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

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

PROJECT NAME South Quay Marine Terminal	(RIDEM USE ONLY)
TOWN East Providence	STW/WQC File #:
BRIEF PROJECT DESCRIPTION: Port redevelopment to create a start of the art facility aimed at serving the offshore wind industry. The port will have a deep draft berth, a new bulkhead and heavy load bearing capacity throughout the site.	Date Received:

Stormwater Management Plan (SMP) Elements – Minimum Standards

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

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

PART 1. PROJECT AND SITE INFORMATION

PROJECT TYPE (Check all that apply)

☐ Residential	x Commercial	☐ Federal	☐ Retrofit	☐ Restoration
☐ Road	☐ Utility	X Fill	X Dredge	☐ Mine
☐ Other (specify):				

SITE INFORMATION

X 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: Providence River	☐ Coldwater	☐ Warmwater	☐ Unassessed
☒ Waterbody ID: RI0007020E-01B	☐ 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: Dissolved Oxygen, Total Nitrogen and Fecal Coliform	☐ 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.

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

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: Metro Bay
☒ Sea level rise mitigation has been designed into this project

LUHPPL IDENTIFICATION - MINIMUM STANDARD 8:		
1. OFFICE OF Land Revitalization and Sustainable Materials Management (OLRSMM)		
	☒ 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:** Jeff Crawford **(SR-10-1954)**
	☐ 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)	(SR-10-1954)
	☐ 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 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: Q1 Water Transportation
	☒ 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 – THIS PROJECT DOES NOT MEET THE CRITERIA OF A REDEVELOPMENT PROJECT		
	☐ Total Pre-Construction Impervious Area (**TIA**)	
	☐ Total Site Area (**TSA**)	
	☐ Jurisdictional Wetlands (**JW**)	
	☐ Conservation Land (**CL**)	
☐ Calculate the Site Size (defined as contiguous properties under same ownership)		
	☐ Site Size (**SS**) = (**TSA**) – (**JW**) – (**CL**)	
	☐ (**TIA**) / (**SS**) =	☐ (**TIA**) / (**SS**) >**0.4**?
☐ 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)		
DP-1: Northeast	120	3.5		0	27 + The onsite infiltration trenches (19,400 cf)
DP-2: West	0	0		0	5600 cf
DP-3:Southwest	0	0		0	5891 cf
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.): In Stormwater Report, as well as the HydroCAD model for the Utility Building Roof Runoff Model.

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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)**
DP-1:	120	10		10	27.2
DP-2:	0	0		0	0
DP-3:	0	0		0	0
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.): See the stormwater report and attachedtables

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:	

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.).					

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)
DP-1:	2.55		14.76		35.92		73.24	
DP-2:	0.58	0.07	3.35	10.46	8.15	52.09	16.61	84.00
DP-3:	0.75	0.00	4.23	0.00	10.36	11.43	21.11	29.78
DP-4:	3.26		18.77		45.73		93.31	
TOTALS:	7.14	0.07	41.11	10.46	100.16	63.52	204.27	113.78

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

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	Infiltration Chamber	NA	3.5	10	NA	NA	External	Yes		>50 ft
2	1,2,3, 4	Infiltration Trenches	NA	-	-	NA	NA	Internal	Yes		>50 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	Chamber	Infiltration Chamber	GZ-1		9.3	13	3.7	Fill- Modeled as B	2.41**
1	Trench 4	Infiltration Trench	GZ-1	GZ-7	9.3	11.4	2.1	Fill- Modeled as B	2.41
2	Trench 1	Infiltration Trench	GZ-1	GZ-5	9.3	13.5	4.2	Fill- Modeled as B	2.41
2	Trench 2	Infiltration Trench	GZ-2	P-09	9.3	12.4	3.1	Fill- Modeled as B	2.41
3	Trench 3	Infiltration Trench	GZ-6	VC-6B	0	11.4	11.4	Fill- Modeled as B	2.41
		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

** Exfiltration rate based on existing soils and proposed granular fill, as site is being raised approximately 5 ft. Almost all BMPs will exist only within the fill material. The bottom of the BMPs are placed just above the existing materials, and over 2 feet from estimated groundwater. This exfiltration rate is based on a Rawls Rate of a Loamy Sand, which was used as a basis for the granular fill that will be used on site since there will be less than 10% fines within that fill.

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. While it is an industrial site, groundwater recharge is acceptable as the entire property surface is permeable and there are such shallow grades on site (0.005 ft/ft) that heavy sediment transport and pollutant loadings is unlikely to occur. Furthermore, the crushed stone infiltration trenches will act as a filter as runoff passes through them.
☐	☒	☐	Are these activities already covered under an MSGP? If "No," please explain if you have applied for an MSGP or intend to do so? There are no current activities on site, and prior to the site becoming operational, the site will be covered by the MSGP.
☒	☐	☐	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: Limiting the amount of impervious area on site, infiltration trenches.
☐	☐	☐	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.). Stormwater Management Report

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?

		Not applicable
☒	☐	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:
		☒	RI-registered P.E. Name: Joshua Rosenberg, P.E. , William Ladd, P.E.

Subwatershed and Impervious Area Summary				
Subwatershed (area to each design point)	**First Receiving Water ID or MS4**	**Area Disturbed (units)**	**Existing Impervious (units)**	**Proposed Impervious (units)**
DP-1:	RI0007020E-01B	9.31 acres	0	120 sf
DP-2:	RI0007020E-01B	19.26 acres	0	0
DP-3:	RI0007020E-01B	1.53 acres	0	0
DP-4:				
TOTALS:	RI0007020E-01B	30.09 acres	0 sf	120 sf

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

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

Stormwater Report

South Quay Marine Terminal

649 Waterfront Drive
East Providence, RI

Prepared for:
RI Waterfront Enterprises, LLC
1080 Main Street
Pawtucket, RI

Prepared by:
McAllister Marine Engineering, LLC
16 Hoxie Avenue
Charlestown, RI 02813

Project Summary

The South Quay project in Rhode Island will create a modern intermodal, state of the art, high capacity, high flexibility port that will be specially prepared to handle multiple types of cargo, including bulk, break bulk, container, heavy oversized, and the immense size and weights of equipment and components used for the growing offshore wind market. Situated directly on a protected deep-water channel along the northeastern banks of the Providence River, across the harbor from direct rail lines and another large port facility, within one mile of a heavily trafficked interstates, and along the line of passenger ferry routes, the South Quay is perfectly situated to be the location to unite multiple forms of transportation infrastructure within an intermodal port.

The South Quay Marine Terminal is being designed to be a state-of-the-art port facility with access to deep water and high ground bearing strength. The goal is to be able to receive international vessels with heavy cargo consisting of large components such as those that are used in offshore wind farms. The facility should be equipped to berth the vessel, provide a stable surface to offload those components, and have utilities to allow the vessel to take on fresh water and plug in to power so as to not need to run off its generators. These same characteristics are desirable for vessels or barges calling on the port to load out the components for installation at their final destination.

For the offloaded components, the site needs to be designed to have sufficient bearing capacity to allow maximum flexibility on storage and movement of those components, and the capacity to support crane picks and movement. The upland surface should be flexible and easy to maintain so as to not have cracks or damage caused by movement and storage of parts, which is why a granular surface is preferred to a hardened one.

In addition to supporting this emerging industry, the South Quay is being designed to be well suited to meeting the growing demand for northeastern shipping and construction markets. Planned as an intermodal port, it is the South Quay's goal to enhance trade and economic growth while upholding freight efficiency, safety, and connectivity for the state and regional residents and businesses.

The Project will have a major economic development impact and part of that impact will be recruiting and expanding industrial and commercial business throughout the region. To have this impact take hold, there is a commitment to developing partnerships, not only with offshore wind developers and industrial users but with the larger local and regional community.

The proposed stormwater control system is designed with multiple stormwater treatment and conveyance Best Management Practices (BMPs) that will capture and treat runoff from the developed site as well as protect the adjacent resource areas including the Providence River Riverfront area. The stormwater management system has been designed in compliance with the Rhode Island Stormwater Design and Installation Manual.

For the stormwater analysis, the hydrologic conditions were compared for the existing conditions and the proposed conditions using HydroCAD v. 10.0. The existing conditions were divided into four (4) subcatchments. The proposed conditions were divided into three (3) subcatchments, however with two discharge points where the pipe network outfalls are located, in the northwestern and southwestern part of the property. Both the Existing Watershed and Proposed Watershed plans are included with this report. The majority of this existing land-cover is a gravel area, in fair condition (CN= 85) with some small areas of vegetative cover, mostly shallow rooted. The on-site soils are a mixture of fill with varying amounts of silts and fines. The proposed land cover will remain consistent with the existing land cover type, with the biggest change of adding several feet of granular low fine content fill (CN=76), which will actually act more in a more permeable manner and transmit water more effectively.

The proposed site will be filled to meet the performance and Sea level rise specifications. A minimum of the upper three feet will be backfilled with a dense graded aggregate, meeting the following specifications:

SIEVE SIZE	PERCENT FINER BY WEIGHT
2-Inch	100
1 1/2-Inch	70-100
3/4-Inch	50-85
No. 4	30-55
No. 50	8-24
No. 200	3-10

Dense graded aggregate lends itself well to this site as it compacts well to provide a stable wearing surface for Terminal operations, and the gradation of the materials allows it to retain a relatively high permeability[1]

Soil Information

[1] Laboratory tests of a similarly graded material, OK DOT Type M base, showed an average permeability of 165 ft/day, "*Stability and Permeability of Proposed Aggregate Bases in Oklahoma, Final Report FHWA-OK-09-05",* prepared by: Naju N. Khoury, Musharraf Zaman, Rouzbeh Ghabchi, Hassan Kazmee, School of Civil Engineering and Environmental Scient, The University of Oklahoma, Norman, Oklahoma 73019.

The soils at the project site area are classified by the Natural Resources Conservation Service, and the information was gathered through their WebSoil Survey Soils as Dumps Soils. This corresponds with the known history of the site, as it was created from dredge spoils.

We reviewed the map entitled "Surficial Geologic Map of the Providence Quadrangle, Rhode Island" dated 1956. That map shows the higher ground and hillside to the east of the site adjacent to Veterans Memorial Parkway and the surrounding areas are underlain by glacial kame deposits, which are glacial outwash deposits described as irregularly shaped mounds of sand and gravel. The lower lying areas at the base of the hillside and along the alignment of the former railroad tracks are mapped as man-made artificial fill.

From our review of the map entitled "Bedrock Geology Map of the Providence Quadrangle, Rhode Island" dated 1959, the bedrock underlying the site consists of sedimentary and meta-sedimentary rocks of Pennsylvanian age known as the Rhode Island Formation. This formation includes greenish gray, dark gray to black shale, sandstone, graywacke, conglomerate, and meta-anthracite.

For more specific detail on the types of soils that exist on site, we reviewed a series of boring logs and a geotechnical report conducted from various planning efforts conducted over the history of the site, as well as some investigations conducted associated with this design process.

Project partners GZA GeoEnvironmental and Sage Environmental have conducted a series of boring and geoprobe investigations across the property in an effort to characterize the soils for different purposes.

The generalized soil conditions at all parcels typically consist of a surficial layer of artificial fill, underlain by deposits of organic silt, sand, and sand and gravel. There is approximately 5 to 39 feet of artificial fill that is typically underlain by organic silt to depths between 35 and 57 feet below existing ground surface.

Artificial Fill

Surficial artificial fill was encountered throughout the Site, resulting from the dredge spoil fill that was used to create the site. The thickness of the artificial fill encountered in the borings ranged from 5 to 39 feet. The fill was generally comprised of sand with varying amounts of gravel and silt, with a relative density typically in the medium dense range.

Organic Silt

A layer of organic silt was observed in most borings. The thickness of the organic silt layer ranged from 20 feet to 47.5 feet and terminated between 35 feet to 57 feet below ground surface. The relative density of the organic silt was typically very loose.

Sand, Silt and Gravel (Glacial Outwash)

The organic silt was underlain by naturally deposited sand, gravel, silty sand, and silty sand and gravel (glacial outwash). Cobbles and boulders were frequently encountered within the glacial outwash. The

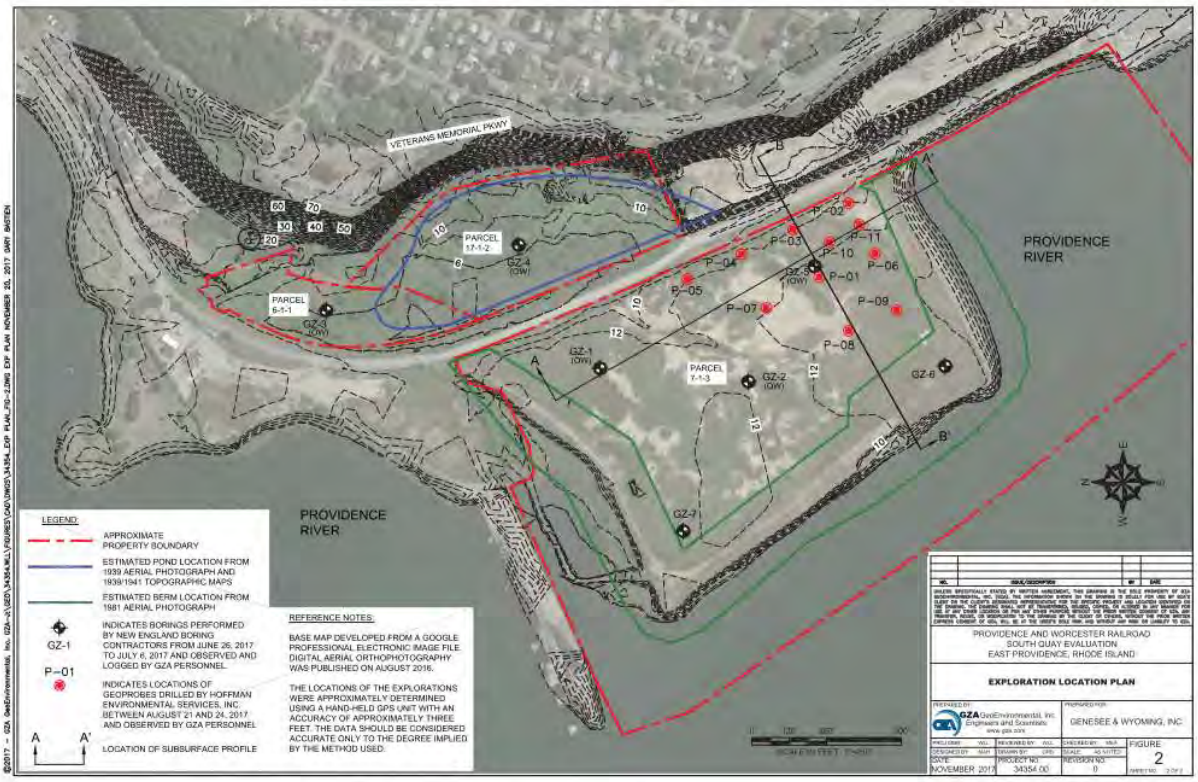
relative density of this stratum ranged from very loose to very dense with a typical relative density of medium dense.

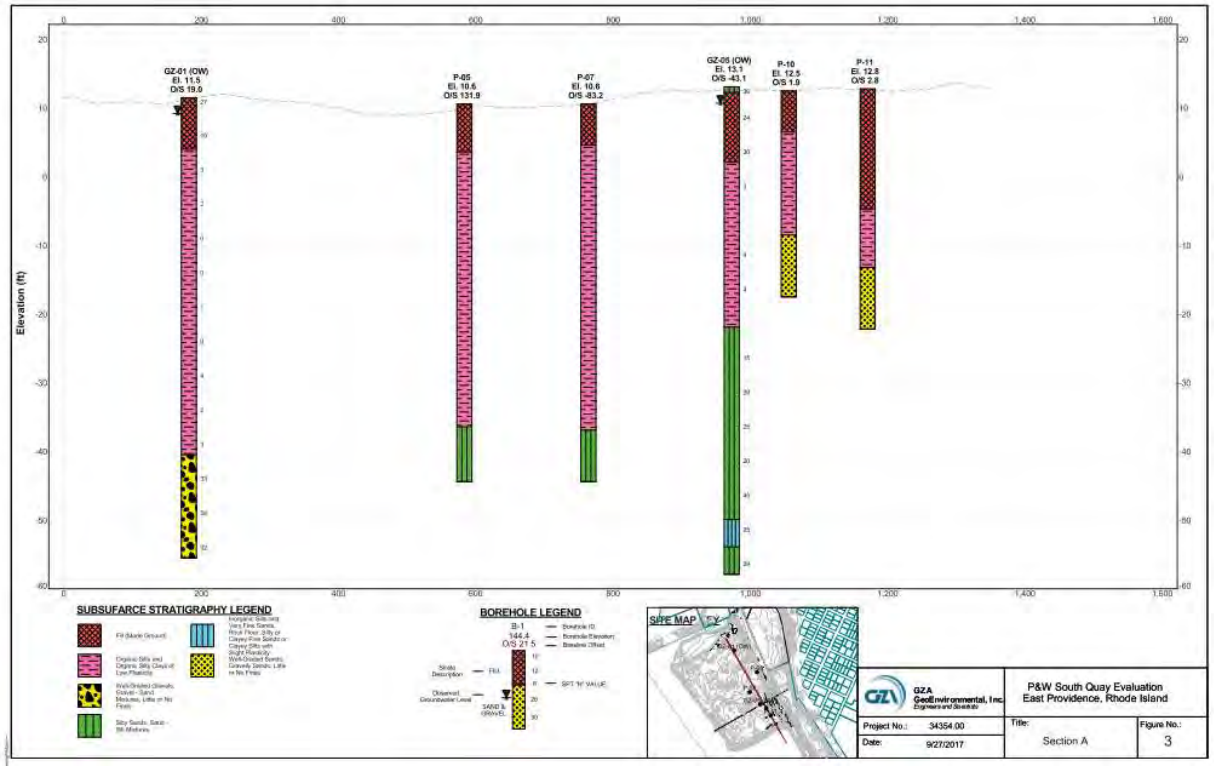
Bedrock

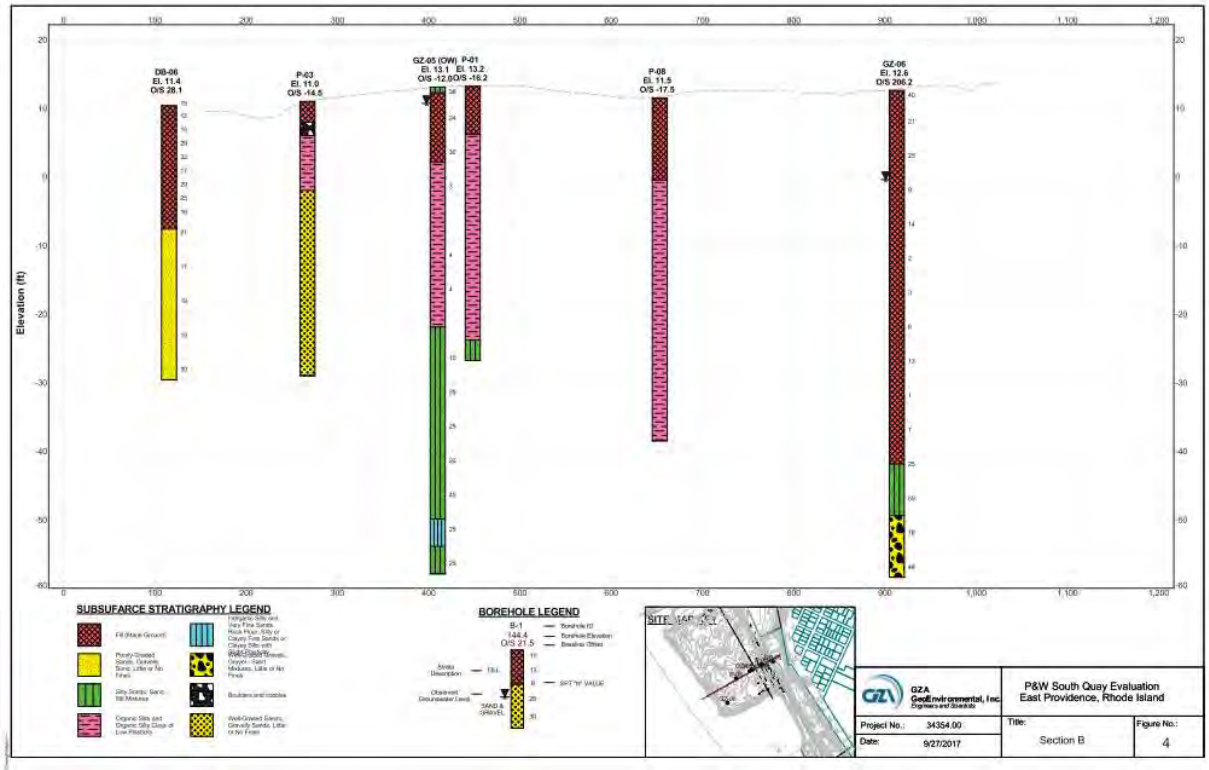
Bedrock was not encountered or cored as part of this drilling program.

Groundwater

Stabilized groundwater depth readings were measured in the five observation wells at least 17 days after well installation. The depth to groundwater was observed to range from 1.3 feet to 7.6 feet below ground surface. Unstabilized groundwater depth readings were measured at time of drilling in Boreholes GZ-6 and GZ-7 at 13 feet and 4 feet respectively. Because of the varying nature of the fill soils, the groundwater readings can fluctuate across the site, however a generalized groundwater elevation of 9.3 was used for the site. It should be noted that groundwater level observations were made under the conditions at the time of the borings, and that groundwater levels may vary with temperature, rainfall, and other factors different than those at the time of the measurements.







Stormwater Control and Peak Flow Attenuation

No new untreated discharges will be created as a result of the proposed work. The table below shows the reduction in peak flow rates (cfs) and volumes (acre-ft) for each of the discharge points from the proposed conditions compared to the existing conditions. As is allowable under the RI Stormwater Design and Installation Manual, peak flow rates and volumes were controlled to the maximum extent practicable as this is a redevelopment project. The existing site has no stormwater quality controls and the proposed project will provide stormwater management and treatment strategies and promote a significant amount of groundwater recharge.

Reduction from Predevelopment Runoff								
	2 yr storm		10 yr storm		25 yr storm		100 yr storm	
Discharge Point	Rate (cfs)	Volume (acre-ft)	Rate (cfs)	Volume (acre-ft)	Rate (cfs)	Volume (acre-ft)	Rate (cfs)	Volume (acre-ft)
Northwest	32.98	3.122	37.88	4.307	49.11	5.126	99.16	6.625
South	5.88	0.412	0.02	0.475	5.53	-0.209	-8.67	-0.92

Stormwater Management Approach

The stormwater goals of the South Quay project are achieved with several key actions:

- Limiting the use of impervious materials on the surface - The site will use a granular wearing surface of dense graded aggregate, which is a well graded, pervious and relatively permeable material. This will help promote more initial abstraction and reduce the volume of runoff compared to an impermeable surface.
- Avoiding steep slopes- While the site is being raised several feet, the vast majority of the site will be graded at a shallow slope of 0.005 ft/ft and the edges will be graded at a 4H:1V (horizontal distance (H), vertical rise (V)) slope to meet up with surrounding grades. This will keep runoff rates lower than what they would be at steeper slopes.
- Promoting Recharge - The use of crushed stone infiltration trenches spaced throughout the property will capture runoff, provide water quality treatment and recharge stormwater into the subsurface. Promoting infiltration will reduce runoff rates and volumes and mimic natural hydrology.
- Direct Recharge of the Impervious Roof Area associated with the utility building. The utility building represents the only impervious area on site. The runoff generated from that rooftop will be piped directly into a cultec recharger chamber system, set on a

bed of crushed stone. This will provide direct recharge of the water quality volume and more of what is generated from the rooftop.

Stormwater Management Standards Compliance

The proposed stormwater management systems for the South Quay Marine Terminal project have been designed in compliance with the 11 minimum standards set forth in the RI Stormwater Design and Installation Standards Manual from the Rhode Island DEM and CRMC. The proposed stormwater BMPs have been designed to protect surface and ground water resources and wetlands.

As listed and required under the RI Stormwater Design and Installation Standards Manual, there are eleven (11) Stormwater Management Standards required for projects falling under its jurisdiction. The eleven standards and how compliance with each will be achieved are discussed below:

1. *LID Site Planning and Design Strategies* – The SQMT has incorporated several Low Impact Development Site Planning and Design Strategies in it to minimize the impacts of stormwater runoff. Most notably, there is almost no impervious area (only for the small utility building) being created as part of the project, thereby reducing runoff rates and volumes and promoting recharge in subsurface soils. Furthermore, stormwater management controls are placed throughout the site, providing conveyance and recharge throughout the site, rather than trying to manage stormwater in larger areas after they have accumulated from different tributary areas.
2. *Groundwater Recharge* – As noted above, the amount of impervious area has been kept to a minimum on the site, with only 120 sf of impervious area being created as a result of a precast utility building. Therefore, the required recharge volume for the entire site is only 3.5 cubic feet and the proposed development will vastly exceed those recharge requirements.
3. *Water Quality* – Through the use of crushed stone infiltration trenches that will filter and recharge the groundwater throughout the site, the SQMT will treat and handle more than the required Water Quality volume on site.
4. *Conveyance and Natural Channel Protection* - This standard is waived as the project discharges to the Providence River.
5. *Overbank Flood Protection* - This standard is waived as the project discharges to the Providence River.
6. *Redevelopment and Infill Projects* – The SQMT project does not meet the definitions of other a redevelopment project (there is not more than 10,000 sf impervious) or an infill project (the site is not currently serviced by utility infrastructure). Therefore, this standard does not apply.
7. *Pollution Prevention* – The project will prevent the discharge of pollutants from stormwater through the implementation of the Soil and Erosion Control Plan for construction activities and the Stormwater Pollution Prevention Plan that will be associated with the RIPDES filing for this project.

8. *Land Uses with Higher Potential Pollutant Loads (LUHPPL)* – The SQMT is considered a LUHPPL by the fact that it is an industrial site subject to a RIPDES Multi-Sector General Permit. While it is an industrial site, groundwater recharge is acceptable as the entire property surface is permeable and there are such shallow grades on site (0.005 ft/ft) that heavy sediment transport and pollutant loadings is unlikely to occur. Furthermore, the crushed stone infiltration trenches will act as a filter as runoff passes through them.
9. *Illicit Discharges* - There are no known or suspected illicit discharge within the immediate project site area. No illicit discharges shall be made, and a compliance statement is provided with the Stormwater Report.
10. *Construction Activity Soil Erosion, Runoff, Sedimentation, and Pollution Prevention Control Measure Requirements* – A Soil Erosion and Sedimentation Control (SESC) Plan has been prepared for this project.
11. *Stormwater Management System Operation and Maintenance* - A site-specific Operation and Maintenance Manual (O&M Manual) is included as part of this report. The draft manual details procedures for maintain the Stormwater BMPs as well as schedules and troubleshooting issues. The O&M manual defines the parties responsible the execution of the procedures detailed within it.

The RI Stormwater Manual also sets guidance of stormwater discharges to impaired waters. The receiving water body, the Providence River, ID RI0007020E-01B, is a class SB1(A) waterbody and its impairments include dissolved oxygen, total nitrogen, and fecal coliform. The South Quay site is less than 40% impervious, with the only impervious area proposed is the 120-sf utility building located along the northern edge of the site. Roof runoff does not contain the same level of contaminant loads as a parking area or roadway and therefore does not need pretreatment. The roof runoff for the utility is being directed to a set of subsurface recharge chambers set on a bed of crushed stone to infiltrate the runoff. These chambers have a storage capacity of 27 cf, which is more than 7 times the required capacity of 3.5 cf for the tributary impervious area. In addition, the project site had infiltration trenches throughout promoting groundwater recharge across the entire site. Therefore, this project complies with the goals of discharge to an impaired water and will not contribute negative water quality effects to the Providence River.

RI Waterfront Enterprises
South Quay Marine Terminal Project

Pre Development Volumes									
		2 yr storm		10 yr storm		25 yr storm		100 yr storm	
Discharge Point	Tributary Subcatchments	Rate (cfs)	Volume (acre-ft)	Rate (cfs)	Volume (acre-ft)	Rate (cfs)	Volume (acre-ft)	Rate (cfs)	Volume (acre-ft)
North	1	20.38	1.715	35.92	3.048	47.73	4.092	73.24	6.412
West	2	4.62	0.359	8.15	0.638	10.82	0.856	16.61	1.341
South	3	5.88	0.412	10.36	0.733	13.76	0.983	21.11	1.541
Onsite	4	25.93	2.238	45.73	3.979	60.78	5.341	93.31	8.37

Post Development									
		2 yr storm		10 yr storm		25 yr storm		100 yr storm	
Discharge Point	Tributary Subcatchments	Rate (cfs)	Volume (acre-ft)	Rate (cfs)	Volume (acre-ft)	Rate (cfs)	Volume (acre-ft)	Rate (cfs)	Volume (acre-ft)
Northwest	1	17.95	1.19	51.92	3.358	70.22	5.163	84	9.498
Northwest	2								
South	3	0	0	10.34	0.258	8.23	1.192	29.78	2.461

RI Waterfront Enterprises
South Quay Marine Terminal Project

Reduction from Predevelopment Runoff										
			2 yr storm		10 yr storm		25 yr storm		100 yr storm	
Discharge Point	Pre-Development Subcatchment	Post Development Subcatchment	Rate (cfs)	Volume (acre-ft)	Rate (cfs)	Volume (acre-ft)	Rate (cfs)	Volume (acre-ft)	Rate (cfs)	Volume (acre-ft)
Northwest	1,2,4	1,2	32.98	3.122	37.88	4.307	49.11	5.126	99.16	6.625
South	3	3	5.88	0.412	0.02	0.475	5.53	-0.209	-8.67	-0.92

Table 1 Required Recharge Volume
South Quay Marine Terminal

Required Recharge Volume determined by the following equation:

$Re_v = 1"xF \times (A_{imp})/12$ where:

Re_v	Required Recharge Volume
F	Recharge Factor
A_{imp}	Impervious Area

Given:
NRCS Hydrologic Soil Type - B
Target Depth Factor = 0.35 inch

Post Development Subcatchment	A_{imp} $ft.^2$	A_{imp} acre	F inch	R_v acre-ft	R_v $ft.^3$
1	120	0.003	0.35	0.0001	3.5
2	0	0.00	0.35	0.0000	0
3	0	0.00	0.35	0.0000	0
Totals for the developed site	120.00	0.00	0.60	0.00	3.50

Table 2 Water Quality Volume
South Quay Marine Terminal

$V_{WQ} = (D_{WQ}/12\ in/ft)*(A_{imp}*43{,}560\ ft.^2/acre)$
where

V_{WQ}	Water Quality Volume
D_{WQ}	Water Quality Depth
A_{imp}	Impervious Area

D_{WQ} 1 in

Subcatchment	A_{imp}	A_{imp}	V_{WQ}	$V_{provided}$	$V_{provided} > V_{req}$
	$ft.^2$	acre	$ft.^3$	$ft.^3$	Yes/No
1	120	0.00	10.00	19,400	Yes
2	0	0.00	0.00	15,554	Yes
3	0	0.00	0.00	5,891	Yes
Totals	120	0.00	10	40,845	Yes

Alternative WQV Volume
DWQ = 0.2 inches over entire disturbed area

D_{WQ} 0.2 in

Subcatchment	A_{dist}	A_{dist}	V_{WQ}	$V_{provided}$	$V_{provided} > V_{req}$
	$ft.^2$	acre	$ft.^3$	$ft.^3$	Yes/No
1	405,482	9.31	6,758.03	19,400	Yes
2	838,940	19.26	13,982.33	15,554	Yes
3	66,477	1.53	1,107.95	5,891	Yes
Totals	1,310,899	30.09	21,848	40,845	Yes

Table 3 Water Quality Flow
South Quay Marine Terminal

WQr = qu*A*Q
where

WQr	peak discharge in cfs	
qu	unit peak discharge	290
A_{imp}	Impervious Area in square miles	
Q	runoff volume in watershed inches	

Subcatchment	A	A	Q	WQr	$V_{provided} > V_{req}$
	ft.^{2}	sq mi	in	cfs	Yes/No
1	405,000	0.0145	0.00	0.0001	Yes
2	839,300	0.0301	0.00	0.0000	Yes
3	66,500	0.0024	0.00	0.0000	Yes
Totals	1,310,800	0.05	0	0	Yes

Table 4