271 cf
Primary=1.9 cfs 6,271 cf

Link EX FES4: South Basin - South FES Inflow=0.5 cfs 1,678 cf
Primary=0.5 cfs 1,678 cf

Link PR FES2: North Basin - East FES Inflow=1.6 cfs 5,349 cf
Primary=1.6 cfs 5,349 cf

Total Runoff Area = 471,760 sf Runoff Volume = 29,990 cf Average Runoff Depth = 0.76"
23.58% Pervious = 111,239 sf 76.42% Impervious = 360,522 sf

1-Year Storm Event

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Type III 24-hr 1-Year Rainfall=2.80"

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 10.1: Offsite Wooded Area to Runoff Area=31,628 sf 0.00% Impervious Runoff Depth=0.61"
Flow Length=85' Slope=0.0550 '/' Tc=6.9 min CN=70/0 Runoff=0.4 cfs 1,597 cf

Subcatchment 10.2: Onsite Area to Rear Runoff Area=13,043 sf 0.00% Impervious Runoff Depth=0.65"
Tc=6.0 min CN=71/0 Runoff=0.2 cfs 704 cf

Subcatchment 10.3: Middle and North of Runoff Area=87,694 sf 74.76% Impervious Runoff Depth=2.07"
Flow Length=1,040' Tc=16.4 min CN=70/98 Runoff=3.2 cfs 15,154 cf

Subcatchment 10.4: South/Middle of Site Runoff Area=48,459 sf 94.79% Impervious Runoff Depth=2.48"
Flow Length=250' Slope=0.0250 '/' Tc=8.6 min CN=74/98 Runoff=2.7 cfs 10,000 cf

Subcatchment 10.5: Pavement Behind Runoff Area=21,235 sf 100.00% Impervious Runoff Depth=2.57"
Tc=6.0 min CN=0/98 Runoff=1.3 cfs 4,546 cf

Subcatchment 10.6: Part of Building C Runoff Area=18,120 sf 100.00% Impervious Runoff Depth=2.57"
Tc=6.0 min CN=0/98 Runoff=1.1 cfs 3,879 cf

Subcatchment 10.7: Building D Roof Runoff Area=14,392 sf 100.00% Impervious Runoff Depth=2.57"
Tc=6.0 min CN=0/98 Runoff=0.9 cfs 3,081 cf

Subcatchment 10.8: Building E Roof and Runoff Area=27,561 sf 18.65% Impervious Runoff Depth=1.12"
Flow Length=650' Tc=12.8 min CN=74/98 Runoff=0.6 cfs 2,565 cf

Subcatchment 10.9: Area to FES 192 Runoff Area=29,459 sf 100.00% Impervious Runoff Depth=2.57"
Tc=6.0 min CN=0/98 Runoff=1.8 cfs 6,307 cf

Subcatchment 20.1: North/East of Site Runoff Area=34,541 sf 80.57% Impervious Runoff Depth=2.22"
Tc=6.0 min CN=74/98 Runoff=1.9 cfs 6,397 cf

Subcatchment 20.2: Building B Roof Runoff Area=36,867 sf 100.00% Impervious Runoff Depth=2.57"
Tc=6.0 min CN=0/98 Runoff=2.3 cfs 7,893 cf

Subcatchment 30.1: Middle of Site Runoff Area=70,721 sf 90.65% Impervious Runoff Depth=2.40"
Tc=6.0 min CN=74/98 Runoff=4.1 cfs 14,157 cf

Subcatchment 30.2: Front/East of Site inc Runoff Area=12,565 sf 93.76% Impervious Runoff Depth=2.46"
Tc=6.0 min CN=74/98 Runoff=0.7 cfs 2,573 cf

Subcatchment 40: South/Site Drive Runoff Area=25,475 sf 78.86% Impervious Runoff Depth=2.19"
Tc=6.0 min CN=74/98 Runoff=1.4 cfs 4,653 cf

Reach 3R: 36" Pipe - 1st Segment Avg. Flow Depth=1.13' Max Vel=2.83 fps Inflow=6.9 cfs 32,680 cf
36.0" Round Pipe n=0.013 L=247.0' S=0.0012 '/' Capacity=22.9 cfs Outflow=6.9 cfs 32,680 cf

Reach 4R: 36" Pipe - 2st Segment Avg. Flow Depth=0.94' Max Vel=5.36 fps Inflow=10.1 cfs 47,835 cf
36.0" Round Pipe n=0.013 L=278.0' S=0.0051 '/' Capacity=47.8 cfs Outflow=10.1 cfs 47,835 cf

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Type III 24-hr 1-Year Rainfall=2.80"

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Reach 5R: 36" Pipe - 3st Segment Avg. Flow Depth=1.30' Max Vel=3.41 fps Inflow=10.1 cfs 47,835 cf
36.0" Round Pipe n=0.013 L=236.0' S=0.0015 '/' Capacity=25.7 cfs Outflow=10.1 cfs 47,835 cf

Reach DS 1_2: Dry Swale - Segments 1 Avg. Flow Depth=0.50' Max Vel=1.49 fps Inflow=2.7 cfs 10,000 cf
n=0.035 L=412.0' S=0.0051 '/' Capacity=9.8 cfs Outflow=2.4 cfs 10,000 cf

Reach DS 3_8: Dry Swale - Segments 3-8 Avg. Flow Depth=0.47' Max Vel=1.66 fps Inflow=7.6 cfs 30,379 cf
n=0.035 L=300.0' S=0.0050 '/' Capacity=56.3 cfs Outflow=7.2 cfs 30,379 cf

Pond P1: Existing Ditch Peak Elev=135.21' Storage=941 cf Inflow=7.8 cfs 32,681 cf
Outflow=6.9 cfs 32,680 cf

Link DP1: Existing Detention Basin Inflow=17.3 cfs 83,508 cf
Primary=17.3 cfs 83,508 cf

Link EX FES1: North Basin - West FES Inflow=10.1 cfs 47,835 cf
Primary=10.1 cfs 47,835 cf

Link EX FES3: South Basin - North FES Inflow=4.9 cfs 16,731 cf
Primary=4.9 cfs 16,731 cf

Link EX FES4: South Basin - South FES Inflow=1.4 cfs 4,653 cf
Primary=1.4 cfs 4,653 cf

Link PR FES2: North Basin - East FES Inflow=4.1 cfs 14,290 cf
Primary=4.1 cfs 14,290 cf

Total Runoff Area = 471,760 sf Runoff Volume = 83,509 cf Average Runoff Depth = 2.12"
23.58% Pervious = 111,239 sf 76.42% Impervious = 360,522 sf

2-Year Storm Event

72928 PR Drainage

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Proposed Redevelopment
Type III 24-hr 2-Year Rainfall=3.30"

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 10.1: Offsite Wooded Area to Runoff Area=31,628 sf 0.00% Impervious Runoff Depth=0.89"
Flow Length=85' Slope=0.0550 '/' Tc=6.9 min CN=70/0 Runoff=0.7 cfs 2,338 cf

Subcatchment 10.2: Onsite Area to Rear Runoff Area=13,043 sf 0.00% Impervious Runoff Depth=0.94"
Tc=6.0 min CN=71/0 Runoff=0.3 cfs 1,020 cf

Subcatchment 10.3: Middle and North of Runoff Area=87,694 sf 74.76% Impervious Runoff Depth=2.52"
Flow Length=1,040' Tc=16.4 min CN=70/98 Runoff=3.9 cfs 18,393 cf

Subcatchment 10.4: South/Middle of Site Runoff Area=48,459 sf 94.79% Impervious Runoff Depth=2.96"
Flow Length=250' Slope=0.0250 '/' Tc=8.6 min CN=74/98 Runoff=3.2 cfs 11,973 cf

Subcatchment 10.5: Pavement Behind Runoff Area=21,235 sf 100.00% Impervious Runoff Depth=3.07"
Tc=6.0 min CN=0/98 Runoff=1.6 cfs 5,428 cf

Subcatchment 10.6: Part of Building C Runoff Area=18,120 sf 100.00% Impervious Runoff Depth=3.07"
Tc=6.0 min CN=0/98 Runoff=1.3 cfs 4,631 cf

Subcatchment 10.7: Building D Roof Runoff Area=14,392 sf 100.00% Impervious Runoff Depth=3.07"
Tc=6.0 min CN=0/98 Runoff=1.1 cfs 3,679 cf

Subcatchment 10.8: Building E Roof and Runoff Area=27,561 sf 18.65% Impervious Runoff Depth=1.47"
Flow Length=650' Tc=12.8 min CN=74/98 Runoff=0.8 cfs 3,376 cf

Subcatchment 10.9: Area to FES 192 Runoff Area=29,459 sf 100.00% Impervious Runoff Depth=3.07"
Tc=6.0 min CN=0/98 Runoff=2.2 cfs 7,530 cf

Subcatchment 20.1: North/East of Site Runoff Area=34,541 sf 80.57% Impervious Runoff Depth=2.69"
Tc=6.0 min CN=74/98 Runoff=2.2 cfs 7,731 cf

Subcatchment 20.2: Building B Roof Runoff Area=36,867 sf 100.00% Impervious Runoff Depth=3.07"
Tc=6.0 min CN=0/98 Runoff=2.7 cfs 9,423 cf

Subcatchment 30.1: Middle of Site Runoff Area=70,721 sf 90.65% Impervious Runoff Depth=2.88"
Tc=6.0 min CN=74/98 Runoff=4.9 cfs 16,994 cf

Subcatchment 30.2: Front/East of Site inc Runoff Area=12,565 sf 93.76% Impervious Runoff Depth=2.94"
Tc=6.0 min CN=74/98 Runoff=0.9 cfs 3,083 cf

Subcatchment 40: South/Site Drive Runoff Area=25,475 sf 78.86% Impervious Runoff Depth=2.65"
Tc=6.0 min CN=74/98 Runoff=1.6 cfs 5,630 cf

Reach 3R: 36" Pipe - 1st Segment Avg. Flow Depth=1.24' Max Vel=2.97 fps Inflow=8.2 cfs 39,974 cf
36.0" Round Pipe n=0.013 L=247.0' S=0.0012 '/' Capacity=22.9 cfs Outflow=8.2 cfs 39,974 cf

Reach 4R: 36" Pipe - 2st Segment Avg. Flow Depth=1.03' Max Vel=5.64 fps Inflow=12.1 cfs 58,367 cf
36.0" Round Pipe n=0.013 L=278.0' S=0.0051 '/' Capacity=47.8 cfs Outflow=12.1 cfs 58,367 cf

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Proposed Redevelopment
Type III 24-hr 2-Year Rainfall=3.30"

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Reach 5R: 36" Pipe - 3st Segment Avg. Flow Depth=1.44' Max Vel=3.57 fps Inflow=12.1 cfs 58,367 cf
36.0" Round Pipe n=0.013 L=236.0' S=0.0015 '/' Capacity=25.7 cfs Outflow=12.0 cfs 58,367 cf

Reach DS 1_2: Dry Swale - Segments 1 Avg. Flow Depth=0.54' Max Vel=1.56 fps Inflow=3.2 cfs 11,973 cf
n=0.035 L=412.0' S=0.0051 '/' Capacity=9.8 cfs Outflow=2.9 cfs 11,973 cf

Reach DS 3_8: Dry Swale - Segments 3-8 Avg. Flow Depth=0.53' Max Vel=1.77 fps Inflow=9.1 cfs 36,616 cf
n=0.035 L=300.0' S=0.0050 '/' Capacity=56.3 cfs Outflow=8.7 cfs 36,616 cf

Pond P1: Existing Ditch Peak Elev=135.34' Storage=1,379 cf Inflow=9.6 cfs 39,974 cf
Outflow=8.2 cfs 39,974 cf

Link DP1: Existing Detention Basin Inflow=20.7 cfs 101,228 cf
Primary=20.7 cfs 101,228 cf

Link EX FES1: North Basin - West FES Inflow=12.0 cfs 58,367 cf
Primary=12.0 cfs 58,367 cf

Link EX FES3: South Basin - North FES Inflow=5.8 cfs 20,077 cf
Primary=5.8 cfs 20,077 cf

Link EX FES4: South Basin - South FES Inflow=1.6 cfs 5,630 cf
Primary=1.6 cfs 5,630 cf

Link PR FES2: North Basin - East FES Inflow=4.9 cfs 17,154 cf
Primary=4.9 cfs 17,154 cf

Total Runoff Area = 471,760 sf Runoff Volume = 101,229 cf Average Runoff Depth = 2.57"
23.58% Pervious = 111,239 sf 76.42% Impervious = 360,522 sf

10-Year Storm Event

72928 PR Drainage

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Proposed Redevelopment
Type III 24-hr 10-Year Rainfall=4.90"

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 10.1: Offsite Wooded Area to Runoff Area=31,628 sf 0.00% Impervious Runoff Depth=1.96"
Flow Length=85' Slope=0.0550 '/' Tc=6.9 min CN=70/0 Runoff=1.6 cfs 5,172 cf

Subcatchment 10.2: Onsite Area to Rear Runoff Area=13,043 sf 0.00% Impervious Runoff Depth=2.04"
Tc=6.0 min CN=71/0 Runoff=0.7 cfs 2,219 cf

Subcatchment 10.3: Middle and North of Runoff Area=87,694 sf 74.76% Impervious Runoff Depth=3.98"
Flow Length=1,040' Tc=16.4 min CN=70/98 Runoff=6.2 cfs 29,098 cf

Subcatchment 10.4: South/Middle of Site Runoff Area=48,459 sf 94.79% Impervious Runoff Depth=4.54"
Flow Length=250' Slope=0.0250 '/' Tc=8.6 min CN=74/98 Runoff=4.8 cfs 18,331 cf

Subcatchment 10.5: Pavement Behind Runoff Area=21,235 sf 100.00% Impervious Runoff Depth=4.66"
Tc=6.0 min CN=0/98 Runoff=2.3 cfs 8,252 cf

Subcatchment 10.6: Part of Building C Runoff Area=18,120 sf 100.00% Impervious Runoff Depth=4.66"
Tc=6.0 min CN=0/98 Runoff=2.0 cfs 7,042 cf

Subcatchment 10.7: Building D Roof Runoff Area=14,392 sf 100.00% Impervious Runoff Depth=4.66"
Tc=6.0 min CN=0/98 Runoff=1.6 cfs 5,593 cf

Subcatchment 10.8: Building E Roof and Runoff Area=27,561 sf 18.65% Impervious Runoff Depth=2.73"
Flow Length=650' Tc=12.8 min CN=74/98 Runoff=1.6 cfs 6,266 cf

Subcatchment 10.9: Area to FES 192 Runoff Area=29,459 sf 100.00% Impervious Runoff Depth=4.66"
Tc=6.0 min CN=0/98 Runoff=3.2 cfs 11,448 cf

Subcatchment 20.1: North/East of Site Runoff Area=34,541 sf 80.57% Impervious Runoff Depth=4.20"
Tc=6.0 min CN=74/98 Runoff=3.5 cfs 12,093 cf

Subcatchment 20.2: Building B Roof Runoff Area=36,867 sf 100.00% Impervious Runoff Depth=4.66"
Tc=6.0 min CN=0/98 Runoff=4.1 cfs 14,327 cf

Subcatchment 30.1: Middle of Site Runoff Area=70,721 sf 90.65% Impervious Runoff Depth=4.44"
Tc=6.0 min CN=74/98 Runoff=7.5 cfs 26,172 cf

Subcatchment 30.2: Front/East of Site inc Runoff Area=12,565 sf 93.76% Impervious Runoff Depth=4.51"
Tc=6.0 min CN=74/98 Runoff=1.3 cfs 4,727 cf

Subcatchment 40: South/Site Drive Runoff Area=25,475 sf 78.86% Impervious Runoff Depth=4.16"
Tc=6.0 min CN=74/98 Runoff=2.5 cfs 8,833 cf

Reach 3R: 36" Pipe - 1st Segment Avg. Flow Depth=1.55' Max Vel=3.28 fps Inflow=12.1 cfs 64,323 cf
36.0" Round Pipe n=0.013 L=247.0' S=0.0012 '/' Capacity=22.9 cfs Outflow=12.1 cfs 64,323 cf

Reach 4R: 36" Pipe - 2st Segment Avg. Flow Depth=1.28' Max Vel=6.31 fps Inflow=18.3 cfs 93,421 cf
36.0" Round Pipe n=0.013 L=278.0' S=0.0051 '/' Capacity=47.8 cfs Outflow=18.2 cfs 93,421 cf

72928 PR Drainage

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Proposed Redevelopment
Type III 24-hr 10-Year Rainfall=4.90"

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Reach 5R: 36" Pipe - 3st Segment Avg. Flow Depth=1.86' Max Vel=3.94 fps Inflow=18.2 cfs 93,421 cf
36.0" Round Pipe n=0.013 L=236.0' S=0.0015 '/' Capacity=25.7 cfs Outflow=18.2 cfs 93,421 cf

Reach DS 1_2: Dry Swale - Segments 1 Avg. Flow Depth=0.68' Max Vel=1.76 fps Inflow=4.8 cfs 18,331 cf
n=0.035 L=412.0' S=0.0051 '/' Capacity=9.8 cfs Outflow=4.4 cfs 18,331 cf

Reach DS 3_8: Dry Swale - Segments Avg. Flow Depth=0.68' Max Vel=2.05 fps Inflow=14.0 cfs 56,933 cf
n=0.035 L=300.0' S=0.0050 '/' Capacity=56.3 cfs Outflow=13.5 cfs 56,933 cf

Pond P1: Existing Ditch Peak Elev=135.71' Storage=3,384 cf Inflow=15.7 cfs 64,324 cf
Outflow=12.1 cfs 64,323 cf

Link DP1: Existing Detention Basin Inflow=31.4 cfs 159,573 cf
Primary=31.4 cfs 159,573 cf

Link EX FES1: North Basin - West FES Inflow=18.2 cfs 93,421 cf
Primary=18.2 cfs 93,421 cf

Link EX FES3: South Basin - North FES Inflow=8.8 cfs 30,900 cf
Primary=8.8 cfs 30,900 cf

Link EX FES4: South Basin - South FES Inflow=2.5 cfs 8,833 cf
Primary=2.5 cfs 8,833 cf

Link PR FES2: North Basin - East FES Inflow=7.5 cfs 26,420 cf
Primary=7.5 cfs 26,420 cf

Total Runoff Area = 471,760 sf Runoff Volume = 159,574 cf Average Runoff Depth = 4.06"
23.58% Pervious = 111,239 sf 76.42% Impervious = 360,522 sf

25-Year Storm Event

72928 PR Drainage

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Proposed Redevelopment
Type III 24-hr 25-Year Rainfall=6.10"

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 10.1: Offsite Wooded Area to Runoff Area=31,628 sf 0.00% Impervious Runoff Depth=2.88"
Flow Length=85' Slope=0.0550 '/' Tc=6.9 min CN=70/0 Runoff=2.4 cfs 7,603 cf

Subcatchment 10.2: Onsite Area to Rear Runoff Area=13,043 sf 0.00% Impervious Runoff Depth=2.98"
Tc=6.0 min CN=71/0 Runoff=1.0 cfs 3,239 cf

Subcatchment 10.3: Middle and North of Runoff Area=87,694 sf 74.76% Impervious Runoff Depth=5.11"
Flow Length=1,040' Tc=16.4 min CN=70/98 Runoff=7.9 cfs 37,346 cf

Subcatchment 10.4: South/Middle of Site Runoff Area=48,459 sf 94.79% Impervious Runoff Depth=5.73"
Flow Length=250' Slope=0.0250 '/' Tc=8.6 min CN=74/98 Runoff=6.0 cfs 23,126 cf

Subcatchment 10.5: Pavement Behind Runoff Area=21,235 sf 100.00% Impervious Runoff Depth=5.86"
Tc=6.0 min CN=0/98 Runoff=2.9 cfs 10,373 cf

Subcatchment 10.6: Part of Building C Runoff Area=18,120 sf 100.00% Impervious Runoff Depth=5.86"
Tc=6.0 min CN=0/98 Runoff=2.5 cfs 8,851 cf

Subcatchment 10.7: Building D Roof Runoff Area=14,392 sf 100.00% Impervious Runoff Depth=5.86"
Tc=6.0 min CN=0/98 Runoff=2.0 cfs 7,030 cf

Subcatchment 10.8: Building E Roof and Runoff Area=27,561 sf 18.65% Impervious Runoff Depth=3.75"
Flow Length=650' Tc=12.8 min CN=74/98 Runoff=2.2 cfs 8,619 cf

Subcatchment 10.9: Area to FES 192 Runoff Area=29,459 sf 100.00% Impervious Runoff Depth=5.86"
Tc=6.0 min CN=0/98 Runoff=4.0 cfs 14,390 cf

Subcatchment 20.1: North/East of Site Runoff Area=34,541 sf 80.57% Impervious Runoff Depth=5.36"
Tc=6.0 min CN=74/98 Runoff=4.4 cfs 15,423 cf

Subcatchment 20.2: Building B Roof Runoff Area=36,867 sf 100.00% Impervious Runoff Depth=5.86"
Tc=6.0 min CN=0/98 Runoff=5.1 cfs 18,009 cf

Subcatchment 30.1: Middle of Site Runoff Area=70,721 sf 90.65% Impervious Runoff Depth=5.62"
Tc=6.0 min CN=74/98 Runoff=9.4 cfs 33,117 cf

Subcatchment 30.2: Front/East of Site inc Runoff Area=12,565 sf 93.76% Impervious Runoff Depth=5.70"
Tc=6.0 min CN=74/98 Runoff=1.7 cfs 5,968 cf

Subcatchment 40: South/Site Drive Runoff Area=25,475 sf 78.86% Impervious Runoff Depth=5.31"
Tc=6.0 min CN=74/98 Runoff=3.2 cfs 11,281 cf

Reach 3R: 36" Pipe - 1st Segment Avg. Flow Depth=1.76' Max Vel=3.44 fps Inflow=14.9 cfs 83,231 cf
36.0" Round Pipe n=0.013 L=247.0' S=0.0012 '/' Capacity=22.9 cfs Outflow=14.9 cfs 83,231 cf

Reach 4R: 36" Pipe - 2st Segment Avg. Flow Depth=1.45' Max Vel=6.68 fps Inflow=22.7 cfs 120,577 cf
36.0" Round Pipe n=0.013 L=278.0' S=0.0051 '/' Capacity=47.8 cfs Outflow=22.7 cfs 120,577 cf

72928 PR Drainage

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Proposed Redevelopment
Type III 24-hr 25-Year Rainfall=6.10"

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Reach 5R: 36" Pipe - 3st Segment Avg. Flow Depth=2.19' Max Vel=4.10 fps Inflow=22.7 cfs 120,577 cf
36.0" Round Pipe n=0.013 L=236.0' S=0.0015 '/' Capacity=25.7 cfs Outflow=22.6 cfs 120,577 cf

Reach DS 1_2: Dry Swale - Segments 1 Avg. Flow Depth=0.76' Max Vel=1.87 fps Inflow=6.0 cfs 23,126 cf
n=0.035 L=412.0' S=0.0051 '/' Capacity=9.8 cfs Outflow=5.5 cfs 23,126 cf

Reach DS 3_8: Dry Swale - Segments Avg. Flow Depth=0.78' Max Vel=2.22 fps Inflow=17.8 cfs 72,390 cf
n=0.035 L=300.0' S=0.0050 '/' Capacity=56.3 cfs Outflow=17.2 cfs 72,390 cf

Pond P1: Existing Ditch Peak Elev=135.96' Storage=5,366 cf Inflow=20.5 cfs 83,231 cf
Outflow=14.9 cfs 83,231 cf

Link DP1: Existing Detention Basin Inflow=39.4 cfs 204,375 cf
Primary=39.4 cfs 204,375 cf

Link EX FES1: North Basin - West FES Inflow=22.6 cfs 120,577 cf
Primary=22.6 cfs 120,577 cf

Link EX FES3: South Basin - North FES Inflow=11.1 cfs 39,085 cf
Primary=11.1 cfs 39,085 cf

Link EX FES4: South Basin - South FES Inflow=3.2 cfs 11,281 cf
Primary=3.2 cfs 11,281 cf

Link PR FES2: North Basin - East FES Inflow=9.5 cfs 33,432 cf
Primary=9.5 cfs 33,432 cf

Total Runoff Area = 471,760 sf Runoff Volume = 204,375 cf Average Runoff Depth = 5.20"
23.58% Pervious = 111,239 sf 76.42% Impervious = 360,522 sf

100-Year Storm Event

72928 PR Drainage

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Proposed Redevelopment
Type III 24-hr 100-Year Rainfall=8.60"

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 10.1: Offsite Wooded Area to Runoff Area=31,628 sf 0.00% Impervious Runoff Depth=4.98"
Flow Length=85' Slope=0.0550 '/' Tc=6.9 min CN=70/0 Runoff=4.1 cfs 13,136 cf

Subcatchment 10.2: Onsite Area to Rear Runoff Area=13,043 sf 0.00% Impervious Runoff Depth=5.10"
Tc=6.0 min CN=71/0 Runoff=1.8 cfs 5,548 cf

Subcatchment 10.3: Middle and North of Runoff Area=87,694 sf 74.76% Impervious Runoff Depth=7.51"
Flow Length=1,040' Tc=16.4 min CN=70/98 Runoff=11.6 cfs 54,867 cf

Subcatchment 10.4: South/Middle of Site Runoff Area=48,459 sf 94.79% Impervious Runoff Depth=8.21"
Flow Length=250' Slope=0.0250 '/' Tc=8.6 min CN=74/98 Runoff=8.5 cfs 33,150 cf

Subcatchment 10.5: Pavement Behind Runoff Area=21,235 sf 100.00% Impervious Runoff Depth=8.36"
Tc=6.0 min CN=0/98 Runoff=4.1 cfs 14,793 cf

Subcatchment 10.6: Part of Building C Runoff Area=18,120 sf 100.00% Impervious Runoff Depth=8.36"
Tc=6.0 min CN=0/98 Runoff=3.5 cfs 12,623 cf

Subcatchment 10.7: Building D Roof Runoff Area=14,392 sf 100.00% Impervious Runoff Depth=8.36"
Tc=6.0 min CN=0/98 Runoff=2.8 cfs 10,026 cf

Subcatchment 10.8: Building E Roof and Runoff Area=27,561 sf 18.65% Impervious Runoff Depth=6.01"
Flow Length=650' Tc=12.8 min CN=74/98 Runoff=3.4 cfs 13,793 cf

Subcatchment 10.9: Area to FES 192 Runoff Area=29,459 sf 100.00% Impervious Runoff Depth=8.36"
Tc=6.0 min CN=0/98 Runoff=5.7 cfs 20,523 cf

Subcatchment 20.1: North/East of Site Runoff Area=34,541 sf 80.57% Impervious Runoff Depth=7.80"
Tc=6.0 min CN=74/98 Runoff=6.4 cfs 22,445 cf

Subcatchment 20.2: Building B Roof Runoff Area=36,867 sf 100.00% Impervious Runoff Depth=8.36"
Tc=6.0 min CN=0/98 Runoff=7.1 cfs 25,683 cf

Subcatchment 30.1: Middle of Site Runoff Area=70,721 sf 90.65% Impervious Runoff Depth=8.09"
Tc=6.0 min CN=74/98 Runoff=13.4 cfs 47,673 cf

Subcatchment 30.2: Front/East of Site inc Runoff Area=12,565 sf 93.76% Impervious Runoff Depth=8.18"
Tc=6.0 min CN=74/98 Runoff=2.4 cfs 8,564 cf

Subcatchment 40: South/Site Drive Runoff Area=25,475 sf 78.86% Impervious Runoff Depth=7.75"
Tc=6.0 min CN=74/98 Runoff=4.7 cfs 16,449 cf

Reach 3R: 36" Pipe - 1st Segment Avg. Flow Depth=2.18' Max Vel=3.65 fps Inflow=20.1 cfs 123,593 cf
36.0" Round Pipe n=0.013 L=247.0' S=0.0012 '/' Capacity=22.9 cfs Outflow=20.1 cfs 123,593 cf

Reach 4R: 36" Pipe - 2st Segment Avg. Flow Depth=1.78' Max Vel=7.22 fps Inflow=31.5 cfs 178,460 cf
36.0" Round Pipe n=0.013 L=278.0' S=0.0051 '/' Capacity=47.8 cfs Outflow=31.5 cfs 178,460 cf

72928 PR Drainage

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Proposed Redevelopment
Type III 24-hr 100-Year Rainfall=8.60"

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Reach 5R: 36" Pipe - 3st Segment Avg. Flow Depth=3.00' Max Vel=4.14 fps Inflow=31.5 cfs 178,460 cf
36.0" Round Pipe n=0.013 L=236.0' S=0.0015 '/' Capacity=25.7 cfs Outflow=27.6 cfs 178,460 cf

Reach DS 1_2: Dry Swale - Segments 1 Avg. Flow Depth=0.90' Max Vel=2.06 fps Inflow=8.5 cfs 33,150 cf
n=0.035 L=412.0' S=0.0051 '/' Capacity=9.8 cfs Outflow=7.9 cfs 33,150 cf

Reach DS 3_8: Dry Swale - Segments Avg. Flow Depth=0.96' Max Vel=2.50 fps Inflow=25.7 cfs 104,909 cf
n=0.035 L=300.0' S=0.0050 '/' Capacity=56.3 cfs Outflow=25.0 cfs 104,909 cf

Pond P1: Existing Ditch Peak Elev=136.45' Storage=10,507 cf Inflow=30.6 cfs 123,594 cf
Outflow=20.1 cfs 123,593 cf

Link DP1: Existing Detention Basin Inflow=55.8 cfs 299,274 cf
Primary=55.8 cfs 299,274 cf

Link EX FES1: North Basin - West FES Inflow=27.6 cfs 178,460 cf
Primary=27.6 cfs 178,460 cf

Link EX FES3: South Basin - North FES Inflow=15.8 cfs 56,237 cf
Primary=15.8 cfs 56,237 cf

Link EX FES4: South Basin - South FES Inflow=4.7 cfs 16,449 cf
Primary=4.7 cfs 16,449 cf

Link PR FES2: North Basin - East FES Inflow=13.5 cfs 48,128 cf
Primary=13.5 cfs 48,128 cf

Total Runoff Area = 471,760 sf Runoff Volume = 299,275 cf Average Runoff Depth = 7.61"
23.58% Pervious = 111,239 sf 76.42% Impervious = 360,522 sf

Appendix E – Minimum Standard 6 – Redevelopment and Infill Calculations

Water Quality Volume Calculation WorkSheet

This worksheet is designed to assist the project engineer with a determination of the required water quality treatment area. The worksheet leads the designer through redevelopment applicability first and then receiving water requirements. This tool is intended to compliment to the Redevelopment Criteria Guidance and the Water Quality Guidance and assist both the designer and the permit application reviewer towards consistent results. Enter information into only the **YELLOW** Boxes.

[Redevelopment Criteria Guidance](#)

[Water Quality Goals "Stormwater Compensation Method"](#)

Step 1 - Determine which office in OWR you are applying to: [Application Guidance](#)

Step 2 - Site Information value/calculation units

Total Site Area (total area of project parcels)	TS	11.16	acres
Total Jurisdictional Wetlands and/or floodplain within the above TSA	JW1	0.00	acres
Existing impervious also within the Jurisdictional Wetlands	-JW2	0.00	acres
Conservation Land within the TSA		0.00	acres
Site Size = (TSA)-(JW1-JW2)-CL	SS=	11.16	acres

Step 3 - Redevelopment Applicability

Total Impervious Area (pre-construction)	TIA=	8.89	acres
% Impervious (if ≥40% - redevelopment standard 3.2.6 applies)		0.80	

REPEAT IF NECESSARY Steps 4, 5 and 6 for EACH Waterbody ID (RIVER-ID as found in the GIS Map Server)

Step 4 - Receiving waterbody information

Waterbody ID or RIVER ID from GIS Map Server	
Waterbody Name from GIS Map Server	
Name the sub-watersheds (design-points) contributing to this Waterbody ID	
Is this Waterbody Impaired/TMDL for any Phosphorus, Metals or Bacteria?	YES
Is this Waterbody Impaired for Nitrogen?	NO

Step 5 - Pre-Post Construction Conditions to the Waterbody

Total Pre-Construction Impervious Surface to this Waterbody ID	8.89	acres
Total Disturbed Existing Impervious (DI)	6.84	acres
Total Post-Construction Impervious to this Waterbody ID	8.28	acres
Net Increased Impervious (NII)	-0.61	acres

Step 6 - Infiltration and BMP information - Note: Increasing infiltration will likely decrease stormwater treatment area for Metals, Bacteria and Phosphorus

I am proposing to infiltrate this percentage WQv to this WBID	0%	%
I am proposing this number of BMP's	1	#

RESULTS - Select the Larger Number of the 2 numbers provided

Applicable Condition	Min Water Quality Treatment Area	Min Treatment w/o WQ consideration
No Impairment or TMDL - New Development		
No Impairment or TMDL - Redevelopment		
Only Phosphorus, Metals or Bacteria Impairment - New Development		
Only Phosphorus, Metals or Bacteria Impairment - Redevelopment	-1.22	2.81
Nitrogen Impairment - New Development		
Nitrogen Impairment - Redevelopment		
REQUIRED STORMWATER TREATMENT AREA	2.8	acres

* Enter the name of the STP (both type and label) which has been designed to treat this particular Rev or Rea.

**Appendix F – Minimum Standard 7 and
11 – Stormwater Management System
Operation and Maintenance Plan and
Source Control and Pollution Prevention
Plan (Bound Separately)**

Appendix G – Minimum Standard 10 – Soil Erosion and Sediment Control Plan (Bound Separately)

Appendix H – Soils Information

- › Soil Boring Logs
- › NRCS Soils Data

Soil Boring Logs

LOG KEY



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BURMISTER SOIL CLASSIFICATION

COMPONENT	NAME	PROPORTIONAL TERM	PERCENT BY WEIGHT	IDENTIFICATION OF FINES		
				Material	PI	Atterberg Thread Dia.
MAJOR	GRAVEL, SAND, FINES*		>50	SILT	0	Cannot Roll
Minor	Gravel, Sand, Fines*	and	35 - 50	Clayey SILT	1-5	1/4"
		some	20-35	SILT & CLAY	5-10	1/8"
		little	10-20	CLAY & SILT	10-20	1/16"
		trace	0-10	Silty CLAY	20-40	1/32"
				CLAY	>40	1/64"

*See identification of fines table.

GRADATION DESIGNATION	PROPORTION OF COMPONENT	PLASTIC SOILS		GRAVEL & SAND	
		Consistency	Blows/Ft. SPT N-Value	Density	Blows/Ft. SPT N-Value
Fine to coarse	All fractions > 10%	Very Soft	< 2	Very Loose	< 4
Medium to coarse	<10% fine	Soft	2 - 4	Loose	4 - 10
Fine to medium	<10% coarse	Medium Stiff	4 - 8	Medium Dense	10 - 30
Coarse	<10% fine and medium	Stiff	8 - 15	Dense	30 - 50
Medium	<10% coarse and fine	Very Stiff	15 - 30	Very Dense	> 50
Fine	<10% coarse and medium	Hard	>30		

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS) (ASTM D 2487)

MAJOR DIVISIONS	Group Symbols
Coarse Grained Soils More than 50% of material larger than No. 200 sieve.	Gravel More than 50% larger than No. 4 sieve.
	Clean Gravels (Little or no fines) GW GP
	Gravels with Fines (Appreciable amount of fines) GM GC
	Sand More than 50% smaller than No. 4 sieve.
	Clean Sands (Little or no fines) SW SP
	Sands with Fines (Appreciable amount of fines) SM SC
Fine Grained Soils More than 50% of material smaller than No. 200 sieve.	Silts and Clays Liquid Limit <50 ML CL
	Silts and Clays Liquid Limit >50 MH CH OH
	Highly Organic Soils Pt

ORGANIC SOIL CLASSIFICATION

Fibrous PEAT (Pt) - Lightweight, spongy, mostly visible organic matter, water squeezes readily from sample. Typically near top of deposit.
 Fine Grained PEAT (Pt) - Lightweight, spongy, little visible organic matter, water squeezes readily from sample. Typically below fibrous peat.
 Organic Silt (OL) - Typically gray to dark gray, often has strong H₂S odor. Typically contains shells or shell fragments. Lightweight. Usually found near coastal regions. May contain wide range of sand fractions.
 Organic Clay (OH) - Typically gray to dark gray, high plasticity. Usually found near coastal regions. May contain wide range of sand fractions. Need organic content test for final identification.

ABBREVIATIONS

MR = Mud Rotary	Tv = Field Vane Shear Test (Torvane) Shear Strength
HSA = Hollow Stem Auger	PP = Pocket Penetrometer Shear Strength
SSA = Solid Stem Auger	PI = Plasticity Index
SS = Split Spoon Sampler	Wn = Moisture Content
U = Undisturbed Sample (Shelby Tube)	CO = Consolidation
MC = Modified California Sampler	UC = Unconfined Compression Test
V = Vibracore	UU = Unconsolidated Undrained (Triaxial) Test
M = Macrocore	SI = Sieve Analysis
	DS = Direct Shear
USCS = Unified Soil Classification System (ASTM D2487)	PID = Photoionization Detector
NYCBC = New York City Building Code	ppm = Parts Per Million
WOR = Weight of Rods	REC = Recovery
WOH = Weight of Hammer	RQD = Rock Quality Designation
SPT = Standard Penetration Test (ASTM D1586)	▼ = Measured Water Level
N-Value = Cumulative number of uncorrected blows for the middle two six-inch intervals (blows/foot).	

TEST BORING LOG



GZA
GeoEnvironmental, Inc.
Engineers and Scientists

Carpionato Group LLC
Former Benny's
1400 West Main Road
Middletown, Rhode Island

EXPLORATION NO.: GZ-01
SHEET: 1 of 1
PROJECT NO: 34385.35
REVIEWED BY: Doug Le Do

Logged By: O. Cavallini
Drilling Co.: Hoffman Environmental Services
Foreman: Kyle Hoffman

Type of Rig: Tracked ATV
Rig Model: D50
Drilling Method:
HSA

Boring Location: See Plan
Ground Surface Elev. (ft.):
Final Boring Depth (ft.): 22
Date Start - Finish: 12/28/2018 - 12/28/2018

H. Datum:
V. Datum:

Hammer Type: Automatic Hammer
Hammer Weight (lb.): 140
Hammer Fall (in.): 30
Auger or Casing O.D./I.D Dia (in.): 4/3.25

Sampler Type: SS
Sampler O.D. (in.): 2.0
Sampler Length (in.): 24
Rock Core Size: N/A

Groundwater Depth (ft.)

Date	Time	Stab. Time	Water	Casing
12/28/18	15:30	5 Min.	8	20

GZA TEMPLATE TEST BORING - GZA PLOG DATA TEMPLATE 03-20-18.GDT - 1/18/19 13:22 - J:\GINT PROJECT DATABASES\34385.35-FORMER BENNY'S 1400 W MAIN ROAD MIDDLETOWN.GPJ

Depth (ft)	Casing Blows/ (Core Rate)	Sample					SPT Value	Stratum Description (Modified Burmister Classification)	Remark	Field Test Data	Depth (ft.)	Stratum Description	Elev. (ft.)
		No.	Depth (ft.)	Pen (in)	Rec. (in)	Blows (RQD)							
5		S-1	0.0-2.0	24	16	13 14 18 19	32	S-1: Top 5": Brown, fine to coarse SAND, some Gravel, little Silt Bottom 11": Dark gray, SILT, trace fine Sand, trace Gravel			0.33	ASPHALT	
		S-2	2.0-4.0	24	16	8 7 9 8	16	S-2: Medium dense, brown, fine to coarse SAND, some fine Gravel, some Silt			1	FILL	
		S-3	4.0-6.0	24	7	7 10 13 15	23	S-3: Medium dense, dark gray, SILT and FRACTURED ROCK					
10		S-4	10.0-12.0	24	16	6 11 11 9	22	S-4: Medium dense, dark gray, SILT, little Gravel, trace fine Sand					GLACIAL TILL
15		S-5	15.0-17.0	24	14	10 17 17 16	34	S-5: Dense, dark gray, SILT, trace fine Sand, trace Gravel					
20		S-6	20.0-22.0	24	16	13 24 51 61	75	S-6: Very dense, dark gray, SILT, little Gravel, little fine Sand					
								End of exploration at 22 feet			22		

REMARKS

See Log Key for exploration of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Exploration No.:
GZ-01

TEST BORING LOG



GZA
GeoEnvironmental, Inc.
Engineers and Scientists

Carponato Group LLC
Former Benny's
1400 West Main Road
Middletown, Rhode Island

EXPLORATION NO.: GZ-02
SHEET: 1 of 1
PROJECT NO: 34385.35
REVIEWED BY: Doug Le Do

Logged By: O. Cavallini
Drilling Co.: Hoffman Environmental Services
Foreman: Kyle Hoffman

Type of Rig: Tracked ATV
Rig Model: D50
Drilling Method:
HSA

Boring Location: See Plan
Ground Surface Elev. (ft.):
Final Boring Depth (ft.): 27
Date Start - Finish: 12/28/2018 - 12/28/2018

H. Datum:
V. Datum:

Hammer Type: Automatic Hammer
Hammer Weight (lb.): 140
Hammer Fall (in.): 30
Auger or Casing O.D./I.D Dia (in.): 4/3.25

Sampler Type: SS
Sampler O.D. (in.): 2.0
Sampler Length (in.): 24
Rock Core Size: N/A

Groundwater Depth (ft.)

Date	Time	Stab. Time	Water	Casing
12/28/18	12:00	5 Min.	9.5	25

GZA TEMPLATE TEST BORING - GZA PLOG DATA TEMPLATE 03-20-18.GDT - 1/18/19 13:22 - J:\GINT PROJECT DATABASES\34385.35-FORMER BENNY'S 1400 W MAIN ROAD MIDDLETOWN.GPJ

Depth (ft)	Casing Blows/ (Core Rate)	Sample					SPT Value	Stratum Description (Modified Burmister Classification)	Remark	Field Test Data	Depth (ft.)	Stratum Description	Elev. (ft.)
		No.	Depth (ft.)	Pen (in)	Rec. (in)	Blows (RQD)							
5		S-1	0.0-2.0	24	17	13 19 20 18	39	S-1: Top 8": Brown, fine to coarse SAND, some fine to coarse Gravel, little Silt Bottom 9": Gray, FRACTURED ROCK			0.33	ASPHALT FILL	
		S-2	2.0-4.0	24	22	8 8 12 26	20	S-2: Medium dense, gray, SILT				GLACIAL TILL	
		S-3	4.0-6.0	24	15	19 110 30 23	>100	S-3: Top 11": Gray, FRACTURED ROCK Bottom 4": Very dense, gray/brown, SILT			4.5	INFERRED BOULDER	
10		S-4	10.0-12.0	24	11	6 9 8 11	17	S-4: Medium dense, gray, SILT, wet				GLACIAL TILL	
15		S-5	15.0-17.0	24	17	8 13 19 29	32	S-5: Dense, gray, SILT, some fine to coarse Sand, some fine to coarse Gravel, wet				GLACIAL TILL	
20		S-6	20.0-22.0	24	17	18 19 21 25	40	S-6: Dense, SILT, some Gravel, little fine to coarse Sand, wet				GLACIAL TILL	
25		S-7	25.0-25.3	3	3	75 /3"		S-7: Gray, WEATHERED BEDROCK	1		23	WEATHERED BEDROCK	
30								End of exploration at 27 feet			27		

REMARKS
1 - Rig chatter from 23'-25'.

See Log Key for exploration of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Exploration No.:
GZ-02

TEST BORING LOG



GZA
GeoEnvironmental, Inc.
Engineers and Scientists

Carpionato Group LLC
Former Benny's
1400 West Main Road
Middletown, Rhode Island

EXPLORATION NO.: GZ-03
SHEET: 1 of 1
PROJECT NO: 34385.35
REVIEWED BY: Doug Le Do

Logged By: O. Cavallini
Drilling Co.: Hoffman Environmental Services
Foreman: Kyle Hoffman

Type of Rig: Tracked ATV
Rig Model: D50
Drilling Method:
HSA

Boring Location: See Plan
Ground Surface Elev. (ft.):
Final Boring Depth (ft.): 20.9
Date Start - Finish: 12/31/2018 - 12/31/2018

H. Datum:
V. Datum:

Hammer Type: Automatic Hammer
Hammer Weight (lb.): 140
Hammer Fall (in.): 30
Auger or Casing O.D./I.D Dia (in.): 4/3.25

Sampler Type: SS
Sampler O.D. (in.): 2.0
Sampler Length (in.): 24
Rock Core Size: N/A

Groundwater Depth (ft.)

Date	Time	Stab. Time	Water	Casing
12/31/18	10:10	5 Min.	17.4	20

GZA TEMPLATE TEST BORING - GZA PLOG DATA TEMPLATE 03-20-18.GDT - 1/18/19 13:22 - J:\GINT PROJECT DATABASES\34385.35-FORMER BENNY'S 1400 W MAIN ROAD MIDDLETOWN.GPJ

Depth (ft)	Casing Blows/ (Core Rate)	Sample					SPT Value	Stratum Description (Modified Burmister Classification)	Remark	Field Test Data	Depth (ft.)	Stratum Description	Elev. (ft.)
		No.	Depth (ft.)	Pen (in)	Rec. (in)	Blows (RQD)							
		S-1	0.0-2.0	24	14	20 14 15 8	29	S-1: Medium dense, dark gray, GRAVEL and fine to coarse SAND, some Silt			0.33	ASPHALT	
		S-2	2.0-4.0	24	17	11 8 5 4	13	S-2: Top 10": Dark gray, GRAVEL, some fine to coarse Sand, some Silt, trace Construction Debris Bottom 7": Dark gray, SILT, trace Gravel			3	FILL	
5		S-3	4.0-6.0	24	24	10 12 12 17	24	S-3: Medium dense, gray, SILT				GLACIAL TILL	
10		S-4	10.0-12.0	24	19	14 13 9 9	22	S-4: Top 7": FRACTURED ROCK Bottom 12": Dark gray, SILT, trace fine to coarse Sand, trace Gravel			10	TRANSFERRED BOULDER	
15		S-5	15.0-17.0	24	20	14 14 15 19	29	S-5: Medium dense, gray/brown, SILT, some Gravel, little fine to coarse Sand				GLACIAL TILL	
20		S-6	20.0-20.9	11	9	49 100 /5"		S-6: Very dense, gray, WEATHERED BEDROCK, wet			20	WEATHERED BEDROCK	
								End of exploration at 20.9 feet					

REMARKS

See Log Key for exploration of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Exploration No.:
GZ-03

TEST BORING LOG



GZA
GeoEnvironmental, Inc.
Engineers and Scientists

Carpionato Group LLC
 Former Benny's
 1400 West Main Road
 Middletown, Rhode Island

EXPLORATION NO.: GZ-04
SHEET: 1 of 1
PROJECT NO: 34385.35
REVIEWED BY: Doug Le Do

Logged By: O. Cavallini
Drilling Co.: Hoffman Environmental Services
Foreman: Kyle Hoffman

Type of Rig: Tracked ATV
Rig Model: D50
Drilling Method:
 HSA

Boring Location: See Plan
Ground Surface Elev. (ft.):
Final Boring Depth (ft.): 17.25
Date Start - Finish: 12/31/2018 - 12/31/2018

H. Datum:
V. Datum:

Hammer Type: Automatic Hammer
Hammer Weight (lb.): 140
Hammer Fall (in.): 30
Auger or Casing O.D./I.D Dia (in.): 4/3.25

Sampler Type: SS
Sampler O.D. (in.): 2.0
Sampler Length (in.): 24
Rock Core Size: N/A

Groundwater Depth (ft.)

Date	Time	Stab. Time	Water	Casing
12/31/18	12:30	5 Min.	10.3	17

GZA TEMPLATE TEST BORING - GZA PLOG DATA TEMPLATE 03-20-18.GDT - 1/18/19 13:22 - J:\GINT PROJECT DATABASES\34385.35-FORMER BENNY'S 1400 W MAIN ROAD MIDDLETOWN.GPJ

Depth (ft)	Casing Blows/ (Core Rate)	Sample					SPT Value	Stratum Description (Modified Burmister Classification)	Remark	Field Test Data	Depth (ft.)	Stratum Description	Elev. (ft.)
		No.	Depth (ft.)	Pen (in)	Rec. (in)	Blows (RQD)							
5		S-1	0.0-2.0	24	17	18 17 16 21	33	S-1: Dense, brown, fine GRAVEL, some fine to coarse Sand, little Silt			0.33	ASPHALT	
		S-2	2.0-4.0	24	15	6 7 5 9	12	S-2: Medium dense, dark gray SILT, trace Gravel			2	FILL	
		S-3	4.0-6.0	24	24	16 17 18 17	35	S-3: Dense, dark gray SILT, trace Gravel, trace fine to coarse Sand					
		S-4	10.0-12.0	24	14	12 18 32 22	50	S-4: Very dense, gray/brown GRAVEL, some Silt, little fine to coarse Sand					
		S-5	15.0-16.3	15	12	17 28 69 /3"	97	S-5: Very dense, gray WEATHERED BEDROCK, wet			15	WEATHERED BEDROCK	
		S-6	17.0-17.3	3	2	33 /3"		S-6: GRAVEL, some Silt, trace fine to coarse Sand, wet		1 2	17.25		
							End of exploration at 17.25 feet						

REMARKS

1 - Auger refusal at approximately 17' below existing ground surface.
 2 - Bouncing refusal at 17.25' below existing ground surface.

See Log Key for exploration of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Exploration No.:
GZ-04

TEST BORING LOG



GZA
GeoEnvironmental, Inc.
Engineers and Scientists

Carpionato Group LLC
 Former Benny's
 1400 West Main Road
 Middletown, Rhode Island

EXPLORATION NO.: GZ-05
SHEET: 1 of 1
PROJECT NO: 34385.35
REVIEWED BY: Doug Le Do

Logged By: O. Cavallini
Drilling Co.: Hoffman Environmental Services
Foreman: Kyle Hoffman

Type of Rig: Tracked ATV
Rig Model: D50
Drilling Method:
 HSA

Boring Location: See Plan
Ground Surface Elev. (ft.):
Final Boring Depth (ft.): 15.33
Date Start - Finish: 12/31/2018 - 12/31/2018

H. Datum:
V. Datum:

Hammer Type: Automatic Hammer
Hammer Weight (lb.): 140
Hammer Fall (in.): 30
Auger or Casing O.D./I.D Dia (in.): 4/3.25

Sampler Type: SS
Sampler O.D. (in.): 2.0
Sampler Length (in.): 24
Rock Core Size: N/A

Groundwater Depth (ft.)

Date	Time	Stab. Time	Water	Casing
Not Measured				

Depth (ft)	Casing Blows/ (Core Rate)	Sample					SPT Value	Stratum Description (Modified Burmister Classification)	Remark	Field Test Data	Depth (ft.)	Stratum Description	Elev. (ft.)
		No.	Depth (ft.)	Pen (in)	Rec. (in)	Blows (RQD)							
		S-1	0.0-2.0	24	13	19 18 22 18	40	S-1: Dense GRAVEL, some fine to coarse Sand, little Silt			0.33	ASPHALT	
		S-2	2.0-2.6	7	7	45 35 /1"		S-2: Dense, gray, WEATHERED BEDROCK	1		2	FILL	
5		S-3	4.0-4.3	4	3	65 /4"		S-3: Gray, WEATHERED BEDROCK and SILT					
10		S-4	10.0-10.5	6	4	93/6"		S-4: Gray, WEATHERED BEDROCK and SILT					
15		S-5	15.0-15.3	4	3	80 /4"		S-5: Gray, WEATHERED BEDROCK and SILT			15.33		
								End of exploration at 15.33 feet					

REMARKS
 1 - Drill rig chatter from 2 to 15' below existing ground surface

See Log Key for exploration of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Exploration No.:
GZ-05

GZA TEMPLATE TEST BORING - GZA PLOG DATA TEMPLATE 03-20-18.GDT - 1/18/19 13:22 - J:\GINT PROJECT DATABASES\34385.35-FORMER BENNY'S 1400 W MAIN ROAD MIDDLETOWN.GPJ

TEST BORING LOG



GZA
GeoEnvironmental, Inc.
Engineers and Scientists

Carpionato Group LLC
Former Benny's
1400 West Main Road
Middletown, Rhode Island

EXPLORATION NO.: GZ-06
SHEET: 1 of 1
PROJECT NO: 34385.35
REVIEWED BY: Doug Le Do

Logged By: O. Cavallini
Drilling Co.: Hoffman Environmental Services
Foreman: Kyle Hoffman

Type of Rig: Tracked ATV
Rig Model: D50
Drilling Method:
HSA

Boring Location: See Plan
Ground Surface Elev. (ft.):
Final Boring Depth (ft.): 20.25
Date Start - Finish: 1/3/2019 - 1/3/2019

H. Datum:
V. Datum:

Hammer Type: Automatic Hammer
Hammer Weight (lb.): 140
Hammer Fall (in.): 30
Auger or Casing O.D./I.D Dia (in.): 4/3.25

Sampler Type: SS
Sampler O.D. (in.): 2.0
Sampler Length (in.): 24
Rock Core Size: N/A

Groundwater Depth (ft.)

Date	Time	Stab. Time	Water	Casing
1/3/19	10:15	5 Min.	DRY	20

GZA TEMPLATE TEST BORING - GZA PLOG DATA TEMPLATE 03-20-18.GDT - 1/18/19 13:23 - J:\GINT PROJECT DATABASES\34385.35-FORMER BENNY'S 1400 W MAIN ROAD MIDDLETOWN.GPJ

Depth (ft)	Casing Blows/ (Core Rate)	Sample					SPT Value	Stratum Description (Modified Burmister Classification)	Remark	Field Test Data	Depth (ft.)	Stratum Description	Elev. (ft.)
		No.	Depth (ft.)	Pen (in)	Rec. (in)	Blows (RQD)							
5		S-1	0.0-2.0	24	4	3 7 11 11	18	S-1: Medium dense, brown SILT and GRAVEL, trace fine to coarse Sand			0.33	ASPHALT FILL	
		S-2	2.0-4.0	24	15	8 9 13 24	22	S-2: Medium dense, brown SILT, some Gravel, trace fine to coarse Sand			4.33	GLACIAL TILL	
		S-3	4.0-6.0	24	20	17 42 20 20	62	S-3: Top 4": Brown SILT, little Gravel, trace fine to coarse Sand Bottom 16": Gray GRAVEL, little fine to coarse Sand, trace Silt			5.33	INFERRED BOULDER	
10		S-4	10.0-10.3	4	0	50 /4"		S-4: NO RECOVERY	1		9	GLACIAL TILL	
15		S-5	15.0-17.0	24	21	17 38 32 56	70	S-5: Very dense, gray WEATHERED BEDROCK				WEATHERED BEDROCK	
20		S-6	20.0-20.3	3	3	40 /3"		S-6: Gray WEATHERED BEDROCK			20.25		
								End of exploration at 20.25 feet					

REMARKS
1 - Drill rig chatter from 9 to 13.5' below existing ground surface

See Log Key for exploration of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Exploration No.:
GZ-06

TEST BORING LOG



GZA
GeoEnvironmental, Inc.
Engineers and Scientists

Carpionato Group LLC
Former Benny's
1400 West Main Road
Middletown, Rhode Island

EXPLORATION NO.: GZ-07
SHEET: 1 of 1
PROJECT NO: 34385.35
REVIEWED BY: Doug Le Do

Logged By: O. Cavallini
Drilling Co.: Hoffman Environmental Services
Foreman: Kyle Hoffman

Type of Rig: Tracked ATV
Rig Model: D50
Drilling Method:
HSA

Boring Location: See Plan
Ground Surface Elev. (ft.):
Final Boring Depth (ft.): 18.1
Date Start - Finish: 1/2/2019 - 1/2/2019

H. Datum:
V. Datum:

Hammer Type: Automatic Hammer
Hammer Weight (lb.): 140
Hammer Fall (in.): 30
Auger or Casing O.D./I.D Dia (in.): 4/3.25

Sampler Type: SS
Sampler O.D. (in.): 2.0
Sampler Length (in.): 24
Rock Core Size: N/A

Groundwater Depth (ft.)

Date	Time	Stab. Time	Water	Casing
1/2/19	10:20	5 Min.	12.5	18

GZA TEMPLATE TEST BORING - GZA PLOG DATA TEMPLATE 03-20-18.GDT - 1/18/19 13:23 - J:\GINT PROJECT DATABASES\34385.35-FORMER BENNY'S 1400 W MAIN ROAD MIDDLETOWN.GPJ

Depth (ft)	Casing Blows/ (Core Rate)	Sample					SPT Value	Stratum Description (Modified Burmister Classification)	Remark	Field Test Data	Depth (ft.)	Stratum Description	Elev. (ft.)	
		No.	Depth (ft.)	Pen (in)	Rec. (in)	Blows (RQD)								
5		S-1	0.0-2.0	24	0	10 10 14 19	24	S-1: NO RECOVERY			0.33	ASPHALT		
		S-2	2.0-4.0	24	11	28 30 28 32	58	S-2: Very dense, gray SILT and GRAVEL, some fine to coarse Sand			2	FILL		
		S-3	4.0-6.0	24	24	28 24 26 30	50	S-3: Very dense, gray SILT and GRAVEL, some fine to coarse Sand						
		S-4	10.0-12.0	24	20	10 19 20 37	39	S-4: Dense, dark gray SILT, little Gravel, trace fine to coarse Sand						
		S-5	15.0-17.0	24	18	17 44 46 63	90	S-5: Very dense, gray WEATHERED BEDROCK and SILT, wet				14	WEATHERED BEDROCK	
		S-6	18.0-18.1	1	0	50 /1"		S-6: NO RECOVERY			2	18.1		
20		End of exploration at 18.1 feet												

REMARKS
2 - Auger refusal at approximately 18 ft.

See Log Key for exploration of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Exploration No.:
GZ-07

TEST BORING LOG



GZA
GeoEnvironmental, Inc.
Engineers and Scientists

Carpionato Group LLC
Former Benny's
1400 West Main Road
Middletown, Rhode Island

EXPLORATION NO.: GZ-08
SHEET: 1 of 1
PROJECT NO: 34385.35
REVIEWED BY: Doug Le Do

Logged By: O. Cavallini
Drilling Co.: Hoffman Environmental Services
Foreman: Kyle Hoffman

Type of Rig: Tracked ATV
Rig Model: D50
Drilling Method:
HSA

Boring Location: See Plan
Ground Surface Elev. (ft.):
Final Boring Depth (ft.): 20.25
Date Start - Finish: 1/2/2019 - 1/2/2019

H. Datum:
V. Datum:

Hammer Type: Automatic Hammer
Hammer Weight (lb.): 140
Hammer Fall (in.): 30
Auger or Casing O.D./I.D Dia (in.): 4/3.25

Sampler Type: SS
Sampler O.D. (in.): 2.0
Sampler Length (in.): 24
Rock Core Size: N/A

Groundwater Depth (ft.)

Date	Time	Stab. Time	Water	Casing
1/2/19	12:45	5 Min.	9.4	20

GZA TEMPLATE TEST BORING - GZA PLOG DATA TEMPLATE 03-20-18.GDT - 1/18/19 13:23 - J:\GINT PROJECT DATABASES\34385.35-FORMER BENNY'S 1400 W MAIN ROAD MIDDLETOWN.GPJ

Depth (ft)	Casing Blows/ (Core Rate)	Sample					SPT Value	Stratum Description (Modified Burmister Classification)	Remark	Field Test Data	Depth (ft.)	Stratum Description	Elev. (ft.)
		No.	Depth (ft.)	Pen (in)	Rec. (in)	Blows (RQD)							
5		S-1	0.0-2.0	24	15	6 8 9 10	17	S-1: Top 5": Brown, fine to coarse SAND, some fine Gravel, some Silt Bottom 10': Gray SILT, trace Gravel			0.33	ASPHALT FILL	
		S-2	2.0-4.0	24	16	13 12 12 16	24	S-2: Medium dense, gray/brown SILT, trace Gravel, trace fine Sand					
		S-3	4.0-6.0	24	18	16 24 40 24	64	S-3: Very dense, gray/brown SILT, some fine to coarse Sand, some fine to coarse Gravel					
		S-4	10.0-12.0	24	16	15 18 15 28	33	S-4: Dense, gray SILT, trace Gravel					
		S-5	15.0-17.0	24	23	12 22 50 61	72	S-5: Top 11": Gray SILT, trace fine to coarse Sand, trace Gravel, wet Bottom 12": Gray WEATHERED BEDROCK, wet			16	WEATHERED BEDROCK	
		S-6	20.0-20.3	3	2	60 /3"		S-6: Gray WEATHERED BEDROCK, wet End of exploration at 20.25 feet			20.25		

REMARKS

See Log Key for exploration of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Exploration No.:
GZ-08

TEST BORING LOG



GZA
GeoEnvironmental, Inc.
Engineers and Scientists

Carpionato Group LLC
 Former Benny's
 1400 West Main Road
 Middletown, Rhode Island

EXPLORATION NO.: GZ-09
SHEET: 1 of 1
PROJECT NO: 34385.35
REVIEWED BY: Doug Le Do

Logged By: O. Cavallini
Drilling Co.: Hoffman Environmental Services
Foreman: Kyle Hoffman

Type of Rig: Tracked ATV
Rig Model: D50
Drilling Method:
 HSA

Boring Location: See Plan
Ground Surface Elev. (ft.):
Final Boring Depth (ft.): 14.1
Date Start - Finish: 1/2/2019 - 1/2/2019

H. Datum:
V. Datum:

Hammer Type: Automatic Hammer
Hammer Weight (lb.): 140
Hammer Fall (in.): 30
Auger or Casing O.D./I.D Dia (in.): 4/3.25

Sampler Type: SS
Sampler O.D. (in.): 2.0
Sampler Length (in.): 24
Rock Core Size: N/A

Groundwater Depth (ft.)

Date	Time	Stab. Time	Water	Casing
1/2/19	15:05	5 Min.	DRY	14

GZA TEMPLATE TEST BORING - GZA PLOG DATA TEMPLATE 03-20-18.GDT - 1/18/19 13:23 - J:\GINT PROJECT DATABASES\34385.35-FORMER BENNY'S 1400 W MAIN ROAD MIDDLETOWN.GPJ

Depth (ft)	Casing Blows/ (Core Rate)	Sample					SPT Value	Stratum Description (Modified Burmister Classification)	Remark	Field Test Data	Depth (ft.)	Stratum Description	Elev. (ft.)
		No.	Depth (ft.)	Pen (in)	Rec. (in)	Blows (RQD)							
5		S-1	0.0-2.0	24	15	9 9 6 6	15	S-1: Top 4": Tan, fine to coarse SAND, some Gravel, trace Silt Bottom 11": Gray/brown SILT, some Gravel, trace fine to coarse Sand			0.33	ASPHALT	
		S-2	2.0-4.0	24	23	14 41 39 33	80	S-2: Very dense, gray/brown SILT and GRAVEL, trace fine to coarse Sand				GLACIAL TILL	
		S-3	4.0-6.0	24	15	10 20 17 18	37	S-3: Dense, brown/gray SILT, some Gravel, little fine to coarse Sand					
		S-4	10.0-11.3	16	16	15 27 70 /4"	97	S-4: Very dense, gray WEATHERED BEDROCK and SILT			10		WEATHERED BEDROCK
		S-5	14.0-14.1	1	0	45 /1"		S-5: NO RECOVERY			14.1		
								End of exploration at 14.1 feet	1 2				

REMARKS
 1 - Drill rig chatter from approximately 12-14 ft.
 2 - Auger refusal at approximately 14 ft.

See Log Key for exploration of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Exploration No.:
GZ-09

NRCS Soils Data

Custom Soil Resource Report
Map—Hydrologic Soil Group



MAP LEGEND

- Area of Interest (AOI)**
 - Area of Interest (AOI)
- Soils**
 - Soil Rating Polygons**
 - A
 - A/D
 - B
 - B/D
 - C
 - C/D
 - D
 - Not rated or not available
 - Soil Rating Lines**
 - A
 - A/D
 - B
 - B/D
 - C
 - C/D
 - D
 - Not rated or not available
 - Soil Rating Points**
 - A
 - A/D
 - B
 - B/D

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: State of Rhode Island: Bristol, Kent, Newport, Providence, and Washington Counties
 Survey Area Data: Version 21, Sep 3, 2021

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

Date(s) aerial images were photographed: May 6, 2015—Sep 12, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
NP	Newport-Urban land complex	C	4.6	17.6%
PmA	Pittstown silt loam, 0 to 3 percent slopes	C	2.2	8.5%
PmB	Pittstown silt loam, 3 to 8 percent slopes	C	2.2	8.4%
Se	Stissing silt loam	D	0.6	2.5%
UD	Udorthents-Urban land complex	A	1.0	3.7%
Ur	Urban land		15.4	59.2%
Totals for Area of Interest			26.0	100.0%

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

References

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- United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. <http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084>

Custom Soil Resource Report

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

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Appendix I – FEMA Flood Mapping

National Flood Hazard Layer FIRMette

71°17'53"W 41°32'33"N



Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS



0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*



OTHER AREAS OF FLOOD HAZARD

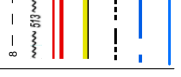
OTHER AREAS



GENERAL STRUCTURES



OTHER FEATURES



MAP PANELS



The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 3/4/2022 at 9:12 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.



0 250 500 1,000 1,500 2,000 Feet 1:6,000
 Basemap: USGS National Map; Orthoimagery: Data refreshed October, 2020