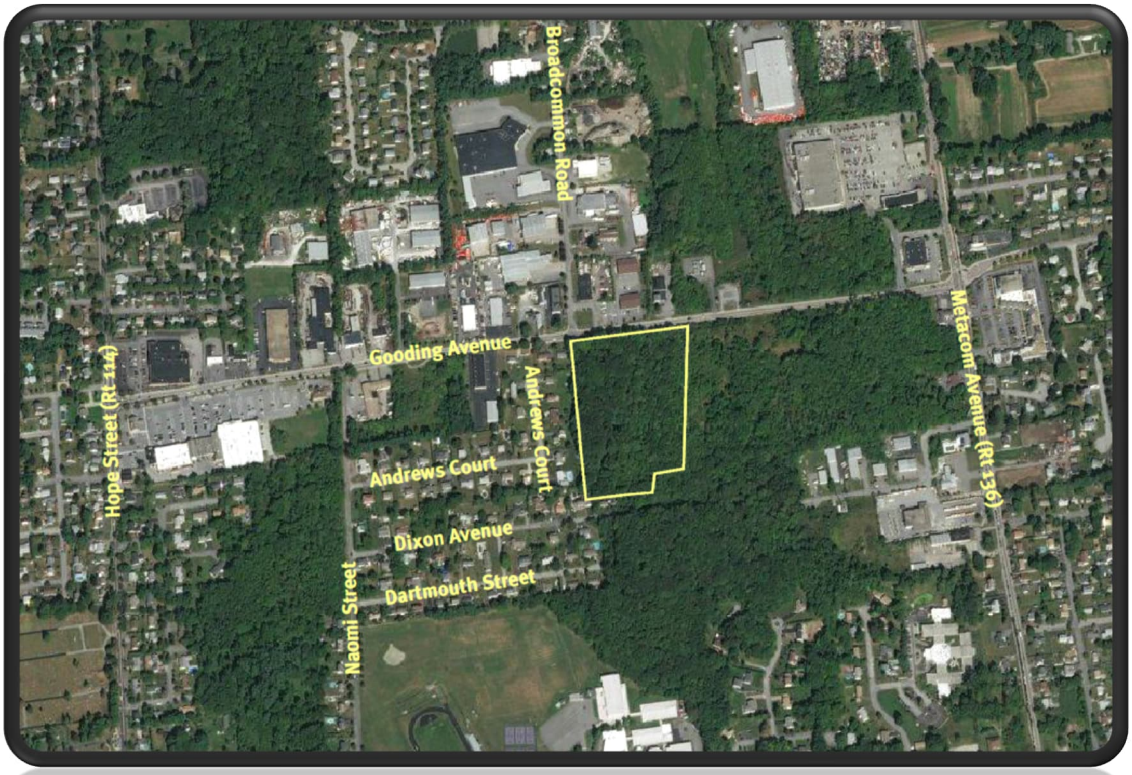
DiPrete Engineering

Stormwater Management Report



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REGISTERED
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4/7/2025

Gooding Avenue Development

Located in Bristol, Rhode Island

Applicant: Kendan, LLC.

1-19-2018

Revised: 3-27-2025

Table of Contents

Executive Summary

On behalf of the Client, we are submitting drainage calculations for the proposed development on Gooding Avenue in Bristol, Rhode Island. The site is located on Assessors' Plat 111 Lot 1. The site is currently undeveloped and exists today as almost entirely wooded. The client proposes to construct a new 80 room hotel building with associated parking and access driveways.

The post development stormwater will be treated for water quality using Best Management Practices (BMPs). The Site has been designed to meet the Rhode Island Stormwater Design and Installation Standards Manual (RISDISM). The site is largely made up of wetland and perimeter wetland areas and almost entirely Hydrologic Group D soils. Groundwater tables in the development area range from 24" to 36" below existing grade. Based on this information, low infiltration rates have been used in modeling the proposed BMPs to treat the water quality storm event. Also, the eastern end of the underground infiltration system A (UIS-A) will be located entirely above grade to maintain groundwater separation. Wherever this occurs, sand material will be installed between the bottom of stone and native soil below loam layer.

To mitigate post development flows on site, a sand filter and an underground infiltration/detention system will be utilized. The detention system has been designed to control runoff for the 1 through 100 year storm events. The sand filter and underground infiltration system have been designed as water quality BMPs. These will remove 85% or more of TSS (total suspended solids) generated by the proposed parking areas and access roads.

This report details how the site will show no net increase in stormwater runoff from pre development to post development conditions, and how the proposed BMPs will provide water quality treatment for stormwater runoff. The proposed improvements will not increase the rate of stormwater runoff onto the State Highway.

Pre development Conditions versus Post Development Conditions for each watershed are summarized below:

Subwatershed (design point)	1-yr Peak Flow		10-yr Peak Flow		25-yr Peak Flow		100-yr Peak Flow	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
DP-1:	2.34	0.99	6.50	4.99	9.08	6.75	14.58	10.39

All flows in cubic feet per second (cfs)

Sub-watershed (design point)	1-yr Volume		10-yr Volume		25-yr Volume		100-yr Volume	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
DP-1:	0.228	0.131	0.605	0.421	0.845	0.639	1.371	1.182

All flows in acre feet per second (af)

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

PROJECT NAME **Gooding Avenue Development**	**(RIDEM USE ONLY)** **STW/WQC File #:** **Date Received:**
TOWN **Bristol, RI**	
BRIEF PROJECT DESCRIPTION: 80-room hotel, parking and infrastructure	

Stormwater Management Plan (SMP) Elements – Minimum Standards

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 submit 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)

☐ Residential	☒ Commercial	☐ Federal	☐ Retrofit	☐ Restoration
☐ Road	☐ Utility	☐ Fill	☐ Dredge	☐ Mine
☐ 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.) See Guidance to identify receiving waters.

☒ **Groundwater**	☐ **Surface Water**	☐ **MS4**
☐ GAA	☐ Isolated Wetland	☐ RIDOT
☒ GA	☐ Named Waterbody	☐ RIDOT Alteration Permit is Approved
☐ GB	☐ Unnamed Waterbody Connected to Named Waterbody	☐ Town
		☐ Other (specify):

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

☒ Groundwater or Disconnected Wetland	☐ SRWP		
☒ Waterbody Name: Silver Creek	☐ Coldwater	☒ Warmwater	☐ Unassessed
☒ Waterbody ID: RI0007026R-01	☐ 4th order stream of pond 50 acres or more		
☐ TMDL for:	☐ Watershed of flood prone river (e.g., Pocasset River)		
☐ Contributes to a priority outfall listed in the TMDL	☐ Contributes stormwater to a public beach		
☐ 303(d) list – Impairment(s) for:	☐ Contributes to shellfishing grounds		

PROJECT HISTORY		
☒ RIDEM Pre- Application Meeting	Meeting Date:	☐ Minutes Attached
☐ Municipal Master Plan Approval	Approval Date:	☐ Minutes Attached
☐ Subdivision Suitability Required	Approval #:	
☐ Previous Enforcement Action has been taken on the property	Enforcement #:	

FLOODPLAIN & FLOODWAY See Guidance Pertaining to Floodplain and Floodways	
☐ Riverine 100-year floodplain: **FEMA FLOODPLAIN FIRMETTE** has been reviewed and the 100-year floodplain is on site	
☐ 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	
☐ Calculated by Professional Engineer	
☐ Calculations are provided for cut vs. fill/displacement volumes proposed within the 100-year floodplain	Amount of Fill (CY):
	Amount of Cut (CY):
☐ Restrictions or modifications are proposed to the flow path or velocities in a floodway	
☐ Floodplain storage capacity is impacted	
☒ Project area is not within 100-year floodplain as defined by RIDEM	

CRMC JURISDICTION
☐ CRMC Assent required
☐ Property subject to a Special Area Management Plan (SAMP). If so, specify which SAMP:
☐ Sea level rise mitigation has been designed into this project

LUHPPL IDENTIFICATION - MINIMUM STANDARD 8:			
1. OFFICE OF WASTE MANAGEMENT (OWM)			
	☐ 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:**
	☐ 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)		
	☐ This site is identified on the RIDEM Environmental Resources Map as one of the following regulated facilities		**SITE ID#**:
		☐ CERCLIS/Superfund (NPL)	
		☐ State Hazardous Waste Site (SHWS)	
		☐ Environmental Land Usage Restriction (ELUR)	
		☐ Leaking Underground Storage Tank (LUST)	
		☐ Closed Landfill	
Note: If any boxes in 1 above are checked, the applicant must contact the RIDEM OWM 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:			
	☐ Industrial Site with RIPDES MSGP, except where No Exposure Certification exists. http://www.dem.ri.gov/programs/water/permits/ripdes/stormwater/status.php		
	☐ Auto Fueling Facility (e.g., gas station)		
	☐ Exterior Vehicles Service, Maintenance, or Equipment Cleaning Area		

	☐ Road Salt Storage and Loading Areas (exposed to rainwater)	
	☐ Outdoor Storage and Loading/Unloading of Hazardous Substances	
3.	**STORMWATER INDUSTRIAL PERMITTING**	
	☐ 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:
	☐ 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 #
	☐ Additional stormwater treatment is required by the MSGP Explain:	

REDEVELOPMENT STANDARD – MINIMUM STANDARD 6		
☒ Pre Construction Impervious Area		
	☒ Total Pre-Construction Impervious Area (**TIA**) 0 acres	
	☒ Total Site Area (**TSA**) 9.78 acres	
	☒ Jurisdictional Wetlands (**JW**) 8.80 acres	
	☒ Conservation Land (**CL**) 0 acres	
☒ Calculate the Site Size (defined as contiguous properties under same ownership)		
	☒ Site Size (**SS**) = (**TSA**) – (**JW**) – (**CL**) 0.98 acres	
	☒ (**TIA**) / (**SS**) = 0	☒ (**TIA**) / (**SS**) >**0.4**? NO
☐ 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.

Note: A written description must be provided specifying why each method is not being used or is not applicable at the Site. Appropriate answers may include:

- Town requires … (state the specific local requirement)
- Meets Town's dimensional requirement of …
- Not practical for site because …
- Applying for waiver/variance to achieve this (pending/approved/denied)
- Applying for wavier/variance to seek relief from this (pending/approved/denied)

A) PRESERVATION OF UNDISTURBED AREAS, BUFFERS, AND FLOODPLAINS	**IF NOT IMPLEMENTED, EXPLAIN HERE**
☒ Sensitive resource areas and site constraints are identified (required) ☒ Local development regulations have been reviewed (required) ☐ All vegetated buffers and coastal and freshwater wetlands will be protected during and after construction ☐ Conservation Development or another site design technique has been incorporated to protect open space and pre-development hydrology. **Note:** If Conservation Development has been used, check box and skip to Subpart C ☐ As much natural vegetation and pre-development hydrology as possible has been maintained	Building and parking areas have been designed to minimize disturbances to the maximum extent practicable. Approximately 4,720 sf of wetland area is proposed to be disturbed during this project. The wetland has previously been determined to hold little to no environmental value.

B) LOCATE DEVELOPMENT IN LESS SENSITIVE AREAS AND WORK WITH THE NATURAL LANDSCAPE CONDITIONS, HYDROLOGY, AND SOILS ☐ Development sites and building envelopes have been appropriately distanced from wetlands and waterbodies ☐ Development and stormwater systems have been located in areas with greatest infiltration capacity (e.g., soil groups A and B) ☐ Plans show measures to prevent soil compaction in areas designated as Qualified Pervious Areas (QPA's) ☒ Development sites and building envelopes have been positioned outside of floodplains ☒ Site design positions buildings, roadways and parking areas in a manner that avoids impacts to surface water features ☒ Development sites and building envelopes have been located to minimize impacts to steep slopes (≥15%) ☐ Other (describe):	Building and parking areas have been designed to minimize disturbances to the maximum extent practicable.
C) MINIMIZE CLEARING AND GRADING ☒ Site clearing has been restricted to minimum area needed for building footprints, development activities, construction access, and safety. ☒ Site has been designed to position buildings, roadways, and parking areas in a manner that minimizes grading (cut and fill quantities) ☐ Protection for stands of trees and individual trees and their root zones to be preserved has been specified, and such protection extends at least to the tree canopy drip line(s) ☐ Plan notes specify that public trees removed or damaged during construction shall be replaced with equivalent	
D) REDUCE IMPERVIOUS COVER ☐ Reduced roadway widths (≤22 feet for ADT ≤ 400; ≤ 26 feet for ADT 400 - 2,000) ☐ Reduced driveway areas (length minimized via reduced ROW width (≤ 45 ft.) and/or reduced (or absolute minimum) front yard setback; width minimized to ≤ 9 ft. wide one lane; ≤ 18 ft. wide two lanes; shared driveways; pervious surface) ☐ Reduced building footprint: Explain approach: ☐ Reduced sidewalk area (≤ 4 ft. wide; one side of the street; unpaved path; pervious surface) ☐ Reduced cul-de-sacs (radius < 45 ft; vegetated island; alternative turn-around) ☐ Reduced parking lot area: Explain approach ☐ Use of pervious surfaces for driveways, sidewalks, parking areas/overflow parking areas, etc. ☒ Minimized impervious surfaces (project meets or is less than maximum specified by Zoning Ordinance) ☐ Other (describe):	
E) DISCONNECT IMPERVIOUS AREA ☐ Impervious surfaces have been disconnected, and runoff has been diverted to QPAs to the maximum extent possible ☐ Residential street edges allow side-of-the-road drainage into vegetated open swales ☐ Parking lot landscaping breaks up impervious expanse AND accepts runoff ☒ Other (describe):	Multiple BMPs are proposed for this site. Impervious areas are divided between the separate BMPs.
F) MITIGATE RUNOFF AT THE POINT OF GENERATION ☒ Small-scale BMPs have been designated to treat runoff as close as possible to the source	

G) PROVIDE LOW-MAINTENANCE NATIVE VEGETATION ☒ Low-maintenance landscaping has been proposed using native species and cultivars ☐ Plantings of native trees and shrubs in areas previously cleared of native vegetation are shown on site plan ☐ Lawn areas have been limited/minimized, and yards have been kept undisturbed to the maximum extent practicable on residential lots	
H) RESTORE STREAMS/WETLANDS ☐ Historic drainage patterns have been restored by removing closed drainage systems, daylighting buried streams, and/or restoring degraded stream channels and/or wetlands ☐ Removal of invasive species ☐ Other	Approximately 4,720 sf of wetland area is proposed to be disturbed during this project. The wetland has been previously determined to hold little to no environmental value. Disturbances have been minimized to the maximum extent practicable.

PART 3. SUMMARY OF REMAINING STANDARDS

GROUNDWATER RECHARGE – MINIMUM STANDARD 2		
YES	**NO**	
☒	☐	The project has been designed to meet the groundwater recharge standard.
☐	☐	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);
☐	☐	Your waiver request has been explained in the Narrative, if applicable.
☐	☒	Is this site identified as a Regulated Facility in Part 1, Minimum Standard 8: LUHPPL Identification?
☐	☐	If "Yes," has approval for infiltration by the Office of Waste Management 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)**
			Portion of Re_v directed to a QPA (cu ft)		
DP-1:	50,181	418		418	4,748
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.

☒ Indicate where the pertinent calculations and/or information for the above items are provided (i.e., name of report/document, page numbers, appendices, etc.):

Stormwater Report

WATER QUALITY – MINIMUM STANDARD 3		
YES	**NO**	
☒	☐	Does this project meet or exceed the required water quality volume WQv (see RICR 8.9.E-I)?
☒	☐	Is the proposed final impervious cover greater than 20% of the disturbed area (see RICR 8.9.E-I)?
☒	☐	If "Yes," either the Modified Curve Number Method or the Split Pervious/Impervious method in Hydro-CAD was used to calculate WQv; or,
☐	☐	If "Yes," either TR-55 or TR-20 was used to calculate WQv; and,
☐	☐	If "No," the project meets the minimum WQv of 0.2 watershed inches over the entire disturbed area.
☐	☐	Not Applicable
☒	☐	Does this project meet or exceed the ability to treat required water quality flow WQf (see RICR 8.9.I.1-3)?
☐	☒	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.
☐	☒	RICR 8.36. A Pollutant Loading Analysis is needed and has been completed.
☒	☐	The Water Quality Guidance Document (Water Quality Goals and Pollutant Loading Analysis Guidance for Discharges to Impaired Waters) has been followed as applicable.
☐	☒	BMPs are proposed that are on the approved technology list . If "Yes," please provide all required worksheets from the manufacturer.
☐	☒	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 (sq ft)	Total WQ_v Required (cu ft)	LID Stormwater Credits (see RICR 8.18) WQv directed to a QPA (cu ft)	Water Quality Treatment Remaining (cu ft)	Water Quality Provided by BMPs (cu ft)
DP-1:	50,181	4,182		4,182	4,748
DP-2:					
DP-3:					
DP-4:					
TOTALS:					

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.

☒ YES ☐ NO	This project has met the setback requirements for each BMP. If "No," please explain:

☒ Indicate where the pertinent calculations and/or information for the above items are provided (i.e., name of report/document, page numbers, appendices, etc.):
Stormwater Report

CONVEYANCE AND NATURAL CHANNEL PROTECTION (RICR 8.10) – MINIMUM STANDARD 4		
YES	**NO**	
☐	☒	Is this standard waived? If "Yes," please indicate one or more of the reasons below:
		☐ 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. ☐ The project directs is a small facility with impervious cover of less than or equal to 1 acre. ☐ 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). (Note: LID design strategies can greatly reduce the peak discharge rate).
☒	☐	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:	Silver Creek	N	8,268	8,268	0.27
DP-2:					
DP-3:					
DP-4:					
TOTALS:					
Note: The Channel Protection Volume Standard must be met in each waterbody ID.					
☒ YES ☐ 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).				
☐ YES ☒ NO	Do additional design restrictions apply resulting from any discharge to cold-water fisheries; If "Yes," please indicate restrictions and solutions below.				
☒ 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 Report					

OVERBANK FLOOD PROTECTION (RICR 8.11) AND OTHER POTENTIAL HIGH FLOWS – MINIMUM STANDARD 5			
YES	**NO**		
☐	☒	Is this standard waived? If yes, please indicate one or more of the reasons below:	
		☐	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.
		☐	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).
☐	☒	Does the project flow to an MS4 system or subject to other stormwater requirements? If "Yes," indicate as follows:	
		☐	RIDOT
		☐	Other (specify):
Note: 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.			
		Indicate below which model was used for your analysis. ☐ TR-55 ☐ TR-20 ☒ HydroCAD ☐ Bentley/Haestad ☐ Intellisolve ☐ Other (Specify):	
YES	**NO**		
☒	☐	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.):	
☒	☐	Do off-site areas contribute to the sub-watersheds and design points? If "Yes,"	
☒	☐	Are the areas modeled as "present condition" for both pre- and post-development analysis?	
☒	☐	Are the off-site areas shown on the subwatershed maps?	
☒	☐	Does the drainage design confirm safe passage of the 100-year flow through the site for off-site runoff?	
☐	☒	Is a Downstream Analysis required (see RICR 8.11.E.1)?	
☒	☐	Calculate the following:	
		☒	Area of disturbance within the sub-watershed (areas) 1.74
		☒	Impervious cover (%) 12%
☐	☒	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)?	
☒	☐	Does this project meet the overbank flood protection standard?	

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:	0.18	0.10	2.34	0.99	6.50	4.99	14.58	10.39
DP-2:								
DP-3:								
DP-4:								
TOTALS:								

** Utilize modified curve number method or split pervious /impervious method in HydroCAD.

Note: 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.	Stormwater Report
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.	Stormwater Report
Final sizing calculations for structural stormwater BMPs, including contributing drainage area, storage, and outlet configuration.	Stormwater Report
Stage-storage, inflow and outflow hydrographs for storage facilities (e.g., detention, retention, or infiltration facilities).	Stormwater Report

Table 5-2 Summary of Best Management Practices											
BMP ID	**DP #**	**BMP Type** (e.g., bioretention, tree filter)	**BMP Functions**					**Bypass Type**	**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)	External (E) Internal (I) or NA	Yes/ No	Technical Justification (Design Report page number)	Distance Provided
UIS-A	1	Underground Infiltration	Y	Y	Y	NA	N	I	Y	Section 3.3	12.6 ft
SF-B	1	Sand Filter	Y	Y	Y	NA	N	I	Y	Section 3.3	24.0 ft
UDS-A	1	Underground Detention	N	N	N	Y	Y	NA	Y	Section 3.3	15.0 ft
		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**						
			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)	Exfiltration Rate Applied (in/hr)
			Primary	Secondary					
1	UIS-A	Underground Infiltration	TP-4	-	73.00	70.00	3.0	D	0.52
1	SF-B	Sand Filter	TP-6	-	69.00	66.00	3.0	D	0.52
		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**	
☐	☐	☒	Describe any LUHPPLs identified in Part 1, Minimum Standard 8, Section 2. If not applicable, continue to Minimum Standard 9.
☐	☐	☒	Are these activities already covered under an MSGP? If "No," please explain if you have applied for an MSGP or intend to do so?
☐	☐	☒	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:
☐	☐	☒	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**	
☒	☐	☐	Have you checked for illicit discharges?
☐	☒	☐	Have any been found and/or corrected? If "Yes," please identify.
☒	☐	☐	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**		
☒	☐	☐	Have you included a Soil Erosion and Sediment Control Plan Set and/or Complete Construction Plan Set?	
☒	☐	☐	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:	
			☐	Soil Erosion and Sediment Control Plan Project Narrative, including a description of how the fifteen (15) Performance Criteria have been met:
			☐	Provide Natural Buffers and Maintain Existing Vegetation
			☐	Minimize Area of Disturbance
			☐	Minimize the Disturbance of Steep Slopes
			☐	Preserve Topsoil
			☐	Stabilize Soils
			☐	Protect Storm Drain Inlets
			☐	Protect Storm Drain Outlets
			☐	Establish Temporary Controls for the Protection of Post-Construction Stormwater Control Measures
			☐	Establish Perimeter Controls and Sediment Barriers
			☐	Divert or Manage Run-On from Up-Gradient Areas
			☐	Properly Design Constructed Stormwater Conveyance Channels
			☐	Retain Sediment On-Site
			☐	Control Temporary Increases in Stormwater Velocity, Volume, and Peak Flows
			☐	Apply Construction Activity Pollution Prevention Control Measures
			☐	Install, Inspect, and Maintain Control Measures and Take Corrective Actions
			☐	Qualified SESC Plan Preparer's Information and Certification
			☐	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
			☐	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 PLAN – MINIMUM STANDARDS 7 AND 9		
Operation and Maintenance Section		
YES	**NO**	
☒	☐	Have you minimized all sources of pollutant contact with stormwater runoff, to the maximum extent practicable?
☒	☐	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?
☒	☐	Lawn, Garden, and Landscape Management meet the requirements of RISDISM Section G.7? If "No," why not?
☒	☐	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.).
☐	☒	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:

☐	☒	Is stormwater being directed from public areas to private property? If "Yes," note the following: Note: 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		
☒	☐	Designated snow stockpile locations?
☒	☐	Trash racks to prevent floatables, trash, and debris from discharging to Waters of the State?
☒	☐	Asphalt-only based sealants?
☐	☒	Pet waste stations? (Note: 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).
☒	☐	Regular sweeping? Please describe:
☒	☐	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).
☒	☐	A prohibition of phosphate-based fertilizers? (Note: 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**		
☒	☐		Existing and proposed drainage area delineations
☒	☐		Locations of all streams and drainage swales
☒	☐		Drainage flow paths, mapped according to the DEM *Guidance for Preparation of Drainage Area Maps* (included in RISDISM Appendix K)
☒	☐		Complete drainage area boundaries; include off-site areas in both mapping and analyses, as applicable
☒	☐		Logs of borings and/or test pit investigations along with supporting soils/geotechnical report
☒	☐		Mapped seasonal high-water-table test pit locations
☒	☐		Mapped locations of the site-specific borings and/or test pits and soils information from the test pits at the locations of the BMPs
☒	☐		Mapped locations of the BMPs, with the BMPs consistently identified on the Site Construction Plans
☒	☐		Mapped bedrock outcrops adjacent to any infiltration BMP
☒	☐		Soils were logged by a:
		☒	DEM-licensed Class IV soil evaluator Name: John Keegan, RI Soil Evaluator D-4008
		☐	RI-registered P.E. Name:

Subwatershed and Impervious Area Summary				
Subwatershed (area to each design point)	**First Receiving Water ID or MS4**	**Area Disturbed (acres)**	**Existing Impervious (acres)**	**Proposed Impervious (acres)**
DP-1: Silver Creek	RI0007026R-01	1.74	0.130	1.152
DP-2:				
DP-3:				
DP-4:				
TOTALS:				

Site Construction Plans (Indicate that the following applicable specifications are provided)		
YES	**NO**	
☒	☐	Existing and proposed plans (scale not greater than 1" = 40') with North arrow
☒	☐	Existing and proposed site topography (with 1 or 2-foot contours); 10-foot contours accepted for off-site areas
☒	☐	Boundaries of existing predominant vegetation and proposed limits of clearing
☒	☐	Site Location clarification
☒	☐	Location and field-verified boundaries of resource protection areas such as: ► freshwater and coastal wetlands, including lakes and ponds ► coastal shoreline features Perennial and intermittent streams, in addition to Areas Subject to Storm Flowage (ASSFs)
☒	☐	All required setbacks (e.g., buffers, water-supply wells, septic systems)
☒	☐	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: ► 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
☒	☐	Logs of borings and/or test pit investigations along with supporting soils/geotechnical report and corresponding water tables
☒	☐	Mapping of any OWM-approved remedial actions/systems (including ELURs)
☒	☐	Location of existing and proposed roads, buildings, and other structures including limits of disturbance; ► 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
☒	☐	Locations, cross sections, and profiles of all stream or wetland crossings and their method of stabilization

1.0 Project Description

The purpose of this report is to specify a Storm Water Management System to be implemented at the new project on Gooding Avenue.

The site totals 9.78 acres located on Assessor's Plat 111 Lot 1 in Bristol, Rhode Island. The site is located south of Gooding Avenue near the intersection of Broadcommon Road. A National Forest to the east of the site provides a buffer between the site and Silver Creek.

The proposed development will include a new 13,364 sf hotel building, associated parking and access driveways. The site will be serviced by public water and sewer. Water will be provided by Bristol Country Water Authority and Sewer will be provided by the Town of Bristol.

The stormwater quality will be improved by utilizing Best Management Practices (BMPs) as established by the RISDISM for the treatment of stormwater runoff from the proposed development. BMPs will consist of a sand filter and underground infiltration/detention system. The systems have been designed to meet the RIDEM Stormwater Design and Installations Standards Manual.

2.0 Site Conditions

2.1 SOILS

There are the following soil types within the analyzed area of the Site as mapped by the NRCS USDA Soil Conservation service:

Soil Symbol	Description	Hydrologic Group
PmA	Pittstown silt loam, 0 to 3 percent slopes	C
PmB	Pittstown silt loam, 3 to 8 percent slopes	C
Se	Stissing silt loam	D

Site specific soil evaluations can be found in Appendix A2.1.

2.2 EXISTING SITE CONDITIONS

Currently the site is undeveloped and predominately woods. All stormwater from the site discharges directly to the onsite wetland areas and ultimately to Silver Creek. The site is largely made up of wetland and perimeter wetland areas and is almost entirely Hydrologic Group D soils. Groundwater tables range from 24" to 36" below existing grade. There is an existing sewer easement that bisects the site.

The entire site slopes diagonally from the higher elevation at the northwest corner along Gooding Avenue to the southeast with all existing slopes < 15%. Stormwater from the site flows overland following the existing slopes. Gooding Avenue has curbing along both sides of the road and a closed drainage network that prevents stormwater from Gooding Avenue from flowing onto the site. However,

a portion of the adjacent residential lots to the west of the site does flow toward the site. These flows have been incorporated into the model.

Currently, none of the existing runoff is treated or detained before being discharged to the wetland. The design point that has been used in modeling the site is the onsite wetland.

2.3 POST SITE CONDITIONS

Following development, the site will be modeled as multiple sub-catchment areas. A small portion of the site to the east will be directed via overland flow first to the Cascade Separator for pretreatment and then to the sand filter (Sand Filter B). An underground detention system (UDS-B) will provide additional storage for the sand filter, allowing a greater volume of water to be stored and infiltrated above the required 1.2" water quality storm.

The main subcatchment of the site contains the proposed building and parking areas. All runoff from the parking areas will be collected in the proposed drainage network and directed to a WQ bypass structure. This structure will direct the WQ storm to the underground infiltration system (UIS-A) and all larger storms to the underground detention system (UDS-A). All runoff from the proposed roof will also tie into the drainage network via roof leader. UDS-A will handle peak mitigation for the site and contains a low flow outlet to meet CPv criteria. Outflows from UDS-A will discharge to the wetland via a culvert and headwall. UIS-A will be equipped with isolator rows to infiltrate 25% of the water quality storm. An isolator row bypass will be used to direct flows to the appropriate areas of the underground infiltration system.

Stormwater from all undetained areas will flow overland as in pre-development conditions. This water will flow overland directly to the wetland. Since all stormwater will continue to be discharged to the wetland, post development conditions have also been modeled with one design point.

The proposed drainage analysis uses stormwater management systems to control and treat runoff from the proposed development. The following BMP's are used on site and have been designed to include the following elements:

- Pretreatment Proprietary Device
    - Pretreatment TSS removal of runoff from roadways and sidewalks
    - Contech's Cascade Separator selected as RIDEM pre-approved product for this application
- Sand Filter
    - Fully infiltrates the 1.2" water quality stormwater event
    - 2.0' of sand media mix including 6" of top soil and 1.5' of sand filter sand for stormwater infiltration
- Underground Infiltration System
    - Stormtech SC-740 Chambers or approved equal
    - Fully infiltrates the 1.2" water quality stormwater event
    - Equipped with isolator rows to infiltrate a minimum of 25% of the WQv
    - Variable depth sand layer to native soil beneath bottom of stone where fill is required

- Underground Detention System
    - Stores Channel Protection Volume (CPv)
    - Provided Overbank Flood Protection (Qp) for the 1-100 year storm events

The above elements are used to meet the design standards of the Rhode Island Stormwater Design and Installation Standard.

The primary goal of increasing water quality treatment is accomplished by providing water quality BMPs. Stormwater runoff mitigation is provided through the use of the underground detention system with a low flow outlet. By reducing post development stormwater flow rate to a level no greater than the pre development rate, the second goal of the proposed drainage system is achieved. Any potential impacts from the proposed development on the abutting properties and wetlands has been mitigated.

3.0 Minimum Standards

The site has been designed to meet the minimum standards as outlined in the Rhode Island Stormwater Design and Installation Standards Manual (RISDISM). The following sections outline how the site meets and exceeds the minimum required standards.

3.1 Minimum Standard 1: LID Site Planning and Design Strategies

See "Appendix A: Stormwater Management Checklist" from the RISDISM provided at the beginning of this report.

3.2 Minimum Standard 2: Groundwater Recharge

Groundwater is to be recharged per watershed based on impervious area coverage in accordance with section 3.2.2 of the RISDISM.

The required recharge volume is based on all impervious area, not just areas which are captured in the proposed BMPs.

Groundwater recharge is determined from the following equation:
Re_V=1"*F*I/12

Where:

Re_V=Groundwater Recharge Volume (ac-ft)

F=Recharge Factor based on Hydrologic Soil Groups (HSG) (see table below)

I=Impervious Area (acres)

HSG	Recharge Factor (F)
A	0.60
B	0.35
C	0.25
D	0.10

Recharge volume for watershed 1 is provided through the use of UIS-A and Sand Filter B. The total impervious on the site is 1.152 acres. The soil has been modeled as HSG D, therefore the total recharge required for the site is 418 cu.ft. See Table 2-1 of the Appendix A checklist for a summary of recharge values.

HydroCAD printouts are available in Appendix A3.2 for the 1.2" water quality storm. The water quality storm is calculated in HydroCAD using the 'calculate separate Pervious/Impervious runoff' option.

3.3 Minimum Standard 3: Water Quality

All stormwater from developed area is treated through an approved BMP before being discharged. This site has been designed to use a sand filter and an underground infiltration system to treat stormwater before either being discharged to the wetland or being stored within the detention system. See the following sand filter design sheet and water quality underground infiltration section for water quality requirements. There are no pollutant-specific requirements and/or pollutant removal efficiencies applicable to the site as the result of SAMP, TMDL, or other watershed-specific requirements.

3.3.1 Sand Filter Calculations

DiPrete Engineering
Engineers • Planners • Surveyors

Sand Filter Sizing

Name of Sand Filter: SF-B

Sand Filter Parameters		
At,Total Area to Sand Filter	0.615	(Acres)
Impervious Area To Sand Filter	0.265	(Acres)
d_f, Filter Bed Depth	2.00	(feet)
k, Coefficient of Permeability	3.5	(ft/day)
h_f, Average Height of Water	0.50	(ft)
t_f, Design Filter Bed Drain Time	2.00	(days)
Ponding Depth	12	(in)
Loam Depth	6	(in)

Water Quality Calculations

WQ_v= 1inch x Impervious Area

WQ_v= 962 (Cubic Feet)

Minimum Size of Sand Filter Filter Area

$A_f=(WQ_v)x(d_f)/[(k)x(h_f+d_f)(t_f)]$

Required Af= 110 (Square Feet)

Where A_f is the required filter bed area

Provided Af= 324 (Square Feet)

Sand Filter Pre Treatment

Type of Pre Treatment: Other

Required Water Quality Volume

75% of the WQv must be held within system

Required WQ_v 721 (Cubic Feet)

Volume of Loam	53 (Cubic Feet)
Volume of Ponding	507 (Cubic Feet)
Volume of Voids in Filter Bed	214 (Cubic Feet)
Total	**774 (Cubic Feet)**

3.3.2 Water Quality Underground Infiltration System

The Underground Infiltration System (UIS-A) has been designed as a water quality system. The system has been sized using HydroCAD and an infiltration rate based on a parent material within the footprint of the BMP. The project site largely consists of sandy loam and an infiltration rate was used from table 5.5.4 of the RISDISM. See Appendix A3.2 for HydroCAD printouts for the water quality event. The underground infiltration system has been designed to fully infiltrate the water quality event.

Pretreatment for the underground infiltration system has been provided through the use of isolator rows. The isolator rows have been designed to store and infiltrate a minimum of 25% of the water quality volume.

3.4 Minimum Standard 4: Conveyance and Natural Channel Protection

3.4.1 Drainage Network Design Parameters:

A. PIPES

- All drainage pipes are HDPE or equivalent unless otherwise noted.
- Manning's coefficient = 0.012 for HDPE Pipe
- Diameters & lengths as specified
- The 100-year design storm is utilized for the drainage pipe design to ensure that the drainage system contains and channels water to the BMP areas as shown on the plans.
- The rational method has been used for the closed drainage system.

B. STRUCTURES

- Catch basins – Pre-cast concrete with 2' sump unless otherwise noted and inverts as specified
- Manholes – Pre-cast concrete with inverts as specified.

See the Inlet and Pipe summaries on the following pages designed for the 100-year storm event as noted above. All runoff from the 100-year storm event will be captured in the proposed drainage system without bypassing.

3.4.2 Channel Protection Volume:

The underground detention system has been designed to release the 1 year storm volume over a 24 hour time span in accordance with Section 3.2.4 of the RISDISM. The underground detention system has been designed to hold the full CPv for the site.

Based on site constraints, a sand filter with accompanying detention storage is provided in the northeast portion of the site. The entire water quality (1.2") storm is infiltrated through the practice, however there is a small amount of runoff overflowing the proposed spillway for the 1-year storm. The total volume flowing to the wetland from developed areas during the 1-year storm is only 0.035 ac-ft.

The Channel Protection Volume is determined from the following equation:
$CP_V=0.65V_r$

CP_V=required channel protection storage volume
V_r=runoff volume from the 1-year, 24-hour storm (obtained from HydroCAD)
Average release rate, $CP_{qavg}=V_r/T=Q_{CPv}$
Max Release Rate=$CP_{qmax}=2*CP_{qavg}$
T=extended detention time (24 hours)

BMP / Subcatchment	V_r (cf) To BMP	CP_v (cf) Required (0.65* V_r)	CP_v (cf) BMP Volume Infiltrated	CP_V (cf) Total	Required Max Release Rate (cfs)	Provided Max Release Rate (cfs)
Wetland/Silver Creek	12,719	8,268	6,273	8,268	0.294	HCAD

HydroCAD printouts are available in Appendix A3.5.4.2 for the 1-year storm event.

3.5 Minimum Standard 5: Overbank Flood Protection & Downstream Analysis

3.5.1 Method of Analysis

USDA Soil Conservation Service Method as defined by Technical Release No. 20 (TR-20) determines Stormwater runoff rate and volume. Type III rainfall distribution is utilized. Time of concentration is determined using Technical Release No 55 (TR-55) methodology, through the computer program *HydroCAD ver. 10.0* by Applied Microcomputer Systems.

Soil evaluations have been performed by SITEC, Inc. The existing soil has a texture of sandy loam. Due to the presence of wetland areas and HSG D soils, the soils have been modeled as a loam texture for a more conservative approach. Based on table 5.3 of the RIDISM an infiltration rate of 0.52 in/hr has been used in HydroCAD.

The drainage system has been designed to mitigate all stormwater flows for the 1 through 100 year storm events. The emergency outlets have been sized to handle the 100 year storm event.

3.5.2 Design Storm

Analysis of 1-year, 10-year, 25-year, and 100-year frequency storms are included. The following 24-hour rainfall intensities are obtained from the Rhode Island Stormwater Design and Installation Standards Manual, Table 3-1 for Bristol County.

1 year =	2.8 inches
10 year =	4.9 inches
25 year =	6.1 inches
100 year=	8.6 inches

3.5.3 Design Point Breakdown

The site is analyzed as one watershed area. In the pre development stage there is 1 subcatchment. In the post development stage there are 3 subcatchments. The watershed will demonstrate zero increase in runoff rate due to the proposed development. A description of each subcatchment is summarized as follows:

<u>Design Point #1: Wetland</u>

Watershed #1 flows to Design Point- 1 (DP-1). The design point is the on-site wetland.

In pre development conditions there is only one watershed to the Design Point. Pre-01 (10) contains the entire site and some off-site areas. Stormwater reaches DP-1 (11) via overland flow. Pre-01 is predominately woods with some grass areas along Gooding Avenue. The watershed also includes two residential homes with driveways along Gooding Avenue to the west of the site. A Tc value of 14.6 minutes was used.

In post development conditions there are 3 sub watersheds:

Post-01 (100) contains all undetained areas surrounding the proposed development. These areas will either be grass or undisturbed areas from pre-conditions. Stormwater will reach the design point via overland flow as in existing conditions. Some stormwater will be directed around the proposed

development via a small grassed swale to the west of the parking area. A Tc value of 7.3 minutes was used.

Post-02 (101) collects runoff from the proposed building and parking areas. Stormwater is captured in the proposed drainage network and directed to the WQ bypass structure (102) in the parking area south of the building. This bypass will direct the WQv to UIS-A via the isolator row bypass structure (103). Larger storms will be directed to the peak detention system (UDS-A) (106). Discharges from UDS-A will be directed to the design point through a culvert with a headwall. A Tc value of 6.0 minutes was used.

Post-03 (107) collects runoff from the drive aisle and a small portion of the parking area as well as the walkway and grass areas north of the proposed building to Sand Filter B and Underground Detention System B. Stormwater will flow overland and reach the cascade separator through the pipe network into the Sand Filter (109). The sand filter will receive additional storage from Underground Detention System B (110) which is connected by four 6" culverts. Larger storms will be discharged via overflow spillway and directed to the design point. A Tc value of 6.0 minutes was used.

Below is a summary of the hydrologic parameters for the pre and post development sub-areas in Design Point-1.

	Area (acres)	CN	Tc (min)
Pre-01	2.765	78	14.6
Post-01	0.858	79	7.3
Post-02	1.334	91	6.0
Post-03	0.572	88	6.0

3.5.4 Q_p BMP Calculations

This section includes calculations for the Qp BMPs for the site. Calculations include Rip Rap Aprons and the Emergency Outlet Calculations.

The underground detention system has been sized to safely pass the 100 year storm without overtopping the system. The outlet control structure will be equipped with an overflow weir. In the event that an outlet is clogged or not functioning, stormwater would flow over the weir and through the culvert to the wetland. See attached HydroCAD.

Outlet Protection

A rip rap apron and level spreader have been designed at the drainage pipe discharge from the underground detention system. The rip rap apron is designed to prevent scour at the storm water outlet and to minimize the potential for downstream erosion by reducing the velocity of concentrated storm water flows. See calculations on the following page. A level spreader is also proposed at the end of the rip rap apron of the underground detention system.

3.5.5 Downstream Analysis

A downstream analysis is required under the following conditions:

Area of Disturbance (Acres)	Impervious Cover (%)
>5 to 10	>75
>10 to 25	>50
>25 to 50	>25
>50	All Projects

The total site is 9.78 acres. The project proposes to disturb 1.74 acres and is 1.152 acres of impervious. This is approximately 12% impervious cover. Since the disturbed area is less than 5 acres, a downstream analysis is not required. However, in order to provide a comparison of flows with respect to a stream that historically floods (Silver Creek), we have provided a Downstream Summary in Appendix A3.5.4.7.

3.5.6 Overbank Flood Protection Conclusion

The tables below present a summary of the pre development flows vs. the mitigated post development 1flows. The table shows a decrease in the rate of runoff for all storms included in the analysis.

Pre Development Flows vs. Post Development Flows Mitigated

Watershed #1: (DP-1)

Subwatershed (design point)	**1-yr Peak Flow**		**10-yr Peak Flow**		**25-yr Peak Flow**		**100-yr Peak Flow**	
	Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
DP-1:	2.34	0.99	6.50	4.99	9.08	6.75	14.58	10.39

All flows in cubic feet per second (cfs)

As shown in the tables above, no increase in stormwater runoff rate will occur following the proposed construction during the 1 through 100 year storm events.

Also note that, due to concerns within the overall Silver Creek watershed and constraints therein, the applicant is also demonstrating that the proposed stormwater system will result in a decrease in runoff volume.

Watershed #1: (DP-1)

Sub-watershed (design point)	1-yr Volume		10-yr Volume		25-yr Volume		100-yr Volume	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
DP-1:	0.228	0.131	0.605	0.421	0.845	0.639	1.371	1.182

All flows in acre feet per second (af)

As shown in the tables above, no increase in stormwater runoff volume will occur following the proposed construction during the 1 through 100 year storm events.

3.6 Minimum Standard 6: Redevelopment and Infill Projects.

The site is not classified as a redevelopment or infill project.

3.7 Minimum Standard 7: Pollution Prevention

A Soil Erosion and Sediment Control Plan (SESC) for this development can be found under a separate document. See the Soil Erosion and Sediment Control Plan for the development prepared by DiPrete Engineering. The SESC contains information for construction pollution prevention. For post construction pollution prevention see the Operations and Maintenance (O&M) document prepared for this development by DiPrete Engineering.

3.8 Minimum Standard 8: Land Uses with High Potential Pollutant Loads (LUHPPLs)

The site is not considered LUHHPL.

3.9 Minimum Standard 9: Illicit Discharges

There are no proposed Illicit Discharges on site. The site will be serviced by public water and sewer.

3.10 Minimum Standard 10: Construction Activity Soil Erosion, Runoff and Sedimentation and Pollution Prevention Control Measure Requirements

See the SESC for this development prepared by DiPrete Engineering.

3.11 Minimum Standard 11: Stormwater Management System Operation and Maintenance

See the O&M for this development prepared by DiPrete Engineering.

Appendix A

A2.1 Soil Evaluations

Hotel Development
Gooding Avenue
Bristol, Rhode Island

Test Pits to Determine Groundwater
John Keegan RI Soil Evaluator D-4008
12/12/14

TestPit#	Depth	Horizon	Texture	Color	REDOX	Depth
1	0"-12"	Ap	SL	10YR 3/2		
	12"-20"	Bw1	SL	2.5Y4/4		
	20"- 24"	Bw2	SL	5Y4/3	m2p 10YR4/4	24"
	24"-72"	Cd	SL	5Y 5/1	m3p 10YR4/4	36"

Till becomes denser and rocky with depth
Hole is dry

TestPit#	Depth	Horizon	Texture	Color	REDOX	Depth
2	0"-12"	Ap	SL	10YR 3/2		
	12"-20"	Bw1	SL	2.5Y4/4		
	20"- 30"	Bw2	SL	5Y4/3	m2p 10YR4/4	30"
	30"-77"	Cd	SL	5Y 5/1	m3p 10YR4/4	32"

Till becomes denser and rocky with depth
Hole is dry

TestPit#	Depth	Horizon	Texture	Color	REDOX	Depth
3	0"-12"	Ap	SL	10YR 3/2		
	12"-20"	Bw1	SL	2.5Y4/4		
	20"- 30"	Bw2	SL	5Y4/3	m2p 10YR4/4	28"
	30"-72"	Cd	SL	5Y 5/1	m3p 10YR4/4	32"

Till becomes denser and rocky with depth
Hole is dry

TestPit#	Depth	Horizon	Texture	Color	REDOX	Depth
4	0"-12"	Ap	SL	10YR 3/2		
	12"-20"	Bw1	SL	2.5Y4/4		
	20"- 30"	Bw2	SL	5Y4/3	m2p 10YR4/4	30"
	30"-72"	Cd	SL	5Y 5/1	m3p 10YR4/4	32"

Till becomes denser and rocky with depth
Hole is dry

TestPit#	Depth	Horizon	Texture	Color	REDOX	Depth
5	0"-12"	Ap	SL	10YR 3/2		
	12"-20"	Bw1	SL	2.5Y4/4		
	20"- 30"	Bw2	SL	5Y4/3	m2p 10YR4/4	28"
	30"-60"	Cd	SL	5Y 5/1	m3p 10YR4/4	32"

Till becomes denser and rocky with depth
Hole is dry

TestPit#	Depth	Horizon	Texture	Color	REDOX	Depth
6	0"-12"	Ap	SL	10YR 3/2		
	12"-20"	Bw1	SL	2.5Y4/4		
	20"- 36"	Bw2	SL	5Y4/3	m2p 10YR4/4	36"
	36"-77"	Cd	SL	5Y 5/1	m3p 10YR4/4	38"

Sandy lenses and Mixing at 30"
Till becomes denser and rocky with depth
Hole is dry

TestPit#	Depth	Horizon	Texture	Color	REDOX	Depth
7	0"-12"	Ap	SL	10YR 3/2		
	12"-20"	Bw1	SL	2.5Y4/4		
	20"- 36"	Bw2	SL	5Y4/3	m2p 10YR4/4	36"
	36"-72"	Cd	SL	5Y 5/1	m3p 10YR4/4	38"

Till becomes denser and rocky with depth
Hole is dry

A3.2 Water Quality HydroCAD 1.2” Storm Analysis

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 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: WPre-01 Runoff Area=2.765 ac 4.59% Impervious Runoff Depth=0.14"
Flow Length=409' Tc=14.6 min CN=77/98 Runoff=0.17 cfs 0.033 af

Subcatchment 100: WPost-01 Runoff Area=0.858 ac 10.02% Impervious Runoff Depth=0.19"
Flow Length=339' Tc=7.3 min CN=77/98 Runoff=0.10 cfs 0.014 af

Subcatchment 101: WPost-02 Runoff Area=1.334 ac 68.74% Impervious Runoff Depth=0.71"
Tc=6.0 min CN=77/98 Runoff=1.01 cfs 0.079 af

Subcatchment 107: WPost-03 Runoff Area=0.572 ac 48.25% Impervious Runoff Depth=0.55"
Tc=6.0 min CN=80/98 Runoff=0.33 cfs 0.026 af

Reach 11: Wetland Inflow=0.17 cfs 0.033 af
Outflow=0.17 cfs 0.033 af

Reach 111: Wetland Inflow=0.10 cfs 0.014 af
Outflow=0.10 cfs 0.014 af

Pond 102: Qp/WQ ByPass Peak Elev=74.89' Inflow=1.01 cfs 0.079 af
Primary=1.01 cfs 0.079 af Secondary=0.00 cfs 0.000 af Outflow=1.01 cfs 0.079 af

Pond 103: Isolator ByPass Peak Elev=74.03' Inflow=1.01 cfs 0.079 af
Primary=1.01 cfs 0.065 af Secondary=0.08 cfs 0.014 af Outflow=1.01 cfs 0.079 af

Pond 104: UIS A (Isolator Row) with Peak Elev=74.03' Storage=1,935 cf Inflow=1.01 cfs 0.065 af
Outflow=0.01 cfs 0.065 af

Pond 105: UIS A with Underground Sand Filter Peak Elev=70.08' Storage=91 cf Inflow=0.08 cfs 0.014 af
Outflow=0.04 cfs 0.014 af

Pond 106: UDS A Peak Elev=70.00' Storage=0 cf Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Pond 109: Sand Filter B Peak Elev=69.75' Storage=897 cf Inflow=0.33 cfs 0.026 af
Discarded=0.00 cfs 0.021 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.021 af

A3.4.2 Drainage Network Hydraulic Calculations

DiPrete Engineering
Engineers • Planners • Surveyors

Project Name: Gooding Avenue
Project Number: 2536-001

25-Year Storm
Date: 2/28/2024

Pipe Analysis

Pipe ID	Pipe Length	Pipe Size	Pipe Slope	Flow Rate	Capacity Full	Velocity	Invert Down	Invert Up
	(ft)	(in)	(%)	(cfs)	(cfs)	(ft/s)	(Ft)	(ft)
7 - 8	31.23	18	0.50%	4.6	8.05	4.7	73.50	73.66
4 - 7	31.77	18	0.50%	1.8	8.05	3.7	73.66	73.82
3 - 4	70.67	18	0.50%	0.8	8.06	2.9	73.82	74.17
2 - 3	34.57	15	0.50%	0.8	4.95	2.9	74.85	75.02
1 - 2	96.10	8.004	0.50%	0.3	0.93	2.4	75.18	75.66
6 - 7	26.04	15	0.51%	2.9	5.01	4.2	73.90	74.03
5 - 6	89.55	12	0.50%	0.6	2.73	2.8	74.28	74.73
CS-3 - 22	5.51	12	0.50%	2.5	2.73	3.9	69.00	69.03
17 - CS-3	9.18	12	0.50%	2.6	2.73	3.9	69.03	69.07
16 - 17	28.66	12	0.50%	2.6	2.73	4.0	69.07	69.22
12 - 16	39.32	12	6.12%	1.7	9.56	9.2	69.22	71.62
11 - 12	71.81	12	1.00%	0.8	3.86	3.9	71.62	72.34
15 - 16	28.72	12	0.53%	0.5	2.81	2.7	69.22	69.37
14 - 15	93.35	12	1.89%	0.4	5.31	3.8	69.37	71.13
13 - 14	31.42	12	1.00%	0.1	3.86	2.2	71.13	71.44

DiPrete Engineering
Engineers • Planners • Surveyors

Project Name: Gooding Avenue
Project Number: 2536-001

100-Year Storm
Date: 2/28/2024

Pipe Analysis

Pipe ID	Pipe Length	Pipe Size	Pipe Slope	Flow Rate	Capacity Full	Velocity	Invert Down	Invert Up
	(ft)	(in)	(%)	(cfs)	(cfs)	(ft/s)	(Ft)	(ft)
7 - 8	31.23	18	0.50%	6.0	8.05	5.0	73.50	73.66
4 - 7	31.77	18	0.50%	2.4	8.05	4.0	73.66	73.82
3 - 4	70.67	18	0.50%	1.0	8.06	3.1	73.82	74.17
2 - 3	34.57	15	0.50%	1.0	4.95	3.1	74.85	75.02
1 - 2	96.10	9.996	0.50%	0.4	1.68	2.5	75.18	75.66
6 - 7	26.04	15	0.51%	3.8	5.01	4.5	73.90	74.03
5 - 6	89.55	12	0.50%	0.7	2.73	3.0	74.28	74.73
CS-3 - 22	5.51	12	0.50%	3.3	2.73	4.2	69.00	69.03
17 - CS-3	9.18	12	0.50%	3.3	2.73	4.2	69.03	69.07
16 - 17	28.66	12	0.50%	3.3	2.73	4.2	69.07	69.22
12 - 16	39.32	12	6.12%	2.2	9.56	9.9	69.22	71.62
11 - 12	71.81	12	1.00%	1.1	3.86	4.2	71.62	72.34
15 - 16	28.72	12	0.53%	0.7	2.81	2.9	69.22	69.37
14 - 15	93.35	12	1.89%	0.5	5.31	4.1	69.37	71.13
13 - 14	31.42	12	1.00%	0.1	3.86	2.4	71.13	71.44

DiPrete Engineering
Engineers • Planners • Surveyors

Project Name: Gooding Avenue — 100-Year Storm
Project Number: 2536-001 — Date: 2/28/2024

HGL at Structure

Structure	Rim Elevation	HGL Elevation	Rim-HGL
	(ft)	(ft)	(ft)
8	78.12	0.00	N/A
7	77.79	76.49	1.31
4	78.13	76.81	1.32
3	78.99	76.85	2.14
2	78.66	76.86	1.80
1	76.94	76.90	0.05
6	77.53	76.80	0.73
5	77.23	77.02	0.21
22	71.01	0.00	N/A
CS-3	71.46	70.87	0.59
17	72.05	71.17	0.89
16	72.48	71.65	0.83
12	75.12	71.95	3.17
11	76.00	73.51	2.50
15	73.60	72.09	1.51
14	76.75	72.12	4.64
13	75.14	72.04	3.11

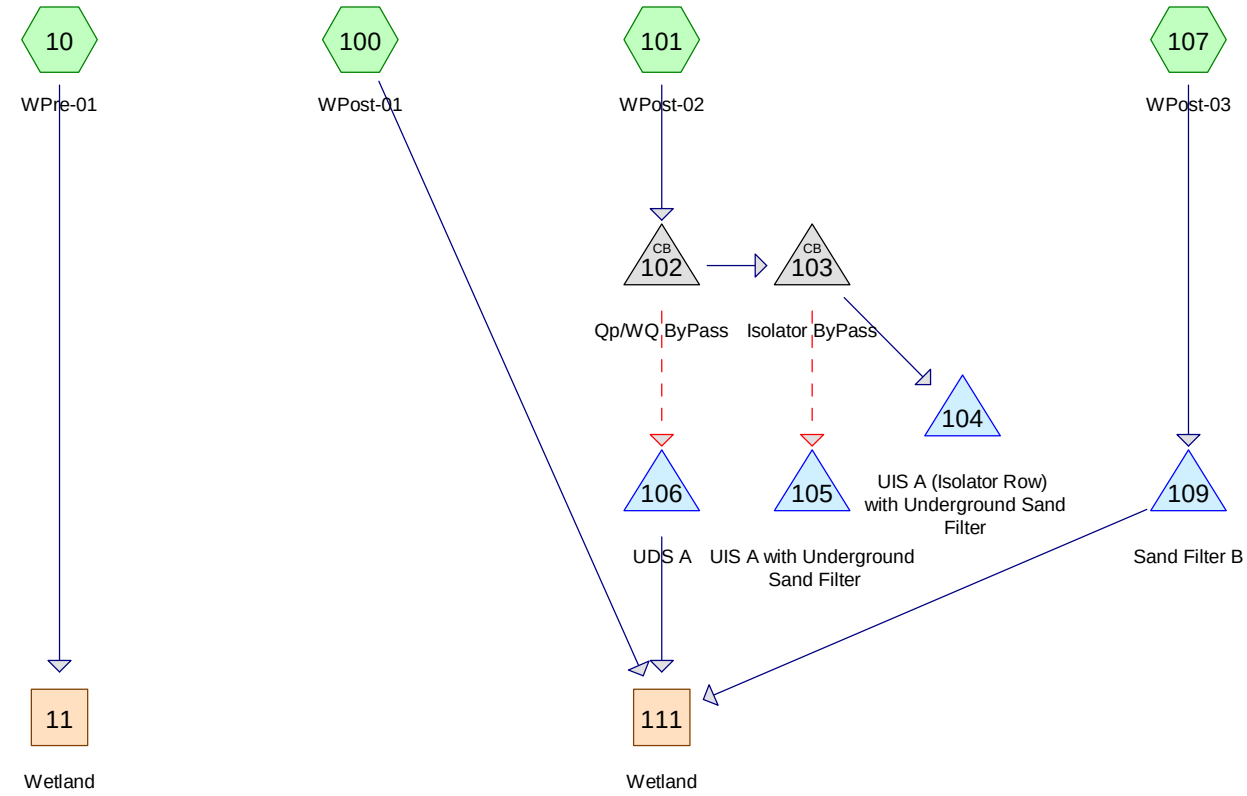
DiPrete Engineering
Engineers • Planners • Surveyors

Project Name: Gooding Avenue
Project Number: 2536-001

10-Year Storm
Date: 2/28/2024

Structure	Area	Inlet Time	Intensity	Runoff C	Q=Cia	Q Carry over	Q Captured	Q Bypassed	Bypass Structure	Inlet Type	Curb Opening	Curb Opening	Grate Length	Grate Width	Depth	Spread
	(sf)	(min)	(in/hr)	(C)	(cfs)	(cfs)	(cfs)	(cfs)			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
6	14,736	6	6.94	0.84	1.99	0	1.99	0.00	---	Grate inlet	---	---	2	2	0.24	24.019
5	3,652	6	6.938	0.81	0.48	0	0.48	0.00	---	Grate inlet	---	---	2	2	0.099	9.865
2	5,863	6	6.938	0.42	0.40	0	0.40	0.00	---	Grate inlet	---	---	2	2	0.088	8.844
4	7,027	6	6.938	0.85	0.96	0	0.96	0.00	---	Grate inlet	---	---	2	2	0.152	15.161
1	4,503	6	6.938	0.34	0.25	0	0.25	0.00	---	Grate inlet	---	---	2	2	0.067	6.714
11	5,075	6	6.938	0.84	0.69	0	0.60	0.09	12	Grate inlet	---	---	2	2	0.145	3.979
12	6,060	6	6.938	0.76	0.74	0.085	0.48	0.34	16	Grate inlet	---	---	2	2	0.075	7.471
16	2,806	6	6.938	0.72	0.32	0.355	0.67	0.01	---	Grate inlet	---	---	2	2	0.106	2.397
14	4,978	6	6.938	0.25	0.20	0.013	0.17	0.04	15	Grate inlet	---	---	2	2	0.06	4.715
13	2,363	6	6.938	0.25	0.10	0	0.08	0.01	14	Grate inlet	---	---	2	2	0.043	4.252
15	2,987	6	6.938	0.29	0.14	0.041	0.17	0.01	16	Grate inlet	---	---	2	2	0.047	3.2

A3.5.4.1 HydroCAD Node Diagram



Subcat Reach Pond Link

Routing Diagram for 2536-001-ALLS-PHCD-INHS
Prepared by DiPrete Engineering, Printed 7/25/2024
HydroCAD® 10.20-3g s/n 01125 © 2023 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.972	74	>75% Grass cover, Good, HSG C (10, 100, 101, 107)
0.848	80	>75% Grass cover, Good, HSG D (10, 100, 101, 107)
1.152	98	Impervious (101, 107)
0.254	98	Offsite Impervious (10, 100, 101)
2.303	77	Woods, Good, HSG D (10, 100, 101)
5.529	**82**	**TOTAL AREA**

A3.5.4.2 HydroCAD 1-Year Storm Analysis

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 10: WPre-01 Runoff Area=2.765 ac 4.59% Impervious Runoff Depth=0.99"
Flow Length=409' Tc=14.6 min CN=78 Runoff=2.34 cfs 0.228 af

Subcatchment 100: WPost-01 Runoff Area=0.858 ac 10.02% Impervious Runoff Depth=1.04"
Flow Length=339' Tc=7.3 min CN=79 Runoff=0.97 cfs 0.075 af

Subcatchment 101: WPost-02 Runoff Area=1.334 ac 68.74% Impervious Runoff Depth=1.89"
Tc=6.0 min CN=91 Runoff=2.92 cfs 0.210 af

Subcatchment 107: WPost-03 Runoff Area=0.572 ac 48.25% Impervious Runoff Depth=1.72"
Tc=6.0 min CN=89 Runoff=1.15 cfs 0.082 af

Reach 11: Wetland Inflow=2.34 cfs 0.228 af
Outflow=2.34 cfs 0.228 af

Reach 111: Wetland Inflow=0.99 cfs 0.131 af
Outflow=0.99 cfs 0.131 af

Pond 102: Qp/WQ ByPass Peak Elev=75.94' Inflow=2.92 cfs 0.210 af
Primary=1.26 cfs 0.188 af Secondary=1.67 cfs 0.022 af Outflow=2.92 cfs 0.210 af

Pond 103: Isolator ByPass Peak Elev=74.21' Inflow=1.26 cfs 0.188 af
Primary=1.23 cfs 0.064 af Secondary=1.23 cfs 0.123 af Outflow=1.26 cfs 0.188 af

Pond 104: UIS A (Isolator Row) with Peak Elev=74.21' Storage=2,102 cf Inflow=1.23 cfs 0.064 af
Outflow=0.01 cfs 0.064 af

Pond 105: UIS A with Underground Sand Filter Peak Elev=73.28' Storage=3,841 cf Inflow=1.23 cfs 0.123 af
Outflow=0.04 cfs 0.123 af

Pond 106: UDS A Peak Elev=70.43' Storage=938 cf Inflow=1.67 cfs 0.022 af
Outflow=0.02 cfs 0.022 af

Pond 109: Sand Filter B Peak Elev=70.55' Storage=1,874 cf Inflow=1.15 cfs 0.082 af
Discarded=0.00 cfs 0.021 af Primary=0.25 cfs 0.035 af Outflow=0.26 cfs 0.056 af

A3.5.4.3 HydroCAD 10-Year Storm Analysis

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 10: WPre-01 Runoff Area=2.765 ac 4.59% Impervious Runoff Depth=2.63"
Flow Length=409' Tc=14.6 min CN=78 Runoff=6.50 cfs 0.605 af

Subcatchment 100: WPost-01 Runoff Area=0.858 ac 10.02% Impervious Runoff Depth=2.72"
Flow Length=339' Tc=7.3 min CN=79 Runoff=2.61 cfs 0.194 af

Subcatchment 101: WPost-02 Runoff Area=1.334 ac 68.74% Impervious Runoff Depth=3.89"
Tc=6.0 min CN=91 Runoff=5.82 cfs 0.432 af

Subcatchment 107: WPost-03 Runoff Area=0.572 ac 48.25% Impervious Runoff Depth=3.68"
Tc=6.0 min CN=89 Runoff=2.40 cfs 0.175 af

Reach 11: Wetland Inflow=6.50 cfs 0.605 af
Outflow=6.50 cfs 0.605 af

Reach 111: Wetland Inflow=4.99 cfs 0.421 af
Outflow=4.99 cfs 0.421 af

Pond 102: Qp/WQ ByPass Peak Elev=76.13' Inflow=5.82 cfs 0.432 af
Primary=1.31 cfs 0.332 af Secondary=4.52 cfs 0.099 af Outflow=5.82 cfs 0.432 af

Pond 103: Isolator ByPass Peak Elev=75.14' Inflow=1.31 cfs 0.332 af
Primary=0.33 cfs 0.090 af Secondary=1.29 cfs 0.242 af Outflow=1.31 cfs 0.332 af

Pond 104: UIS A (Isolator Row) with Peak Elev=75.14' Storage=2,918 cf Inflow=0.33 cfs 0.090 af
Outflow=0.01 cfs 0.081 af

Pond 105: UIS A with Underground Sand Filter Peak Elev=75.14' Storage=8,530 cf Inflow=1.29 cfs 0.242 af
Outflow=0.04 cfs 0.214 af

Pond 106: UDS A Peak Elev=71.20' Storage=4,162 cf Inflow=4.52 cfs 0.099 af
Outflow=0.12 cfs 0.099 af

Pond 109: Sand Filter B Peak Elev=70.71' Storage=2,062 cf Inflow=2.40 cfs 0.175 af
Discarded=0.00 cfs 0.022 af Primary=2.33 cfs 0.127 af Outflow=2.34 cfs 0.149 af

A3.5.4.4 HydroCAD 25-Year Storm Analysis

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 10: WPre-01 Runoff Area=2.765 ac 4.59% Impervious Runoff Depth=3.67"
Flow Length=409' Tc=14.6 min CN=78 Runoff=9.08 cfs 0.845 af

Subcatchment 100: WPost-01 Runoff Area=0.858 ac 10.02% Impervious Runoff Depth=3.77"
Flow Length=339' Tc=7.3 min CN=79 Runoff=3.61 cfs 0.269 af

Subcatchment 101: WPost-02 Runoff Area=1.334 ac 68.74% Impervious Runoff Depth=5.06"
Tc=6.0 min CN=91 Runoff=7.47 cfs 0.562 af

Subcatchment 107: WPost-03 Runoff Area=0.572 ac 48.25% Impervious Runoff Depth=4.83"
Tc=6.0 min CN=89 Runoff=3.11 cfs 0.230 af

Reach 11: Wetland Inflow=9.08 cfs 0.845 af
Outflow=9.08 cfs 0.845 af

Reach 111: Wetland Inflow=6.75 cfs 0.639 af
Outflow=6.75 cfs 0.639 af

Pond 102: Qp/WQ ByPass Peak Elev=76.22' Inflow=7.47 cfs 0.562 af
Primary=1.34 cfs 0.375 af Secondary=6.13 cfs 0.187 af Outflow=7.47 cfs 0.562 af

Pond 103: Isolator ByPass Peak Elev=76.15' Inflow=1.34 cfs 0.375 af
Primary=0.30 cfs 0.101 af Secondary=1.32 cfs 0.274 af Outflow=1.34 cfs 0.375 af

Pond 104: UIS A (Isolator Row) with Peak Elev=75.81' Storage=3,368 cf Inflow=0.30 cfs 0.101 af
Outflow=0.01 cfs 0.082 af

Pond 105: UIS A with Underground Sand Filter Peak Elev=75.80' Storage=9,848 cf Inflow=1.32 cfs 0.274 af
Outflow=0.04 cfs 0.217 af

Pond 106: UDS A Peak Elev=71.61' Storage=6,321 cf Inflow=6.13 cfs 0.187 af
Outflow=0.16 cfs 0.187 af

Pond 109: Sand Filter B Peak Elev=70.75' Storage=2,107 cf Inflow=3.11 cfs 0.230 af
Discarded=0.00 cfs 0.022 af Primary=3.04 cfs 0.182 af Outflow=3.04 cfs 0.204 af

A3.5.4.5 HydroCAD 100-Year Storm Analysis

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 10: WPre-01 Runoff Area=2.765 ac 4.59% Impervious Runoff Depth=5.95"
Flow Length=409' Tc=14.6 min CN=78 Runoff=14.58 cfs 1.371 af

Subcatchment 100: WPost-01 Runoff Area=0.858 ac 10.02% Impervious Runoff Depth=6.07"
Flow Length=339' Tc=7.3 min CN=79 Runoff=5.74 cfs 0.434 af

Subcatchment 101: WPost-02 Runoff Area=1.334 ac 68.74% Impervious Runoff Depth=7.52"
Tc=6.0 min CN=91 Runoff=10.86 cfs 0.836 af

Subcatchment 107: WPost-03 Runoff Area=0.572 ac 48.25% Impervious Runoff Depth=7.28"
Tc=6.0 min CN=89 Runoff=4.57 cfs 0.347 af

Reach 11: Wetland Inflow=14.58 cfs 1.371 af
Outflow=14.58 cfs 1.371 af

Reach 111: Wetland Inflow=10.39 cfs 1.182 af
Outflow=10.39 cfs 1.182 af

Pond 102: Qp/WQ ByPass Peak Elev=76.38' Inflow=10.86 cfs 0.836 af
Primary=1.30 cfs 0.382 af Secondary=9.56 cfs 0.454 af Outflow=10.86 cfs 0.836 af

Pond 103: Isolator ByPass Peak Elev=76.23' Inflow=1.30 cfs 0.382 af
Primary=0.44 cfs 0.103 af Secondary=1.21 cfs 0.279 af Outflow=1.30 cfs 0.382 af

Pond 104: UIS A (Isolator Row) with Peak Elev=75.90' Storage=3,412 cf Inflow=0.44 cfs 0.103 af
Outflow=0.01 cfs 0.083 af

Pond 105: UIS A with Underground Sand Filter Peak Elev=75.88' Storage=9,947 cf Inflow=1.21 cfs 0.279 af
Outflow=0.04 cfs 0.222 af

Pond 106: UDS A Peak Elev=72.84' Storage=13,272 cf Inflow=9.56 cfs 0.454 af
Outflow=0.24 cfs 0.450 af

Pond 109: Sand Filter B Peak Elev=70.82' Storage=2,185 cf Inflow=4.57 cfs 0.347 af
Discarded=0.00 cfs 0.022 af Primary=4.50 cfs 0.298 af Outflow=4.51 cfs 0.321 af

Summary for Subcatchment 10: WPre-01

Runoff = 14.58 cfs @ 12.20 hrs, Volume= 1.371 af, Depth= 5.95"
Routed to Reach 11 : Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (ac)	CN	Description
*	0.127	98	Offsite Impervious
	0.478	74	>75% Grass cover, Good, HSG C
	0.240	80	>75% Grass cover, Good, HSG D
	1.920	77	Woods, Good, HSG D
	2.765	78	Weighted Average
	2.638	77	95.41% Pervious Area
	0.127	98	4.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	37	0.0450	0.13		**Sheet Flow, 1A-1B** Grass: Dense n= 0.240 P2= 3.30"
8.5	63	0.0778	0.12		**Sheet Flow, 1B-1C** Woods: Light underbrush n= 0.400 P2= 3.30"
0.2	41	0.0341	2.97		**Shallow Concentrated Flow, 1C-1D** Unpaved Kv= 16.1 fps
1.3	268	0.0451	3.42		**Shallow Concentrated Flow, 1D-1E** Unpaved Kv= 16.1 fps
14.6	409	Total			

Summary for Subcatchment 100: WPost-01

Runoff = 5.74 cfs @ 12.10 hrs, Volume= 0.434 af, Depth= 6.07"
Routed to Reach 111 : Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (ac)	CN	Description
*	0.086	98	Offsite Impervious
	0.292	74	>75% Grass cover, Good, HSG C
	0.176	80	>75% Grass cover, Good, HSG D
	0.304	77	Woods, Good, HSG D
	0.858	79	Weighted Average
	0.772	77	89.98% Pervious Area
	0.086	98	10.02% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	100	0.0610	0.27		**Sheet Flow, 1A-1B**
					Grass: Short n= 0.150 P2= 3.30"
1.1	239	0.0468	3.48		**Shallow Concentrated Flow, 1B-1C**
					Unpaved Kv= 16.1 fps
7.3	339	Total			

Summary for Subcatchment 101: WPost-02

Runoff = 10.86 cfs @ 12.08 hrs, Volume= 0.836 af, Depth= 7.52"
Routed to Pond 102 : Qp/WQ ByPass

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (ac)	CN	Description
*	0.876	98	Impervious
*	0.041	98	Offsite Impervious
	0.192	74	>75% Grass cover, Good, HSG C
	0.146	80	>75% Grass cover, Good, HSG D
	0.079	77	Woods, Good, HSG D
	1.334	91	Weighted Average
	0.417	77	31.26% Pervious Area
	0.917	98	68.74% Impervious Area

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

Summary for Subcatchment 107: WPost-03

Runoff = 4.57 cfs @ 12.08 hrs, Volume= 0.347 af, Depth= 7.28"
Routed to Pond 109 : Sand Filter B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (ac)	CN	Description
*	0.276	98	Impervious
	0.286	80	>75% Grass cover, Good, HSG D
	0.010	74	>75% Grass cover, Good, HSG C
	0.572	89	Weighted Average
	0.296	80	51.75% Pervious Area
	0.276	98	48.25% Impervious Area

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

Summary for Reach 11: Wetland

Inflow Area = 2.765 ac, 4.59% Impervious, Inflow Depth = 5.95" for 100-Year event
Inflow = 14.58 cfs @ 12.20 hrs, Volume= 1.371 af
Outflow = 14.58 cfs @ 12.20 hrs, Volume= 1.371 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach 111: Wetland

Inflow Area = 1.430 ac, 25.31% Impervious, Inflow Depth > 9.92" for 100-Year event
Inflow = 10.39 cfs @ 12.10 hrs, Volume= 1.182 af
Outflow = 10.39 cfs @ 12.10 hrs, Volume= 1.182 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond 102: Qp/WQ ByPass

Inflow Area = 1.334 ac, 68.74% Impervious, Inflow Depth = 7.52" for 100-Year event
Inflow = 10.86 cfs @ 12.08 hrs, Volume= 0.836 af
Outflow = 10.86 cfs @ 12.08 hrs, Volume= 0.836 af, Atten= 0%, Lag= 0.0 min
Primary = 1.30 cfs @ 12.07 hrs, Volume= 0.382 af
Routed to Pond 103 : Isolator ByPass
Secondary = 9.56 cfs @ 12.08 hrs, Volume= 0.454 af
Routed to Pond 106 : UDS A

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 76.38' @ 12.08 hrs
Flood Elev= 78.61'

Device	Routing	Invert	Outlet Devices
#1	Primary	73.50'	**6.00" Vert. WQ UIS** C= 0.600 Limited to weir flow at low heads
#2	Device 3	75.75'	**6.0' long Weir Plate** 2 End Contraction(s)
#3	Secondary	72.50'	**18.00" Vert. QP Pond** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.29 cfs @ 12.07 hrs HW=76.37' TW=74.49' (Dynamic Tailwater)
↑—**1=WQ UIS** (Orifice Controls 1.29 cfs @ 6.59 fps)

Secondary OutFlow Max=9.54 cfs @ 12.08 hrs HW=76.38' TW=71.44' (Dynamic Tailwater)
↑—**3=QP Pond** (Passes 9.54 cfs of 15.05 cfs potential flow)
↑—**2=Weir Plate** (Weir Controls 9.54 cfs @ 2.59 fps)

Summary for Pond 103: Isolator ByPass

Inflow Area = 1.334 ac, 68.74% Impervious, Inflow Depth = 3.44" for 100-Year event
Inflow = 1.30 cfs @ 12.07 hrs, Volume= 0.382 af
Outflow = 1.30 cfs @ 12.07 hrs, Volume= 0.382 af, Atten= 0%, Lag= 0.0 min
Primary = 0.44 cfs @ 14.98 hrs, Volume= 0.103 af
Routed to Pond 104 : UIS A (Isolator Row) with Underground Sand Filter
Secondary = 1.21 cfs @ 11.72 hrs, Volume= 0.279 af
Routed to Pond 105 : UIS A with Underground Sand Filter

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 76.23' @ 14.98 hrs
Flood Elev= 78.96'

Device	Routing	Invert	Outlet Devices
#1	Primary	73.00'	**15.00" Vert. Isolator Row** C= 0.600 Limited to weir flow at low heads
#2	Device 3	74.00'	**4.0' long Weir Plate** 2 End Contraction(s)
#3	Secondary	73.55'	**15.00" Vert. UIS** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 14.98 hrs HW=75.88' TW=75.89' (Dynamic Tailwater)
↑—**1=Isolator Row** (Controls 0.00 cfs)

Secondary OutFlow Max=1.20 cfs @ 11.72 hrs HW=74.21' TW=74.01' (Dynamic Tailwater)
↑—**3=UIS** (Passes 1.20 cfs of 1.37 cfs potential flow)
↑—**2=Weir Plate** (Weir Controls 1.20 cfs @ 1.47 fps)

Summary for Pond 104: UIS A (Isolator Row) with Underground Sand Filter

Inflow Area = 1.334 ac, 68.74% Impervious, Inflow Depth = 0.92" for 100-Year event
Inflow = 0.44 cfs @ 14.98 hrs, Volume= 0.103 af
Outflow = 0.01 cfs @ 3.88 hrs, Volume= 0.083 af, Atten= 97%, Lag= 0.0 min
Discarded = 0.01 cfs @ 3.88 hrs, Volume= 0.083 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 75.90' @ 14.99 hrs Surf.Area= 1,211 sf Storage= 3,412 cf

Plug-Flow detention time= 1,716.7 min calculated for 0.083 af (81% of inflow)
Center-of-Mass det. time= 1,626.6 min (2,243.5 - 616.9)

Volume	Invert	Avail.Storage	Storage Description
#1	70.00'	1,210 cf	**Sand Filter (Prismatic)** Listed below (Recalc) 3,633 cf Overall x 33.3% Voids
#2A	73.00'	904 cf	**15.00'W x 80.76'L x 3.50'H Field A** -Impervious 4,240 cf Overall - 1,525 cf Embedded = 2,715 cf x 33.3% Voids
#3A	73.50'	1,525 cf	**ADS_StormTech SC-740** x 33 Inside #2 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap Row Length Adjustment= +0.44' x 6.45 sf x 3 rows
#4	73.50'	34 cf	**4.00'D x 5.46'H Vertical Cone/Cylinder** x 0.5 -Impervious
		3,673 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
70.00	1,211	0	0
73.00	1,211	3,633	3,633

Device	Routing	Invert	Outlet Devices
#1	Discarded	70.00'	**0.520 in/hr Infilration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.01 cfs @ 3.88 hrs HW=70.09' (Free Discharge)
1=Infilration (Exfiltration Controls 0.01 cfs)

Summary for Pond 105: UIS A with Underground Sand Filter

Inflow	=	1.21 cfs @	11.72 hrs, Volume=	0.279 af
Outflow	=	0.04 cfs @	11.33 hrs, Volume=	0.222 af, Atten= 96%, Lag= 0.0 min
Discarded	=	0.04 cfs @	11.33 hrs, Volume=	0.222 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 75.88' @ 14.96 hrs Surf.Area= 3,526 sf Storage= 9,947 cf

Plug-Flow detention time= 1,748.5 min calculated for 0.222 af (79% of inflow)
Center-of-Mass det. time= 1,681.0 min (2,422.2 - 741.2)

Volume	Invert	Avail.Storage	Storage Description
#1	70.00'	3,509 cf	**Sand Filter (Prismatic)** Listed below (Recalc) 10,539 cf Overall x 33.3% Voids
#2A	73.00'	2,571 cf	**43.50'W x 80.76'L x 3.50'H Field A** -Impervious 12,295 cf Overall - 4,574 cf Embedded = 7,722 cf x 33.3% Voids
#3A	73.50'	4,574 cf	**ADS_StormTech SC-740** x 99 Inside #2 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap Row Length Adjustment= +0.44' x 6.45 sf x 9 rows
#4	73.50'	69 cf	**4.00'D x 5.46'H Vertical Cone/Cylinder**
		10,723 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
70.00	3,513	0	0
73.00	3,513	10,539	10,539

Device	Routing	Invert	Outlet Devices
#1	Discarded	70.00'	**0.520 in/hr Infiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.04 cfs @ 11.33 hrs HW=73.50' (Free Discharge)
1=Infiltration (Exfiltration Controls 0.04 cfs)

Summary for Pond 106: UDS A

Inflow = 9.56 cfs @ 12.08 hrs, Volume= 0.454 af
Outflow = 0.24 cfs @ 16.56 hrs, Volume= 0.450 af, Atten= 98%, Lag= 268.4 min
Primary = 0.24 cfs @ 16.56 hrs, Volume= 0.450 af
Routed to Reach 111 : Wetland

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 72.84' @ 16.56 hrs Surf.Area= 5,712 sf Storage= 13,272 cf

Plug-Flow detention time= 780.6 min calculated for 0.450 af (99% of inflow)
Center-of-Mass det. time= 776.0 min (1,599.5 - 823.5)

Volume	Invert	Avail.Storage	Storage Description
#1	70.00'	3,495 cf	**60.00" Round CMP_Round 60" - Header** x 2 L= 89.0'
#2	70.00'	19,144 cf	**60.00" Round Pipe Storage** x 13 L= 75.0'
		22,639 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Device 4	70.00'	**1.00" Horiz. Low Flow CPv** C= 0.600 Limited to weir flow at low heads
#2	Device 4	70.65'	**2.00" W x 2.00" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 4	74.50'	**4.0' long x 0.5' breadth Outlet Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#4	Primary	69.00'	**12.00" Round Culvert** L= 120.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 69.00' / 68.00' S= 0.0083 '/' Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=0.24 cfs @ 16.56 hrs HW=72.84' TW=0.00' (Dynamic Tailwater)
└**4=Culvert** (Passes 0.24 cfs of 6.03 cfs potential flow)
  ├**1=Low Flow CPv** (Orifice Controls 0.04 cfs @ 8.11 fps)
  ├**2=Orifice/Grate** (Orifice Controls 0.19 cfs @ 6.99 fps)
  └**3=Outlet Weir** (Controls 0.00 cfs)

Summary for Pond 109: Sand Filter B

Inflow Area = 0.572 ac, 48.25% Impervious, Inflow Depth = 7.28" for 100-Year event
Inflow = 4.57 cfs @ 12.08 hrs, Volume= 0.347 af
Outflow = 4.51 cfs @ 12.10 hrs, Volume= 0.321 af, Atten= 1%, Lag= 0.8 min
Discarded = 0.00 cfs @ 3.80 hrs, Volume= 0.022 af
Primary = 4.50 cfs @ 12.10 hrs, Volume= 0.298 af
Routed to Reach 111 : Wetland

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Peak Elev= 70.82' @ 12.10 hrs Surf.Area= 326 sf Storage= 2,185 cf

Plug-Flow detention time= 177.0 min calculated for 0.321 af (92% of inflow)
Center-of-Mass det. time= 137.1 min (914.0 - 776.9)

Volume	Invert	Avail.Storage	Storage Description
#1	69.00'	1,003 cf	**Ponding Storage (Prismatic)** Listed below (Recalc) -Impervious
#2	67.00'	215 cf	**Sand/Loam (Prismatic)** Listed below (Recalc) 652 cf Overall x 33.0% Voids
#3	69.00'	1,068 cf	**24.00" Round UDS-B** x 4 -Impervious L= 85.0'
#4	69.00'	75 cf	**24.00" Round UDS-B** x 2 -Impervious L= 12.0'
		2,361 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
69.00	326	0	0
70.00	494	410	410
71.00	691	593	1,003

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
67.00	326	0	0
69.00	326	652	652

Device	Routing	Invert	Outlet Devices
#1	Discarded	67.00'	**0.520 in/hr Infiltration over Surface area** Phase-In= 0.01'
#2	Primary	70.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.00 cfs @ 3.80 hrs HW=67.04' (Free Discharge)
↑—**1=Infiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=4.50 cfs @ 12.10 hrs HW=70.82' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 4.50 cfs @ 1.42 fps)

A3.5.4.6 HydroCAD Tailwater Analysis

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 100: WPost-01 Runoff Area=0.858 ac 10.02% Impervious Runoff Depth=6.07"
Flow Length=339' Tc=7.3 min CN=79 Runoff=5.74 cfs 0.434 af

Subcatchment 101: WPost-02 Runoff Area=1.334 ac 68.74% Impervious Runoff Depth=7.52"
Tc=6.0 min CN=91 Runoff=10.86 cfs 0.836 af

Subcatchment 107: WPost-03 Runoff Area=0.572 ac 48.25% Impervious Runoff Depth=7.28"
Tc=6.0 min CN=89 Runoff=4.57 cfs 0.347 af

Reach 111-1: Silver Creek Flood Avg. Flow Depth=11.00' Max Vel=5.89 fps Inflow=8,889.84 cfs 52,844.917 af
n=0.030 L=2,100.0' S=0.0014 '/' Capacity=8,879.45 cfs Outflow=8,888.23 cfs 52,772.266 af

Pond 102: Qp/WQ ByPass Peak Elev=76.38' Inflow=10.86 cfs 0.836 af
Primary=1.30 cfs 0.382 af Secondary=9.56 cfs 0.454 af Outflow=10.86 cfs 0.836 af

Pond 103: Isolator ByPass Peak Elev=76.23' Inflow=1.30 cfs 0.382 af
Primary=0.44 cfs 0.103 af Secondary=1.21 cfs 0.279 af Outflow=1.30 cfs 0.382 af

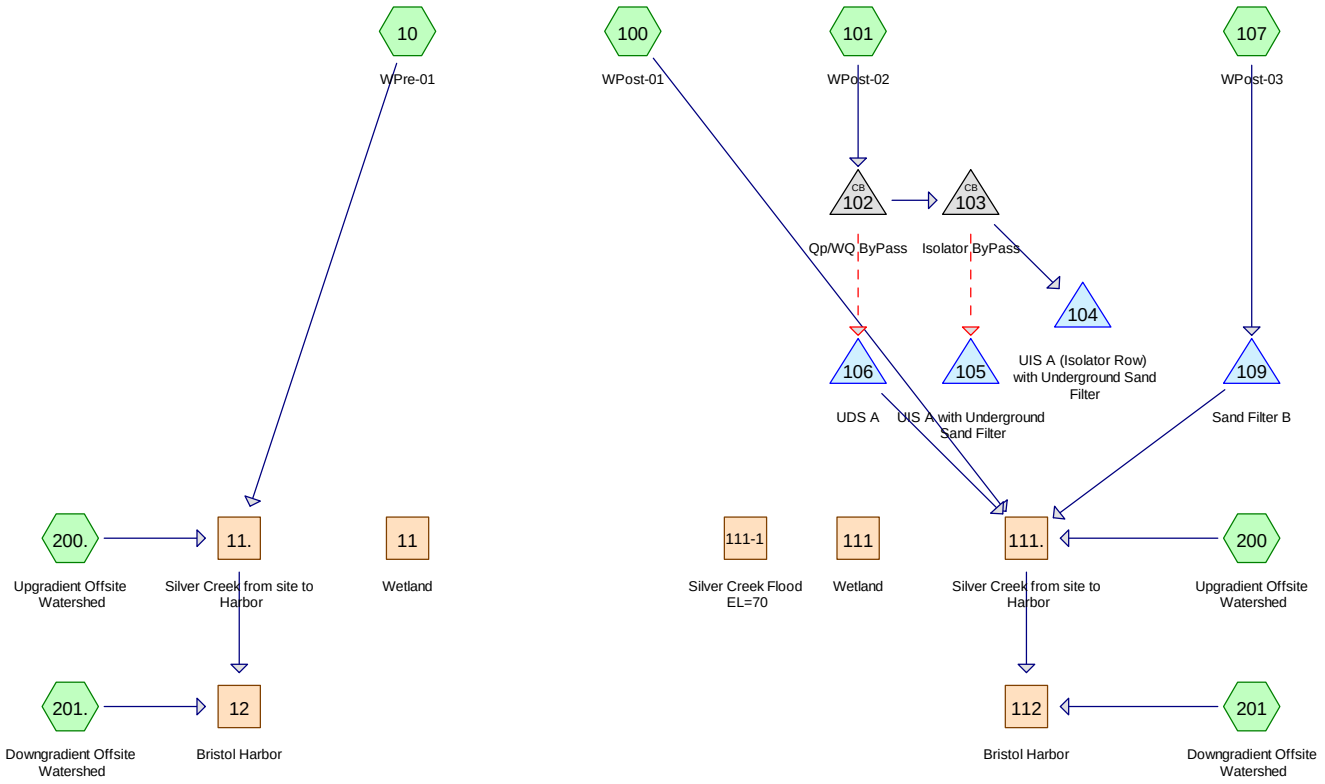
Pond 104: UIS A (Isolator Row) with Peak Elev=75.90' Storage=3,412 cf Inflow=0.44 cfs 0.103 af
Outflow=0.01 cfs 0.083 af

Pond 105: UIS A with Underground Sand Filter Peak Elev=75.88' Storage=9,947 cf Inflow=1.21 cfs 0.279 af
Outflow=0.04 cfs 0.222 af

Pond 106: UDS A Peak Elev=72.84' Storage=13,272 cf Inflow=9.56 cfs 0.454 af
Outflow=0.24 cfs 0.450 af

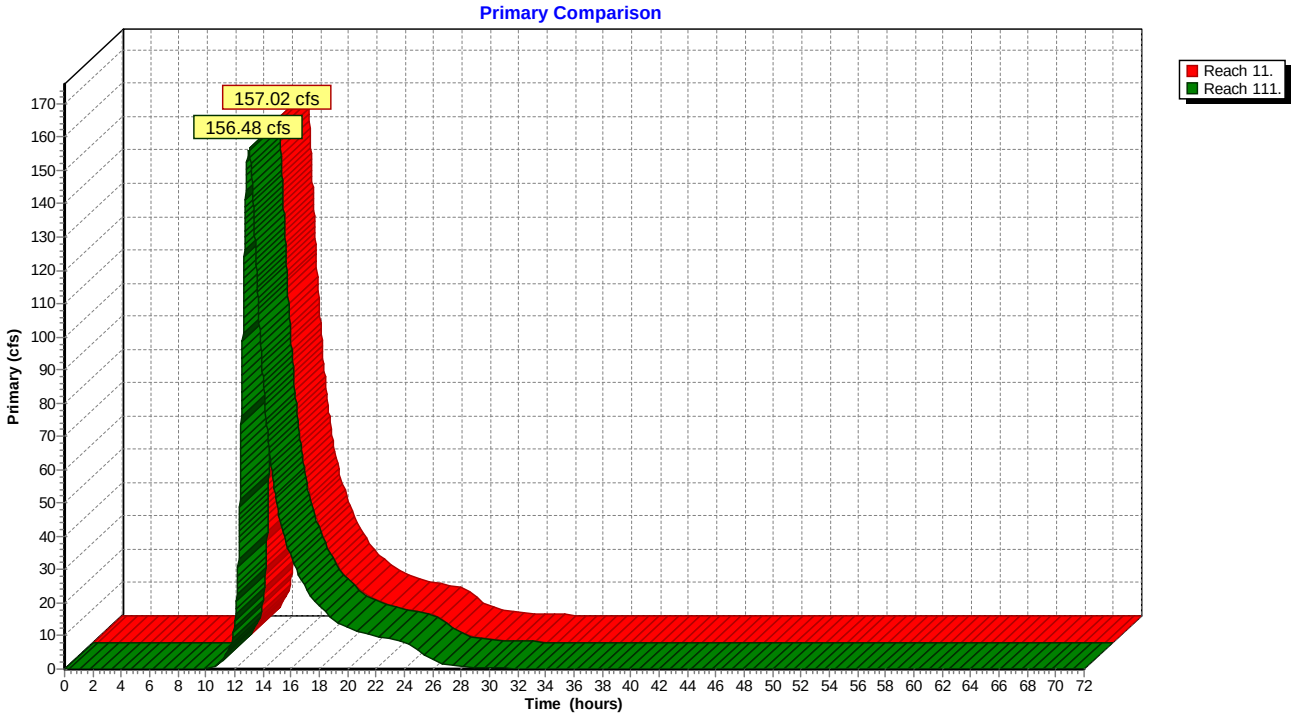
Pond 109: Sand Filter B Peak Elev=70.82' Storage=2,185 cf Inflow=4.57 cfs 0.347 af
Discarded=0.00 cfs 0.022 af Primary=4.50 cfs 0.298 af Outflow=4.51 cfs 0.321 af

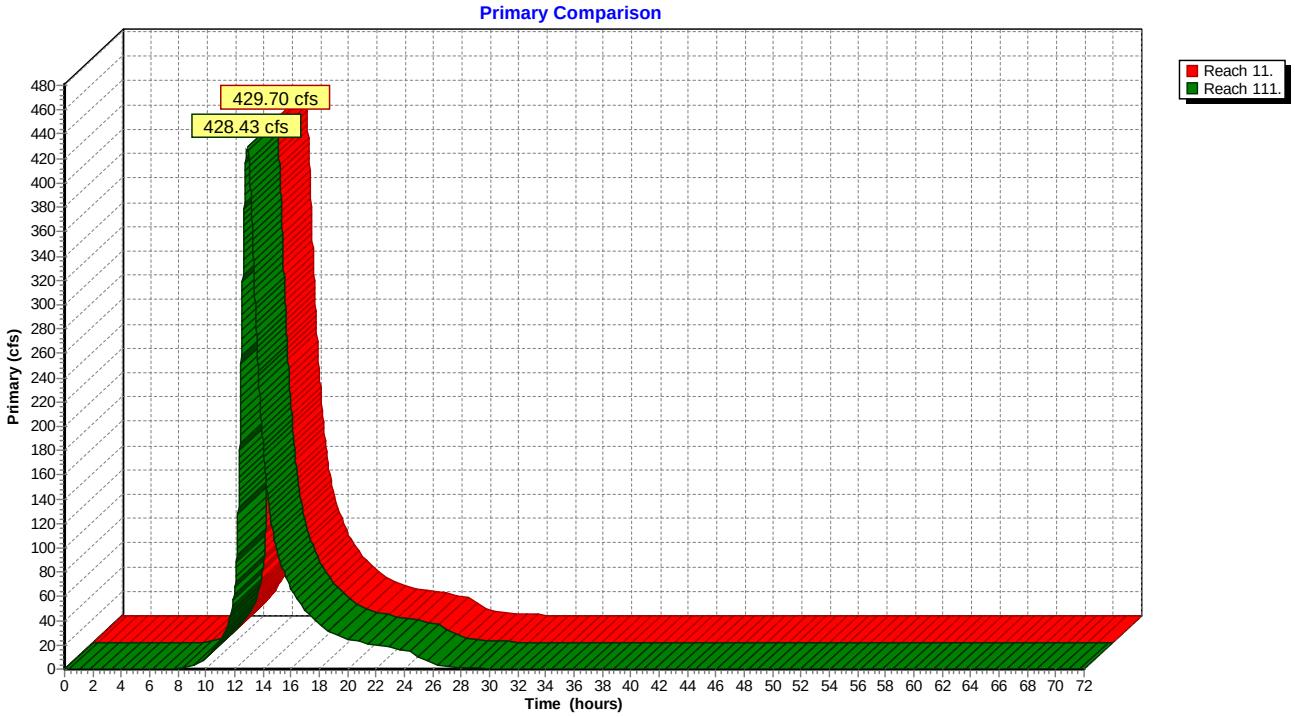
A3.5.5 Downstream Analysis

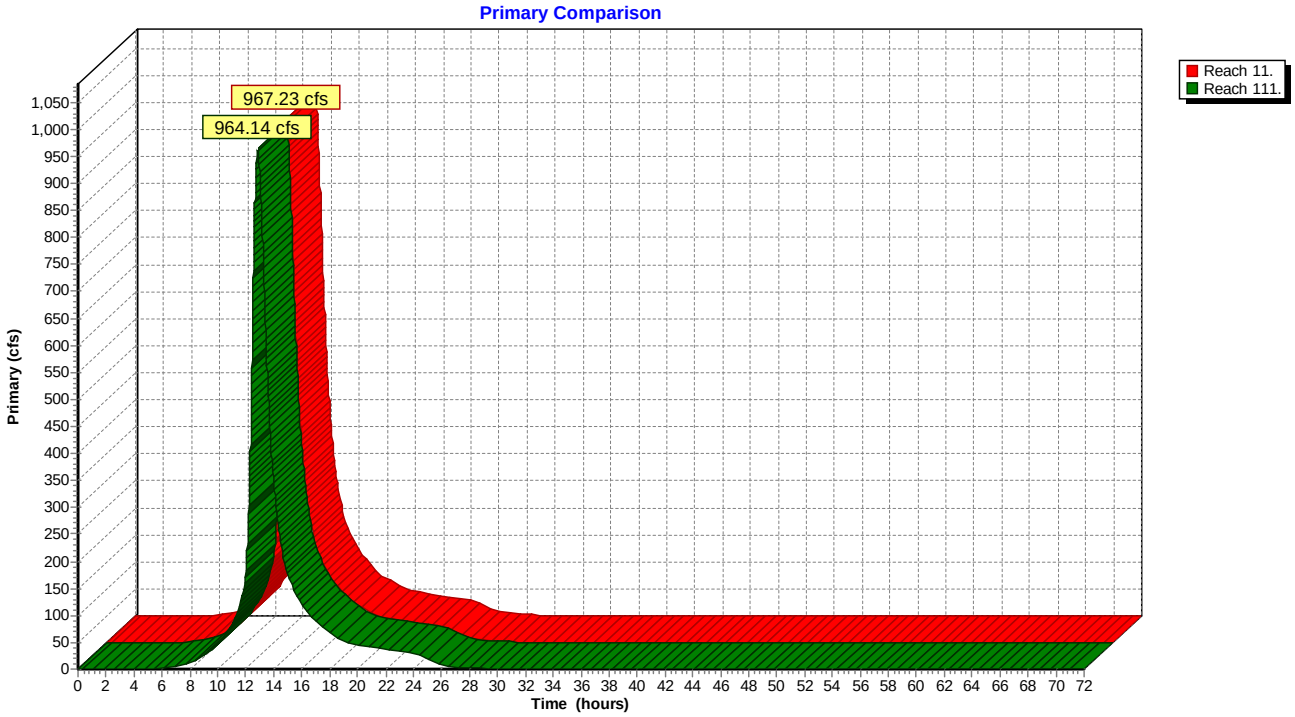


Subcat Reach Pond Link

Routing Diagram for 2536-001-ALLS-PHCD-INHS
Prepared by DiPrete Engineering, Printed 2/28/2024
HydroCAD® 10.20-3g s/n 01125 © 2023 HydroCAD Software Solutions LLC


Primary Comparison
157.02 cfs
156.48 cfs
Reach 11.
Reach 111.
Primary (cfs)
Time (hours)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72


Primary Comparison
429.70 cfs
428.43 cfs
Reach 11.
Reach 111.
Primary (cfs)
Time (hours)
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72


Primary Comparison
967.23 cfs
964.14 cfs
Reach 11.
Reach 111.
Primary (cfs)
Time (hours)
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800
850
900
950
1,000
1,050
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72

Primary Comparison

Time (hours)	Reach 11. (cfs)	Reach 111. (cfs)	Time (hours)	Reach 11. (cfs)	Reach 111. (cfs)	Time (hours)	Reach 11. (cfs)	Reach 111. (cfs)
0.00	0.00	0.00	27.00	3.51	3.66	54.00	0.00	0.02
0.50	0.00	0.00	27.50	2.49	2.65	54.50	0.00	0.02
1.00	0.00	0.00	28.00	1.83	1.98	55.00	0.00	0.02
1.50	0.00	0.00	28.50	1.36	1.51	55.50	0.00	0.02
2.00	0.00	0.00	29.00	1.05	1.18	56.00	0.00	0.02
2.50	0.00	0.00	29.50	0.81	0.95	56.50	0.00	0.02
3.00	0.00	0.00	30.00	0.63	0.77	57.00	0.00	0.02
3.50	0.00	0.00	30.50	0.51	0.63	57.50	0.00	0.02
4.00	0.00	0.00	31.00	0.42	0.54	58.00	0.00	0.02
4.50	0.00	0.00	31.50	0.34	0.47	58.50	0.00	0.02
5.00	0.01	0.01	32.00	0.28	0.41	59.00	0.00	0.02
5.50	0.20	0.20	32.50	0.23	0.36	59.50	0.00	0.02
6.00	0.92	0.92	33.00	0.19	0.31	60.00	0.00	0.02
6.50	2.32	2.32	33.50	0.16	0.28	60.50	0.00	0.02
7.00	4.57	4.57	34.00	0.14	0.25	61.00	0.00	0.02
7.50	7.83	7.80	34.50	0.12	0.23	61.50	0.00	0.02
8.00	12.22	12.17	35.00	0.11	0.20	62.00	0.00	0.02
8.50	17.74	17.67	35.50	0.09	0.19	62.50	0.00	0.02
9.00	25.02	24.91	36.00	0.08	0.18	63.00	0.00	0.02
9.50	35.05	34.89	36.50	0.07	0.17	63.50	0.00	0.02
10.00	47.95	47.72	37.00	0.06	0.16	64.00	0.00	0.02
10.50	63.54	63.21	37.50	0.05	0.15	64.50	0.00	0.02
11.00	83.96	83.61	38.00	0.04	0.14	65.00	0.00	0.02
11.50	112.70	112.31	38.50	0.04	0.13	65.50	0.00	0.02
12.00	182.24	181.65	39.00	0.03	0.12	66.00	0.00	0.02
12.50	**669.38**	**665.22**	39.50	0.03	0.11	66.50	0.00	0.02
13.00	**920.84**	**918.55**	40.00	0.03	0.10	67.00	0.00	0.02
13.50	572.40	571.47	40.50	0.03	0.10	67.50	0.00	0.02
14.00	344.57	344.06	41.00	0.02	0.09	68.00	0.00	0.02
14.50	233.72	233.38	41.50	0.02	0.08	68.50	0.00	0.01
15.00	176.43	176.18	42.00	0.02	0.07	69.00	0.00	0.01
15.50	143.93	143.75	42.50	0.02	0.07	69.50	0.00	0.01
16.00	121.38	121.25	43.00	0.02	0.06	70.00	0.00	0.01
16.50	102.95	102.87	43.50	0.02	0.06	70.50	0.00	0.01
17.00	88.05	88.01	44.00	0.01	0.05	71.00	0.00	0.01
17.50	76.90	76.89	44.50	0.01	0.05	71.50	0.00	0.01
18.00	67.92	67.93	45.00	0.01	0.04	72.00	0.00	0.01
18.50	60.03	60.06	45.50	0.01	0.04			
19.00	53.63	53.69	46.00	0.01	0.04			
19.50	49.10	49.17	46.50	0.01	0.04			
20.00	45.70	45.77	47.00	0.01	0.03			
20.50	42.94	43.01	47.50	0.01	0.03			
21.00	40.60	40.68	48.00	0.01	0.03			
21.50	38.56	38.65	48.50	0.01	0.03			
22.00	36.70	36.79	49.00	0.01	0.03			
22.50	35.00	35.09	49.50	0.01	0.03			
23.00	33.32	33.42	50.00	0.01	0.03			
23.50	31.66	31.76	50.50	0.00	0.03			
24.00	30.00	30.10	51.00	0.00	0.03			
24.50	27.20	27.32	51.50	0.00	0.03			
25.00	18.94	19.08	52.00	0.00	0.03			
25.50	11.96	12.11	52.50	0.00	0.02			
26.00	7.67	7.82	53.00	0.00	0.02			
26.50	5.10	5.25	53.50	0.00	0.02			

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Reach 11.: Silver Creek from site to Avg. Flow Depth=2.39' Max Vel=4.23 fps Inflow=1,269.74 cfs 194.068 af
n=0.035 L=7,022.0' S=0.0078 '/' Capacity=6,919.98 cfs Outflow=967.23 cfs 194.067 af

Reach 111.: Silver Creek from site to Avg. Flow Depth=2.39' Max Vel=4.23 fps Inflow=1,266.30 cfs 193.879 af
n=0.035 L=7,022.0' S=0.0078 '/' Capacity=6,919.98 cfs Outflow=964.14 cfs 193.873 af

Appendix B – Mounding Calculations

DiPrete Engineering has prepared groundwater mounding calculations for the Underground Infiltration System (UIS-A).

DiPrete Engineering has calculated the groundwater mounding using the USGS Hantush Calculator. The calculator is available online at http://pubs.usgs.gov/sir/2010/5102/.

The calculator provided by the USGS requires several variables:

R – Recharge infiltration rate (feet/day):
Recharge rate is the vertical conductivity (Kv) of the soil. The vertical conductivity was determined based on soil texture and table 5-3 in section 5.3.4 of the RISDISM of the RISDISM. A value of 0.52 in/hr or 1.04 ft/day has been used for these calculations.

Sy – Specific Yield:
Specific Yield is specific to the parent material through which the infiltration occurs. Onsite soil evaluations classified the soils as coarse sand. A value for Sy has been obtained from Table 4.3 of Hydrology and Hydraulic Systems by Ram S. Gupta:

TABLE 4.3 REPRESENTATIVE VALUES OF SPECIFIC YIELD FOR SOILS AND ROCKS

Material	Specific Yield (%)
Gravel, coarse	23
Gravel, medium	24
Gravel, fine	25
Sand, coarse	27
Sand, medium	28
Sand, fine	23
Silt	8
Clay	3
Sandstone, fine-grained	21
Sandstone, medium-grained	27
Limestone	14
Dune sand	38
Loess	18
Peat	44
Schist	26
Siltstone	12
Till, predominantly silt	6
Till, predominantly sand	16
Till, predominantly gravel	16
Tuff	21

Source: Todd, 1980.

HYDROLOGY & HYDRAULIC SYSTEMS

RAM S. GUPTA, Ph.D., P.E.
Roger Williams University, Bristol, RI
Delta Engineers, Inc., Bristol, RI

K – Hydraulic conductivity, Kh (feet/day):
Mounding calculations require the hydraulic conductivity (Kh) value of the soils. According to USGS SIR 2010-5102, Vertical Conductivity is approximately 1/10 of horizontal conductivity. The vertical conductivity was determined based on soil texture and table 5-3 in section 5.3.4 of the RISDISM of the RISDISM. To perform the most conservative calculation, rather than use the RISDISM book value of 0.52 inches per hour the maximum value of the USDA.gov published range of 0.6-2.0 in/hr was used to arrive at a more conservative horizontal conductivity of 2.0 in/hr x 10 = 20 inches per hour (40 ft/day).

x & y – ½ of the basin length:
The x and y variables represent the length and width of the system. The overall system is approximately 80.76' x 48.50' and the ½ basin length and width is 40.38' x 29.25.

t – Duration of infiltration period in (days):
For these calculations the infiltration period considered is two days.

hi(0) – initial thickness of saturated zone (feet):
The initial thickness of the saturated zone is the depth from the water table to the impervious limiting layer. Test holes performed nearby did not encounter ledge. Deepest test hole was 77" which was approximately 4' below measured groundwater table. Estimated 2' between bottom of test hole and ledge. Test hole 4 reached a seasonal high groundwater table elevation at depth 30". Ledge could be significantly deeper in the area of the infiltration system but based on available data we provided a conservative assumption for this calculation.

Conclusion:

System Bottom	System Top	100-Year Mound height (ft)	100-Year Mound Elevation
73.00	76.50	2.89	72.89

The mounding height is obtained from the USGS Hantush Calculator. The mound elevation is determined by adding the mound height to the average seasonal high groundwater for each respective storm system.

The mounding calculations for the systems show that for all storm events up to the 100-year storm, the mound is below bottom of the underground chamber system. This means the basin will function as designed for the majority off all storm events.

See attached Mounding Calculation Sheets and HydroCAD.

Watershed Maps

SHEET 1 OF 2

Pre-Watershed Map
Gooding Avenue Development

Bristol, Rhode Island
AP 111 Lot 1

Applicant
Donovan & Sons, Inc.
613 Aquidneck Avenue, Middletown, Rhode Island 02842
tel 401-846-3486

No.	Date	Description	By:
0	11-03-2017	Watershed Maps	D.R.N.

Drawn By: D.R.N. Design By: K.J.D.

This regulatory submission set shall not be used for construction purposes unless stamped 'Issued for Construction' and signed by a DiPrete Engineering representative.

The contractor is responsible for all of the means, methods, safety precautions and requirements, and OSHA conformance in the implementation of this plan and design.

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No.	Date	Description	By:
1	12-08-2020	Watershed Maps	N.M.P.
0	11-03-2017	Watershed Maps	D.R.N.

Drawn By: D.R.N. Design By: K.J.D.

Post-Watershed Map

Gooding Avenue Development

Bristol, Rhode Island
AP 111 Lot 1

Applicant
Donovan & Sons, Inc.
613 Aquidneck Avenue, Middletown, Rhode Island 02842
tel 401-846-3486

SHEET 2 OF 2