DiPrete Engineering

Stormwater Management Report

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No. 16881
04/29/2022
REGISTERED PROFESSIONAL ENGINEER CIVIL

Aquidneck Centre

Located in Middletown, Rhode Island

Applicant: Aquidneck Group LLC

08-31-2021

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Executive Summary

On behalf of the Client, we are submitting drainage calculations for the proposed development at 99 East Main Road, Middletown, RI. The site is located on Assessors' Plat 107SE Lot 106. The site exists today as almost entirely pavement. The client proposes to construct a new one-story building with associated parking, as well as resurface the existing parking lot of the Christmas Tree Shop. The proposed building will be a Starbucks with a drive through window.

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).

Under the RISDISM Section 3.2.6, the site is considered a redevelopment site since the existing site is over 40% impervious. This redevelopment requires minimum stormwater management standards 2,3 and 7-11 to be addressed. The required water quality and recharge volume must include 50% of the redevelopment area. Refer to Appendix A3.7 for a graphical representation of the impervious calculations.

The site today has all stormwater sheet flowing overland to the catch basin at the shopping plaza's East Main Road entrance and ultimately discharges to Bailey's Brook. The stormwater quality will be improved by utilizing BMP's as set by the RISDISM for the treatment and recharge of stormwater runoff. BMP's will consist of an oil/water separator and an underground stone infiltration trench. The underground stone infiltration trench was analyzed for the water quality storm only to show that it is fully infiltrated. Per our analysis of the trench drain and 6" drainage pipe to the oil/water separator, the system will act as a restriction resulting in higher storms bypassing the trench drain. Stormwater beyond the water quality storm will bypass the proposed slot drain and discharge directly to the existing catch basin. The site has been designed to meet the RIDEM Stormwater Design and Installations Manual for redevelopment.

Subwatershed (design point)	**1.2" Peak Flow**		**1-yr Peak Flow**		**2-yr Peak Flow**		**10-yr Peak Flow**		**25-yr Peak Flow**		**100-yr Peak Flow**	
	Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
DP-1:	3.41	2.68	8.87	8.02	10.67	10.24	16.37	15.74	20.61	19.96	29.38	28.57

All flows in cubic feet per second (cfs)

Subwatershed (design point)	**1.2" Peak Volume**		**1-yr Peak Volume**		**2-yr Peak Volume**		**10-yr Peak Volume**		**25-yr Peak Volume**		**100-yr Peak Volume**	
	Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
DP-1:	0.258	0.208	0.66	0.591	0.804	0.730	1.266	1.184	1.614	1.529	2.343	2.254

All volumes in acre-feet (af)

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

PROJECT NAME **Aquidneck Center**	**(RIDEM USE ONLY)** **STW/WQC File #:** **Date Received:**
TOWN **Middletown, RI**	
BRIEF PROJECT DESCRIPTION: Construction of new Starbucks building and associated parking	

Stormwater Management Plan (SMP) Elements – Minimum Standards

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

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

PART 1. PROJECT AND SITE INFORMATION

PROJECT TYPE (Check all that apply)

☐ 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.)

☒ **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: Bailey's Brook	☐ Coldwater	☒ Warmwater	☐ Unassessed
☒ Waterbody ID: RI0007035R-01	☐ 4th order stream of pond 50 acres or more		
☒ TMDL for: Enterococcus	☐ 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: Enterococcus, Phosphorus, Total Lead	☐ Contributes to shellfishing grounds		

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

PROJECT HISTORY		
☐ 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: N/A			
1. OFFICE OF Land Revitalization and Sustainable Materials Management (OLRSMM)			
	☐ 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)	See Appendix B for details
		☐ Leaking Underground Storage Tank (LUST)	
		☐ Closed Landfill	
Note: If any boxes in 1 above are checked, the applicant must contact the RIDEM OLRSMM 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**) 0.577 ac	
	☐ Total Site Area (**TSA**) 0.642 ac	
	☐ Jurisdictional Wetlands (**JW**) 0	
	☐ Conservation Land (**CL**) 0	
☐ Calculate the Site Size (defined as contiguous properties under same ownership)		
	☐ Site Size (**SS**) = (**TSA**) – (**JW**) – (**CL**) 0.642 ac	
	☐ (**TIA**) / (**SS**) = 0.89	☒ (**TIA**) / (**SS**) >**0.4**? Yes
☒ 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	

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):	
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):	
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	

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 OLRSMM 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)		
Redevelopment Area	6,534	136		136	1,525

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.):

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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)**
Redevelopment Area	6,534	545		545	1,525

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.):

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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 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: **Under RISDISM Section 3, the project is considered a redevelopment site, therefore this minimum standard is not required to be addressed.**

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:					
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 Management 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)
		☐	Impervious cover (%)
☐	☐	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)
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 Management 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 Management Report
Final sizing calculations for structural stormwater BMPs, including contributing drainage area, storage, and outlet configuration.	Stormwater Management Report
Stage-storage, inflow and outflow hydrographs for storage facilities (e.g., detention, retention, or infiltration facilities).	Stormwater Management 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
A	1	Stone Trench	Y	Y	Y	NA	NA	NA	Y		
		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	A	Stone Trench	TH-1		51.00	54.00	3.00	C	1.02
		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: Chris Sutter (D-4077)
		☐	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)**
Redevelopment Area	RI0007035R-01	0.581	0.553	0.426

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 OLRSMM-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 Stormwater Management System to be implemented in the new Starbucks at 99 East Main Road, Middletown, RI.

The total shopping plaza site is 12.2 acres located on Assessor's Plat 107SE Lot 106 in Middletown, Rhode Island. The total limit of work for the site is 2.548 acres, however, only 0.581 acres will be disturbed for new construction. The remainder of the site will be a mill and overlay of the existing parking lot. The site is located on East Main Road, near the intersection of West Main Road in the Aquidneck Center shopping plaza. Bailey's Brook runs along the eastern side of the property behind the Shaw's Supermarket. The proposed development will include a new 2,210 sf building, associated drive through lane and parking. The site will be serviced by public water and sewer. Water is provided by Newport Water and Sewer is provided by the Middletown Department of Public Works.

Under the RISDISM Section 3.2.6, the site is considered a redevelopment since the existing site is over 40% impervious, qualifying it for a reduced scope of reporting. This redevelopment requires minimum stormwater management standards 2, 3 and 7-11 to be addressed. The required water quality and recharge volume must include 50% of the redevelopment area. See Appendix A3.7 for a graphical representation of the impervious calculations.

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 an oil/water separator and underground stone infiltration trench. The system has 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
Ur	Urban land	None

The onsite soils are Urban Land which does not of a Hydrologic Group. Soils surrounding the site include NP - Newport-Urban land complex and PmB - Pittstown silt loam, 3 to 8 percent slopes. NP and PmB are Hydrologic Group C soils. Onsite test holes indicated silt onsite. Hydrologic Group C has been used for modeling the site.

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

2.2 EXISTING SITE CONDITIONS

Currently the site is predominately impervious and exists as a parking lot for the shopping plaza. All stormwater flows overland to a single catch basin at the entrance of the Aquidneck Center shopping plaza on East Main Road and ultimately discharges to Bailey's Brook. None of the stormwater is currently treated for water quality or recharge.

2.3 POST SITE CONDITIONS

The redevelopment will reduce the existing impervious cover by 23%. This will result in a naturally decreased stormwater runoff from pre to post development conditions for all storm events, reducing the impact to Bailey's Brook.

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:

- Underground Stone Infiltration Trench
    - Fully Infiltrates the water quality storm event
    - Provides stormwater recharge
    - Oil/water separator prior to system for pretreatment

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

3.0 Minimum Standards

This project is considered a redevelopment in accordance with the Rhode Island Stormwater Design and Installation Standards Manual (RISDISM) Section 3.2.6. Minimum standards 2, 3 and 7-11 only are required to be addressed. The following section outline how the redeveloped site meets these minimum requirements standards.

3.1 Minimum Standard 1: LID Site Planning and Design Strategies

Not applicable for redevelopment, per RISDISM Section 3.

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.
Groundwater recharge is determined from the following equation:
Re_V=1"*F*I/12
Where:
Re_V=Groundwater Recharge Volume (cf)
F=Recharge Factor based on Hydrologic Soil Groups (HSG) (see table below)
I=Impervious Area (sf)

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

Recharge volume for watersheds 1 are provided through the use of an underground stone infiltration trench. See Table 2-1 of the Appendix A checklist for a summary of recharge values.

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

See Appendix A3.2 for the water quality storm HydroCAD analysis. The water quality storm is calculated in HydroCAD using the 'calculate separate Pervious/Impervious runoff' option.

3.3 Minimum Standard 3: Water Quality

The required water quality from the redevelopment area is to be treated through an approved BMP before being discharged to Bailey's Brook. The site has been designed to use an underground stone infiltration trench to provide water quality.

Per Section 3.2.6 of the RISDISM, the water quality requirement may be met by a combination of impervious area reduction and BMP's for at least 50% of the redevelopment area.

Refer to Appendix A3.7 for a graphical representation of the impervious calculations.

Existing Impervious Area:	0.553 acres
Proposed Impervious Area:	0.426 acres
Impervious Reduction:	0.553 - 0.426 = 0.127 acres
WQ Required (Redevelopment):	0.553* 50% = 0.277 acres

Total WQ Required:

Redevelopment – Impervious Reduction	0.277 – 0.127 = 0.150 acres

In conclusion, the required net impervious area calculated for water quality treatment by a BMP is 0.150 acres.

The site has been designed to meet the water quality requirements through the use of an underground stone infiltration trench. The treatment systems have been designed to fully capture and infiltrate the water quality storm without overtopping. Refer to Appendix A3.2 for the water quality storm HydroCAD results.

3.4 Minimum Standard 4: Conveyance and Natural Channel Protection

Under RISDISM Section 3, the project is considered a redevelopment site, therefore this minimum standard is not required to be addressed. Due to the reduction in impervious area, the discharge to Bailey's Brook has been reduced for all storm events, improving the conveyance and natural channel protection for downstream areas form the site.

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 HydroCAD Software Solutions LLC.

The soil has been modeled in HydroCAD with a 1.02 inches/hr infiltration rate per table 5-3 in section 5.3.4 of the RISDISM. Soil evaluations have been performed by DiPrete Engineering. The existing soil has a texture of Sandy Loam. Based on table table 5-3 in section 5.3.4 of the RISDISM underlying soils have the same infiltration rate.

3.5.2 Design Storm

Analysis of 1-year, 2-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 Newport County.

1 year =	2.8 inches
2 year =	3.3 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 one subcatchment. In the post development stage there are two subcatchments. Each watershed will demonstrate zero increase of runoff due to the proposed development. A description of each watershed and associated subcatchments are summarized as follows, for cover types see color watershed maps located in back of this report. Numbers in parentheses ( ) indicate the HydroCAD Node Number.

<u>Design Point 1:</u>

Watershed #1 flows to Design Point – 1 (DP-1). This watershed consists of the entire site. The design point is the catch basin located in the shopping plaza entrance from East Main Road.

In pre development conditions there is only one watershed to DP-1.

Pre-01 (10) contains the entire site. Stormwater reaches DP-1 via overland flow.

In post development conditions there are two subwatersheds:

Post-01 (100) consists of the existing impervious parking lot area that flows overland and discharges directly to DP-1.

Post-02 (101) consists of the proposed development area. Stormwater flows overland to the slot drain (102) before being fully infiltrated during the water quality storm in the stone infiltration trench (103) and bypassing the slot drain (102) in the 1-100 year storms, ultimately discharging to DP-1.

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	3.516	95	6.0
Post-01	2.925	95	6.0
Post-02	0.591	91	6.0

Outlet Protection

The site is proposed to have stormwater flow overland via sheet flow, as it does today. The BMP on site is only intended for the capture, treatment, and recharge of the water quality storm.

3.5.4 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 proposed project disturbs 2.6 acres. A downstream analysis is not required.

3.5.5 Overbank Flood Protection Conclusion

The tables below present a summary of the pre development flows vs. the mitigated post development flows. 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: (DL-1)Watershed #1: (DP-1)

Subwatershed (design point)	**1.2" Peak Flow**		**1-yr Peak Flow**		**2-yr Peak Flow**		**10-yr Peak Flow**		**25-yr Peak Flow**		**100-yr Peak Flow**	
	Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
DP-1:	3.41	2.68	8.87	8.02	10.67	10.24	16.37	15.74	20.61	19.96	29.38	28.57

All flows in cubic feet per second (cfs)

Subwatershed (design point)	**1.2" Peak Volume**		**1-yr Peak Volume**		**2-yr Peak Volume**		**10-yr Peak Volume**		**25-yr Peak Volume**		**100-yr Peak Volume**	
	Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
DP-1:	0.258	0.208	0.66	0.591	0.804	0.730	1.266	1.184	1.614	1.529	2.343	2.254

All volumes in acre-feet (af)

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

3.6 Minimum Standard 6: Redevelopment and Infill Projects.

This site is a redevelopment project. See Minimum Standard 6 in the Appendix A checklist.

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 LUHPPL.

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

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
Department of Environmental Management
Office of Water Resources
Onsite Wastewater Treatment Systems Program

Site Evaluation Form
Part A – Soil Profile Description **Application Number** N/A

Property Owner: Aquidneck Land Group, LLC
Property Location: AP 170SE Lot 106 Middletown, RI
Date of Test Hole: June 8, 2021
Soil Evaluator: Chris Sutter License Number: D-4077
Weather: Clear, 70's Shaded: Yes ☐ No ☑ Time: 8:00 AM

TH 1 Horizon	Depth	Horizon Boundaries		Soil Colors		Re-Dox			Texture	Structure	Consistence	Soil Category
		Dist	Topo	Matrix	Re-Dox Features	Ab.	S.	Contr.				
HTM	0-12"	C	S									Fill
Bwb	12-36"	C	S	10YR 5/6	7.5YR 5/6	F	2	P	fsl	1-sbk	fri	4
Cd1	36-60"	C	S	2.5Y 4/3					vchfsl	0-m	fir	8
Cd2	60-108"			2.5Y 5/3	7.5YR 5/6	C	3	P	chsil	0-m	fir	8

TH 2 Horizon	Depth	Horizon Boundaries		Soil Colors		Re-Dox			Texture	Structure	Consistence	Soil Category
		Dist	Topo	Matrix	Re-Dox Features	Ab.	S.	Contr.				
HTM	0-17"	C	S									Fill
Bwb	17-38"	C	S	10YR 5/6	7.5YR 5/6	F	2	P	fsl	1-sbk	fri	4
Cd1	38-60"	C	S	2.5Y 5/4					chfsl	0-m	fir	8
Cd2	60-108"			2.5Y 5/3	7.5YR 5/6	C	3	P	chsil	0-m	fir	8

TH 1 Soil Class Dense Till Total Depth 108" Impervious/Limiting Layer Depth NA (og) GW Seepage Depth NA SHWT 60" (og)
TH 2 Soil Class Dense Till Total Depth 108" Impervious/Limiting Layer Depth N/A (og) GW Seepage Depth N/A SHWT 60" (og)

Comments:

A3.2 Water Quality HydroCAD 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: PRE-01 Runoff Area=3.515 ac 88.61% Impervious Runoff Depth=0.88"
Tc=6.0 min CN=74/98 Runoff=3.41 cfs 0.258 af

Link DP-1: CATCH BASIN Inflow=3.41 cfs 0.258 af
Primary=3.41 cfs 0.258 af

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 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 100: POST-01 Runoff Area=2.925 ac 85.56% Impervious Runoff Depth=0.85"
Tc=6.0 min CN=74/98 Runoff=2.68 cfs 0.208 af

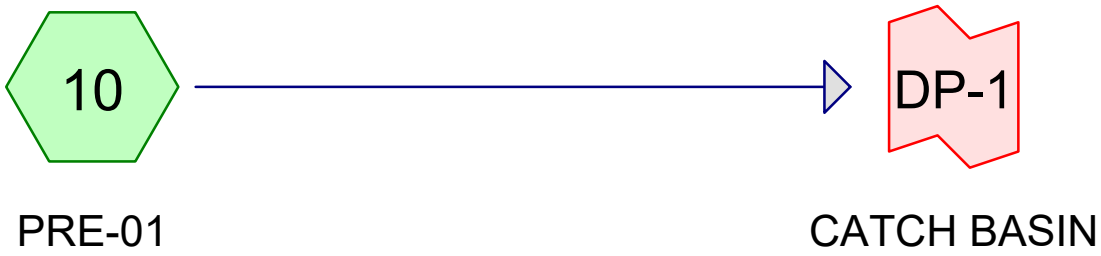
Subcatchment 101: POST-02 Runoff Area=0.591 ac 70.27% Impervious Runoff Depth=0.71"
Tc=6.0 min CN=74/98 Runoff=0.44 cfs 0.035 af

Pond 102: SLOT DRAIN Peak Elev=55.58' Storage=10 cf Inflow=0.44 cfs 0.035 af
Primary=0.44 cfs 0.035 af Secondary=0.00 cfs 0.000 af Outflow=0.44 cfs 0.035 af

Pond 103: STONE TRENCH Peak Elev=55.58' Storage=646 cf Inflow=0.44 cfs 0.035 af
Outflow=0.03 cfs 0.035 af

Link DP-1: EXISTING CB Inflow=2.68 cfs 0.208 af
Primary=2.68 cfs 0.208 af

A3.5.4.1 HydroCAD Node Diagram

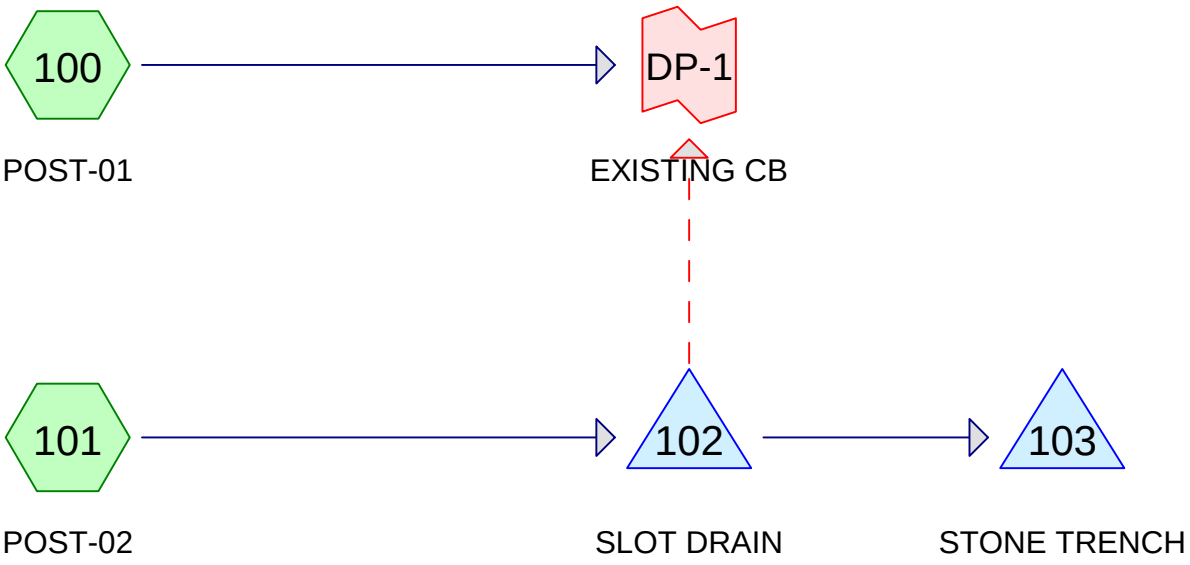


Subcat Reach Pond Link

Routing Diagram for 2162-004-EHCD
Prepared by DiPrete Engineering, Printed 8/31/2021

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.400	74	>75% Grass cover, Good, HSG C (10)
2.975	98	Impervious, HSG C (10)
0.141	98	Roofs, HSG C (10)



Subcat Reach Pond Link

Routing Diagram for 2162-004-PHCD
Prepared by DiPrete Engineering, Printed 4/29/2022
HydroCAD® 10.10-6a s/n 01125 © 2020 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.598	74	>75% Grass cover, Good, HSG C (100, 101)
2.726	98	Impervious, HSG C (100, 101)
0.191	98	Roofs, HSG C (100, 101)

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: PRE-01 Runoff Area=3.515 ac 88.61% Impervious Runoff Depth=2.25"
Tc=6.0 min CN=95 Runoff=8.87 cfs 0.660 af

Link DP-1: CATCH BASIN Inflow=8.87 cfs 0.660 af
Primary=8.87 cfs 0.660 af

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

Subcatchment 100: POST-01 Runoff Area=2.925 ac 85.56% Impervious Runoff Depth=2.25"
Tc=6.0 min CN=95 Runoff=7.21 cfs 0.549 af

Subcatchment 101: POST-02 Runoff Area=0.591 ac 70.27% Impervious Runoff Depth=1.89"
Tc=6.0 min CN=91 Runoff=1.26 cfs 0.093 af

Pond 102: SLOT DRAIN Peak Elev=56.14' Storage=20 cf Inflow=1.26 cfs 0.093 af
Primary=0.71 cfs 0.051 af Secondary=1.07 cfs 0.042 af Outflow=1.27 cfs 0.093 af

Pond 103: STONE TRENCH Peak Elev=56.28' Storage=917 cf Inflow=0.71 cfs 0.051 af
Outflow=0.03 cfs 0.051 af

Link DP-1: EXISTING CB Inflow=8.02 cfs 0.591 af
Primary=8.02 cfs 0.591 af

A3.5.4.3 HydroCAD 2-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: PRE-01 Runoff Area=3.515 ac 88.61% Impervious Runoff Depth=2.74"
Tc=6.0 min CN=95 Runoff=10.67 cfs 0.804 af

Link DP-1: CATCH BASIN Inflow=10.67 cfs 0.804 af
Primary=10.67 cfs 0.804 af

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

Subcatchment 100: POST-01 Runoff Area=2.925 ac 85.56% Impervious Runoff Depth=2.74"
Tc=6.0 min CN=95 Runoff=8.67 cfs 0.668 af

Subcatchment 101: POST-02 Runoff Area=0.591 ac 70.27% Impervious Runoff Depth=2.35"
Tc=6.0 min CN=91 Runoff=1.56 cfs 0.116 af

Pond 102: SLOT DRAIN Peak Elev=56.15' Storage=21 cf Inflow=1.56 cfs 0.116 af
Primary=0.57 cfs 0.054 af Secondary=1.57 cfs 0.062 af Outflow=1.57 cfs 0.116 af

Pond 103: STONE TRENCH Peak Elev=56.27' Storage=913 cf Inflow=0.57 cfs 0.054 af
Outflow=0.03 cfs 0.054 af

Link DP-1: EXISTING CB Inflow=10.24 cfs 0.730 af
Primary=10.24 cfs 0.730 af

A3.5.4.4 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: PRE-01 Runoff Area=3.515 ac 88.61% Impervious Runoff Depth=4.32"
Tc=6.0 min CN=95 Runoff=16.37 cfs 1.266 af

Link DP-1: CATCH BASIN Inflow=16.37 cfs 1.266 af
Primary=16.37 cfs 1.266 af

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

Subcatchment 100: POST-01 Runoff Area=2.925 ac 85.56% Impervious Runoff Depth=4.32"
Tc=6.0 min CN=95 Runoff=13.30 cfs 1.053 af

Subcatchment 101: POST-02 Runoff Area=0.591 ac 70.27% Impervious Runoff Depth=3.89"
Tc=6.0 min CN=91 Runoff=2.52 cfs 0.191 af

Pond 102: SLOT DRAIN Peak Elev=56.16' Storage=23 cf Inflow=2.52 cfs 0.191 af
Primary=0.25 cfs 0.060 af Secondary=2.44 cfs 0.131 af Outflow=2.52 cfs 0.191 af

Pond 103: STONE TRENCH Peak Elev=56.19' Storage=883 cf Inflow=0.25 cfs 0.060 af
Outflow=0.03 cfs 0.060 af

Link DP-1: EXISTING CB Inflow=15.74 cfs 1.184 af
Primary=15.74 cfs 1.184 af

A3.5.4.5 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: PRE-01 Runoff Area=3.515 ac 88.61% Impervious Runoff Depth=5.51"
Tc=6.0 min CN=95 Runoff=20.61 cfs 1.614 af

Link DP-1: CATCH BASIN Inflow=20.61 cfs 1.614 af
Primary=20.61 cfs 1.614 af

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

Subcatchment 100: POST-01 Runoff Area=2.925 ac 85.56% Impervious Runoff Depth=5.51"
Tc=6.0 min CN=95 Runoff=16.75 cfs 1.343 af

Subcatchment 101: POST-02 Runoff Area=0.591 ac 70.27% Impervious Runoff Depth=5.06"
Tc=6.0 min CN=91 Runoff=3.23 cfs 0.249 af

Pond 102: SLOT DRAIN Peak Elev=56.18' Storage=24 cf Inflow=3.23 cfs 0.249 af
Primary=0.19 cfs 0.063 af Secondary=3.22 cfs 0.186 af Outflow=3.23 cfs 0.249 af

Pond 103: STONE TRENCH Peak Elev=56.21' Storage=888 cf Inflow=0.19 cfs 0.063 af
Outflow=0.03 cfs 0.063 af

Link DP-1: EXISTING CB Inflow=19.96 cfs 1.529 af
Primary=19.96 cfs 1.529 af

A3.5.4.6 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: PRE-01 Runoff Area=3.515 ac 88.61% Impervious Runoff Depth=8.00"
Tc=6.0 min CN=95 Runoff=29.38 cfs 2.343 af

Link DP-1: CATCH BASIN Inflow=29.38 cfs 2.343 af
Primary=29.38 cfs 2.343 af

Summary for Subcatchment 10: PRE-01

Runoff = 29.38 cfs @ 12.08 hrs, Volume= 2.343 af, Depth= 8.00"
Routed to Link DP-1 : CATCH BASIN

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
0.400	74	>75% Grass cover, Good, HSG C
2.975	98	Impervious, HSG C
0.141	98	Roofs, HSG C
3.515	95	Weighted Average
0.400	74	11.39% Pervious Area
3.115	98	88.61% Impervious Area

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

Summary for Link DP-1: CATCH BASIN

Inflow Area = 3.515 ac, 88.61% Impervious, Inflow Depth = 8.00" for 100-Year event
Inflow = 29.38 cfs @ 12.08 hrs, Volume= 2.343 af
Primary = 29.38 cfs @ 12.08 hrs, Volume= 2.343 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

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

Subcatchment 100: POST-01 Runoff Area=2.925 ac 85.56% Impervious Runoff Depth=8.00"
Tc=6.0 min CN=95 Runoff=23.87 cfs 1.950 af

Subcatchment 101: POST-02 Runoff Area=0.591 ac 70.27% Impervious Runoff Depth=7.52"
Tc=6.0 min CN=91 Runoff=4.70 cfs 0.370 af

Pond 102: SLOT DRAIN Peak Elev=56.20' Storage=28 cf Inflow=4.70 cfs 0.370 af
Primary=0.17 cfs 0.066 af Secondary=4.70 cfs 0.304 af Outflow=4.70 cfs 0.370 af

Pond 103: STONE TRENCH Peak Elev=56.21' Storage=888 cf Inflow=0.17 cfs 0.066 af
Outflow=0.03 cfs 0.066 af

Link DP-1: EXISTING CB Inflow=28.57 cfs 2.254 af
Primary=28.57 cfs 2.254 af

Summary for Subcatchment 100: POST-01

Runoff = 23.87 cfs @ 12.09 hrs, Volume= 1.950 af, Depth= 8.00"
Routed to Link DP-1 : EXISTING CB

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.60"

Area (ac)	CN	Description
0.422	74	>75% Grass cover, Good, HSG C
2.362	98	Impervious, HSG C
0.141	98	Roofs, HSG C
2.925	95	Weighted Average
0.422	74	14.44% Pervious Area
2.502	98	85.56% Impervious Area

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

Summary for Subcatchment 101: POST-02

Runoff = 4.70 cfs @ 12.09 hrs, Volume= 0.370 af, Depth= 7.52"
Routed to Pond 102 : SLOT DRAIN

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.60"

Area (ac)	CN	Description
0.176	74	>75% Grass cover, Good, HSG C
0.364	98	Impervious, HSG C
0.051	98	Roofs, HSG C
0.591	91	Weighted Average
0.176	74	29.73% Pervious Area
0.415	98	70.27% Impervious Area

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

Summary for Pond 102: SLOT DRAIN

Inflow Area = 0.591 ac, 70.27% Impervious, Inflow Depth = 7.52" for 100-Year event
Inflow = 4.70 cfs @ 12.09 hrs, Volume= 0.370 af
Outflow = 4.70 cfs @ 12.09 hrs, Volume= 0.370 af, Atten= 0%, Lag= 0.1 min
Primary = 0.17 cfs @ 9.55 hrs, Volume= 0.066 af
Routed to Pond 103 : STONE TRENCH
Secondary = 4.70 cfs @ 12.09 hrs, Volume= 0.304 af
Routed to Link DP-1 : EXISTING CB

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 56.20' @ 12.09 hrs Surf.Area= 189 sf Storage= 28 cf
Flood Elev= 56.10' Surf.Area= 16 sf Storage= 19 cf

Plug-Flow detention time= 1.1 min calculated for 0.370 af (100% of inflow)
Center-of-Mass det. time= 1.2 min (771.8 - 770.6)

Volume	Invert	Avail.Storage	Storage Description
#1	54.95'	0 cf	**0.50'D x 1.23'H Elbow to underground**
#2	55.18'	16 cf	**8.00" Round Pipe Storage** L= 46.0'
#3	55.85'	2 cf	**Duraslot Opening (Prismatic)** Listed below (Recalc)
#4	56.10'	144 cf	**Above Grade Flooding (Prismatic)** Listed below (Recalc)
		163 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
55.85	9	0	0
56.10	9	2	2

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
56.10	7	0	0
56.50	714	144	144

Device	Routing	Invert	Outlet Devices
#1	Secondary	56.10'	**47.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	54.95'	**6.00" Round 6" Outlet** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 54.95' / 54.75' S= 0.0200 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.00 cfs @ 9.55 hrs HW=56.05' TW=56.08' (Dynamic Tailwater)
↑—**2=6" Outlet** (Controls 0.00 cfs)

Secondary OutFlow Max=4.58 cfs @ 12.09 hrs HW=56.20' TW=0.00' (Dynamic Tailwater)
↑—**1=Sharp-Crested Rectangular Weir** (Weir Controls 4.58 cfs @ 1.01 fps)

Summary for Pond 103: STONE TRENCH

Inflow Area = 0.591 ac, 70.27% Impervious, Inflow Depth = 1.34" for 100-Year event
Inflow = 0.17 cfs @ 9.55 hrs, Volume= 0.066 af
Outflow = 0.03 cfs @ 5.50 hrs, Volume= 0.066 af, Atten= 84%, Lag= 0.0 min
Discarded = 0.03 cfs @ 5.50 hrs, Volume= 0.066 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 56.21' @ 12.05 hrs Surf.Area= 1,160 sf Storage= 888 cf

Plug-Flow detention time= 359.5 min calculated for 0.066 af (100% of inflow)
Center-of-Mass det. time= 359.6 min (1,097.1 - 737.6)

Volume	Invert	Avail.Storage	Storage Description
#1	54.00'	745 cf	**Stone Trench (Prismatic)** Listed below (Recalc) 2,320 cf Overall - 63 cf Embedded = 2,257 cf x 33.0% Voids
#2	54.25'	63 cf	**8.00" Round Pipe Storage** Inside #1 L= 181.0'
#3	56.00'	383 cf	**Cover to Parking Area (Prismatic)** Listed below (Recalc) -Impervious 1,160 cf Overall x 33.0% Voids
		1,191 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
54.00	1,160	0	0
56.00	1,160	2,320	2,320

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
56.00	1,160	0	0
57.00	1,160	1,160	1,160

Device	Routing	Invert	Outlet Devices
#1	Discarded	54.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'

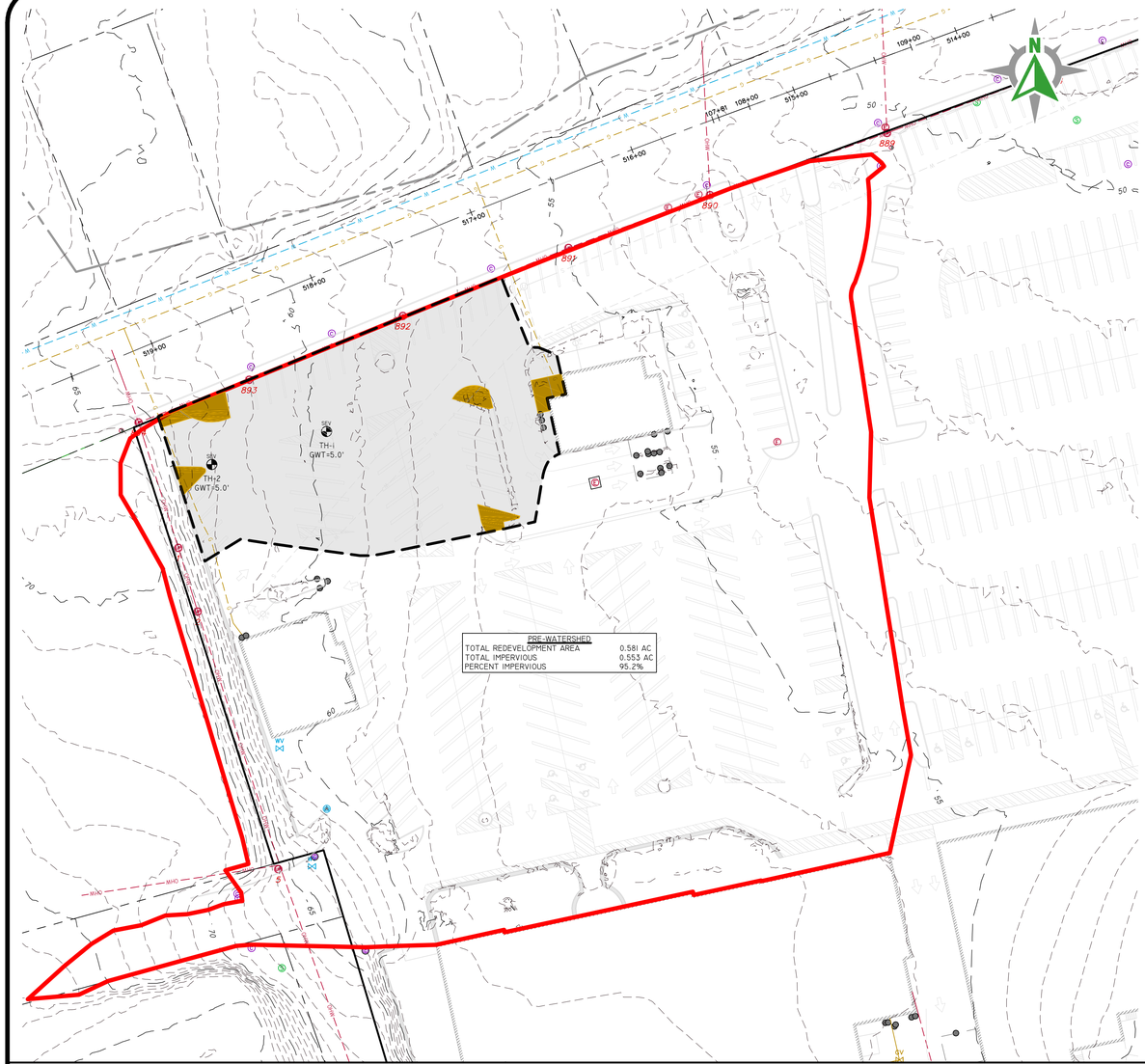
Discarded OutFlow Max=0.03 cfs @ 5.50 hrs HW=54.03' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.03 cfs)

Summary for Link DP-1: EXISTING CB

Inflow Area = 2.925 ac, 85.56% Impervious, Inflow Depth = 9.25" for 100-Year event
Inflow = 28.57 cfs @ 12.09 hrs, Volume= 2.254 af
Primary = 28.57 cfs @ 12.09 hrs, Volume= 2.254 af, Atten= 0%, Lag= 0.0 min

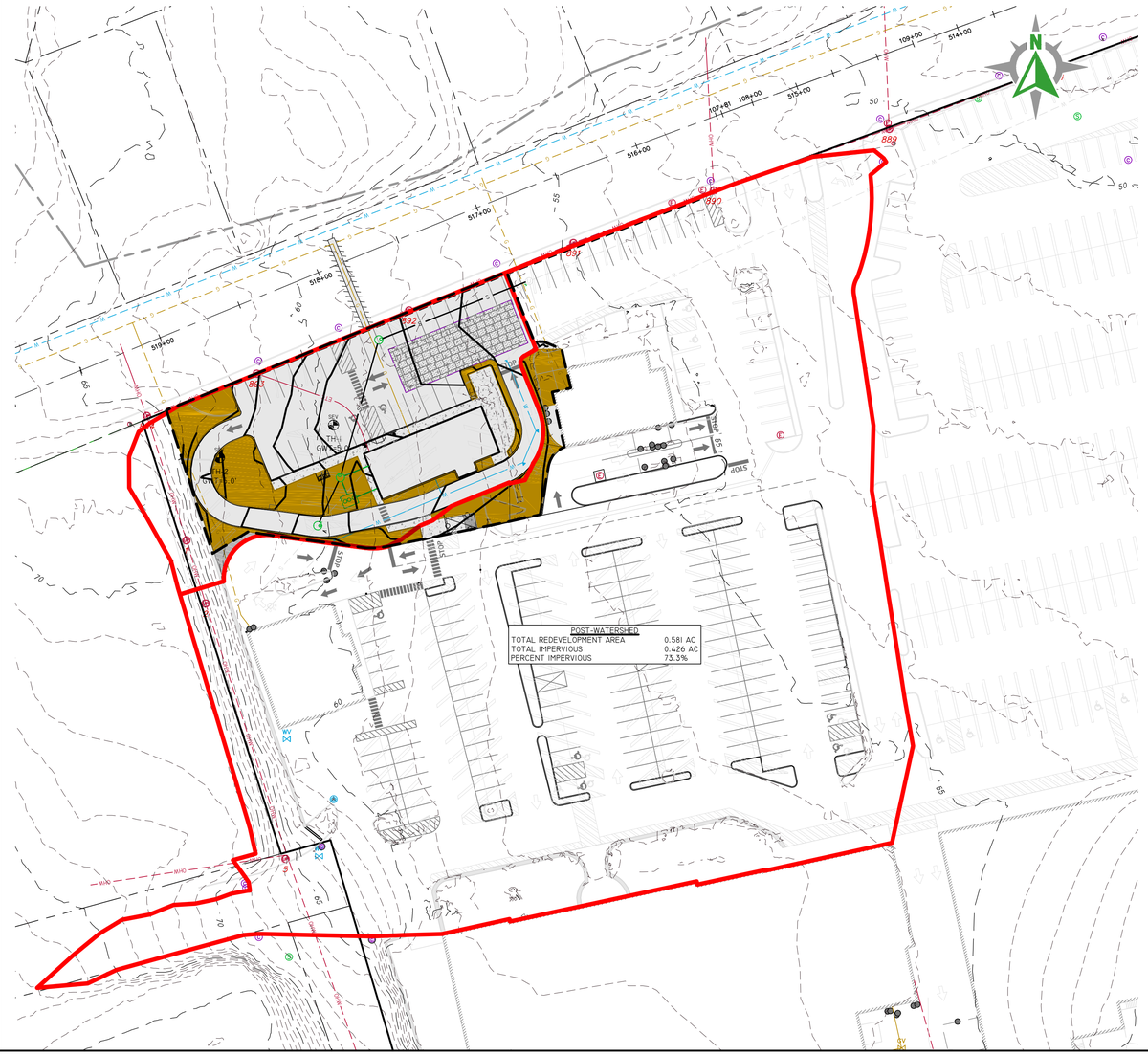
Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

A3.6 Impervious Calculations



PRE-WATERSHED
REDEVELOPMENT AREA

SCALE: 1"=40'
0 20' 40' 80'



POST-WATERSHED
REDEVELOPMENT AREA

SCALE: 1"=40'
0 20' 40' 80'

WATERSHED LEGEND

GRASS - C SOILS

IMPERVIOUS

WATER QUALITY CALCULATIONS

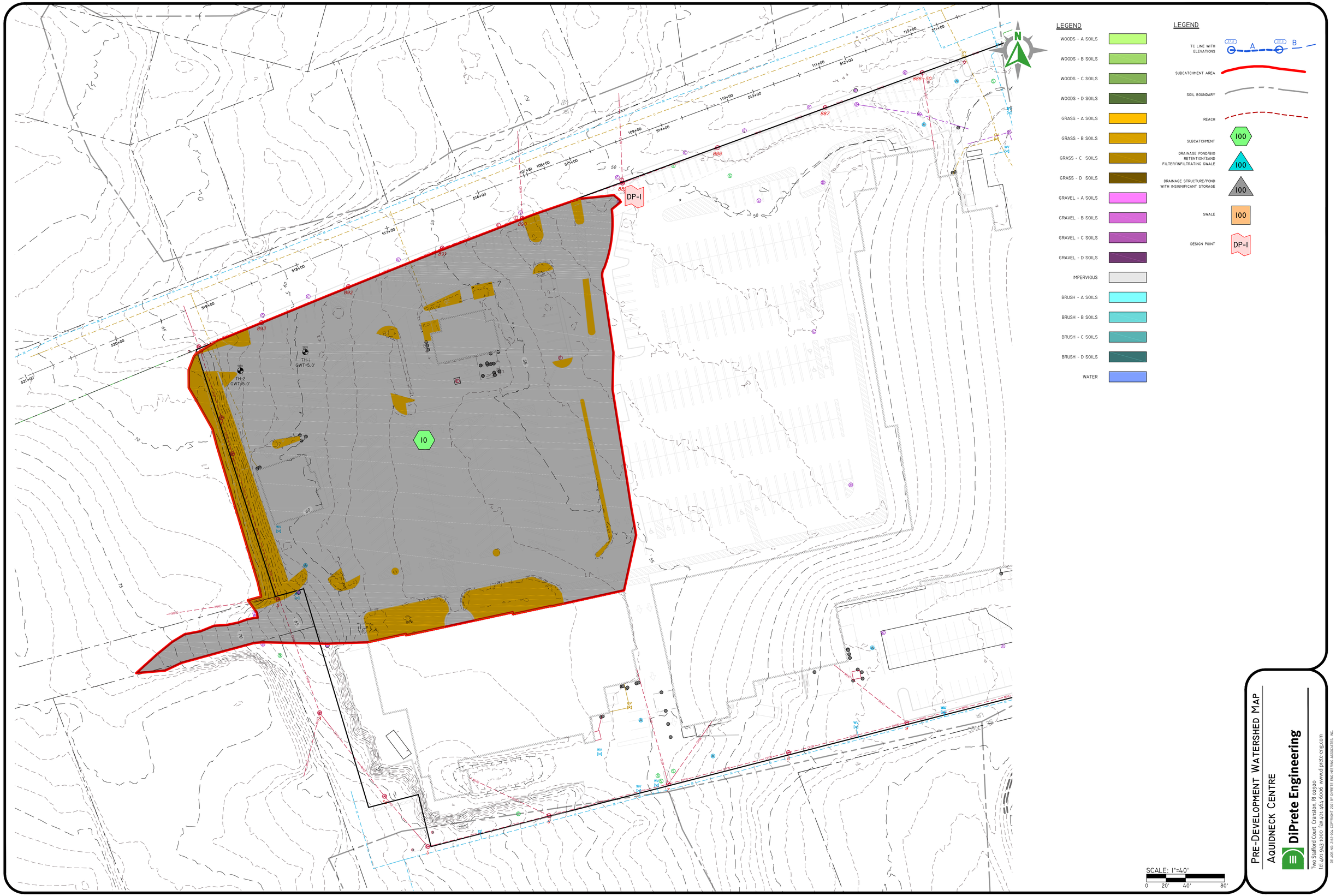
IMPERVIOUS DATA:	
EXISTING IMPERVIOUS	0.553 AC
PROPOSED IMPERVIOUS	0.426 AC
IMPERVIOUS REDUCTION:	
EXISTING - PROPOSED	0.553-0.426=0.127 AC
WQ REQUIRED (REDEVELOPMENT):	
50% EXISTING IMPERVIOUS	0.553*50%=0.277 AC
TOTAL WQ REQUIRED:	
REDEVELOPMENT	0.277 AC
IMPERVIOUS REDUCTION	-0.127 AC
	0.150 AC

IMPERVIOUS CALCULATIONS

AQUIDNECK CENTRE

DiPrete Engineering
Two Stafford Court Cranston, RI 02920
tel 401-943-1000 fax 401-464-6006 www.diprete-eng.com

Watershed Maps



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PRE-DEVELOPMENT WATERSHED MAP

AQUIDNECK CENTRE

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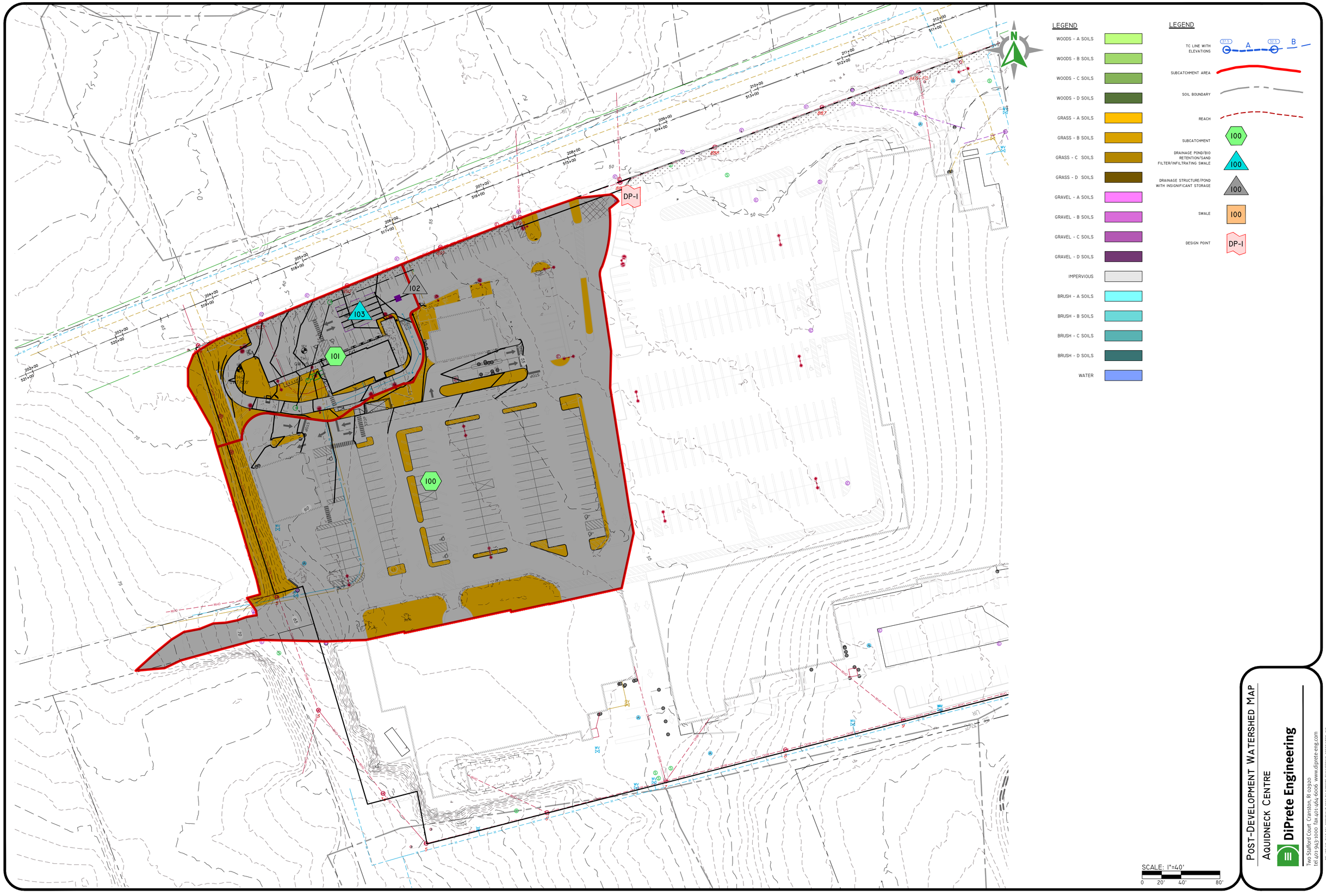

Post-Development Watershed Map

Aquidneck Centre

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