Appendix J

Stormwater Management Plan for Clear River Energy Center

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RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
Office of Water Resources
235 Promenade Street, Providence, RI 02908-5767
Telephone: 401-222-6820; Rhode Island Relay: 711; FAX: 401-222-6177

Application for Stormwater Construction Permit and Water Quality Certification

Use this form to request a Stormwater Construction Permit or Water Quality Certification (WQC). [This form replaces the formerly used WQC Program Application; Applications for a Stormwater Discharge System Registration and to Modify a Groundwater or Stormwater Discharge System (GWD/UIC Program); and the RIPDES Notice of Intent (NOI) Stormwater General Permit for Construction Activity (CGP).] **If a Freshwater Wetlands (FWW) Application is required, this form must be submitted in addition to the FWW Application form.**

Please complete this form online before printing. Submit the completed form with all required documentation and fee to:
(Check or money order must be made payable to the Rhode Island General Treasurer.) Stormwater Construction Permit Fee will be waived for applications submitted concurrently with a Freshwater Wetlands Application.

Permit Application Center (PAC)
RIDEM
235 Promenade Street, Room 260
Providence, RI 02908-5767

Provide all applicable information by completing the **shaded** areas.

Double-click to select:	☑ **New Permit** Fee = $400.	☐ **Permit Modification**	

Site & Project

City/Town:	Street Address:	Water Body Class:
Burrillville	WALLUM LAKE ROAD	B

Plat(s):	Lot(s):	Project Name:
	153-001, 153-002, 137-002, 137-003, 135-002	CLEAR RIVER ENERGY CENTER

Location:	Water Body Name(s):
SITE IS APPROXIMATELY 800' SOUTHEAST OF ALGONQUIN LANE AND WALLUM LAKE ROAD.	Iron Mine Brook

Latitude:	Longitude:	Utility Pole #:	Total Site Area:	Site Area to be Disturbed:
41°57'54.34"N	71°45'15.04"W	75	67 acres	36.15 acres

RI Federal Aid Project #:	RI Contract #:	Was there a Pre-Application Meeting?	Provide Meeting Date:
		☑ Yes ☐ No	10/01/16

Owner / Applicant

Organization/Company Name	Contact Name of Owner's Representative for Questions
: Clear River Energy LLC	Bryan Schueler

First Name:	Last Name:	Email:	Phone:
Bryan	Schueler	bschueler@invenergyllc.com	(312) 582-1421

Address:	City/Town:	State:	Zip:
One South Wacker Drive, Suite 1900	Chicago	IL	60606

I certify under penalty of law that I've requested and authorized the investigation, compilation, and submission of all the information, in whatever form, contained in this Application; I have personally examined and am familiar with the information submitted herein; and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe the information is true, accurate and complete. I'm aware that it's the owner's responsibility to implement or hire a qualified contractor responsible to implement any required Soil Erosion and Sediment Control Plan, so as to effectively control stormwater discharges leaving the site during the construction period. I authorize RIDEM personnel access to the property for purposes of observing conditions pertinent to this application and assessing compliance with any permit or determination resulting from this application.

Applicant's Signature:	Title:	Date:
[signature]	Vice President	03/31/17

Professional

Professional's Name:	Professional's License Type(s) and Number(s):	
Alexander E. Deuson, P.E.	RI PE #11618	
Company Name:	**Email:**	**Phone:**
HDR Engineering, Inc.	alexander.deuson@hdrinc.com	(602) 385-1621

I certify under penalty of law that the project described in this application and associated materials is in compliance with the RI Stormwater Design and Installation Standards Manual (as amended) and the Rhode Island Soil Erosion and Sediment Control Handbook (as amended) [if required] and I believe all information presented in this application and the accompanying materials are true, accurate and complete. All engineering designs, plans and specifications [if required] included in this application were done by me or by someone working directly for me. The Natural Heritage Area Information [if required] and the site specific Soil Erosion and Sediment Control Plan [if required] were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering or developing the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete at the time this application is made. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Professional's Signature:	Title:	Date:
[signature]	Engineer	03/31/17

PERMIT HISTORY AND APPLICABILITY - **Double-click** to check all boxes that apply to the proposed project.

Permit History

Provide all other application or file numbers associated with this site. — **RIDEM USE ONLY**

RI CRMC Assent:	US Army Corps of Engineers:	RIDEM Program Name & File Number:

Stormwater Construction Activity

Select all that apply. [Stormwater submissions must comply with all requirements of the RI Stormwater Design and Installation Standards Manual (RISDISM). Click links below to refer to other applicable Rules.]

There are Freshwater Wetlands on the subject or adjacent property, AND the project proposes:

- ☑ New or increased impervious cover for property other than a single family home; or
- ☑ Disturbance of more than 10,000 sq. ft. of existing impervious cover; or
- ☑ To fill in any amount of floodplain or alter storm flowage to a river, stream or wetland on any lot.

Refer to Freshwater Wetland: Rules

FWW Application # Required:

The project requires an application to RI CRMC, AND proposes:

- ☐ A residential development of 6 units or more; or
- ☑ A project that results in the creation of 10,000 sq. ft. or more of impervious area.

Refer to Water Quality: Rules

STW/WQC Application # Required:

The project proposes an infiltration system listed in Section 5.3 of the RISDISM (i.e. infiltration trench, infiltration basin, UIC chamber or drywell) that receives stormwater from:

- ☐ A residential impervious area that is more than 10,000 sq.ft.; or
- ☐ A non-residential roof area greater than 10,000 sq.ft.; or
- ☑ A non-residential (commercial, industrial, institutional...) road or parking area of any size.

Indicate if the treatment system discharges:

- ☐ Below the ground (UIC); or
- ☑ Above the ground and infiltrates (not UIC), but must be reviewed for compliance with the RISDISM to be protective of groundwater.

Refer to Groundwater Discharge: Rules

UIC/GWD Application # Required:

The project proposes **discharge of stormwater** to waters of the State [including a Separate Storm Sewer System (MS4)], AND :

- ☐ Disturbs less than 1 acre, but the activity is part of a larger common plan resulting in more than 1 acre of disturbance.
- ☑ Disturbs more than 1 acre of property.

Site is within or directly discharges to a Natural Heritage Area? No

Refer to RI Pollutant Discharge Elimination System: General Permit

RIPDES Application # Required:

Water Quality Certification (WQC)

Select all project type(s):

- ☐ Discharge that requires a Federal Permit
  - ☐ Federal Energy Regulatory Commission (FERC)
  - ☐ Marinas - New Construction or Expansion
  - ☐ Individual Permit
  - ☐ Fill Waters of the State
- ☐ Harbor Management Plan
- ☐ Flow Alteration
- ☑ Stormwater Master Plan

Refer to Water Quality: Rules Guidance

STW/WQC Application # Required:

Submission Requirements

Please submit separately bound documents, as required. Additional copies are required when submitting concurrently with a Freshwater Wetlands Application.

Site Plan(s)
RISDISM Appendix A Checklist and LID Planning Assessment
Stormwater Analysis and Drainage Report
Soil Erosion and Sediment Control (SESC) Plan
Post-Construction Operation and Maintenance (O&M) Plan
Stormwater Construction Permit Fee Waived when submitting concurrently with a Freshwater Wetland Application
1 Completed Freshwater Wetland Application Form

Amt Paid:

Check No:

Date Received:

Stormwater Management Plan

For

Clear River Energy Center

Town of Burrillville
Providence County, Rhode Island

PREPARED FOR:
Invenergy Thermal Development LLC
Chicago, IL 60606

PREPARED BY:
HDR Engineering, Inc.
Pittsburgh, PA 15222

SUBMITTED TO:
Rhode Island Department of Environmental Management
Office of Water Resources
235 Promenade Street, Room 260
Providence, Rhode Island 02908

HDR Project No. 10021318

March 2017

ALEXANDER DEUSON
3/14/17
STATE OF RHODE ISLAND
No. 0011618
HOPE
REGISTERED
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APPENDICES

OWNER CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under the direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete.

I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. I am aware that it is the responsibility of the site owner and operator to implement and amend the Soil Erosion and Sediment Control Plan as appropriate in accordance with the requirements of the RIPDES Construction General Permit.

____

Owner Signature: Date

Owner Name: TBD
Owner Title: TBD
Company Name: Invenergy Thermal Development LLC
Address: One South Wacker Drive, Suite 1900, Chicago, IL 60606
Phone Number: TBD
Email Address: TBD

OPERATOR CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under the direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete.

I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. I am aware that it is the responsibility of the owner/operator to implement and amend the Soil Erosion and Sediment Control Plan as appropriate in accordance with the requirements of the RIPDES Construction General Permit.

____

Operator Signature: Date

Contractor Representative: TBD
Contractor Title: TBD
Contractor Company Name: TBD
Address: TBD
Phone Number: TBD
Email Address: TBD

1.0 INTRODUCTION

1.1 Site Description

The Clear River Energy Center (CREC) site is located in a forested, predominantly rural area. The 67 acres of land area will be purchased from the Spectra Energy Algonquin Compressor Station site (“Spectra”) and is a subset of a 730-acre site that Spectra owns that currently contains the Algonquin Compressor Station. The Facility will be constructed just south of the existing compressor station. The Algonquin Compressor Station is surrounded by dense vegetation. The CREC will require a new access road which will be located south of, and parallel to, the existing Algonquin Road. The closest residents are approximately 2,300 feet to the north of the north-northeast corner of the property line.

1.2 Receiving Waters

The primary surface hydrologic feature, Iron Mine Brook, is located east of the CREC site. Iron Mine Brook is a perennial stream that flows in a northeasterly direction through the southern portion of Wetland 1 (refer to the Drawings in Appendix B). Iron Mine Brook is a lower perennial stream (R2) with a sandy bottom. Iron Mine Brook flows beneath Wallum Lake Road to the east of the proposed CREC via culvert and eventually discharges to the Clear River. Iron Mine Brook is a RIDEM Category 3 river, meaning that there is insufficient or no data to identify its designated uses, and is classified as a Class-B waterbody. A Class-B waterbody can be considered potentially suitable for bathing, fish and wildlife habitat, recreational use, agricultural use, industrial supply and other legitimate uses, including navigation. Iron Mine Brook is approximately 10 to 12 feet wide; it therefor has an associated 200-foot Riverbank Wetland per the Rhode Island Department of Environmental Management (RIDEM) Wetland Regulations.

Two unnamed intermittent streams are present in the eastern Project area. Both of these streams originate north of the Project area, and flow under Algonquin Lane via culverts. The two streams meet in the northeastern portion of Wetland 1 and flow south, passing through a metal pipe culvert under the woods road, until ultimately reaching Iron Mine Brook. These streams average less than 10 feet wide in their reach through the proposed Project site; they therefor have an associated 100-foot Riverbank Wetland per the RIDEM Wetland Regulations.

The primary surface hydrologic feature in the western portion of the proposed Project area is an unnamed perennial tributary to Dry Arm Brook, which flows through the western branch of Wetland 2 in a generally northeasterly direction. This perennial stream is designated as a Class-B waterbody. In its reach through the proposed Project site, this stream is a lower perennial stream with a sandy and muddy bottom (R2). Where it passes through the proposed Project area, this stream averages less than 10 feet wide; it therefor has an associated 100-foot Riverbank Wetland per the RIDEM Wetland Regulations.

Two unnamed intermittent streams are located in the western portion of the proposed Project site, which discharge into the unnamed perennial tributary to Dry Arm Brook. A fifth unnamed, intermitted stream is located in the central Project area and flows through a forested wetland. Each of these streams average less than 10 feet wide in their reach through the proposed Project site; they therefor have an associated 100-foot Riverbank Wetland per the RIDEM Wetland Regulations. Refer to the Drawings in Appendix B for stream locations.

1.3 Natural Heritage Area Information

All construction activities required to submit an Notice of Intent (NOI) to RIDEM are required to provide the Natural Heritage Area (NHA) information in the NOI application. This information is to assist RIDEM in the determination of projects that propose a Stormwater or allowable non-Stormwater discharge to a NHA, or has discharge related activities that may potentially affect a listed or proposed-to-be-listed endangered or threatened species or its critical habitat.

The online RIDEM mapping services depicting NHAs were consulted for this project. The powerblock site is not within, or discharging directly to, listed NHAs.

1.4 Historic Preservation and Cultural Resources Information

The currently proposed configuration of the CREC Facility will result in the excavation of soils in an undeveloped wooded area. Archaeological testing in this area identified several small scatters of artifacts, along with two archaeological sites. The Iron Mine Brook Dune site (RI 2757) was further investigated, and found to be not significant. A barn foundation located within the frontage area can be avoided by the proposed construction. Therefore, construction of the CREC Facility will have no impact on archaeological resources . Should any changes be required to the construction footprint, the Applicant will work with the RIHPHC to identify and minimize any impacts to archaeological resources. The CREC Facility will also have no effect on above ground resources.

The CREC is within the John H. Chaffee Blackstone River Valley National Heritage Corridor (the “Corridor”). In 1986, Congress established the Corridor to preserve and interpret the unique and significant contributions of the valley’s resources and history to the nation’s heritage. The Valley contains thousands of structures and entire landscapes that represent the history of the American Industrial Revolution and the complex economic and social relationships of the people who lived and worked there. Although all of Burrillville lies within the Corridor, the CREC is not located near any known historic elements that have been outlined as contributors to the historic nature of the Corridor. We therefore believe that the proposed impacts of the CREC will not affect the settings, characteristics, or feelings of these historical resources, or the Corridor.

1.5 Site Features and Constraints

The first goal in the low impact development (LID) site planning and design process is to avoid disturbance of natural features. This includes identification and preservation of natural areas that can be used in the protection of water resources.

Sensitive resources that exist at the site are described herein. Impact to these features or mitigation to such impact has been the primary goal of the site design.

- Floodplains: there are no FEMA-mapped floodplains on site or within the limits of disturbance. See attached map in Appendix F.
- Steep slopes (>15%): According to elevation data collected in 2011 with Light Detection and Ranging technology and obtained from the Rhode Island GIS database, the elevation of the proposed site varies from approximately 530 to 590 feet above sea level, with the parcel sloping downward from southwest to northeast. The average grade on the property is 5.5%, but the hill in the southwestern portion of the Site has steeper slopes. This hill (area of steep slopes) has been avoided to preclude future slope stability issues. See attached map in Appendix F.
- Areas with the potential to receive run-on from off-site areas: The majority of the site receives runoff from offsite areas. This constraint has been mitigated through the site grading plan and stormwater management system proposed. See attached map in Appendix F.
- Erodible soils: the preliminary geotechnical report prepared for the project site did not note specific erodible soils.

- Wetlands, hydric soils, surface waters, and their riparian buffers, specimen trees, natural vegetation, forest areas, and stream crossings: these constraints are described in Section 1.2. See attached map in Appendix F.
- Historic properties, historic cemeteries or cultural resources: these constraints are described in Section 1.4. There are no conflicts.

2.0 STORMWATER SITE PLANNING, ANALYSIS, AND DESIGN REPORT

Minimum Standard 1 of the Rhode Island Stormwater Design and Installation Standards Manual, last amended March 2015 (RISDISM) establishes an approach for measuring compliance with appropriate LID site planning and design and requires that the site planning process be formally documented and address at least the following objectives. These objectives have been reproduced below with this project's compliance with each following in **bold.**

2.1 Low Impact Development (LID) Planning

2.1.1 Avoid Impacts

1. Protect as much undisturbed open space as possible to maintain pre-development hydrology and allow precipitation to naturally infiltrate into the ground. **The site design and layout have been optimized to minimize footprint and protect as much undisturbed open space as feasible while still accomplishing the project objective (installation of a power generation facility). The site's proposed drainage pattern and post-construction stormwater management program have been designed to maintain the pre-development hydrology to the extent practicable. Care has been given to discharge stormwater to the surrounding wetlands in a maner that protects the existing hydrology and drainage patterns to the extent possible. To protect against soil erosion up-flow level spreaders have been utilized to dissipate energy. Refer to of the Drawings in Appendix B for proposed site grading and layout.**
2. Maximize the protection of natural drainage areas, streams, surface waters, wetlands, and jurisdictional wetland buffers. **The site design and layout have been prepared with the goal of minimizing disturbance to on-site streams and wetlands to the extent practicable. Stream and wetland impacts are proposed in order to construct and operate the facility, however these impacts have been reduced through the use of retaining walls, site general**

arrangement (GA) configuration, and access road alignment selection. Further details regarding the access road alignment and GA configuration can be found on the Drawings in Appendix B.

3. Minimize land disturbance, including clearing and grading, and avoid areas susceptible to erosion and sediment loss. **The disturbance limits for this project have been reduced to the extent practicable to support facility construction and operation. Areas prone to erosion and soil loss have been avoided (e.g., steep slopes at the southwest corner of the site).**
4. Minimize soil compaction and restore soils compacted as a result of construction activities or prior development. **The majority of the site disturbance area is proposed to be improved surfaces (gravel or pavement) for which minimization of compaction is infeasible. In areas proposed to be restored to existing conditions (laydown areas), provisions have been made to the Soil Erosion and Sediment Control (SESC) plan requiring the contractor to limit compaction to the minimum amount required to construct the facility. Provisions to restore in-situ relative compaction levels to pre-construction conditions, to the extent practicable, have also been included in the SESC plan. The SESC plan is provided as part of the full application package in Appendix E.**

2.1.2 Reduce Impacts

5. Provide low-maintenance, native vegetation that encourages retention and minimizes the use of lawns, fertilizers, and pesticides. **Low-maintenance and natively vegetated surfaces have been specified in areas proposed for restoration following construction. A small portion of the overall site is proposed to be improved surfaces, at which locations native vegetation is infeasible. The use of lawns, fertilizers, and pesticides has been minimized to the extent practicable and is described in "Operations and Maintenance" plan (refer to Appendix D of this document).**
6. Minimize impervious surfaces. **The GA has minimized the impervious surface to the maximum extent practicable while still accomplishing the project's goals. Refer to of the Drawings in Appendix B for proposed site grading and layout. Construction and operation of a power generation facility requires impervious surface minimization measures and include, but are not limited to,**

bringing buildings closer together and utilizing retaining walls to minimize grading activities.

7. Minimize the decrease in the "time of concentration" from pre-construction to post construction, where "time of concentration" means the time it takes for runoff to travel from the hydraulically most distant point of the drainage area to the point of interest within a watershed. **The site's stormwater management program and associated proposed grading and drainage plans have been designed specifically to minimize the decrease to Time of Concentration (Tc) in the post-construction condition, to the maximum extent practicable given site constraints.**

2.1.3 Manage Impacts at the Source

8. Infiltrate precipitation as close as possible to the point it reaches the ground using vegetated conveyance and treatment systems. **Vegetated conveyance and treatment systems have been proposed in applicable areas. The powerblock area is classified as a Land Use with Higher Potential Pollutant Loads (LUHPPL), and is precluded from infiltrating precipitation. A dry swale is proposed in the access road area to meet this LID objective. Additional details regarding the proposed stormwater Best Management Practices (BMPs) is presented in Section 2.5 of this report, below.**
9. Break up or disconnect the flow of runoff over impervious surfaces. **The site access road has been designed with a cross slope to help meet this LID objective. This LID objective is not applicable to the powerblock area, as it is classified as LUHPPL.**
10. Provide source controls to prevent or minimize the use or exposure of pollutants into stormwater runoff at the site in order to prevent or minimize the release of those pollutants into stormwater runoff. **Source control BMPs will be provided at the project site in the form of a Operation and Maintenance Plan in Appendix D.**

2.1.4 LID Credits

The LID Stormwater Credit rewards the use of LID techniques for disconnecting impervious surfaces and preserving natural hydrologic conditions. The Credit allows project applicants to reduce or eliminate the structural stormwater BMPs otherwise required to meet groundwater recharge (Rev) and water quality volume (WQv) criteria by directing stormwater runoff to qualifying pervious areas (QPAs) that provide recharge and treatment.

The majority of this projectsite is made up of LUHPPL, installation of QPAs is infeasible at the project site and no LID Credits are sought. The overall configuration of the power generation facility and its access road precludes development of a site drainage program which complies with the minimum criteria for draining stormwater to a QPA. Specifically, Section 4.6.1.1 of the RISDISM requires rooftop and non-rooftop impervious areas draining to any one discharge location not to exceed 1,000 square feet. Micro-division of the approximately 700,000 square feet (powerblock area only) of proposed impervious surface into individual areas which drain to QPAs is an infeasible alternative due to the equipment and building sizes required to accomplish the overall objective of the project.

In addition to being infeasible due to drainage plan requirements, Section 4.6.1.1 of the RISDISM requires the minimum QPA length be that of its contributing impervious area flow path. Compliance with this requirement would necessitate the overall disturbance limits increase substantially, which would impact additional aquatic resources and be counter to LID objective 1.

2.2 Hydrologic and Hydraulic Analysis

Portions of the project site proposed for improvement have been analyzed in accordance with guidance presented in Appendix K of the RISDISM. Six Points of Interest (POIs) have been established, POI A though POI F and shown on the Drawings in Appendix C. The same POIs are used in the pre- and post-development conditions. There are minor existing roadway culverts within the project area, which are proposed for removal or replacement. The only known existing drainage facilities in any POI drainage areas is the culverts under the existing cart path. Cover types within all drainage areas are currently forested.

POI A is at the proposed discharge structure from the powerblock's detention facility (refer to Appendix B for additional design details). POI A drains to Iron Mine Brook, and is set in existing wetlands.

POI B is set at the downstream end of the proposed culvert for an unnamed stream (and approximately location of a culver for the existing wood road). POI B discharges to Iron Mine Brook.

POI C has been established immediately south of Wallum Lake Road at the downstream end of a proposed roadway culvert. POI C discharges to Iron Mine Brook.

POI D is an off-site point of interest, needed to determine the peak runoff reduction caused by the project at this off-site area. The proposed grading plan (refer to Appendix B) results in a small amount of area tributary to POI D being diverted to POIs A and B. This reduction is quantified in the calculations discussed below and presented in Appendix C.

POI E is at the existing road culvert for Iron Mine Brook. POI E is needed to perform the downstream analysis.

POI F is set at the downstream end of a proposed wildlife crossing culvert (and the approximate location of a culvert under the existing wood road). POI F discharges to Iron Mine Brook.

2.2.1 Groundwater Recharge

The recharge criterion (Rev) requires that the stormwater be recharged based on the amount of impervious area and in accordance with RISDISM Section 3.3.2. The groundwater recharge requirement may be waived or reduced by applying the LID Stormwater Credit; however, as discussed in Section 2.1.4, due to the nature of the proposed project, no LID Stormwater Credit is sought. Recharge requirements are based on hydrologic soil group (HSG).

The powerblock area is classified as a LUHPPL, for which infiltration or Groundwater Recharge is prohibited per RISDISM Section 3.3.2. The access road area meets the Groundwater Recharge criteria through the use of a Dry Swale (see Section 2.5, below, for additional detail).

Groundwater Recharge at the project site's proposed access road is summarized below. The access road area meets the minimum requirements of the RISDISM Minimum Standard 2. The require volume was calculated using Section 3.3.2 of the RISDISM guidance; please refer to Appendix C for the stormwater calculations.

Table 1 – Summary of Groundwater Recharge (Rev)		
Area	Required minimum Rev, cf	Provided Rev, cf
Powerblock	N/A	N/A
Access Road	1,350	3,180

Water Quality Volume

The water quality volume (WQv) is the amount of stormwater runoff from any given storm that must be captured and treated in order to remove a significant fraction of stormwater pollutants on an average annual basis. The required WQv, which results in the capture and treatment of the entire runoff volume for 90 percent of the average annual storm events, is equivalent to the runoff associated with the first 1.2 inches of rainfall over the impervious surface (i.e., 1 inch of runoff).

The powerblock area meets this criterion through the use of a Gravel Wet Vegetated Treatment System (GWVTS), see Section 2.5 of this document for additional details regarding this structural stormwater management BMP. The access road area meets this criterion through the use of a Dry Swale. Minimum required water quality volumes were calculated in accordance with RISDISM Section 3.3.3 (refer to Appendix C for calculations). The proposed site's compliance with Minimum Standard 3 is summarized below.

Table 2 - Summary of Water Quality Volume (WQv)		
Area	Required minimum WQv, cf	Provided WQv, cf
Powerblock	59,940	65,210
Access Road	5,400	6,230

2.2.2 Water Quality Flow

The GWVTS proposed to treat the powerblock's drainage area is connected to a detention pond proposed as a peak mitigation facility. In accordance with RISDISM Section 3.3.3.2, calculation of the water quality flow is required. The water quality flow must be calculated to insure that only the water quality volume reaches the proposed Gravel WVTS, and storms of higher return period are bypassed to the detention basin to avoid damaging flows impacting the WVTS.

The water quality flow (WQf) is the peak flow rate associated with the water quality design storm or WQv. Flow diversion structures for off-line stormwater treatment practices must be designed to bypass flows greater than the WQf. Refer to Appendix C for calculations. The WQf and associated bypass structure has been designed in accordance with RISDISM Section 3.3.3.2, and is summarized below

Table 3 - Summary of Water Quality Flow (WQf)		
Area	Calculated WQf, cfs*	Actual WQf, cfs
Powerblock	6.73	3.76
Access Road	0.61	0.32

*Flows greater than this are diverted into the detention basin (refer to Appendix B for stormwater BMP locations).

2.2.3 Channel Protection

The channel protection volume (CPv) is the 24-hour extended detention of the post-development runoff volume from the 1-year, 24-hour Type III design storm event.

For facility sizing criteria, the basis for hydrologic and hydraulic evaluation of the project site are as follows:

- The NRCS TR-20 model was used to determine the CPv (in accordance with Section 3.3.4 of the RISDISM guidance).
- Conveyance systems were sized using the NRCS TR-55 (swales and storm sewers).
- Off-site areas draining to proposed BMPs were modeled in their “present condition” for the one-year storm event.
- The length of sheet flow used in time of concentration (tc) calculations was limited to no more than 100 feet.
- CPv was modeled to be released at a uniform rate over 24-hour duration.

The RISDISM guidance document requires computation of the CPv using methodology developed by Harrington (1987). For the proposed project, the runoff volume associated with the 1-year, 24-hour Type III storm event was computed for each drainage area (refer to Appendix C for calculations), and the CPv determined by multiplying this runoff volume for each area by 0.65. The results of this analysis are presented below.

Table 4 - Summary of Channel Protection Volumes CPv)

Area	Calculated CPv, cf	Calculated average release rate, cfs	Provided average release rate, cfs
Powerblock	227,651	2.63	2.57
Access Road	36,302	0.47	N/A*

*Less than 2 fps

As summarized above, the powerblock drainage area’s detention pond has been designed to meet Channel Protection criteria. The access road’s detention basin has also been designed to meet these criteria. Refer to Appendix C for calculations.

2.2.4 Overbank Flood Protection

Peak flow attenuation is required for the 10-year and 100-year, 24-hour Type III design storm events. The primary purpose of this sizing criterion is to prevent an increase in the frequency and magnitude of out-of-bank flooding (i.e., flow events that exceed the bankfull capacity of the channel and, therefor, must spill over to the floodplain). One of the key objectives of an out-of-bank flooding requirement is to protect downstream structures (houses, businesses, culverts, bridge abutments, etc.) from increased flows and velocities from upstream development. The intent of this criterion is to prevent increased flood damage from infrequent, but very large storm events; maintain the boundaries of the predevelopment floodplain; and protect the physical integrity of a stormwater management practice.

For facility sizing criteria, the basis for hydrologic and hydraulic evaluation of the project site are as follows:

- The TR-20 model was used for determining the required storage and outlet structures for attenuating the peak flows from the 10-year and 100-year, 24-hour Type III design storms.
- The standard for characterizing pre-development land use for on-site areas was woods (entire proposed drainage area is wooded).
- For purposes of computing runoff, all pervious lands prior to development were assumed to be in good condition regardless of conditions existing at the time of computation.
- Off-site areas that drain to a proposed facility were modeled as "present condition" for peak-flow attenuation requirements.
- Off-site areas drain to the proposed stormwater management BMPs. The calculations in Appendix C of this document demonstrate safe passage of the 100-year event based on actual conditions upstream.
- Due to the size of some of the drainage areas, the Lag method was used to calculate the Tc. To maintain compatibility for both the pre-development conditions and the post-development conditions.

The detention basin at the south side of the powerblock area and detention basin serving the proposed access road have been designed to meet Minimum Standard 5. The results are summarized below.

Table 5 - Summary of Overbank Flood Protection (Qp), cfs				
POI	10-year pre-development runoff rate, cfs	10-year post-development runoff rate, cfs	100-year pre-development runoff rate, cfs	100-year post-development runoff rate, cfs
A	20.16	18.29	46.68	40.42
B	86.73	74.75	197.47	174.13
C	9.01	8.29	20.85	18.29
D	140.96	137.55	327.06	319.56
F	13.08	7.01	30.37	16.28

2.2.5 Downstream Analysis

A downstream analysis is required for projects meeting the project size and impervious cover characteristics specified in the RISDISM or when deemed appropriate by the approving agency when existing conditions are already causing a problem (e.g., known drainage or flooding conditions or existing channel erosion is evident), to determine whether peak flow impacts are fully attenuated by controlling the 10- and 100-year events. The criterion used for the limit of the downstream analysis is referred to as the “10% rule.” Under the 10% rule, a hydrologic and hydraulic analysis is extended downstream to the point where the site represents 10% of the total drainage area. For example, a 10-acre disturbed area within the subwatershed would be analyzed to the point downstream with a drainage area of 100 acres.

This project's disturbance area within the watershed and proposed impervious cover percentage require the preparation of a Downstream Analysis in accordance with Section 3.3.6 of the RISDISM. Such an analysis has been prepared, and the site's proposed stormwater management BMPs meet the requirements of RISDISM Section 3.3.6 related to Downstream Analysis. See Appendix C for calculations.

2.3 Land Uses with Higher Potential Pollutant Loads (LUHPPL)

The powerblock area of the project site qualifies as a LUHPPL in accordance Section 3.0 of the RIDEM Stormwater Manual. The only portion of the development that is not considered a LUHPPL is the access road to the powerblock. The proposed site use in the powerblock area is a power generation facility (industrial site as defined in RIPDES Rule 31(b)(15)). The site does not qualify for a No Exposure Certification for Exclusion from RIPDES Stormwater Permitting. Only the drainage area comprised of the project's access road is not considered a LUHPPL.

2.4 Illicit Discharges

Illicit discharges to stormwater management systems are prohibited, including stormwater best management practices and pipes intended to transport stormwater to ground water, surface water, or municipal separate storm sewer system (MS4). Illicit discharges to the stormwater management system, e.g., illicit connections, are discharges not entirely comprised of stormwater that are not specifically authorized by a National Pollutant Discharge Elimination System (NPDES) or RIPDES permit. The project plan is not discharging to any MS4s.

2.5 Structural Best Management Practices

Structural BMPs to be installed at the project site include a Dry Swale (RISDISM # 5.7) and a Gravel Wet Vegetated Treatment System (RISDISM # 5.2). The Dry Swale has been divided into four reaches for hydraulic modeling purposes (BMP No. 15R, 29R, 18R, and 20R). Refer to the Drawings in Appendix B for design details of each proposed facility and Appendix C for calculations.

The Gravel Wet Vegetated Treatment System meets the following design criteria:

- Surface area must be a minimum of 0.35% of drainage area.

- At least 10% of the WQv shall be provided in a sediment forebay or other pretreatment practice. The remaining 90% of the WQv may be provided in some combination of one or more basins filled with gravel and Extended Detention (ED) storage above the gravel. ED storage volume shall not exceed 50% of the WQv and shall drain over 24 hours.
- Maintain substrate in saturated condition

The Dry Swale meets the following design criteria:

- Maximum longitudinal slope of 4%, without checkdams.
- Non-erosive (3.5 to 5.0 fps) peak velocity for the 1-year storm.
- Safe conveyance of the 10-year storm.
- Side slopes gentler than 2:1 (3:1 preferred).
- The maximum allowable temporary ponding time of 48 hours.
- 10% of the WQv in pretreatment, usually provided using check dams at culverts or driveway crossings.
- Storage of WQv in facility (wet swale) or through properly sized filter media/bioretention soil (dry swale).
- Bottom width no greater than 8 feet, but no less than 2 feet.
- Dry Swale utilizes bioretention soil media as detailed in Appendix F of RISDISM.

The proposed post construction stormwater management BMPs meet or exceed all criteria listed above. Refer to Appendix C for calculations demonstrating designed compliance, and Appendix B for plan drawings of details

2.6 Stormwater Design Calculations

Stormwater design calculations have been included in Appendix C of this document. Please refer to this appendix for further information.

3.0 SOIL EROSION AND SEDIMENT CONTROL

The Soil Erosion and Sediment Control report is included in the Appendix E of this report. The drawings are in Appendix B.

4.0 OPERATION AND MAINTENANCE

The Operation and Maintenance manual is included in the Appendix D of this report.

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APPENDICES

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Appendix A – Checklist

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APPENDIX A: STORMWATER MANAGEMENT CHECKLIST AND LID PLANNING REPORT

PROJECT NAME: CLEAR RIVER ENERGY CENTER	(RIDEM USE ONLY)
CONTACT FOR STORMWATER DESIGN QUESTIONS: Alexander E. Deuson, P.E.	
PHONE NUMBER: (602) 385-1621	
EMAIL ADDRESS: alexander.deuson@hdrinc.com	
BRIEF PROJECT DESCRIPTION: New Electric Plant	DATE RECEIVED

STORMWATER MANAGEMENT PLAN ELEMENTS

APPENDIX A: STORMWATER MANAGEMENT CHECKLIST	STORMWATER ANALYSIS AND DRAINAGE REPORT	SOIL EROSION AND SEDIMENT CONTROL PLAN	OPERATIONS AND MAINTENANCE PLAN
PART 1: PROJECT AND SITE INFORMATION **MINIMUM STANDARDS:** 6. REDEVELOPMENT 8. LUHHPL IDENTIFICATION **PART 2.** **MINIMUM STANDARD:** 1. LID SITE PLANNING **PART 3.** SUMMARY OF REMAINING STANDARDS **PART 4.** SUBWATERSHED MAPPING SITE PLAN DETAILS	ADDRESSES MINIMUM STANDARDS: 2. GROUNDWATER RECHARGE 3. WATER QUALITY VOLUME 4. CONVEYANCE & NATURAL CHANNEL PROTECTION 5. OVERBANK AND FLOOD PROTECTION 9. ILLICIT DISCHARGE DETECTION AND ELIM.	ADDRESSES MINIMUM STANDARDS: 7. POLLUTION PREVENTION DURING CONSTRUCTION 10. CONSTRUCTION EROSION AND SEDIMENTATION CONTROL	ADDRESSES MINIMUM STANDARDS: 7. POLLUTION PREVENTION AFTER CONSTRUCTION 11. OPERATIONS AND MAINTENANCE

Note: **All** stormwater construction projects **must submit** a Stormwater Management Plan (SMP). However, not every element listed below (see the Stormwater Management Plan Table) is required per the RISDISM and the RIPDES Construction General Permit (CGP). This checklist will help you identify the elements of the stormwater plan you are required to submit with your permit application.

PART 1. PROJECT AND SITE INFORMATION

PROJECT TYPE (Check all that apply)

☐ RESIDENTIAL	X COMMERCIAL	☐ FEDERAL	☐ RETROFIT	☐ RESTORATION
X ROAD	X UTILITY	X FILL	☐ DREDGE	☐ MINE

☐ OTHER: (please explain)	
SITE INFORMATION	
X VICINITY MAP X EXISTING ZONING	
DISCHARGE LOCATION: The WQv discharges to: (you may choose more than one answer if there are several discharge points on the project) (Guidance to identify receiving waters)	
☐ GROUNDWATER	GROUNDWATER ☐ GAA ☐ GA ☐ GB
X SURFACE WATER	☐ ISOLATED WETLAND ☐ NAMED WATERBODY X UNNAMED WATERBODY CONNECTED TO NAMED WATERBDY
☐ MS4	☐ RIDOT ☐ RIDOT ALTERATION PERMIT IS APPROVED ☐ TOWN ☐ OTHER:_______________
RECEIVING WATER INFORMATION: (check all that apply and *repeat* this row for each waterbody)	
THE WATER QUALITY VOLUME DISCHARGES TO: ☐ N/A (discharges to: CSO, Disconnected wetland or Groundwater) WATERBODY NAME:__Iron Mine Brook______ WATERBODY ID: _______________ IMPAIRMENTS: _______________ ☐ TMDL FOR: _______________ ☐ CONTRIBUTES TO A PRIORITY OUTFALL LISTED IN THE TMDL	☐ IMPAIRED (303(d) LIST) ☐ SRPW ☐ COLDWATER ☐ WARMWATER ☐ UNASSESSED ☐ 4TH ORDER STREAM ☐ POND OF 50 ACRES OR MORE ☐ KNOWN HISTORY OF REPETITIVE FLOODING (i.e. Pocassett River) ☐ CONTRIBUTES STORMWATER TO A PUBLIC BEACH ☐ CONTRIBUTES TO SHELLFISHING GROUNDS
PROJECT HISTORY:	
X PRE-APPPLICATION MEETING DATE: __Oct. 2016_______	☐ MINUTES ARE ATTACHED
☐ RIDEM GRANT FUNDING INVOLVED	GRANT SOURCE:____________
☐ TOWN MASTER PLAN APPROVAL DATE: _________	☐ MINUTES ARE ATTACHED
☐ SUBDIVISION SUITABILITY REQUIRED	APPROVAL #: _______________
☐ PREVIOUS ENFORCEMENT ACTION HAS BEEN TAKEN ON THIS PROPERTY	ENFORCEMENT # _____________

FRESHWATER WETLANDS JURISDICTION: X FEMA FLOODPLAIN FIRMETTE HAS BEEN REVIEWED ☐ CALCULATIONS ARE PROVIDED FOR CUT/FILL PROPOSED ANYWHERE WITHIN THE 100-YR FLOODPLAIN X RESTRICTIONS OR MODIFICATINS ARE PROPOSED TO THE FLOWPATH OR VELOCITIES IN A FLOODWAY. X FLOODPLAIN STORAGE CAPACITY IS IMPACTED	AMOUNT OF FILL: __147_______(CY) AMOUNT OF CUT: __150_______(CY)
CRMC JURISDICTION ☐ THIS PROJECT REQUIRES A CRMC PERMIT ☐ THE PROPERTY IS SUBJECT TO A SPECIAL AREA MANAGEMENT PLAN ☐ SEA LEVEL RISE MITIGATION WAS DESIGNED INTO THIS PROJECT	
MINUMUM STANDARD 8: LUHHPL IDENTIFICATION	
OFFICE OF WASTE MANAGEMENT (OWM) ☐ THERE ARE KNOWN OR SUSPECTED RELEASES OF HAZARDOUS MATERIAL AT THE SITE ☐ THIS SITE IS ON THE LIST OF CERCLA and STATE SITES in RI	OWM CONTACT: ____________ ☐ SITE ID#:_______________
STORMWATER INDUSTRIAL PERMITTING X THERE ARE EXISTING OR PROPOSED ACTIVITIES THAT ARE CONSIDERED LAND USES WITH HIGHER POTENTIAL POLLUTANT LOADS (LUHPPLS) (see Table 3-2) X 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. ☐ ADDITIONAL STORMWATER TREATMENT IS REQUIRED BY THE MSGP	ACTIVITIES: (SE) Electric Power Generation Natural Gas SECTOR: __01_______________________ MSGP PERMIT #: __RIR500000_________ EXPLAIN ADDITIONAL TREATMENT: ____ ____________________________________

MINIMUM STANDARD 6. REDEVELOPMENT (*Required calculation for all construction projects)

☐ PRE-CONSTRUCTION IMPERVIOUS AREA		TOTAL IMPERVIOUS AREA **(TIA)** = _________
☐ CALCULATE THE SITE SIZE SITE SIZE **(SS)** = **(TSA)** – **(JW)** – **(CL)** = _____________		TOTAL SITE AREA **(TSA)** = ________________ JURISDICTIONAL WETLANDS **(JW)**: _________ CONSERVATION LAND **(CL)** = ______________
(TIA)/(SS) = _____________	**(TIA)/(SS)** IS > 0.4) ☐ YES (REDEVELOPMENT) (address minimum standards 3 and 7-11)	**(TIA)/(SS)** IS < 0.4) X NO (NEW DEVELOPMENT) (all standards must be addressed)

PART 2: MINIMUM STANDARD 1

LOW IMPACT DEVELOPMENT ASSESSMENT

(**NOT REQUIRED FOR REDEVELOPMENT OR RETROFITS**) – You may delete this section if it is not required

State Law requires the use of low impact-design techniques as the primary method of stormwater control to the maximum extent practicable. LID is intended to maintain or replicate predevelopment hydrology through the use of site planning, source control, and small-scale practices integrated throughout the site to prevent, infiltrate, and manage runoff as close to its source as possible. Non-structural LID techniques to Avoid and Reduce the stormwater impacts of development shall be explored as a first priority before LID structural practices are planned to Manage stormwater as part of a comprehensive LID approach.

The applicant must document specific LID Site Planning and Design Strategies applied for the project (see Manual Chapter Four and the *RI Low Impact Development (LID) Site Planning and Design Guidance Manual* for more details regarding each strategy). This checklist is designed to guide the required documentation of the site planning process, and to ensure that the proposed project is consistent with and taking advantage of LID strategies required or allowed in the municipality where the project is proposed. Included within this checklist are specific LID techniques (and practices) taken from the *RI Low Impact Development (LID) Site Planning and Design Guidance Manual* that a municipality may require or allow.

If a particular strategy is not used or not applicable, a written description of why a certain method is not used or applicable at the site must be provided. Appropriate answers may include such statements as:

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

A) PRESERVATION OF UNDISTURBED AREAS, BUFFERS AND FLOODPLAINS X Sensitive resource areas and site constraints are identified (required) X Local development regulations have been reviewed (required) ☐ All vegetated buffers and coastal and freshwater wetlands have been designed to be protected during and after construction X Conservation Development or other site design technique to protect open space and pre-development hydrology; [NOTE: If this technique has been used, check box and skip to **c**.] ☐ Maintain as much natural vegetation and pre-development hydrology as possible	***IF NOT IMPLEMENTED - EXPLAIN HERE***
B) LOCATE DEVELOPMENT IN LESS SENSITIVE AREAS AND WORK WITH THE NATURAL LANDSCAPE CONDITIONS, HYDROLOGY, AND SOILS ☐ Building envelopes/ development sites directed away from wetlands/waterbodies ☐ Development and stormwater systems are 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) ☐ Building envelopes/ development sites are directed away from floodplains ☐ Site designed to locate buildings, roadways and parking to avoid impacts to surface water features. ☐ Building envelopes/ development sites directed away from steep slopes (≥15%) ☐ Other:	***IF NOT IMPLEMENTED - EXPLAIN HERE*** **This is a LUHPPL Project**
C) MINIMIZE CLEARING AND GRADING X Site clearing restricted to <u>minimum area needed</u> for building footprints, development activities, construction access and safety. X Site designed to locate buildings, roadways and parking to minimize grading (cut and fill quantities) X Protection for stands of trees and individual trees and their root zones to be preserved is specified and such protection extends at least to the drip line ☐ Notes on plan specify that public trees that are removed or damaged during construction shall be replaced with equivalent.	***IF NOT IMPLEMENTED - EXPLAIN HERE*** **This is Private Property**

D) REDUCE IMPERVIOUS COVER	IF NOT IMPLEMENTED - EXPLAIN HERE
X Reduce roadway widths (≤22 feet for ADT ≤ 400; ≤ 26 feet for ADT 400-2,000)	**This is a industrial power generation facility. Road widths are set to accommodate full range and size of vehicles up to and including semi trailer trucks.**
☐ Reduce 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)	
X Reduced building footprint: Explain approach	**Limited powerblock area**
X Reduce sidewalk area (≤ 4 ft. wide; one side of the street; unpaved path; pervious surface)	**None proposed**
X Reduce cul-de-sacs (radius < 45 ft; vegetated island; alternative turn-around)	**None proposed**
☐ Reduced parking lot area: Explain approach	**LUHPPL Site**
X Pervious surfaces (driveways, sidewalks, parking areas/overflow parking area)	
☐ Maximum Impervious Surface (project meets or is less than the maximum specified by the Zoning Ordinance	
☐ Other (describe):	

E) DISCONNECT IMPERVIOUS AREA	IF NOT IMPLEMENTED - EXPLAIN HERE
☐ Impervious surfaces have been disconnected and runoff has been diverted to QPAs to the maximum extent possible	**LUHPPL Site**
☐ Residential street edges allow side-of-the-road drainage into vegetated open swales	
☐ Parking lot landscaping breaks up impervious expanse AND accepts runoff	
☐ Other:	

F) MITIGATE RUNOFF AT THE POINT OF GENERATION	IF NOT IMPLEMENTED - EXPLAIN HERE
X Small-scale BMPs have been designated to treat runoff as close as possible to the source	**Dry Swale**

G) PROVIDE LOW-MAINTENANCE NATIVE VEGETATION	IF NOT IMPLEMENTED - EXPLAIN HERE
X Low-maintenance landscaping is proposed using native species and cultivars	
X Plantings of native trees and shrubs in areas previously cleared of native vegetation are shown on the site plan	
☐ Lawn areas have been limited and/or minimized and yards have been kept undisturbed to the maximum extent on residential lots	

H) RESTORE STREAMS/WETLANDS	IF NOT IMPLEMENTED - EXPLAIN HERE
☐ Historic drainage patterns have been restored by removing closed drainage systems, daylighting buried streams, and/or restoring degraded stream channels and/or wetlands.	**N/A no historical drainage patterns**
☐ Removal of invasive species	**No invasive species**
X Other	**Removed flow restrictions from existing culverts**

PART 3: SUMMARY OF REMAINING STANDARDS

Minimum Standard 2: Groundwater Recharge

☐ YES ☒ NO The project has been designed to meet the groundwater recharge standard.

If No, please explain the justification for groundwater recharge criterion waiver (i.e. threat of groundwater contamination, or physical limitation), if applicable (see Section 3.3.2);

Please describe your waiver request __

LUHHPL Site

☐ YES ☒ NO Is this site listed as a CERCLA or contaminated site?, if yes?

☐ YES ☐ NO Has any part of the site been approved for infiltration by the Office of Waste Management? (see Subsurface Contamination Guidance)

☐ YES ☐ NO Is there an ELUR on the property?

TABLE 2-1: Summary of Recharge (see Manual section 3.3.2)

Subwatershed	Total Re_v Required (Acre-ft)	LID Stormwater Credits (Manual see Section 4.6.1)		Recharge Required by Remaining BMPs (acre-ft)	Recharge Provided by BMPs (acre-ft)
		Impervious volume directed to a QPA (acre-ft)	Recharge Credit Applied (acre-ft)		
DP-1: Point B	0.0187	N/A	N/A	0	0.024
DP-2: Point C	0.0123	N/A	N/A	0	0.049
DP-3:					
DP-4:					
Totals:	0.031	N/A	N/A	0	0.073

**Note: Only BMPs listed in Manual Table 3-5, List of BMPs Acceptable for Recharge may be used to meet the recharge requirement.*

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

Appendix C - Sections 3 & 4

Minimum Standard 3: Water Quality

X YES ☐ NO Does this project meet or exceed the required water quality volume WQv (see section 3.3.3)?

× YES ☐ NO Is the proposed final impervious cover is greater than 20% of the disturbed area (see section 3.3.3)?

☐ If yes, the Spit Pervious/Impervious method in Hydro-Cad was used to calculate WQv, or

☒ If yes, 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.

X YES ☐ NO Does this project meet or exceed the ability to treat required water quality flow WQf(see section 3.3.3.2)?

☐ YES X NO Is there 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.

☐ RISDISM section H.3 Pollutant Loading Analysis

☐ The Water Quality Guidance Document (Water Quality Goals and Pollutant Loading Analysis Guidance for Discharges to Impaired Waters)

☐ YES X NO BMPs are proposed that are on the approved technology list if yes, please provide all of the required worksheets from the manufacturer.

☐ YES X NO 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 Manual section 3.3.3)

Subwatershed	Total WQ_v Required (Acre-ft)	LID Stormwater Credits (Manual see Section 4.6.1)		Water Quality Treatment Remaining (acre-ft)	Water Quality Provided by BMPs (acre-ft)
		Impervious volume directed to a QPA (acre-ft)	Water Quality Credit Applied (acre-ft)		
DP-1: Point A	1.376	N/A	N/A	0.121	1.497
DP-2: Point B	0.075	N/A	N/A	0.024	0.094
DP-3: Point C	0.049	N/A	N/A	0	0.049
DP-4:					
Totals:	1.500	N/A	N/A	0.145	1.640

**Note: Only BMPs listed in Chapter 5 of the Manual or the Approved Technologies List of BMPs is Acceptable for Water Quality treatment.*

X YES ☐ NO This project has met the setback requirements for each BMP. If no, please explain

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

Appendix C - Sections 3 & 4

Minimum Standard 4: Conveyance and Natural Channel Protection (3.3.4)

☐ YES X NO Is this standard waived? If yes, please check 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 order), bodies of water >50.0 acres in surface area (i.e., lakes, ponds, reservoirs), or tidal waters.

☐ The project directs is a small facility with impervious cover of less than or equal to 1 acre.

☐ The project has a post-development peak discharge rate from the facility that is less than 2 cfs for the 1-year, 24-hour Type III design storm event (prior to any attenuation). (**NOTE:** *LID design strategies can greatly reduce the peak discharge rate)*

X YES ☐ NO Conveyance and natural channel protection for the site have been met.

If no, explain why ____
____

TABLE 4-1: Summary of Channel Protection Volumes (see Manual section 3.3.4)

Drainage Point	Receiving Water Body Name	Coldwater Fishery? Y/N	Total CPv Required (acre-ft)	Total CPv Provided (acre-ft)	Release Rate Modeled in the 1-yr storm (cfs)
DP-1:	Iron Mine Brook	N	5.97	4.31	2.57
DP-2:	Iron Mine Brook	N	0.61	0.11	0.26
DP-3:					
DP-4:					
Totals:			6.58	4.42	2.83

X YES ☐ NO The CPv is released at roughly a uniform rate over a 24-hour duration (see example sizing calculations in Appendix D of the RISDISM).

☐ YES X NO Do additional design restrictions apply resulting from any discharge to cold water fisheries;

If yes, please indicate restrictions and solutions
____
____

X Indicate below where the pertinent calculations and/or information for the above items are provided (i.e. name of report/document, page numbers);

Minimum Standard 5: Overbank Flood Protection (3.3.5) (and other potential high flows)

☐ YES X NO Is this standard waived? If yes, please check 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 order), bodies of water >50.0 acres in surface area (i.e., lakes, ponds, reservoirs), or tidal waters.

☐ A Downstream Analysis (see section 3.3.6), indicates that peak discharge control would not be beneficial or would exacerbate peak flows in a downstream tributary of a particular site (i.e. through coincident peaks)

☐ YES X NO Does the project flow to an MS4 system? If yes, indicate below:

☐ RIDOT ☐ Other __________________

(**NOTE**: *your 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 your strategy to comply with RIDEM and the MS4.

____

____

____

X YES ☐ NO Did you use a model for your analysis, if yes, indicate below

☐ TR-55 X TR-20 X Hydrocad ☐ Other _____________

X YES ☐ NO Does the hydrologic model demonstrate that flows from the 100-year event will be safely conveyed to a control practice designed to manage the 100-year event? If no, please explain

____

____

X YES ☐ NO Do off-site areas contribute to the subwatersheds and design points? If yes,

X YES ☐ NO Are the areas modeled as "present condition" for both pre- and post-development analysis

X YES ☐ NO Are the off-site areas are shown on the subwatershed maps

X YES ☐ NO Does the hydrologic model confirm safe passage of the 100-year flow through the site for off-site runoff;

X YES ☐ NO Is a Downstream Analysis required? (see Manual Section 3.3.6):

Please calculate the following:

Area of disturbance within the sub-watershed (areas) 35.14

Impervious cover (%) 51.8

☐ YES X NO Is a dam breach analysis required (earthen embankements over six (6) feet in height, or a capacity of 15 acre-feet or more, and contributes to a significant or high hazard dam?

X YES ☐ NO Does this project meet the overbank flood protection standard?

Table 5-1 Hydraulic Analysis Summary

Subwatershed (design point)	**1.2" Peak Flow Pre (cfs)**	**Post (cfs)**	**1-yr Peak Flow Pre (cfs)**	**Post (cfs)**	**10-yr Peak Flow Pre (cfs)**	**Post (cfs)**	**100-yr Peak Flow Pre (cfs)**	**Post (cfs)**
DP-1: Point A	0.39	1.30	6.5	6.44	20.16	18.29	46.68	40.42
DP-2: Point B	2.12	1.52	28.94	24.02	86.73	74.75	197.47	174.13
DP-3: Point C	0.17	0.3	2.89	2.88	9.01	8.29	20.85	18.29
DP-4: Point F	0.26	0.14	4.23	2.27	13.08	7.01	30.37	16.28
DP-5: Point D	2.72	2.65	45.55	44.54	140.96	137.55	327.06	319.56
Totals:	5.66	5.91	88.11	80.15	269.94	245.89	622.43	568.68

X Indicate below where the pertinent calculations and/or information for the above items are provided (i.e. name of report/document, page numbers);

- ✓ Existing condition analysis for each subwatershed, including (curve numbers, times of concentration, runoff rates, volumes, and water surface elevations showing methodologies used and supporting calculations);

  Appendix C - Section 11

- ✓ Proposed condition 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);

  Appendix C – Section 12

- ✓ Final sizing calculations for structural stormwater BMPs including, contributing drainage area, storage, and outlet configuration;

  Appendix C - Section 6

- ✓ Stage-storage, inflow and outflow hydrographs for storage facilities (e.g., detention, retention, or infiltration facilities);

  Appendix C – Section 12

Table 5-2 Summary of Best Management Practices

DP No.	BMP ID.	BMP Type (i.e. bioretention or tree filter)	BMP Functions (acre-ft)				Overbank Flood Reduction	Internal Bypass	Horizontal Setback Criteria Met	
			Pre-treatment (volume)	Re_v	WQ_v	CP_v	Y/N	Y/N	Distance (ft)	From constraint (i.e. private well or foundation)
A	2P & 3P	Gravel WVTS	0.14	0	1.24	5.23	Y	Y	N/A	N/A
B	15R & 25R	Dry Swales	0	0.02	0.07	0.28	Y	N	588’	Building
C	18R & 20R	Dry Swales	0	0.01	0.05	0.55	Y	N	184’	Private Water Well
		TOTAL:	0.14	.03	1.36	6.06				

Table 5-3 Summary of Soils to evaluate each BMP

DP No.	BMP ID.	BMP Type (i.e. bioretention or tree filter)	Soils Analysis for Each BMP						
			Primary (Test Pit ID #)	Secondary (Test Pit ID #)	Top of Filter Elevation (ft)	SHWT Elevation (ft)	Separation Distance (ft)	Hydrologic Soil Group A,B,C or D	Exfiltration Rate Applied (in/hr)
		TOTAL:							

Minimum Standard 7: (questions are now asked in Minimum Standard 10 and 11)

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

X YES ☐ NO Are there any existing activities or land uses proposed that would be considered LUHPPLs (see Manual Table 3-2)? If yes, please describe. If no, you may continue on to Minimum Standard 9:

Electric Power Facility

☐ YES X NO Are these activities already covered under an MSGP? If, no please explain if you have applied for an MSGP, or intend to do so?

____

X YES ☐ NO ☐ List the specific BMPs that are proposed for this project that receive stormwater from LUHPPL drainage areas. These BMP types must be listed in Manual Table 3-3, “Acceptable BMPs for Use at LUHPPLs”;

Please list BMPs Lined Gravel WVTS

☐ 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);______________________________

Minimum Standard 9: Illicit Discharges

☐ YES ☐ NO Have you checked for illicit discharges? N/A

☐ YES ☐ NO Have any been found and/or corrected? If yes, please identify

____

X YES ☐ NO Does your report explain preventative measures that keep non-stormwater discharges out of the Waters of the State (during and after construction)?

Minimum Standard 10 Soil Erosion and Sediment Control

X YES ☐ NO Have you included a Soil Erosion and Sediment Control Plan Set and/or Complete Construction Plan Set?

X YES ☐ NO Did you provide 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 a 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.

Minimum Standard 7&11: Stormwater Management System Operation, Maintenance and Pollution Prevention Plan (See section 3.2.11 and Appendices G and E for guidance)

X YES ☐ NO Have you minimized all sources of pollutant contact with stormwater runoff, to the maximum extent practicable?

X YES ☐ NO Have you provided a separately bound **Operations, Maintenance and Pollution Prevention Manual** for the site and for all of the BMPs?

The (O&M and PP Plan Contains):

X YES ☐ NO Contact name, address, and phone number of the responsible party for maintenance;

X YES ☐ NO 8.5" x 11" map indicating the location of all of the proposed stormwater BMPs that will require maintenance;

X YES ☐ NO Description of routine and non-routine maintenance tasks and their frequency for required elements for each BMP;

☐ YES X NO A description and delineation of public safety features;

X YES ☐ NO An estimated operations and maintenance budget;

☐ YES X NO Minimum vegetative cover requirements;

X YES ☐ NO Access and safety for maintenance?

X YES ☐ NO Lawn, Garden and Landscape Management meet the requirements of section G.7? If not, why not?

____

____

☐ YES X NO Is the property owner or homeowners association is responsible for the stormwater maintenance of all BMP's?

If no, you must provide a legally binding and enforceable maintenance agreement (see Appendix E-page 26) that identifies the entity that will be responsible for maintenance of the stormwater. Please indicate where this agreement can be found in your report: N/A

☐ YES X NO Do you anticipate that you will need legal agreements related to the stormwater structures? (e.g. off-site easements, deed restrictions, and covenants).
If yes, have you obtained them? Or please explain your plan to obtain them:

____

____

☐ YES X NO Is stormwater being directed from public areas to private property? If yes, (**NOTE**: *this is not allowed unless there is a funding mechanism in place to provide the finances for the long-term maintenance of the BMP and drainage unless there is a funding mechanism is demonstrated that can guarantee the long-term maintenance of a stormwater BMP by an individual homeowner*)

____

____

Pollution Prevention Section Contains:

X YES ☐ NO Designated snow stockpile locations?

X YES ☐ NO Trash racks to prevent floatables, trash and debris from discharging to waters of the state?

☐ YES X NO Asphalt only based sealants?

☐ YES X NO Pet waste stations? (**NOTE:** *if a receiving water has a bacterial impairment and the project involves housing units, this could be an important part your pollution prevention plan*)

☐ YES X NO Regular sweeping? Please describe ______________________________

X YES ☐ NO Deicing specifications in accordance with Appendix G of the Manual. (**NOTE**: *if the groundwater is GAA or this area contributes to a drinking water supply, this could be an important part of your pollution prevention plan (see Appendix G):*

____

X YES ☐ NO A prohibition of phosphate based fertilizers? (**NOTE**: *if the site discharges to a phosphorus impaired waterbody, this could be an important part of your pollution prevention plan*)?

PART 3: SUBWATERSHED MAPPING AND SITE PLAN DETAILS

Existing and Proposed Subwatershed Mapping (REQUIRED)

X Existing and proposed drainage area delineations

- ✓ Locations, cross sections, and profiles of all streams and drainage swales and their method of stabilization;
- ✓ Drainage flow paths, mapped according to the DEM *Guidance for Preparation of Drainage Area Maps* (included in 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,

X Mapped locations of the site-specific borings and/or test pits and soils information from the test pits at the locations of the BMPs

X Mapped locations of the BMPs with the BMPs consistently identified on the Site Construction Plans

☐ Mapping bedrock within 3' of any BMP

☐ YES X NO Soils were logged by a:

- ☐ DEM-licensed Class IV soil evaluator Name: ____________________
- ☐ RI-registered PE. Name; ____________________________________

Subwatershed Summary *(add or subtract rows as necessary)*				
Subwatershed (acres to each design point)	**First Receiving Water ID or MS4**	**Area Disturbed (acres)**	**Existing Impervious (acres)**	**Proposed Impervious (acres)**
DP-1: Point A		6.02	0	18.46
DP-2: Point B		19.00	1.86	1.80
DP-3: Point C		0.88	0	0.62
DP-4: Point F		3.63	0	0
DP-5: Point D		4.10	0	0
Totals:		33.63	1.86	20.88

Site Construction Plans (the following applicable specifications are provided)

- ✓ 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, lakes, 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, 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 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., invert of pipes, manholes, etc.);

- ► Location of floodplain and, if applicable, floodway limits and relationship of site to upstream and downstream properties or drainage that could be affected by work in the floodplain;
- ► Planting plans for structural stormwater BMPs, including species, size, planting methods, and maintenance requirements of proposed planting;
- ► Logs of borings and/or test pit investigations along with supporting soils/geotechnical report and corresponding water tables.

✓ Mapping of any OWM approved activities related to current/former site use areas for any known contamination and/or remedial clean-up efforts.

✓ 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, as well as location(s) of final discharge point (wetland, waterbody);
- ► 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

Appendix B – Drawings

PROVIDED UNDER SEPARATE COVER

11 Stanwix Street | Suite 800 | Pittsburgh, PA 15222
T 412.497.6000

Appendix C – Calculations

11 Stanwix Street | Suite 800 | Pittsburgh, PA 15222
T 412.497.6000

Drainage Report

For

Clear River Energy LLC
Rhode Island

March 2017

DISCHARGE POINT COMPARISONS

Point A			
Storm	**Existing (1S)**	**Proposed (21L)**	**Velocity [1]**
10-Year	20.16	18.29	0.77
100-Year	46.68	40.42	1.05

Note [1] - Exit at Level Spreader

Point B			
Storm	**Existing (2S)**	**Proposed (22L)**	
10-Year	86.73	74.75	
100-Year	181.63	178.73	

Note 1 -

Note 2

Point C			
Storm	**Existing (3S)**	**Proposed (21R)**	
10-Year	9.01	8.29	
100-Year	20.85	18.29	

Point D			
Storm	**Existing (4S)**	**Proposed (23S)**	**% Increase**
10-Year	140.96	137.55	-2.42%
100-Year	327.06	319.56	-2.29%

DISCHARGE POINT COMPARISONS

Point E			
Storm	**Existing**	**Proposed**	**% Increase**
10-Year	136.42	119.88	-12.12%
100-Year	327.16	283.38	-13.38%

Point F			
Storm	**Existing**	**Proposed**	**% Increase**
10-Year	13.08	7.01	-46.41%
100-Year	30.37	16.28	-46.39%

Invenergy – Rhode Island - Clear River Energy

Main Site (2P & 3P)

Total Drainage Area = 17.993 ac
Impervious Area = 16.51 ac
HSG = D

Groundwater Recharge (Re_v)

Note: LUHPPL therefore no infiltration required

$$Re_v = (1")(F)\left(\frac{I}{12}\right)$$

Table 3-4	
HSG	Recharge Factor (F)
A	0.60
B	0.35
C	0.25
D	0.10

F = recharge factor (Table 3-4)
I = 16.51 impervious area (ac)

Re_v = 1*F*(I/12)

Re_v = 0 groundwater recharge volume (ac-ft)

Re_v = 0 groundwater recharge volume (ft^3)

Water Quality Volume (WQ_v)

Note:

$$WQ_v = (1")\left(\frac{I}{12}\right)$$

I = 16.51 impervious area (ac)

WQ_v = 1*(I/12)

WQ_v = 1.376 Total Water Quality Volume (ac-ft) **OR** 59,931 ft^3 65,192 ft^3 - Actual Total Volume
1.4966 ac-ft - Actual Total Volume

Forbay = 0.14 10% of WQ_v in ac-ft **OR** 5,993 ft^3 19,882 ft^3 - Actual Forbay volume

WQ_v = 1.24 90% of WQ_v in ac-ft **OR** 53,938 ft^3 45,310 ft^3 - Actual rest of the WQ volume

---

Modified CN

Note:

$$CN = 1000/\left[10 + 5P + 10Q - 10\left(Q^2 + 1.25QP\right)^{1/2}\right]$$

P = 1.2 rainfall in inches (use 1.2 inches for the Water Quality Storm)
Q = 0.92 runoff volume in watershed inches (equal to WQ_v / total drainage area)
A_t = 17.993 total drainage area in acres

CN = 1000/(10+5*P+10*Q-10*((Q^2)+1.25*Q*P)^(1/2))

CN = 97.26 Use = 98

Invenergy – Rhode Island - Clear River Energy

Main Site (2P & 3P)

Water Quality Flow (WQ_f)

Note:

$$WQ_f = (q_u)(A)(Q)$$

I_a = 0.04

T_c = 6 min. **OR** 0.10 hrs

I_a/P = 0.03

q_u = 260 unit peak discharge in cfs/mi²/inch (from Exhibit 4-III of the TR-55 Manual)

A = 0.028 drainage area in mi²

Q = 0.92

WQ_f = qu*A*Q

WQ_f = 6.71 peak discharge for a water quality event (cfs)

WQ_{f_actual} = 5.10 actual peak discharge for a water quality event (cfs) from HydroCAD **OK**

Surface Area of Filter Bed (A_f)

Note: LUHPPL therefore no infiltration required

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

WQ_v = 59,931 Water Quality Volume in ft³

d_f = Filter Bed Depth in ft

k = Coefficient of Permeability of Filter Media in ft/day

h_f = Average height of water above surface in ft

t_f = Design filter bed drain time in days

A_f = (WQv*df)/((k)*(hf+df)*(tf))

A_f = Surface area of filter bed in ft²

Channel Protection Volume (CP_v)

Note:

$$CP_v = (V_r)/(0.65)$$

V_r = 147,973 runoff volume from 1-yr 24-hr Type III storm (ft³)

T = 86400 Extended detention time (24 hrs) sec

CP_v = 227,651 required channel protection storage volume (ft³)

CP_v / T 2.63 Average Release Rate (cfs)

2.57 Actual Release Rate (cfs) from HydroCAD **OK**

Invenergy – Rhode Island - Clear River Energy

Main Site (2P & 3P)

Downstream Analysis (Point E)

Note: Flow rates are from HydroCAD

DA_{total} =	468.979	total drainage area in acres
DA_{site} =	16.505	Site impervious drainage area in acres
	3.52%	

Pre_{10} =	137.39	cfs
$Post_{10}$ =	119.83	cfs
	12.78%	decrease

Pre_{100} =	324.81	cfs
$Post_{100}$ =	279.40	cfs
	13.98%	decrease

Gravel WVTS Surface Analysis

Note:

DA_{site} =	16.505	site drainage area in acres	
DA_{site} =	718,958	site drainage area in sq. ft.	
$Min\text{-}WVTS_{surface}$ =	2,516	required minimum surface area for WVTS in sq. ft.	
$Forebay_{surface}$ =	3,802	14.21% minimum is 10%	**OK**
$WVTS_{surface}$ =	22,959		
$WVTS_{surface}$ =	26,761	Actual WVTS surface area provided in sq ft	**OK**

Invenergy – Rhode Island - Clear River Energy

Entrance Road - West End (15R & 25R)

Total Drainage Area =	1.26	ac
Impervious Area =	0.899	ac
HSG =	C	Note: use C instead of D because the soil is above the wetland

---

Groundwater Recharge (Re_v)

Note:

$$Re_v = (1")(F)\left(\frac{I}{12}\right)$$

Table 3-4	
HSG	Recharge Factor (F)
A	0.60
B	0.35
C	0.25
D	0.10

F = 0.25 recharge factor (Table 3-4)

I = 0.899 impervious area (ac)

Re_v = 1*F*(I/12)

Re_v = 0.018729 groundwater recharge volume (ac-ft)

Re_v = 816 groundwater recharge volume (ft^3)

Water Quality Volume (WQ_v)

Note:

$$WQ_v = (1")\left(\frac{I}{12}\right)$$

I = 0.899 impervious area (ac)

WQ_v = 1*(I/12)

WQ_v = 0.075 Water Quality Volume (ac-ft) **OR** 3,263 ft^3

$Re_v + WQ_v$ = 4,079 ft^3 Actual = 5,141 ft^3 **OK**

$Re_v + WQ_v$ = 0.094 ac-ft Actual = 0.118 ac-ft

Modified CN

Note:

$$CN = 1000/\left[10 + 5P + 10Q - 10\left(Q^2 + 1.25QP\right)^{1/2}\right]$$

P = 1.2 rainfall in inches (use 1.2 inches for the Water Quality Storm)

Q = 0.71 runoff volume in watershed inches (equal to WQ_v / total drainage area)

A_t = 1.259 total drainage area in acres

CN = 1000/(10+5*P+10*Q-10*((Q^2)+1.25*Q*P)^(1/2))

CN = 94.63 Use = 95 Composit CN

Invenergy – Rhode Island - Clear River Energy

Entrance Road - West End (15R & 25R)

Water Quality Flow (WQ_f)

Note: from DP 13P

$$WQ_f = (q_u)(A)(Q)$$

I_a = 0.11

T_c = 6 min. **OR** 0.10 hrs

I_a /P = 0.09

q_u = 260 unit peak discharge in cfs/mi^2/inch (from Exhibit 4-III of the TR-55 Manual)

A = 0.002 drainage area in mi^2

Q = 0.71

WQ_f = qu*A*Q

WQ_f = 0.37 peak discharge for a water quality event (cfs)

0.08 Actual peak discharge (cfs) from HydroCad **OK**

Surface Area of Filter Bed (A_f)

Note: For a Dry Swell

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

WQ_v = 3,263 Water Quality Volume in ft^3

d_f = 2.5 Filter Bed Depth in ft

k = 1 Coefficient of Permeability of Filter Media in ft/day

h_f = 0.31 Average height of water above surface in ft

t_f = 2 Design filter bed drain time in days

A_f = (WQv*df)/((k)*(hf+df)*(tf))

A_f = 1,452 Surface area of filter bed in ft^2

2,571 Actual surface area **OK**

Channel Protection Volume (CP_v)

Note: West End Ditch from 13P

$$CP_v = (V_r)/(0.65)$$

V_r = 15,903 runoff volume from 1-yr 24-hr Type III storm (ft^3)

T = 86400 Extended detention time (24 hrs) sec

CP_v = 24,466 required channel protection storage volume (ft^3)

CP_v / T = 0.28 Average Release Rate (cfs)

0.13 Actual Release Rate (cfs) from HydroCAD **OK**

Invenergy – Rhode Island - Clear River Energy

Entrance Road - East End (19S, & 34S)

Total Drainage Area = 0.81 ac
Impervious Area = 0.589 ac
HSG = C Note: use C instead of D because the soil is above the wetland

---

Groundwater Recharge (Re_v)

Note:

$$Re_v = (1")(F)\left(\frac{I}{12}\right)$$

	Table 3-4
HSG	Recharge Factor (F)
A	0.60
B	0.35
C	0.25
D	0.10

F = 0.25 recharge factor (Table 3-4)
I = 0.589 impervious area (ac)

Re_v = 1*F*(I/12)

Re_v = 0.012271 groundwater recharge volume (ac-ft)

Re_v = 535 groundwater recharge volume (ft^3)

Water Quality Volume (WQ_v)

Note:

$$WQ_v = (1")\left(\frac{I}{12}\right)$$

I = 0.589 impervious area (ac)

WQ_v = 1*(I/12)

WQ_v = 0.049 Water Quality Volume (ac-ft) **OR** 2,138 ft^3

$Re_v + WQ_v$ = 2,673 ft^3 Actual = 2,420 ft^3 **OK**

$Re_v + WQ_v$ = 0.061 ac-ft Actual = 0.056 ac-ft

Modified CN

Note:

$$CN = 1000/\left[10 + 5P + 10Q - 10\left(Q^2 + 1.25QP\right)^{1/2}\right]$$

P = 1.2 rainfall in inches (use 1.2 inches for the Water Quality Storm)
Q = 0.73 runoff volume in watershed inches (equal to WQ_v / total drainage area)
A_t = 0.805 total drainage area in acres

CN = 1000/(10+5*P+10*Q-10*((Q^2)+1.25*Q*P)^(1/2))

CN = 94.89 Use = 95

Invenergy – Rhode Island - Clear River Energy

Entrance Road - East End (19S, & 34S)

Water Quality Flow (WQ_f)

Note:

$$WQ_f = (q_u)(A)(Q)$$

I_a = 0.11
T_c = 6 min. **OR** 0.10 hrs

I_a /P = 0.09

q_u = 260 unit peak discharge in cfs/mi^2/inch (from Exhibit 4-III of the TR-55 Manual)
A = 0.001 drainage area in mi^2
Q = 0.73

WQ_f = qu*A*Q

WQ_f = $\boxed{0.24}$ peak discharge for a water quality event (cfs)

0.24 Actual peak discharge (cfs) **OK**

Surface Area of Filter Bed (A_f)

Note: For a Dry Swell

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

WQ_v = 2,138 Water Quality Volume in ft^3
d_f = 2.5 Filter Bed Depth in ft
k = 1 Coefficient of Permeability of Filter Media in ft/day
h_f = 0.31 Average height of water above surface in ft
t_f = 2 Design filter bed drain time in days

A_f = (WQv*df)/((k)*(hf+df)*(tf))

A_f = $\boxed{951}$ Surface area of filter bed in ft^2

1,415 Actual surface area **OK**

Channel Protection Volume (CP_v)

Note: Next to Wallum Road (15P)

V_r = 10,873 runoff volume from 1-yr 24-hr Type III storm (ft^3)

T = 86400 Extended detention time (24 hrs) sec

CP_v = $\boxed{16,728}$ required channel protection storage volume (ft^3)

CP_v / T = 0.19 Average Release Rate (cfs)

1.58 Actual Release Rate (cfs) from HydroCAD **OK - below 2 cfs**

Invenergy – Rhode Island - Clear River Energy
Polution Calculations Summary Tables

Polution Calculations for Main Site (2P & 3P)			
Pollutant	Pre-Development	Post with out BMP Net Increase	Post with BMP Net Increase
TSS (lbs TN/year)	477.3	19,242.7	5,123.4
TP (lbs TN/year)	1.0	40.1	13.1
TN(lbs TN/year)	16.3	328.8	187.4
Bacteria (#col/100ml/year)	2,807.5	391,592.8	124,918.1

Polution Calculations for Dry Swale (15R & 29R)			
Pollutant	Pre-Development	Post with out BMP Net Increase	Post with BMP Net Increase
TSS (lbs TN/year)	33.4	1,320.3	132.0
TP (lbs TN/year)	0.1	2.2	1.5
TN(lbs TN/year)	1.1	19.6	8.8
Bacteria (#col/100ml/year)	196.5	15,146.0	4,543.8

Polution Calculations for Dry Swale (18R & 20R)			
Pollutant	Pre-Development	Post with out BMP Net Increase	Post with BMP Net Increase
TSS (lbs TN/year)	21.4	866.8	86.7
TP (lbs TN/year)	0.0	1.4	1.0
TN(lbs TN/year)	0.7	12.9	5.8
Bacteria (#col/100ml/year)	125.6	9,940.5	2,982.2

Invenergy – Rhode Island - Clear River Energy

Polution Calculations for Main Site (2P & 3P) for TSS

A = 17.99 drainage area in acres
P = 51 rainfall depth (inches) - from Figure H-8

Pre-Development:

Note: Site is Undeveloped/Rural

TSS = 51 mg/l (Table H-2)

Post-Development:

Note: Site is Industrial

TSS = 120 mg/l (Table H-2)

TSS Removal

Note: For Main Site

$$L = [(P)(Pj)(Rv)/12](C)(A)(2.72)$$

Pre-Development:

Note: Site is Undeveloped/Rural

P =	51	rainfall depth (inches) - from Figure H-8
Pj =	0.9	rainfall correction factor
Rv =	0.05	runoff coefficient expressing the fraction of rainfall converted to runoff
C =	51	flow-weighted mean concentration of the pollutant in urban runoff (mg/L) - from Table H-2
A =	17.99	contributing drainage area of development site (acres)

Rv = 0.05 + 0.009(%I)

%I = 0 the percent of site imperviousness

L = ((D34*D35*D36)/12)*D37*D38*2.72

L = 477.3 lbs TN/year

Post-Development:

Note: Site is Industrial

P =	51	rainfall depth (inches) - from Figure H-8
Pj =	0.9	rainfall correction factor
Rv =	0.878	runoff coefficient expressing the fraction of rainfall converted to runoff
C =	120	flow-weighted mean concentration of the pollutant in urban runoff (mg/L) - from Table H-2
A =	17.99	contributing drainage area of development site (acres)

Rv = 0.05 + 0.009(%I)

%I = 92 the percent of site imperviousness

L = ((D54*D55*D56)/12)*D57*D58*2.72

L = 19,720.0 lbs

Conclusion:

Net = 19,242.7 Increase in TSS

Invenergy – Rhode Island - Clear River Energy

Polution Calculations for Main Site (2P & 3P) for TSS

Pollutant Removal:

1st BMP:

Note: Forebay

RE =	25%	Removal Efficiency from Table H-4
LR =	4,810.7	Load Reduction (lbs TN/year)
Net Load =	14,432.1	lbs TN/year

2nd BMP:

Note: Gravel WVTS
2nd BMP will operate at 75% efficiency

RE =	86%	Removal Efficiency from Table H-3
LR =	9,308.7	Load Reduction (lbs TN/year)
TSS Net Load =	**5,123.4**	lbs TN/year

Invenergy – Rhode Island - Clear River Energy

Polution Calculations for Main Site (2P & 3P) for TP

A = 17.99 drainage area in acres
P = 51 rainfall depth (inches) - from Figure H-8

Pre-Development:
Note: Site is Undeveloped/Rural

TP = 0.11 mg/l (Table H-2)

Post-Development:
Note: Site is Industrial

TP = 0.25 mg/l (Table H-2)

TSS Removal
Note: For Main Site

$$L = [(P)(Pj)(Rv)/12](C)(A)(2.72)$$

Pre-Development:
Note: Site is Undeveloped/Rural

P =	51	rainfall depth (inches) - from Figure H-8
Pj =	0.9	rainfall correction factor
Rv =	0.05	runoff coefficient expressing the fraction of rainfall converted to runoff
C =	0.11	flow-weighted mean concentration of the pollutant in urban runoff (mg/L) - from Table H-2
A =	17.99	contributing drainage area of development site (acres)

Rv = 0.05 + 0.009(%I)

%I = 0 the percent of site imperviousness

L = ((D34*D35*D36)/12)*D37*D38*2.72

L = 1.0 lbs TN/year

Post-Development:
Note: Site is Industrial

P =	51	rainfall depth (inches) - from Figure H-8
Pj =	0.9	rainfall correction factor
Rv =	0.878	runoff coefficient expressing the fraction of rainfall converted to runoff
C =	0.25	flow-weighted mean concentration of the pollutant in urban runoff (mg/L) - from Table H-2
A =	17.99	contributing drainage area of development site (acres)

Rv = 0.05 + 0.009(%I)

%I = 92 the percent of site imperviousness

L = ((D54*D55*D56)/12)*D57*D58*2.72

L = 41.1 lbs

Conclusion:

Net = 40.1 Increase in TSS

Invenergy – Rhode Island - Clear River Energy

Polution Calculations for Main Site (2P & 3P) for TP

Pollutant Removal:

1st BMP:

Note: Forebay

RE =	8%	Removal Efficiency from Table H-4
LR =	3.2	Load Reduction (lbs TN/year)
Net Load =	36.8	lbs TN/year

2nd BMP:

Note: Gravel WVTS
2nd BMP will operate at 75% efficiency

RE =	86%	Removal Efficiency from Table H-3
LR =	23.8	Load Reduction (lbs TN/year)
TP Net Load =	**13.1**	lbs TN/year

Invenergy – Rhode Island - Clear River Energy

Polution Calculations for Main Site (2P & 3P) for TN

A = 17.99 drainage area in acres
P = 51 rainfall depth (inches) - from Figure H-8

Pre-Development:
Note: Site is Undeveloped/Rural

TN = 1.74 mg/l (Table H-2)

Post-Development:
Note: Site is Industrial

TN = 2.1 mg/l (Table H-2)

TSS Removal
Note: For Main Site

$$L = [(P)(Pj)(Rv)/12](C)(A)(2.72)$$

Pre-Development:
Note: Site is Undeveloped/Rural

P =	51	rainfall depth (inches) - from Figure H-8
Pj =	0.9	rainfall correction factor
Rv =	0.05	runoff coefficient expressing the fraction of rainfall converted to runoff
C =	1.74	flow-weighted mean concentration of the pollutant in urban runoff (mg/L) - from Table H-2
A =	17.99	contributing drainage area of development site (acres)

Rv = 0.05 + 0.009(%I)

%I = 0 the percent of site imperviousness

L = ((D34*D35*D36)/12)*D37*D38*2.72

L = 16.3 lbs TN/year

Post-Development:
Note: Site is Industrial

P =	51	rainfall depth (inches) - from Figure H-8
Pj =	0.9	rainfall correction factor
Rv =	0.878	runoff coefficient expressing the fraction of rainfall converted to runoff
C =	2.1	flow-weighted mean concentration of the pollutant in urban runoff (mg/L) - from Table H-2
A =	17.99	contributing drainage area of development site (acres)

Rv = 0.05 + 0.009(%I)

%I = 92 the percent of site imperviousness

L = ((D54*D55*D56)/12)*D57*D58*2.72

L = 345.1 lbs

Conclusion:

Net = 328.8 Increase in TSS

Invenergy – Rhode Island - Clear River Energy

Polution Calculations for Main Site (2P & 3P) for TN

Pollutant Removal:

1st BMP:
Note: Forebay

RE =	3%	Removal Efficiency from Table H-4
LR =	9.9	Load Reduction (lbs TN/year)
Net Load =	319.0	lbs TN/year

2nd BMP:
Note: Gravel WVTS
2nd BMP will operate at 75% efficiency

RE =	55%	Removal Efficiency from Table H-3
LR =	131.6	Load Reduction (lbs TN/year)
TN Net Load =	**187.4**	lbs TN/year

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Polution Calculations for Main Site (2P & 3P) for Bacteria

A = 17.99 drainage area in acres
P = 51 rainfall depth (inches) - from Figure H-8

Pre-Development:
Note: Site is Undeveloped/Rural

Bacteria = 300 #col/100ml (Table H-2)

Post-Development:
Note: Site is Industrial

Bacteria = 2400 #col/100ml (Table H-2)

TSS Removal

Note: For Main Site

$$\mathbf{L} = [(P)(Pj)(Rv)/12](C)(A)(2.72)$$

Pre-Development:
Note: Site is Undeveloped/Rural

P =	51	rainfall depth (inches) - from Figure H-8
Pj =	0.9	rainfall correction factor
Rv =	0.05	runoff coefficient expressing the fraction of rainfall converted to runoff
C =	300	flow-weighted mean concentration of the pollutant in urban runoff (mg/L) - from Table H-2
A =	17.99	contributing drainage area of development site (acres)

Rv = 0.05 + 0.009(%I)

%I = 0 the percent of site imperviousness

L = ((D26*D27*D28)/12)*D29*D30*2.72

L = 2,807.5 lbs TN/year

Post-Development:
Note: Site is Industrial

P =	51	rainfall depth (inches) - from Figure H-8
Pj =	0.9	rainfall correction factor
Rv =	0.878	runoff coefficient expressing the fraction of rainfall converted to runoff
C =	2400	flow-weighted mean concentration of the pollutant in urban runoff (mg/L) - from Table H-2
A =	17.99	contributing drainage area of development site (acres)

Rv = 0.05 + 0.009(%I)

%I = 92 the percent of site imperviousness

L = ((D46*D47*D48)/12)*D49*D50*2.72

L = 394,400.3 lbs

Conclusion:

Net = 391,592.8 Increase in TSS

Invenergy – Rhode Island - Clear River Energy

Polution Calculations for Main Site (2P & 3P) for **Bacteria**

Pollutant Removal:

1st BMP:

Note: Forebay

RE = 12% Removal Efficiency from Table H-4

LR = 46,991.1 Load Reduction (lbs TN/year)

Net Load = 344,601.7 lbs TN/year

2nd BMP:

Note: Gravel WVTS
2nd BMP will operate at 75% efficiency

RE = 85% Removal Efficiency from Table H-3

LR = 219,683.6 Load Reduction (lbs TN/year)

Bacteria Net Load = **124,918.1** #col/100ml/year

Invenergy – Rhode Island - Clear River Energy

Polution Calculations for Dry Swale (15R & 29R) for TSS

A =	1.259	drainage area in acres
P =	51	rainfall depth (inches) - from Figure H-8

Pre-Development:
Note: Site is Undeveloped/Rural

TSS = 51 mg/l (Table H-2)

Post-Development:
Note: Site is a Road

TSS = 150 mg/l (Table H-2)

TSS Removal
Note: For Dry Swale along West half of Road

$$L = [(P)(Pj)(Rv)/12](C)(A)(2.72)$$

Pre-Development:
Note: Site is Undeveloped/Rural

P =	51	rainfall depth (inches) - from Figure H-8
Pj =	0.9	rainfall correction factor
Rv =	0.05	runoff coefficient expressing the fraction of rainfall converted to runoff
C =	51	flow-weighted mean concentration of the pollutant in urban runoff (mg/L) - from Table H-2
A =	1.259	contributing drainage area of development site (acres)

Rv = 0.05 + 0.009(%I)

%I = 0 the percent of site imperviousness

L = ((D26*D27*D28)/12)*D29*D30*2.72

L = 33.4 lbs TN/year

Post-Development:
Note: Site is a Road

P =	51	rainfall depth (inches) - from Figure H-8
Pj =	0.9	rainfall correction factor
Rv =	0.689	runoff coefficient expressing the fraction of rainfall converted to runoff
C =	150	flow-weighted mean concentration of the pollutant in urban runoff (mg/L) - from Table H-2
A =	1.259	contributing drainage area of development site (acres)

Rv = 0.05 + 0.009(%I)

%I = 71 the percent of site imperviousness

L = ((D46*D47*D48)/12)*D49*D50*2.72

L = 1,353.7 lbs

Conclusion:

Net = 1,320.3 Increase in TSS

Invenergy – Rhode Island - Clear River Energy

Polution Calculations for Dry Swale (15R & 29R) for TSS

Pollutant Removal:

1st BMP:
Note: Dry Swale

RE =	90%	Removal Efficiency from Table H-3
LR =	1,188.3	Load Reduction (lbs TN/year)
TSS Net Load =	**132.0**	lbs TN/year

Invenergy – Rhode Island - Clear River Energy

Polution Calculations for Dry Swale (15R & 29R) for TP

A =	1.259	drainage area in acres
P =	51	rainfall depth (inches) - from Figure H-8

Pre-Development:
Note: Site is Undeveloped/Rural

TP = 0.11 mg/l (Table H-2)

Post-Development:
Note: Site is a Road

TP = 0.25 mg/l (Table H-2)

TSS Removal
Note: For Dry Swale along West half of Road

$$L = [(P)(Pj)(Rv)/12](C)(A)(2.72)$$

Pre-Development:
Note: Site is Undeveloped/Rural

P =	51	rainfall depth (inches) - from Figure H-8
Pj =	0.9	rainfall correction factor
Rv =	0.05	runoff coefficient expressing the fraction of rainfall converted to runoff
C =	0.11	flow-weighted mean concentration of the pollutant in urban runoff (mg/L) - from Table H-2
A =	1.259	contributing drainage area of development site (acres)

Rv = 0.05 + 0.009(%I)

%I = 0 the percent of site imperviousness

L = ((D26*D27*D28)/12)*D29*D30*2.72

L = 0.1 lbs TN/year

Post-Development:
Note: Site is a Road

P =	51	rainfall depth (inches) - from Figure H-8
Pj =	0.9	rainfall correction factor
Rv =	0.689	runoff coefficient expressing the fraction of rainfall converted to runoff
C =	0.25	flow-weighted mean concentration of the pollutant in urban runoff (mg/L) - from Table H-2
A =	1.259	contributing drainage area of development site (acres)

Rv = 0.05 + 0.009(%I)

%I = 71 the percent of site imperviousness

L = ((D46*D47*D48)/12)*D49*D50*2.72

L = 2.3 lbs

Conclusion:

Net = 2.2 Increase in TSS

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Polution Calculations for Dry Swale (15R & 29R) for TP

Pollutant Removal:

1st BMP:

Note: Dry Swale

	RE =	30%	Removal Efficiency from Table H-3
	LR =	0.7	Load Reduction (lbs TN/year)
TP	**Net Load =**	**1.5**	lbs TN/year

Invenergy – Rhode Island - Clear River Energy

Polution Calculations for Dry Swale (15R & 29R) for TN

A = 1.259 drainage area in acres
P = 51 rainfall depth (inches) - from Figure H-8

Pre-Development:
Note: Site is Undeveloped/Rural

TN = 1.74 mg/l (Table H-2)

Post-Development:
Note: Site is a Road

TN = 2.3 mg/l (Table H-2)

TSS Removal

Note: For Dry Swale along West half of Road

$$L = [(P)(Pj)(Rv)/12](C)(A)(2.72)$$

Pre-Development:
Note: Site is Undeveloped/Rural

P =	51	rainfall depth (inches) - from Figure H-8
Pj =	0.9	rainfall correction factor
Rv =	0.05	runoff coefficient expressing the fraction of rainfall converted to runoff
C =	1.74	flow-weighted mean concentration of the pollutant in urban runoff (mg/L) - from Table H-2
A =	1.259	contributing drainage area of development site (acres)

Rv = 0.05 + 0.009(%I)

%I = 0 the percent of site imperviousness

L = ((D26*D27*D28)/12)*D29*D30*2.72

L = 1.1 lbs TN/year

Post-Development:
Note: Site is a Road

P =	51	rainfall depth (inches) - from Figure H-8
Pj =	0.9	rainfall correction factor
Rv =	0.689	runoff coefficient expressing the fraction of rainfall converted to runoff
C =	2.3	flow-weighted mean concentration of the pollutant in urban runoff (mg/L) - from Table H-2
A =	1.259	contributing drainage area of development site (acres)

Rv = 0.05 + 0.009(%I)

%I = 71 the percent of site imperviousness

L = ((D46*D47*D48)/12)*D49*D50*2.72

L = 20.8 lbs

Conclusion:

Net = 19.6 Increase in TSS

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Polution Calculations for Dry Swale (15R & 29R) for TN

Pollutant Removal:

1st BMP:

Note: Dry Swale

	RE =	55%	Removal Efficiency from Table H-3
	LR =	10.8	Load Reduction (lbs TN/year)
TN	**Net Load =**	**8.8**	lbs TN/year

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Polution Calculations for Dry Swale (15R & 29R) for Bacteria

A =	1.259	drainage area in acres
P =	51	rainfall depth (inches) - from Figure H-8

Pre-Development:
Note: Site is Undeveloped/Rural

Bacteria = 300 #col/100ml (Table H-2)

Post-Development:
Note: Site is a Road

Bacteria = 1700 #col/100ml (Table H-2)

TSS Removal
Note: For Dry Swale along West half of Road

$$L = [(P)(Pj)(Rv)/12](C)(A)(2.72)$$

Pre-Development:
Note: Site is Undeveloped/Rural

P =	51	rainfall depth (inches) - from Figure H-8
Pj =	0.9	rainfall correction factor
Rv =	0.05	runoff coefficient expressing the fraction of rainfall converted to runoff
C =	300	flow-weighted mean concentration of the pollutant in urban runoff (mg/L) - from Table H-2
A =	1.259	contributing drainage area of development site (acres)

Rv = 0.05 + 0.009(%I)

%I = 0 the percent of site imperviousness

L = ((D26*D27*D28)/12)*D29*D30*2.72

L = 196.5 #col/100ml/year

Post-Development:
Note: Site is a Road

P =	51	rainfall depth (inches) - from Figure H-8
Pj =	0.9	rainfall correction factor
Rv =	0.689	runoff coefficient expressing the fraction of rainfall converted to runoff
C =	1700	flow-weighted mean concentration of the pollutant in urban runoff (mg/L) - from Table H-2
A =	1.259	contributing drainage area of development site (acres)

Rv = 0.05 + 0.009(%I)

%I = 71 the percent of site imperviousness

L = ((D46*D47*D48)/12)*D49*D50*2.72

L = 15,342.4 lbs

Conclusion:

Net = 15,146.0 Increase

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Polution Calculations for Dry Swale (15R & 29R) for Bacteria

Pollutant Removal:

1st BMP:
Note: Dry Swale

	RE =	70%	Removal Efficiency from Table H-3
	LR =	10,602.2	Load Reduction
Bacteria	**Net Load =**	**4,543.8**	#col/100ml/year

Invenergy – Rhode Island - Clear River Energy

Polution Calculations for Dry Swale (18R & 20R) for TSS

A = 0.805 drainage area in acres
P = 51 rainfall depth (inches) - from Figure H-8

Pre-Development:
Note: Site is Undeveloped/Rural

TSS = 51 mg/l (Table H-2)

Post-Development:
Note: Site is a Road

TSS = 150 mg/l (Table H-2)

TSS Removal
Note: For Dry Swale along West half of Road

$$L = [(P)(Pj)(Rv)/12](C)(A)(2.72)$$

Pre-Development:
Note: Site is Undeveloped/Rural

P =	51	rainfall depth (inches) - from Figure H-8
Pj =	0.9	rainfall correction factor
Rv =	0.05	runoff coefficient expressing the fraction of rainfall converted to runoff
C =	51	flow-weighted mean concentration of the pollutant in urban runoff (mg/L) - from Table H-2
A =	0.805	contributing drainage area of development site (acres)

Rv = 0.05 + 0.009(%I)

%I = 0 the percent of site imperviousness

L = ((D26*D27*D28)/12)*D29*D30*2.72

L = 21.4 lbs TN/year

Post-Development:
Note: Site is a Road

P =	51	rainfall depth (inches) - from Figure H-8
Pj =	0.9	rainfall correction factor
Rv =	0.707	runoff coefficient expressing the fraction of rainfall converted to runoff
C =	150	flow-weighted mean concentration of the pollutant in urban runoff (mg/L) - from Table H-2
A =	0.805	contributing drainage area of development site (acres)

Rv = 0.05 + 0.009(%I)

%I = 73 the percent of site imperviousness

L = ((D46*D47*D48)/12)*D49*D50*2.72

L = 888.2 lbs

Conclusion:

Net = 866.8 Increase

Invenergy – Rhode Island - Clear River Energy

Polution Calculations for Dry Swale (18R & 20R) for TSS

Pollutant Removal:

1st BMP:
Note: Dry Swale

	RE =	90%	Removal Efficiency from Table H-3
	LR =	780.2	Load Reduction
TSS	**Net Load =**	**86.7**	lbs TN/year

Invenergy – Rhode Island - Clear River Energy

Polution Calculations for Dry Swale (18R & 20R) for TP

A = 0.805 drainage area in acres
P = 51 rainfall depth (inches) - from Figure H-8

Pre-Development:
Note: Site is Undeveloped/Rural

TP = 0.11 mg/l (Table H-2)

Post-Development:
Note: Site is a Road

TP = 0.25 mg/l (Table H-2)

TSS Removal

Note: For Dry Swale along West half of Road

$$L = [(P)(Pj)(Rv)/12](C)(A)(2.72)$$

Pre-Development:
Note: Site is Undeveloped/Rural

P =	51	rainfall depth (inches) - from Figure H-8
Pj =	0.9	rainfall correction factor
Rv =	0.05	runoff coefficient expressing the fraction of rainfall converted to runoff
C =	0.11	flow-weighted mean concentration of the pollutant in urban runoff (mg/L) - from Table H-2
A =	0.805	contributing drainage area of development site (acres)

Rv = 0.05 + 0.009(%I)

%I = 0 the percent of site imperviousness

L = ((D26*D27*D28)/12)*D29*D30*2.72

L = 0.0 lbs TN/year

Post-Development:
Note: Site is a Road

P =	51	rainfall depth (inches) - from Figure H-8
Pj =	0.9	rainfall correction factor
Rv =	0.707	runoff coefficient expressing the fraction of rainfall converted to runoff
C =	0.25	flow-weighted mean concentration of the pollutant in urban runoff (mg/L) - from Table H-2
A =	0.805	contributing drainage area of development site (acres)

Rv = 0.05 + 0.009(%I)

%I = 73 the percent of site imperviousness

L = ((D46*D47*D48)/12)*D49*D50*2.72

L = 1.5 lbs

Conclusion:

Net = 1.4 Increase

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Polution Calculations for Dry Swale (18R & 20R) for TP

Pollutant Removal:

1st BMP:
Note: Dry Swale

	RE =	30%	Removal Efficiency from Table H-3
	LR =	0.4	Load Reduction
TP	**Net Load =**	**1.0**	lbs TN/year

Invenergy – Rhode Island - Clear River Energy

Polution Calculations for Dry Swale (18R & 20R) for TN

A = 0.805 drainage area in acres
P = 51 rainfall depth (inches) - from Figure H-8

Pre-Development:
Note: Site is Undeveloped/Rural

TN = 1.74 mg/l (Table H-2)

Post-Development:
Note: Site is a Road

TN = 2.3 mg/l (Table H-2)

TSS Removal
Note: For Dry Swale along West half of Road

$$L = [(P)(Pj)(Rv)/12](C)(A)(2.72)$$

Pre-Development:
Note: Site is Undeveloped/Rural

P =	51	rainfall depth (inches) - from Figure H-8
Pj =	0.9	rainfall correction factor
Rv =	0.05	runoff coefficient expressing the fraction of rainfall converted to runoff
C =	1.74	flow-weighted mean concentration of the pollutant in urban runoff (mg/L) - from Table H-2
A =	0.805	contributing drainage area of development site (acres)

Rv = 0.05 + 0.009(%I)

%I = 0 the percent of site imperviousness

L = ((D26*D27*D28)/12)*D29*D30*2.72

L = 0.7 lbs TN/year

Post-Development:
Note: Site is a Road

P =	51	rainfall depth (inches) - from Figure H-8
Pj =	0.9	rainfall correction factor
Rv =	0.707	runoff coefficient expressing the fraction of rainfall converted to runoff
C =	2.3	flow-weighted mean concentration of the pollutant in urban runoff (mg/L) - from Table H-2
A =	0.805	contributing drainage area of development site (acres)

Rv = 0.05 + 0.009(%I)

%I = 73 the percent of site imperviousness

L = ((D46*D47*D48)/12)*D49*D50*2.72

L = 13.6 lbs

Conclusion:

Net = 12.9 Increase

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Polution Calculations for Dry Swale (18R & 20R) for TN

Pollutant Removal:

1st BMP:

Note: Dry Swale

RE =	55%	Removal Efficiency from Table H-3
LR =	7.1	Load Reduction
TN Net Load =	**5.8**	lbs TN/year

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Polution Calculations for Dry Swale (18R & 20R) for Bacteria

A = 0.805 drainage area in acres

P = 51 rainfall depth (inches) - from Figure H-8

Pre-Development:

Note: Site is Undeveloped/Rural

Bacteria = 300 #col/100ml (Table H-2)

Post-Development:

Note: Site is a Road

Bacteria = 1700 #col/100ml (Table H-2)

TSS Removal

Note: For Dry Swale along West half of Road

$$L = [(P)(Pj)(Rv)/12](C)(A)(2.72)$$

Pre-Development:

Note: Site is Undeveloped/Rural

P =	51	rainfall depth (inches) - from Figure H-8
Pj =	0.9	rainfall correction factor
Rv =	0.05	runoff coefficient expressing the fraction of rainfall converted to runoff
C =	300	flow-weighted mean concentration of the pollutant in urban runoff (mg/L) - from Table H-2
A =	0.805	contributing drainage area of development site (acres)

Rv = 0.05 + 0.009(%I)

%I = 0 the percent of site imperviousness

L = ((D26*D27*D28)/12)*D29*D30*2.72

L = 125.6 #col/100ml/year

Post-Development:

Note: Site is a Road

P =	51	rainfall depth (inches) - from Figure H-8
Pj =	0.9	rainfall correction factor
Rv =	0.707	runoff coefficient expressing the fraction of rainfall converted to runoff
C =	1700	flow-weighted mean concentration of the pollutant in urban runoff (mg/L) - from Table H-2
A =	0.805	contributing drainage area of development site (acres)

Rv = 0.05 + 0.009(%I)

%I = 73 the percent of site imperviousness

L = ((D46*D47*D48)/12)*D49*D50*2.72

L = 10,066.2 lbs

Conclusion:

Net = 9,940.5 Increase

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Polution Calculations for Dry Swale (18R & 20R) for Bacteria

Pollutant Removal:

1st BMP:
Note: Dry Swale

	RE =	70%	Removal Efficiency from Table H-3
	LR =	6,958.4	Load Reduction
Bacteria	**Net Load =**	**2,982.2**	#col/100ml/year

DITCH CALCULATIONS

Dry Swale - 1 (15R)			
Storm	Flow	Depth[1]	Velocity
WQv	0.38	0.11	1.49
1-Year	1.58	0.26	2.40
10-Year	3.47	0.40	3.05
100-Year	6.75	0.58	3.69

Note 1 - Depth of ditch is 2 feet

Dry Swale - 2 (29R)			
Storm	Flow	Depth[1]	Velocity
WQv	0.47	0.13	1.64
1-Year	1.94	0.29	2.62
10-Year	4.30	0.45	3.33
100-Year	8.38	0.64	4.02

Note 1 - Depth of ditch is 2 feet

Dry Swale - 3 (18R)			
Storm	Flow	Depth[1]	Velocity
WQv	0.28	0.04	1.03
1-Year	1.11	0.10	1.75
10-Year	2.41	0.16	2.34
100-Year	4.65	0.24	2.99

Note 1 - Depth of ditch is 2 feet

DITCH CALCULATIONS

Dry Swale - 4 (20R)			
Storm	**Flow**	**Depth[1]**	**Velocity**
WQv	0.4	0.14	1.27
1-Year	1.61	0.31	1.99
10-Year	3.52	0.47	2.52
100-Year	6.82	0.67	3.03
Note 1 - Depth of ditch is 2 feet			

Rerouting Ditch (23R)			
Storm	**Flow**	**Depth[1]**	**Velocity**
1-Year	0.95	0.19	2.06
10-Year	2.95	0.37	2.94
100-Year	6.85	0.58	3.76
Note 1 - Ditch is 1' deep; 2' wide; with 2:1 side slopes			

Ditch below Culvert (30R)			
Storm	**Flow**	**Depth[1]**	**Velocity**
1-Year	1.56	0.23	2.81
10-Year	4.87	0.43	3.99
100-Year	11.31	0.67	5.07
Note 1 - Ditch is 1' deep; 2' wide; with 2:1 side slopes			

Level Spreader (8R)			
Storm	**Flow**	**Depth**	**Velocity**
1-Year	2.57	0.05	0.67
10-Year	3.75	0.06	0.77
100-Year	8.38	0.10	1.05

DITCH CALCULATIONS

Entr. Pipe Exit Ditch (21R)			
Storm	Flow	Depth[1]	Velocity
1-Year	2.88	0.15	2.02
10-Year	8.29	0.29	3.00
100-Year	18.29	0.46	4.00

Note 1 - Ditch is 1' deep; 10' wide; with 2:1 side slopes

STORM WATER CALCULATIONS

Flow Splitter

	29P (Flow Splitter)		
Storms			
	Proposed thru Secondary	Proposed thru Primary (cfs)	Water Elev. (ft)
WQ_f	0	17.23	565.26
10-Year	54.59	26.66	568.34
100-Year	105.27	33.99	570.34

POINT A

	2P (Forebay)		
Storms			
	Existing Calculated (cfs)	Total Proposed (cfs)	Water Elev. (ft)
WQ_f	6.72	5.10	564.50
10-Year		27.83	565.24
100-Year		36.51	565.30

STORM WATER CALCULATIONS

	3P (Gravel Wetland Pond)		
Storms			
	Total	**Total**	
	In (cfs)	**Out (cfs)**	**Water Elev. (ft)**
WQ_f		3.31	561.77
10-Year		23.97	562.95
100-Year		37.4	563.86

	4P (Detention)		
Storms			
	Total	**Total**	
	In (cfs)	**Out (cfs)**	**Water Elev. (ft)**
WQ_f		1.24	558.71
10-Year		3.75	561.48
100-Year		8.35	563.81
1-Year		2.57	559.83

STORM WATER CALCULATIONS

	18P (Level Spreader)		
Storms			
	Total In (cfs)	Total Out (cfs)	Water Elev. (ft)
WQ_f		1.24	558.08
10-Year		3.75	558.17
100-Year		8.35	558.29
1-Year		2.57	558.13

	21L (Point A)		
Storms			
	Existing Calculated (cfs)	Proposed Total (cfs)	Water Elev. (ft)
WQ_f^1	6.72	1.3	
10-Year	20.16	18.29	
100-Year	46.68	40.42	

Note 1 = Calculated

STORM WATER CALCULATIONS

POINT B

	28P (DP for Ramp Culvert)		
Storms			
	Existing Total (cfs)	Proposed Total (cfs)	Water Elev. (ft)
1-Year		1.58	555.44
10-Year		3.46	555.69
100-Year		6.71	556.03

	13P (DP for Swale - 1 & 4)		
Storms			
	Existing Total (cfs)	Proposed Total (cfs)	Water Elev. (ft)
WQ_f	0.22	0.05	538.22
1-Year	0.14	0.13	538.86
10-Year		0.79	539.56
100-Year		6.51	539.94

STORM WATER CALCULATIONS

	17P (12' x 6' Box)		
Storms			
	Existing Total (cfs)	**Proposed Total (cfs)**	**Water Elev. (ft)**
1-Year	28.94	24.02	533.00
10-Year	86.73	74.75	533.76
100-Year[1]	181.63	178.00	534.98

1. Includes flow crossing from the Dry Arm Basin

	30P (Culvert 2)		
Storms			
	Existing Total (cfs)	**Proposed Total (cfs)**	**Water Elev. (ft)**
1-Year		0.95	534.07
10-Year		2.95	534.46
100-Year[1]		6.85	535.14

STORM WATER CALCULATIONS

	22L (Point B)		
Storms			
	Existing Total (cfs)	Proposed Total (cfs)	Water Elev. (ft)
1-Year	28.94	24.02	
10-Year	86.73	74.75	
100-Year[1]	181.63	178.73	

1. Includes flow crossing from the Dry Arm Basin

STORM WATER CALCULATIONS

POINT C

	15P (Point C - Culvert at Entr.)		
Storms			
	Existing Total (cfs)	**Proposed Total (cfs)**	**Water Elev. (ft)**
1-Year	2.89	2.88	529.84
10-Year	9.01	8.29	530.16
100-Year	20.85	18.29	530.33

	31P (Culvert 3)		
Storms			
	Existing Total (cfs)	**Proposed Total (cfs)**	**Water Elev. (ft)**
1-Year		1.11	533.44
10-Year		2.41	533.68
100-Year[1]		4.65	534.01

STORM WATER CALCULATIONS

	23P (DP for Swell at Entrence)		
Storms			
	Existing Total (cfs)	**Proposed Total (cfs)**	**Water Elev. (ft)**
WQ_f	0.22	0.18	531.30
1-Year		1.58	531.74
10-Year		3.47	531.85
100-Year		6.73	532.00

STORM WATER CALCULATIONS

POINT D

	Point D		
Storms			
	Existing Total (cfs)	Proposed Total (cfs)	% Reduction
1-Year	45.55	44.54	2.22%
10-Year	140.96	137.55	2.42%
100-Year	327.06	319.56	2.29%

STORM WATER CALCULATIONS

POINT F

	(Wildlife Crossing #2)		
Storms			
	Existing Total (cfs)	**Proposed Total (cfs)**	**Water Elev. (ft)**
1-Year	4.23	2.27	
10-Year	13.08	7.01	
100-Year	30.37	16.28	

	28L (Point F)		
Storms			
	Existing Total (cfs)	**Proposed Total (cfs)**	**Water Elev. (ft)**
1-Year	4.23	2.27	
10-Year	13.08	7.01	
100-Year	30.37	16.28	

MH STORM SEWER CALCULATIONS
10-YEAR STORM

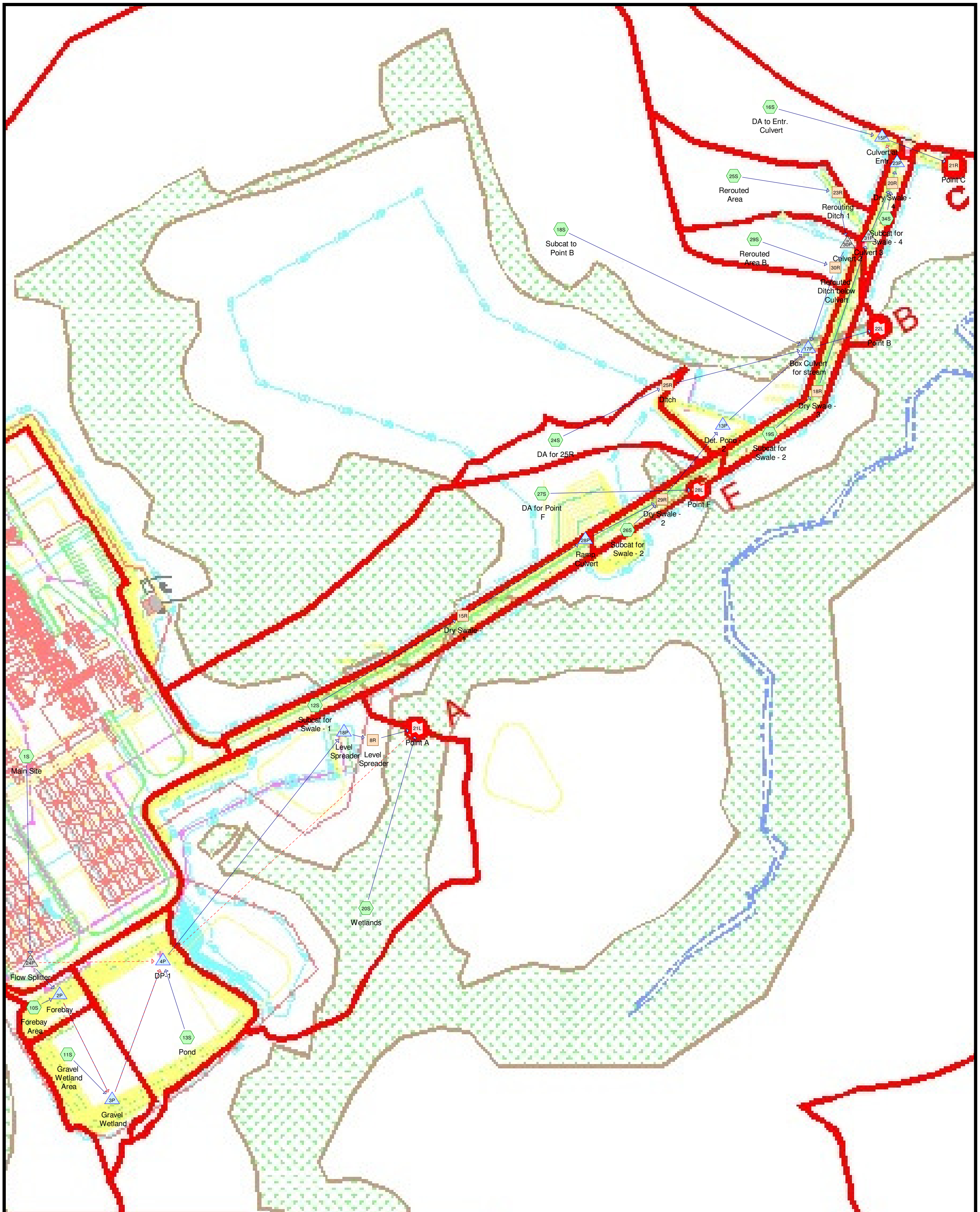
SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)
1	A-01	563.12	573.78	10.66	57.91	0.00	564.44	1.32
2	A-02	563.43	572.62	9.19	39.46	3.86	564.44	1.01
3	A-03	564.02	572.38	8.36	21.98	3.05	564.45	0.43
4	A-04	564.66	572.69	8.03	19.70	3.39	564.80	0.14
5	A-05	565.11	572.94	7.83	16.91	2.60	565.25	0.14
6	A-06	565.44	572.57	7.13	14.85	2.53	565.56	0.13
7	A-07	566.05	573.02	6.97	12.67	3.31	566.16	0.11
8	A-08	566.25	573.84	7.59	9.57	0.00	566.35	0.10
9	A-09	566.52	572.90	6.38	9.72	2.40	566.63	0.11
10	A-10	566.86	572.90	6.04	2.40	2.40	566.92	0.06
11	A1-01	566.89	573.36	6.47	5.11	0.00	566.97	0.08
12	A1-02	567.01	572.77	5.76	5.13	5.13	567.09	0.08
13	A2-01	564.09	573.16	9.07	14.65	3.39	564.45	0.36
14	A2-02	564.18	573.59	9.41	8.66	0.00	564.45	0.27
15	A2-03	564.70	572.95	8.25	9.12	3.31	564.81	0.11
16	A2-04	565.19	572.95	7.76	6.39	3.31	565.28	0.09
17	A2-05	565.52	573.17	7.65	3.31	3.31	565.59	0.07
18	A3-01	564.38	573.16	8.78	3.31	3.31	564.47	0.09
19	A4-01	563.27	572.62	9.35	18.57	2.29	564.44	1.17
20	A4-02	563.91	573.16	9.25	16.75	3.39	564.44	0.53
21	A4-03	564.38	573.16	8.78	13.86	3.31	564.52	0.14
22	A4-04	564.63	574.34	9.71	11.05	0.00	564.76	0.13
23	A4-05	564.84	572.89	8.05	8.73	3.96	564.95	0.11
24	A4-06	565.29	572.92	7.63	5.45	2.45	565.37	0.08
25	A4-07	565.77	572.75	6.98	3.31	3.31	565.83	0.06
26	A5-01	564.91	574.34	9.43	2.88	0.00	564.98	0.07
27	A5-02	565.18	573.45	8.27	3.14	1.67	565.26	0.08
28	A5-03	565.60	573.26	7.66	1.72	1.72	565.65	0.05
29	A6-01	562.49	576.00	13.51	51.65	0.00	563.81	1.32

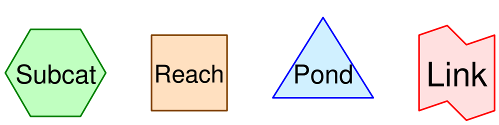
MH STORM SEWER CALCULATIONS
100-YEAR STORM

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)
1	A-01	563.12	573.78	10.66	122.71	0.00	564.49	1.37
2	A-02	563.43	572.62	9.19	83.70	6.88	564.50	1.07
3	A-03	564.02	572.38	8.36	47.29	5.44	564.52	0.50
4	A-04	564.66	572.69	8.03	41.90	6.04	564.87	0.21
5	A-05	565.11	572.94	7.83	35.85	4.65	565.32	0.21
6	A-06	565.44	572.57	7.13	31.17	4.51	565.63	0.20
7	A-07	566.05	573.02	6.97	26.66	5.90	566.22	0.17
8	A-08	566.25	573.84	7.59	20.76	0.00	566.41	0.16
9	A-09	566.52	572.90	6.38	20.04	4.27	566.68	0.16
10	A-10	566.86	572.90	6.04	4.27	4.27	566.96	0.10
11	A1-01	566.89	573.36	6.47	11.39	0.00	567.01	0.12
12	A1-02	567.01	572.77	5.76	9.15	9.15	567.14	0.13
13	A2-01	564.09	573.16	9.07	29.88	6.04	564.52	0.43
14	A2-02	564.18	573.59	9.41	17.78	0.00	564.53	0.35
15	A2-03	564.70	572.95	8.25	17.75	5.90	564.87	0.17
16	A2-04	565.19	572.95	7.76	11.82	5.90	565.34	0.15
17	A2-05	565.52	573.17	7.65	5.90	5.90	565.64	0.12
18	A3-01	564.38	573.16	8.78	5.90	5.90	564.53	0.15
19	A4-01	563.27	572.62	9.35	39.82	4.09	564.49	1.22
20	A4-02	563.91	573.16	9.25	35.86	6.04	564.50	0.59
21	A4-03	564.38	573.16	8.78	29.89	5.90	564.59	0.21
22	A4-04	564.63	574.34	9.71	23.56	0.00	564.83	0.20
23	A4-05	564.84	572.89	8.05	17.37	7.06	565.01	0.17
24	A4-06	565.29	572.92	7.63	10.29	4.37	565.42	0.13
25	A4-07	565.77	572.75	6.98	5.90	5.90	565.88	0.11
26	A5-01	564.91	574.34	9.43	6.08	0.00	565.04	0.13
27	A5-02	565.18	573.45	8.27	6.05	2.97	565.31	0.13
28	A5-03	565.60	573.26	7.66	3.07	3.07	565.69	0.09
29	A6-01	562.49	576.00	13.51	95.11	0.00	563.82	1.33

PIPES FOR STORM SEWER CALCULATIONS

SN	LINE ID	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Pipe Diameter (inches)	Manning's Roughness
28	P-0	A-0	Out-02	44.65	562.96	562.00	2.1500	24.000	0.0130
13	P-1	A-01	A6-01	69.08	563.12	562.96	0.2300	48.000	0.0130
2	P-2	A-02	A-01	130.31	563.43	563.12	0.2400	48.000	0.0130
3	P-3	A-03	A-02	233.18	564.02	563.43	0.2500	48.000	0.0130
4	P-4	A-04	A-03	256.48	564.66	564.02	0.2500	48.000	0.0130
5	P-5	A-05	A-04	182.09	565.11	564.66	0.2500	42.000	0.0130
6	P-6	A-06	A-05	132.96	565.43	565.11	0.2400	42.000	0.0130
7	P-7	A-07	A-06	245.96	566.05	565.43	0.2500	42.000	0.0130
8	P-8	A-08	A-07	78.69	566.25	566.05	0.2500	36.000	0.0130
9	P-9	A-09	A-08	110.45	566.52	566.25	0.2500	36.000	0.0130
1	P-10	A-10	A-09	135.48	566.86	566.52	0.2500	30.000	0.0130
10	P-11	A1-01	A-09	148.86	566.89	566.52	0.2500	36.000	0.0130
11	P-12	A1-02	A1-01	47.30	567.01	566.89	0.2500	30.000	0.0130
22	P-13	A2-01	A-02	256.44	564.09	563.43	0.2600	36.000	0.0130
23	P-14	A2-02	A2-01	34.06	564.18	564.09	0.2700	36.000	0.0130
24	P-15	A2-03	A2-02	208.02	564.70	564.18	0.2500	36.000	0.0130
25	P-16	A2-04	A2-03	195.86	565.19	564.70	0.2500	30.000	0.0130
26	P-17	A2-05	A2-04	132.41	565.52	565.19	0.2500	24.000	0.0130
27	P-18	A3-01	A2-01	117.59	564.38	564.09	0.2500	30.000	0.0130
14	P-19	A4-01	A-01	61.01	563.27	563.12	0.2500	42.000	0.0130
12	P-20	A4-02	A4-01	256.44	563.91	563.27	0.2500	42.000	0.0130
31	P-21	A4-03	A4-02	187.23	564.38	563.91	0.2500	36.000	0.0130
15	P-22	A4-04	A4-03	101.61	564.63	564.38	0.2500	36.000	0.0130
16	P-23	A4-05	A4-04	83.80	564.84	564.63	0.2500	36.000	0.0130
17	P-24	A4-06	A4-05	180.43	565.29	564.84	0.2500	36.000	0.0130
18	P-25	A4-07	A4-06	191.32	565.77	565.29	0.2500	30.000	0.0130
19	P-26	A5-01	A4-04	113.93	564.91	564.63	0.2500	30.000	0.0130
20	P-27	A5-02	A5-01	106.04	565.18	564.91	0.2500	24.000	0.0130
21	P-28	A5-03	A5-02	167.00	565.60	565.18	0.2500	24.000	0.0130
29	P-29	A6-01	Out-01	56.66	562.43	558.00	7.8200	48.000	0.0150
30	P-30	A-0	A6-01	96.09	562.97	562.49	0.5000	48.000	0.0150





Routing Diagram for WQv
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Summary for Subcatchment 1S: Main Site

Runoff = 17.23 cfs @ 12.10 hrs, Volume= 1.356 af, Depth= 0.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr WQv Rainfall=1.20"

Area (ac)	CN	Description
16.505	98	Paved parking, HSG D
16.505		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	158	0.0100	1.16		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
0.5	135	0.0025	4.18	20.51	**Pipe Channel, 130-131** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.013
0.4	110	0.0025	4.72	33.35	**Pipe Channel, 131-132** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013
0.3	79	0.0025	4.72	33.35	**Pipe Channel, 132-133** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013
0.8	246	0.0025	5.23	50.30	**Pipe Channel, 133-134** 42.0" Round Area= 9.6 sf Perim= 11.0' r= 0.88' n= 0.013
0.4	133	0.0025	5.23	50.30	**Pipe Channel, 134-135** 42.0" Round Area= 9.6 sf Perim= 11.0' r= 0.88' n= 0.013
0.6	182	0.0025	5.23	50.30	**Pipe Channel, 135-136** 42.0" Round Area= 9.6 sf Perim= 11.0' r= 0.88' n= 0.013
0.7	256	0.0025	5.72	71.82	**Pipe Channel, 136-137** 48.0" Round Area= 12.6 sf Perim= 12.6' r= 1.00' n= 0.013
0.7	233	0.0025	5.72	71.82	**Pipe Channel, 137-138** 48.0" Round Area= 12.6 sf Perim= 12.6' r= 1.00' n= 0.013
0.4	130	0.0025	5.72	71.82	**Pipe Channel, 138-139** 48.0" Round Area= 12.6 sf Perim= 12.6' r= 1.00' n= 0.013
0.3	113	0.0025	5.72	71.82	**Pipe Channel, 139-Outlet** 48.0" Round Area= 12.6 sf Perim= 12.6' r= 1.00' n= 0.013
7.4	1,775	Total			

Summary for Subcatchment 10S: Forebay Area

Runoff = 0.09 cfs @ 12.09 hrs, Volume= 0.007 af, Depth= 0.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr WQv Rainfall=1.20"

Area (ac)	CN	Description
0.268	80	>75% Grass cover, Good, HSG D
0.086	98	Water Surface, HSG D
0.354	84	Weighted Average
0.268		75.71% Pervious Area
0.086		24.29% Impervious Area

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

Summary for Subcatchment 11S: Gravel Wetland Area

Runoff = 0.55 cfs @ 12.08 hrs, Volume= 0.039 af, Depth= 0.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr WQv Rainfall=1.20"

Area (ac)	CN	Description
0.605	98	Water Surface, HSG D
0.296	80	>75% Grass cover, Good, HSG D
0.228	77	Woods, Good, HSG D
1.129	89	Weighted Average
0.524		46.41% Pervious Area
0.605		53.59% Impervious Area

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

Summary for Subcatchment 12S: Subcat for Swale - 1

Runoff = 0.82 cfs @ 12.07 hrs, Volume= 0.057 af, Depth= 0.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr WQv Rainfall=1.20"

	Area (ac)	CN	Description
*	0.253	95	>75% Grass cover, Good, HSG C
*	0.665	95	Paved parking, HSG C
	0.918	95	Weighted Average
	0.918		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	993	0.1266	3.33		**Lag/CN Method,**

Summary for Subcatchment 13S: Pond

Runoff = 1.31 cfs @ 12.08 hrs, Volume= 0.090 af, Depth= 0.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr WQv Rainfall=1.20"

Area (ac)	CN	Description
1.261	98	Water Surface, HSG C
0.624	80	>75% Grass cover, Good, HSG D
0.064	77	Woods, Good, HSG D
1.949	92	Weighted Average
0.688		35.30% Pervious Area
1.261		64.70% Impervious Area

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

Summary for Subcatchment 16S: DA to Entr. Culvert

Runoff = 0.12 cfs @ 12.51 hrs, Volume= 0.027 af, Depth= 0.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr WQv Rainfall=1.20"

Area (ac)	CN	Description
3.168	77	Woods, Good, HSG D
0.028	98	Paved parking, HSG D
3.196	77	Weighted Average
3.168		99.12% Pervious Area
0.028		0.88% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.9	1,034	0.0359	0.91		**Lag/CN Method,**

Summary for Subcatchment 18S: Subcat to Point B

Runoff = 1.40 cfs @ 12.93 hrs, Volume= 0.448 af, Depth= 0.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr WQv Rainfall=1.20"

Area (ac)	CN	Description
52.205	77	Woods, Good, HSG D
0.898	98	Paved parking, HSG D
53.103	77	Weighted Average
52.205		98.31% Pervious Area
0.898		1.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
47.5	3,073	0.0324	1.08		**Lag/CN Method,**

Summary for Subcatchment 19S: Subcat for Swale - 2

Runoff = 0.54 cfs @ 12.03 hrs, Volume= 0.034 af, Depth= 0.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr WQv Rainfall=1.20"

	Area (ac)	CN	Description
*	0.400	95	Water Surface, HSG C
*	0.144	95	>75% Grass cover, Good, HSG C
	0.544	95	Weighted Average
	0.544		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0	313	0.1239	2.62		**Lag/CN Method,**

Summary for Subcatchment 20S: Wetlands

Runoff = 0.29 cfs @ 12.54 hrs, Volume= 0.066 af, Depth= 0.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr WQv Rainfall=1.20"

Area (ac)	CN	Description
7.773	77	Woods, Good, HSG D
7.773		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.6	1,002	0.0286	0.81		**Lag/CN Method,**

Summary for Subcatchment 24S: DA for 25R

Runoff = 0.03 cfs @ 12.75 hrs, Volume= 0.008 af, Depth= 0.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr WQv Rainfall=1.20"

	Area (ac)	CN	Description
	0.916	77	Woods, Good, HSG D
	0.916		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
36.2	1,580	0.0192	0.73		**Lag/CN Method,**

Summary for Subcatchment 25S: Rerouted Area

Runoff = 0.05 cfs @ 12.49 hrs, Volume= 0.012 af, Depth= 0.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr WQv Rainfall=1.20"

	Area (ac)	CN	Description
	1.380	77	Woods, Good, HSG D
	1.380		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.9	734	0.0260	0.73		**Lag/CN Method,**

Summary for Subcatchment 26S: Subcat for Swale - 2

Runoff = 0.34 cfs @ 12.03 hrs, Volume= 0.021 af, Depth= 0.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr WQv Rainfall=1.20"

	Area (ac)	CN	Description
*	0.234	95	Paved parking, HSG D
*	0.107	95	>75% Grass cover, Good, HSG C
	0.341	95	Weighted Average
	0.341		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.9	293	0.1266	2.61		**Lag/CN Method,**

Summary for Subcatchment 27S: DA for Point F

Runoff = 0.14 cfs @ 12.86 hrs, Volume= 0.042 af, Depth= 0.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr WQv Rainfall=1.20"

Area (ac)	CN	Description
5.040	77	Woods, Good, HSG D
5.040		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
44.0	2,185	0.0219	0.83		**Lag/CN Method,**

Summary for Subcatchment 29S: Rerouted Area B

Runoff = 0.04 cfs @ 12.44 hrs, Volume= 0.007 af, Depth= 0.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr WQv Rainfall=1.20"

Area (sf)	CN	Description
37,749	77	Woods, Good, HSG D
37,749		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	599	0.0260	0.70		**Lag/CN Method,**

Summary for Subcatchment 34S: Subcat for Swale - 4

Runoff = 0.26 cfs @ 12.03 hrs, Volume= 0.016 af, Depth= 0.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr WQv Rainfall=1.20"

	Area (ac)	CN	Description
*	0.072	95	>75% Grass cover, Good, HSG C
*	0.189	95	Paved parking, HSG C
	0.261	95	Weighted Average
	0.261		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.9	292	0.1265	2.61		**Lag/CN Method,**

Summary for Reach 8R: Level Spreader

Inflow Area = 19.937 ac, 92.58% Impervious, Inflow Depth > 0.75" for WQv event
Inflow = 1.24 cfs @ 16.31 hrs, Volume= 1.250 af
Outflow = 1.24 cfs @ 16.32 hrs, Volume= 1.250 af, Atten= 0%, Lag= 0.9 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 0.50 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 0.31 fps, Avg. Travel Time= 2.6 min

Peak Storage= 118 cf @ 16.32 hrs
Average Depth at Peak Storage= 0.03'
Bank-Full Depth= 1.00' Flow Area= 105.0 sf, Capacity= 439.80 cfs

75.00' x 1.00' deep channel, n= 0.030
Side Slope Z-value= 30.0 '/' Top Width= 135.00'
Length= 48.0' Slope= 0.0100 '/'
Inlet Invert= 558.00', Outlet Invert= 557.52'

‡

Summary for Reach 15R: Dry Swale - 1

Inflow Area = 0.918 ac, 0.00% Impervious, Inflow Depth = 0.74" for WQv event
Inflow = 0.82 cfs @ 12.07 hrs, Volume= 0.057 af
Outflow = 0.62 cfs @ 12.14 hrs, Volume= 0.057 af, Atten= 25%, Lag= 3.9 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.76 fps, Min. Travel Time= 8.5 min
Avg. Velocity = 0.59 fps, Avg. Travel Time= 25.6 min

Peak Storage= 317 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.15'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 87.10 cfs

2.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 904.0' Slope= 0.0190 '/'
Inlet Invert= 572.17', Outlet Invert= 555.00'

Summary for Reach 18R: Dry Swale - 3

Inflow Area = 0.544 ac, 0.00% Impervious, Inflow Depth = 0.74" for WQv event
Inflow = 0.54 cfs @ 12.03 hrs, Volume= 0.034 af
Outflow = 0.40 cfs @ 12.09 hrs, Volume= 0.034 af, Atten= 26%, Lag= 3.4 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.18 fps, Min. Travel Time= 7.8 min
Avg. Velocity = 0.42 fps, Avg. Travel Time= 22.1 min

Peak Storage= 187 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.06'
Bank-Full Depth= 1.00' Flow Area= 8.0 sf, Capacity= 54.76 cfs

6.00' x 1.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 550.0' Slope= 0.0273 '/'
Inlet Invert= 548.05', Outlet Invert= 533.01'

‡

Summary for Reach 20R: Dry Swale - 4

Inflow Area = 0.805 ac, 0.00% Impervious, Inflow Depth = 0.74" for WQv event
Inflow = 0.62 cfs @ 12.06 hrs, Volume= 0.050 af
Outflow = 0.59 cfs @ 12.09 hrs, Volume= 0.050 af, Atten= 4%, Lag= 1.7 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.44 fps, Min. Travel Time= 2.3 min
Avg. Velocity = 0.46 fps, Avg. Travel Time= 7.2 min

Peak Storage= 81 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.17'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 66.01 cfs

2.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 198.0' Slope= 0.0109 '/'
Inlet Invert= 532.35', Outlet Invert= 530.19'

Summary for Reach 21R: Point C

Inflow Area = 4.001 ac, 0.70% Impervious, Inflow Depth = 0.23" for WQv event
Inflow = 0.35 cfs @ 12.44 hrs, Volume= 0.077 af
Outflow = 0.35 cfs @ 12.46 hrs, Volume= 0.077 af, Atten= 0%, Lag= 0.9 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 0.90 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 0.55 fps, Avg. Travel Time= 2.3 min

Peak Storage= 30 cf @ 12.46 hrs
Average Depth at Peak Storage= 0.04'
Bank-Full Depth= 2.00' Flow Area= 26.0 sf, Capacity= 240.09 cfs

9.00' x 2.00' deep channel, n= 0.024
Side Slope Z-value= 2.0 '/' Top Width= 17.00'
Length= 77.4' Slope= 0.0136 '/'
Inlet Invert= 526.65', Outlet Invert= 525.60'

‡

Summary for Reach 23R: Rerouting Ditch 1

Inflow Area = 1.380 ac, 0.00% Impervious, Inflow Depth = 0.10" for WQv event
Inflow = 0.05 cfs @ 12.49 hrs, Volume= 0.012 af
Outflow = 0.05 cfs @ 12.53 hrs, Volume= 0.012 af, Atten= 2%, Lag= 2.5 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 0.73 fps, Min. Travel Time= 3.9 min
Avg. Velocity = 0.39 fps, Avg. Travel Time= 7.3 min

Peak Storage= 12 cf @ 12.53 hrs
Average Depth at Peak Storage= 0.03'
Bank-Full Depth= 1.00' Flow Area= 4.0 sf, Capacity= 20.18 cfs

2.00' x 1.00' deep channel, n= 0.025 Earth, clean & winding
Side Slope Z-value= 2.0 '/' Top Width= 6.00'
Length= 171.0' Slope= 0.0137 '/'
Inlet Invert= 536.00', Outlet Invert= 533.66'

Summary for Reach 25R: Ditch

Inflow Area = 0.916 ac, 0.00% Impervious, Inflow Depth = 0.10" for WQv event
Inflow = 0.03 cfs @ 12.75 hrs, Volume= 0.008 af
Outflow = 0.03 cfs @ 12.90 hrs, Volume= 0.008 af, Atten= 6%, Lag= 8.7 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 0.45 fps, Min. Travel Time= 9.7 min
Avg. Velocity = 0.35 fps, Avg. Travel Time= 12.5 min

Peak Storage= 15 cf @ 12.90 hrs
Average Depth at Peak Storage= 0.03'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 60.53 cfs

2.00' x 2.00' deep channel, n= 0.025
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 262.2' Slope= 0.0064 '/'
Inlet Invert= 540.67', Outlet Invert= 539.00'

Summary for Reach 29R: Dry Swale - 2

Inflow Area = 1.259 ac, 0.00% Impervious, Inflow Depth = 0.74" for WQv event
Inflow = 0.78 cfs @ 12.10 hrs, Volume= 0.077 af
Outflow = 0.77 cfs @ 12.14 hrs, Volume= 0.077 af, Atten= 1%, Lag= 2.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.94 fps, Min. Travel Time= 2.3 min
Avg. Velocity = 0.64 fps, Avg. Travel Time= 7.1 min

Peak Storage= 108 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.17'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 90.04 cfs

2.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 273.0' Slope= 0.0203 '/'
Inlet Invert= 553.62', Outlet Invert= 548.08'

Summary for Reach 30R: Rerouted Ditch below Culvert

Inflow Area = 2.247 ac, 0.00% Impervious, Inflow Depth = 0.10" for WQv event
Inflow = 0.09 cfs @ 12.50 hrs, Volume= 0.019 af
Outflow = 0.09 cfs @ 12.54 hrs, Volume= 0.019 af, Atten= 1%, Lag= 2.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.00 fps, Min. Travel Time= 3.5 min
Avg. Velocity = 0.53 fps, Avg. Travel Time= 6.7 min

Peak Storage= 18 cf @ 12.54 hrs
Average Depth at Peak Storage= 0.04'
Bank-Full Depth= 1.00' Flow Area= 4.0 sf, Capacity= 25.17 cfs

2.00' x 1.00' deep channel, n= 0.013
Side Slope Z-value= 2.0 '/' Top Width= 6.00'
Length= 212.0' Slope= 0.0058 '/'
Inlet Invert= 533.54', Outlet Invert= 532.32'

Summary for Pond 2P: Forebay

Inflow Area = 16.859 ac, 98.41% Impervious, Inflow Depth = 0.97" for WQv event
Inflow = 17.32 cfs @ 12.10 hrs, Volume= 1.363 af
Outflow = 5.10 cfs @ 12.41 hrs, Volume= 1.360 af, Atten= 71%, Lag= 18.4 min
Primary = 5.10 cfs @ 12.41 hrs, Volume= 1.360 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 561.00' Surf.Area= 3,802 sf Storage= 3,789 cf
Peak Elev= 564.50' @ 12.45 hrs Surf.Area= 5,436 sf Storage= 19,882 cf (16,094 cf above start)
Flood Elev= 568.00' Surf.Area= 7,249 sf Storage= 42,057 cf (38,268 cf above start)

Plug-Flow detention time= 101.4 min calculated for 1.273 af (93% of inflow)
Center-of-Mass det. time= 42.5 min (826.4 - 783.9)

Volume	Invert	Avail.Storage	Storage Description
#1	558.00'	49,579 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
558.00	2,536	269.1	0.0	0	0	2,536
559.00	2,944	279.8	40.0	1,095	1,095	3,078
560.00	3,366	290.5	40.0	1,261	2,356	3,641
561.00	3,802	301.2	40.0	1,433	3,789	4,225
562.00	4,252	312.0	100.0	4,025	7,814	4,835
563.00	4,716	322.7	100.0	4,482	12,296	5,462
564.00	5,194	333.4	100.0	4,953	17,249	6,110
565.00	5,687	344.1	100.0	5,439	22,687	6,779
566.00	6,193	354.8	100.0	5,938	28,626	7,469
567.00	6,714	365.5	100.0	6,452	35,077	8,180
568.00	7,249	376.2	100.0	6,980	42,057	8,912
569.00	7,798	386.9	100.0	7,522	49,579	9,666

Device	Routing	Invert	Outlet Devices
#1	Primary	558.00'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 558.00' / 558.00' S= 0.0000 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Secondary	565.00'	**60.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 3.0' Crest Height

Primary OutFlow Max=5.10 cfs @ 12.41 hrs HW=564.49' TW=561.57' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 5.10 cfs @ 6.49 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=561.00' TW=561.00' (Dynamic Tailwater)
└─**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 3P: Gravel Wetland

Inflow Area = 17.988 ac, 95.60% Impervious, Inflow Depth > 0.93" for WQv event
Inflow = 5.31 cfs @ 12.36 hrs, Volume= 1.399 af
Outflow = 3.31 cfs @ 13.42 hrs, Volume= 1.384 af, Atten= 38%, Lag= 63.8 min
Primary = 3.31 cfs @ 13.42 hrs, Volume= 1.384 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 561.00' Surf.Area= 22,959 sf Storage= 27,438 cf
Peak Elev= 561.77' @ 13.42 hrs Surf.Area= 23,705 sf Storage= 45,310 cf (17,872 cf above start)
Flood Elev= 568.00' Surf.Area= 30,084 sf Storage= 212,684 cf (185,246 cf above start)

Plug-Flow detention time= 413.2 min calculated for 0.754 af (54% of inflow)
Center-of-Mass det. time= 130.8 min (958.1 - 827.3)

Volume	Invert	Avail.Storage	Storage Description
#1	558.00'	243,305 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
558.00	22,771	626.2	0.0	0	0	22,771
559.00	22,834	626.9	40.0	9,121	9,121	23,401
560.00	22,897	627.7	40.0	9,146	18,267	24,034
561.00	22,959	628.5	40.0	9,171	27,438	24,667
562.00	23,935	639.2	100.0	23,445	50,884	25,919
563.00	24,924	649.9	100.0	24,428	75,312	27,192
564.00	25,928	660.6	100.0	25,424	100,736	28,486
565.00	26,947	671.3	100.0	26,436	127,172	29,801
566.00	27,978	682.1	100.0	27,461	154,633	31,146
567.00	29,024	692.8	100.0	28,499	183,132	32,504
568.00	30,084	703.5	100.0	29,552	212,684	33,883
569.00	31,161	714.3	100.0	30,621	243,305	35,293

Device	Routing	Invert	Outlet Devices
#1	Primary	558.00'	**36.0" Round Culvert** L= 20.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 558.00' / 558.00' S= 0.0000 '/' Cc= 0.900 n= 0.013, Flow Area= 7.07 sf
#2	Device 1	561.00'	**12.0" Vert. Orifice/Grate X 2.00** C= 0.600
#3	Device 2	558.00'	**12.0" Vert. Orifice/Grate** C= 0.600
#4	Device 1	562.50'	**60.0" x 30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 2	562.50'	**60.0" x 30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Secondary	564.00'	**100.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 5.0' Crest Height

Primary OutFlow Max=3.31 cfs @ 13.42 hrs HW=561.77' TW=558.41' (Dynamic Tailwater)
- **1=Culvert** (Passes 3.31 cfs of 42.23 cfs potential flow)
  - **2=Orifice/Grate** (Passes 3.31 cfs of 3.85 cfs potential flow)
    - **3=Orifice/Grate** (Orifice Controls 3.31 cfs @ 4.21 fps)
    - **5=Orifice/Grate** (Controls 0.00 cfs)
  - **4=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=561.00' TW=558.00' (Dynamic Tailwater)
- **6=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 4P: DP-1

Inflow Area = 19.937 ac, 92.58% Impervious, Inflow Depth > 0.89" for WQv event
Inflow = 3.42 cfs @ 13.37 hrs, Volume= 1.474 af
Outflow = 1.24 cfs @ 16.30 hrs, Volume= 1.251 af, Atten= 64%, Lag= 175.7 min
Primary = 1.24 cfs @ 16.30 hrs, Volume= 1.251 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 558.71' @ 16.30 hrs Surf.Area= 49,114 sf Storage= 34,309 cf
Flood Elev= 565.00' Surf.Area= 62,400 sf Storage= 384,495 cf

Plug-Flow detention time= 492.3 min calculated for 1.250 af (85% of inflow)

Center-of-Mass det. time= 396.7 min (1,347.5 - 950.7)

Volume	Invert	Avail.Storage	Storage Description
#1	558.00'	651,999 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
558.00	47,688	883.6	0	0	47,688
559.00	49,705	899.0	48,693	48,693	50,047
560.00	51,750	914.4	50,724	99,417	52,448
561.00	53,824	929.8	52,784	152,201	54,888
562.00	55,926	945.2	54,872	207,072	57,370
563.00	58,056	960.6	56,988	264,060	59,893
564.00	60,214	976.1	59,132	323,192	62,470
565.00	62,400	991.5	61,304	384,495	65,075
566.00	64,615	1,006.9	63,504	448,000	67,720
567.00	66,858	1,022.3	65,733	513,733	70,405
568.00	69,129	1,037.7	67,990	581,723	73,132
569.00	71,429	1,053.2	70,276	651,999	75,915

Device	Routing	Invert	Outlet Devices
#1	Primary	558.00'	**48.0" Round Culvert** L= 663.9' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 558.00' / 551.36' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 12.57 sf
#2	Device 1	558.00'	**9.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	562.50'	**12.0" Vert. Orifice/Grate** C= 0.600
#4	Secondary	568.00'	**45.0 deg x 100.0' long x 1.00' rise Sharp-Crested Vee/Trap Weir** Cv= 2.56 (C= 3.20)

Primary OutFlow Max=1.24 cfs @ 16.30 hrs HW=558.71' TW=558.08' (Dynamic Tailwater)
└─**1=Culvert** (Passes 1.24 cfs of 1.57 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.24 cfs @ 2.87 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=558.00' TW=0.00' (Dynamic Tailwater)
└─**4=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

Summary for Pond 13P: Det. Pond - 2

Inflow Area = 1.259 ac, 0.00% Impervious, Inflow Depth = 0.74" for WQv event
Inflow = 0.77 cfs @ 12.14 hrs, Volume= 0.077 af
Outflow = 0.08 cfs @ 13.91 hrs, Volume= 0.074 af, Atten= 90%, Lag= 106.2 min
Primary = 0.08 cfs @ 13.91 hrs, Volume= 0.074 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 538.35' @ 13.91 hrs Surf.Area= 5,456 sf Storage= 1,839 cf
Flood Elev= 541.00' Surf.Area= 8,791 sf Storage= 20,626 cf

Plug-Flow detention time= 381.4 min calculated for 0.074 af (96% of inflow)
Center-of-Mass det. time= 357.9 min (1,192.4 - 834.5)

Volume	Invert	Avail.Storage	Storage Description
#1	538.00'	20,626 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
538.00	5,054	387.0	0	0	5,054
539.00	6,243	405.8	5,638	5,638	6,305
540.00	7,489	424.7	6,857	12,495	7,621
541.00	8,791	423.9	8,131	20,626	8,049

Device	Routing	Invert	Outlet Devices
#1	Primary	538.00'	**15.0" Round Culvert** L= 94.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 538.00' / 537.00' S= 0.0106 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	538.00'	**2.4" Vert. Orifice/Grate** C= 0.600
#3	Device 1	538.90'	**4.0" Vert. Orifice/Grate** C= 0.600
#4	Device 1	539.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.08 cfs @ 13.91 hrs HW=538.35' TW=533.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.08 cfs of 0.57 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.08 cfs @ 2.41 fps)
  ├─**3=Orifice/Grate** (Controls 0.00 cfs)
  └─**4=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 15P: Culvert at Entr.

Inflow Area = 4.001 ac, 0.70% Impervious, Inflow Depth = 0.23" for WQv event
Inflow = 0.35 cfs @ 12.44 hrs, Volume= 0.077 af
Outflow = 0.35 cfs @ 12.44 hrs, Volume= 0.077 af, Atten= 0%, Lag= 0.0 min
Primary = 0.35 cfs @ 12.44 hrs, Volume= 0.077 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 527.36' @ 12.44 hrs Surf.Area= 11 sf Storage= 2 cf

Plug-Flow detention time= 0.1 min calculated for 0.077 af (100% of inflow)
Center-of-Mass det. time= 0.1 min (886.2 - 886.0)

Volume	Invert	Avail.Storage	Storage Description
#1	527.17'	1,407 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
527.17	6	14.0	0	0	6
528.00	44	35.0	18	18	90
529.00	121	58.1	79	98	268
530.00	266	92.9	189	286	693
531.00	555	117.6	402	688	1,120
532.00	897	157.4	719	1,407	2,001

Device	Routing	Invert	Outlet Devices
#1	Primary	527.17'	**18.0" Round Culvert X 2.00** L= 52.8' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 527.17' / 526.65' S= 0.0098 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	527.17'	**18.0" W x 3.0" H Vert. Orifice/Grate** C= 0.600
#3	Device 1	530.00'	**72.0" x 72.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.35 cfs @ 12.44 hrs HW=527.36' TW=526.69' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 0.35 cfs @ 2.16 fps)
  ├─**2=Orifice/Grate** (Passes 0.35 cfs of 0.38 cfs potential flow)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 17P: Box Culvert for stream

Inflow Area = 57.525 ac, 1.56% Impervious, Inflow Depth > 0.11" for WQv event
Inflow = 1.54 cfs @ 12.93 hrs, Volume= 0.549 af
Outflow = 1.54 cfs @ 12.93 hrs, Volume= 0.549 af, Atten= 0%, Lag= 0.0 min
Primary = 1.54 cfs @ 12.93 hrs, Volume= 0.549 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 533.00' @ 0.00 hrs Surf.Area= 412 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.0 min (1,015.4 - 1,015.4)

Volume	Invert	Avail.Storage	Storage Description
#1	533.00'	25,714 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
533.00	412	159.8	0	0	412
534.00	5,210	513.7	2,362	2,362	19,382
535.00	11,714	795.5	8,245	10,608	48,748
536.00	18,774	996.6	15,106	25,714	77,441

Device	Routing	Invert	Outlet Devices
#1	Primary	532.20'	**144.0" W x 60.0" H Box Culvert** L= 51.5' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 532.20' / 530.66' S= 0.0299 '/' Cc= 0.900 n= 0.024, Flow Area= 60.00 sf

Primary OutFlow Max=0.00 cfs @ 12.93 hrs HW=533.00' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.00 cfs of 27.56 cfs potential flow)

Summary for Pond 18P: Level Spreader

Inflow Area = 19.937 ac, 92.58% Impervious, Inflow Depth > 0.75" for WQv event
Inflow = 1.24 cfs @ 16.30 hrs, Volume= 1.251 af
Outflow = 1.24 cfs @ 16.31 hrs, Volume= 1.250 af, Atten= 0%, Lag= 0.8 min
Primary = 1.24 cfs @ 16.31 hrs, Volume= 1.250 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 558.00' Surf.Area= 2,625 sf Storage= 7,350 cf
Peak Elev= 558.08' @ 16.31 hrs Surf.Area= 2,625 sf Storage= 7,435 cf (85 cf above start)

Plug-Flow detention time= 221.0 min calculated for 1.082 af (86% of inflow)
Center-of-Mass det. time= 1.2 min (1,348.6 - 1,347.5)

Volume	Invert	Avail.Storage	Storage Description
#1	551.00'	8,400 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 21,000 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
551.00	2,625	0	0
556.00	2,625	13,125	13,125
557.00	2,625	2,625	15,750
558.00	2,625	2,625	18,375
559.00	2,625	2,625	21,000

Device	Routing	Invert	Outlet Devices
#1	Primary	558.00'	**75.0" x 35.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.24 cfs @ 16.31 hrs HW=558.08' TW=558.03' (Dynamic Tailwater)
└─**1=Orifice/Grate** (Weir Controls 1.24 cfs @ 0.83 fps)

Summary for Pond 23P:

Inflow Area = 0.805 ac, 0.00% Impervious, Inflow Depth = 0.74" for WQv event
Inflow = 0.59 cfs @ 12.09 hrs, Volume= 0.050 af
Outflow = 0.24 cfs @ 12.43 hrs, Volume= 0.050 af, Atten= 59%, Lag= 20.5 min
Primary = 0.21 cfs @ 12.43 hrs, Volume= 0.049 af
Secondary = 0.03 cfs @ 12.43 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 531.61' @ 12.43 hrs Surf.Area= 707 sf Storage= 442 cf

Plug-Flow detention time= 16.1 min calculated for 0.050 af (100% of inflow)
Center-of-Mass det. time= 16.1 min (844.8 - 828.7)

Volume	Invert	Avail.Storage	Storage Description
#1	530.19'	789 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
530.19	56	110.4	0	0	56
531.00	317	180.9	137	137	1,695
532.01	1,044	364.9	652	789	9,691

Device	Routing	Invert	Outlet Devices
#1	Primary	530.19'	**3.0" Round Culvert** L= 17.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 530.19' / 530.00' S= 0.0110 '/' Cc= 0.900 n= 0.013, Flow Area= 0.05 sf
#2	Secondary	531.60'	**30.0 deg x 7.7' long x 0.40' rise Sharp-Crested Vee/Trap Weir** Cv= 2.61 (C= 3.26)

Primary OutFlow Max=0.21 cfs @ 12.43 hrs HW=531.61' TW=527.35' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 0.21 cfs @ 4.21 fps)

Secondary OutFlow Max=0.03 cfs @ 12.43 hrs HW=531.61' TW=527.35' (Dynamic Tailwater)
└─**2=Sharp-Crested Vee/Trap Weir** (Weir Controls 0.03 cfs @ 0.36 fps)

Summary for Pond 24P: Flow Splitter

Inflow Area = 16.505 ac,100.00% Impervious, Inflow Depth = 0.99" for WQv event
Inflow = 17.23 cfs @ 12.10 hrs, Volume= 1.356 af
Outflow = 17.23 cfs @ 12.10 hrs, Volume= 1.356 af, Atten= 0%, Lag= 0.0 min
Primary = 17.23 cfs @ 12.10 hrs, Volume= 1.356 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 565.26' @ 12.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	562.96'	**24.0" Round Culvert** L= 44.7' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 562.96' / 562.00' S= 0.0215 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Secondary	562.96'	**48.0" Round Culvert** L= 106.2' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 562.96' / 562.43' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 12.57 sf
#3	Device 2	565.70'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=17.21 cfs @ 12.10 hrs HW=565.25' TW=563.34' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 17.21 cfs @ 5.48 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=562.96' TW=558.00' (Dynamic Tailwater)
└─**2=Culvert** (Controls 0.00 cfs)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 28P: Ramp Culvert

Inflow Area = 0.918 ac, 0.00% Impervious, Inflow Depth = 0.74" for WQv event
Inflow = 0.62 cfs @ 12.14 hrs, Volume= 0.057 af
Outflow = 0.62 cfs @ 12.15 hrs, Volume= 0.056 af, Atten= 0%, Lag= 0.4 min
Primary = 0.62 cfs @ 12.15 hrs, Volume= 0.056 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 555.27' @ 12.15 hrs Surf.Area= 108 sf Storage= 31 cf
Flood Elev= 557.00' Surf.Area= 534 sf Storage= 342 cf

Plug-Flow detention time= 5.5 min calculated for 0.056 af (100% of inflow)
Center-of-Mass det. time= 2.8 min (836.1 - 833.3)

Volume	Invert	Avail.Storage	Storage Description
#1	554.61'	342 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
554.61	4	8.0	0	0	4
555.00	56	45.8	10	10	166
556.00	337	150.1	177	187	1,795
556.36	534	184.0	155	342	2,698

Device	Routing	Invert	Outlet Devices
#1	Primary	555.00'	**23.0" W x 14.0" H, R=22.0" Elliptical RCP_Elliptical 23x14** L= 30.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 555.00' / 553.62' S= 0.0460 '/' Cc= 0.900 n= 0.013, Flow Area= 1.83 sf

Primary OutFlow Max=0.62 cfs @ 12.15 hrs HW=555.27' TW=553.79' (Dynamic Tailwater)
↑—**1=RCP_Elliptical 23x14** (Inlet Controls 0.62 cfs @ 1.87 fps)

Summary for Pond 30P: Culvert 2

Inflow Area = 1.380 ac, 0.00% Impervious, Inflow Depth = 0.10" for WQv event
Inflow = 0.05 cfs @ 12.53 hrs, Volume= 0.012 af
Outflow = 0.05 cfs @ 12.53 hrs, Volume= 0.012 af, Atten= 0%, Lag= 0.0 min
Primary = 0.05 cfs @ 12.53 hrs, Volume= 0.012 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 533.76' @ 12.53 hrs
Flood Elev= 534.87'

Device	Routing	Invert	Outlet Devices
#1	Primary	533.66'	**23.0" W x 14.0" H, R=22.0" Elliptical RCP_Elliptical 23x14** L= 24.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 533.66' / 533.54' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 1.83 sf

Primary OutFlow Max=0.05 cfs @ 12.53 hrs HW=533.76' TW=533.58' (Dynamic Tailwater)
↑—**1=RCP_Elliptical 23x14** (Barrel Controls 0.05 cfs @ 1.05 fps)

Summary for Pond 31P: Culvert 3

Inflow Area =	0.544 ac,	0.00% Impervious,	Inflow Depth = 0.74"	for WQv event
Inflow =	0.40 cfs @	12.09 hrs, Volume=	0.034 af	
Outflow =	0.40 cfs @	12.09 hrs, Volume=	0.034 af,	Atten= 0%, Lag= 0.0 min
Primary =	0.40 cfs @	12.09 hrs, Volume=	0.034 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 533.26' @ 12.09 hrs
Flood Elev= 538.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	533.00'	**23.0" W x 14.0" H, R=22.0" Elliptical RCP_Elliptical 23x14** L= 24.0' RCP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 533.00' / 532.35' S= 0.0271 '/' Cc= 0.900 n= 0.013, Flow Area= 1.83 sf

Primary OutFlow Max=0.40 cfs @ 12.09 hrs HW=533.26' TW=532.52' (Dynamic Tailwater)
↑—**1=RCP_Elliptical 23x14** (Inlet Controls 0.40 cfs @ 1.29 fps)

Summary for Link 21L: Point A

Inflow Area =	27.710 ac,	66.61% Impervious,	Inflow Depth > 0.57"	for WQv event
Inflow =	1.30 cfs @	16.04 hrs, Volume=	1.316 af	
Primary =	1.30 cfs @	16.04 hrs, Volume=	1.316 af,	Atten= 0%, Lag= 0.0 min

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

Summary for Link 22L: Point B

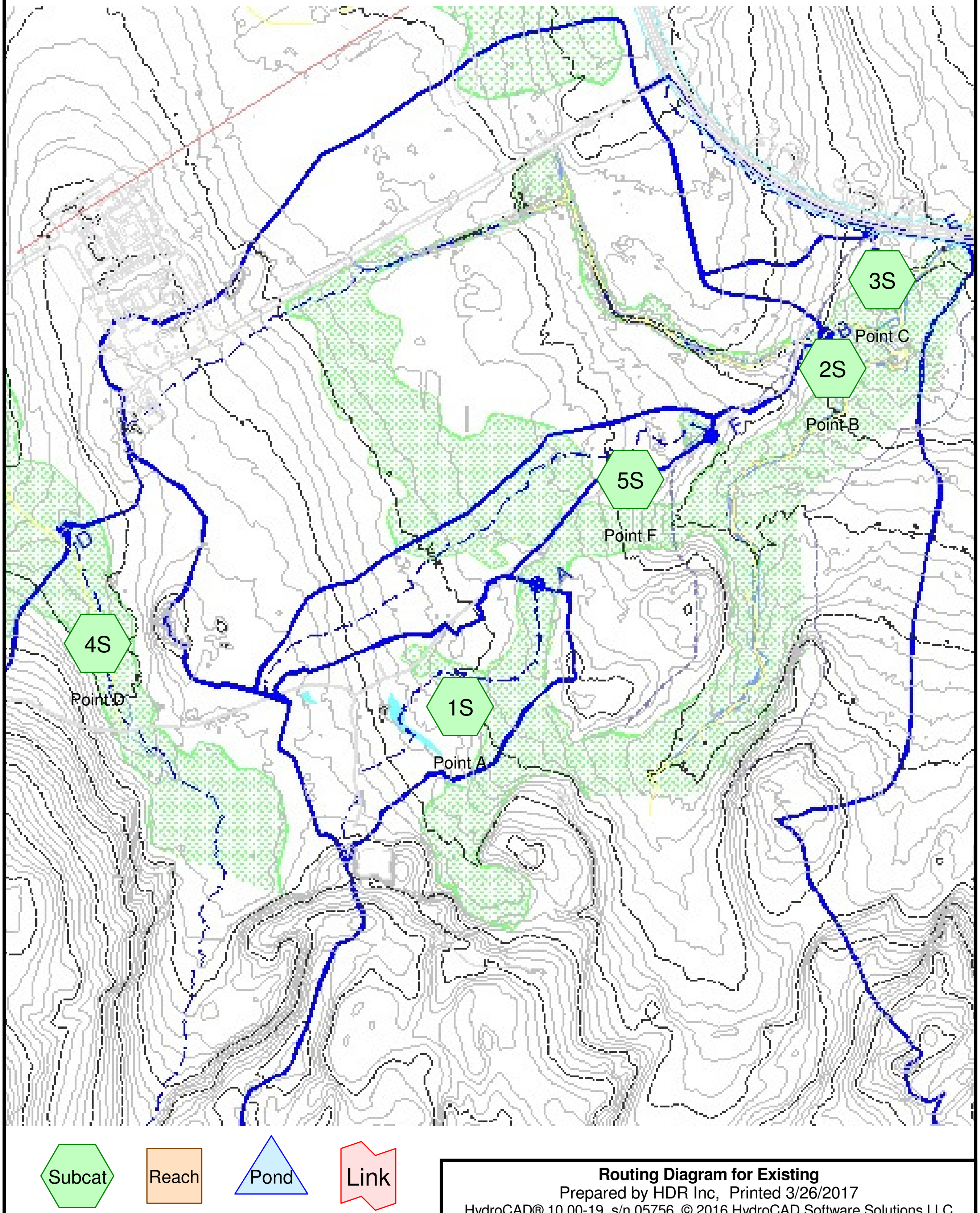
Inflow Area =	57.525 ac,	1.56% Impervious,	Inflow Depth > 0.11"	for WQv event
Inflow =	1.54 cfs @	12.93 hrs, Volume=	0.549 af	
Primary =	1.54 cfs @	12.93 hrs, Volume=	0.549 af,	Atten= 0%, Lag= 0.0 min

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

Summary for Link 28L: Point F

Inflow Area =	5.040 ac,	0.00% Impervious,	Inflow Depth = 0.10"	for WQv event
Inflow =	0.14 cfs @	12.86 hrs, Volume=	0.042 af	
Primary =	0.14 cfs @	12.86 hrs, Volume=	0.042 af,	Atten= 0%, Lag= 0.0 min

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



Routing Diagram for Existing
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Summary for Subcatchment 1S: Point A

Runoff = 6.50 cfs @ 12.44 hrs, Volume= 0.854 af, Depth= 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Rainfall=2.70"

Area (ac)	CN	Description
11.793	77	Woods, Good, HSG D
11.793		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.0	1,588	0.0303	0.91		**Lag/CN Method,**

Summary for Subcatchment 2S: Point B

Runoff = 28.94 cfs @ 12.69 hrs, Volume= 4.860 af, Depth= 0.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Rainfall=2.70"

Area (sf)	CN	Description
2,678,932	77	Woods, Good, HSG D
81,040	98	Paved parking, HSG D
2,759,972	78	Weighted Average
2,678,932		97.06% Pervious Area
81,040		2.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
48.6	3,073	0.0291	1.05		**Lag/CN Method,**

Summary for Subcatchment 3S: Point C

Runoff = 2.89 cfs @ 12.29 hrs, Volume= 0.323 af, Depth= 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Rainfall=2.70"

Area (ac)	CN	Description
4.464	77	Woods, Good, HSG D
4.464		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.7	1,034	0.0331	0.88		**Lag/CN Method,**

Summary for Subcatchment 4S: Point D

Runoff = 45.55 cfs @ 12.49 hrs, Volume= 6.206 af, Depth= 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Rainfall=2.70"

Area (ac)	CN	Description
85.739	77	Woods, Good, HSG D
85.739		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.5	3,135	0.0762	1.66		**Lag/CN Method,**

Summary for Subcatchment 5S: Point F

Runoff = 4.23 cfs @ 12.66 hrs, Volume= 0.680 af, Depth= 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Rainfall=2.70"

Area (ac)	CN	Description
9.400	77	Woods, Good, HSG D
9.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
44.0	2,185	0.0219	0.83		**Lag/CN Method,**

Summary for Subcatchment 1S: Point A

Runoff = 20.16 cfs @ 12.41 hrs, Volume= 2.496 af, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (ac)	CN	Description
11.793	77	Woods, Good, HSG D
11.793		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.0	1,588	0.0303	0.91		**Lag/CN Method,**

Summary for Subcatchment 2S: Point B

Runoff = 86.73 cfs @ 12.69 hrs, Volume= 13.871 af, Depth= 2.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (sf)	CN	Description
2,678,932	77	Woods, Good, HSG D
81,040	98	Paved parking, HSG D
2,759,972	78	Weighted Average
2,678,932		97.06% Pervious Area
81,040		2.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
48.6	3,073	0.0291	1.05		**Lag/CN Method,**

Summary for Subcatchment 3S: Point C

Runoff = 9.01 cfs @ 12.28 hrs, Volume= 0.945 af, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (ac)	CN	Description
4.464	77	Woods, Good, HSG D
4.464		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.7	1,034	0.0331	0.88		**Lag/CN Method,**

Summary for Subcatchment 4S: Point D

Runoff = 140.96 cfs @ 12.43 hrs, Volume= 18.145 af, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (ac)	CN	Description
85.739	77	Woods, Good, HSG D
85.739		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.5	3,135	0.0762	1.66		**Lag/CN Method,**

Summary for Subcatchment 5S: Point F

Runoff = 13.08 cfs @ 12.61 hrs, Volume= 1.989 af, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (ac)	CN	Description
9.400	77	Woods, Good, HSG D
9.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
44.0	2,185	0.0219	0.83		**Lag/CN Method,**

Summary for Subcatchment 1S: Point A

Runoff = 46.68 cfs @ 12.40 hrs, Volume= 5.818 af, Depth= 5.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
11.793	77	Woods, Good, HSG D
11.793		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.0	1,588	0.0303	0.91		**Lag/CN Method,**

Summary for Subcatchment 2S: Point B

Runoff = 197.47 cfs @ 12.64 hrs, Volume= 31.899 af, Depth= 6.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (sf)	CN	Description
2,678,932	77	Woods, Good, HSG D
81,040	98	Paved parking, HSG D
2,759,972	78	Weighted Average
2,678,932		97.06% Pervious Area
81,040		2.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
48.6	3,073	0.0291	1.05		**Lag/CN Method,**

Summary for Subcatchment 3S: Point C

Runoff = 20.85 cfs @ 12.27 hrs, Volume= 2.202 af, Depth= 5.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
4.464	77	Woods, Good, HSG D
4.464		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.7	1,034	0.0331	0.88		**Lag/CN Method,**

Summary for Subcatchment 4S: Point D

Runoff = 327.06 cfs @ 12.43 hrs, Volume= 42.299 af, Depth= 5.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
85.739	77	Woods, Good, HSG D
85.739		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.5	3,135	0.0762	1.66		**Lag/CN Method,**

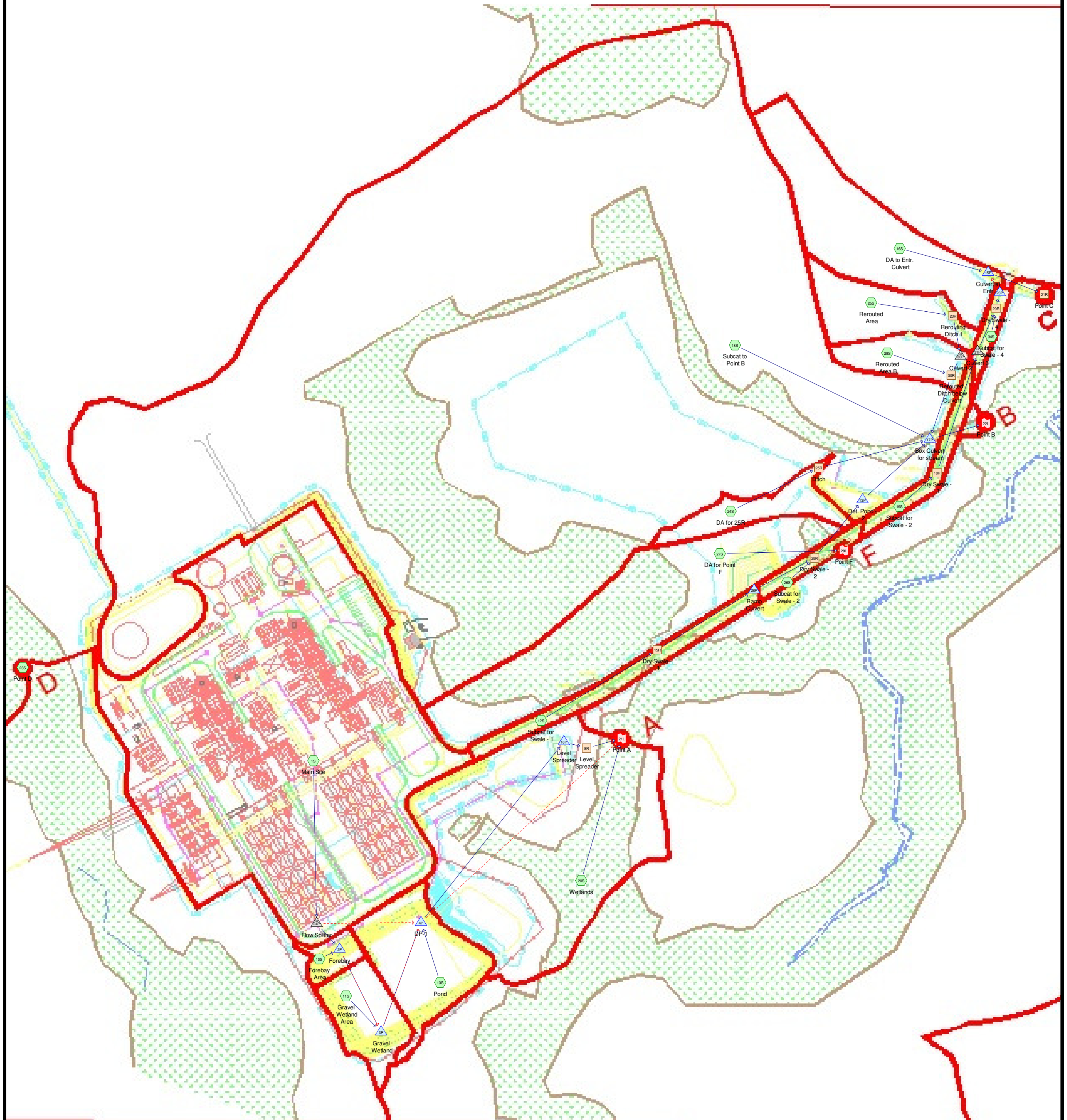
Summary for Subcatchment 5S: Point F

Runoff = 30.37 cfs @ 12.57 hrs, Volume= 4.637 af, Depth= 5.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
9.400	77	Woods, Good, HSG D
9.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
44.0	2,185	0.0219	0.83		**Lag/CN Method,**



Subcat

Reach

Pond

Link

Routing Diagram for Proposed

Prepared by HDR Inc, Printed 3/26/2017

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Summary for Subcatchment 1S: Main Site

Runoff = 41.05 cfs @ 12.10 hrs, Volume= 3.397 af, Depth= 2.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Rainfall=2.70"

Area (ac)	CN	Description
16.505	98	Paved parking, HSG D
16.505		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	158	0.0100	1.16		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
0.5	135	0.0025	4.18	20.51	**Pipe Channel, 130-131** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.013
0.4	110	0.0025	4.72	33.35	**Pipe Channel, 131-132** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013
0.3	79	0.0025	4.72	33.35	**Pipe Channel, 132-133** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013
0.8	246	0.0025	5.23	50.30	**Pipe Channel, 133-134** 42.0" Round Area= 9.6 sf Perim= 11.0' r= 0.88' n= 0.013
0.4	133	0.0025	5.23	50.30	**Pipe Channel, 134-135** 42.0" Round Area= 9.6 sf Perim= 11.0' r= 0.88' n= 0.013
0.6	182	0.0025	5.23	50.30	**Pipe Channel, 135-136** 42.0" Round Area= 9.6 sf Perim= 11.0' r= 0.88' n= 0.013
0.7	256	0.0025	5.72	71.82	**Pipe Channel, 136-137** 48.0" Round Area= 12.6 sf Perim= 12.6' r= 1.00' n= 0.013
0.7	233	0.0025	5.72	71.82	**Pipe Channel, 137-138** 48.0" Round Area= 12.6 sf Perim= 12.6' r= 1.00' n= 0.013
0.4	130	0.0025	5.72	71.82	**Pipe Channel, 138-139** 48.0" Round Area= 12.6 sf Perim= 12.6' r= 1.00' n= 0.013
0.3	113	0.0025	5.72	71.82	**Pipe Channel, 139-Outlet** 48.0" Round Area= 12.6 sf Perim= 12.6' r= 1.00' n= 0.013
7.4	1,775	Total			

Summary for Subcatchment 10S: Forebay Area

Runoff = 0.55 cfs @ 12.08 hrs, Volume= 0.038 af, Depth= 1.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Rainfall=2.70"

Area (ac)	CN	Description
0.268	80	>75% Grass cover, Good, HSG D
0.086	98	Water Surface, HSG D
0.354	84	Weighted Average
0.268		75.71% Pervious Area
0.086		24.29% Impervious Area

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

Summary for Subcatchment 11S: Gravel Wetland Area

Runoff = 2.23 cfs @ 12.07 hrs, Volume= 0.153 af, Depth= 1.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Rainfall=2.70"

Area (ac)	CN	Description
0.605	98	Water Surface, HSG D
0.296	80	>75% Grass cover, Good, HSG D
0.228	77	Woods, Good, HSG D
1.129	89	Weighted Average
0.524		46.41% Pervious Area
0.605		53.59% Impervious Area

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

Summary for Subcatchment 12S: Subcat for Swale - 1

Runoff = 1.91 cfs @ 12.09 hrs, Volume= 0.137 af, Depth= 1.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Rainfall=2.70"

	Area (ac)	CN	Description
	0.253	74	>75% Grass cover, Good, HSG C
*	0.665	98	Paved parking, HSG C
	0.918	91	Weighted Average
	0.253		27.56% Pervious Area
	0.665		72.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	993	0.1266	2.77		**Lag/CN Method,**

Summary for Subcatchment 13S: Pond

Runoff = 4.39 cfs @ 12.07 hrs, Volume= 0.305 af, Depth= 1.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Rainfall=2.70"

Area (ac)	CN	Description
1.261	98	Water Surface, HSG C
0.624	80	>75% Grass cover, Good, HSG D
0.064	77	Woods, Good, HSG D
1.949	92	Weighted Average
0.688		35.30% Pervious Area
1.261		64.70% Impervious Area

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

Summary for Subcatchment 16S: DA to Entr. Culvert

Runoff = 2.11 cfs @ 12.28 hrs, Volume= 0.231 af, Depth= 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Rainfall=2.70"

Area (ac)	CN	Description
3.168	77	Woods, Good, HSG D
0.028	98	Paved parking, HSG D
3.196	77	Weighted Average
3.168		99.12% Pervious Area
0.028		0.88% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.9	1,034	0.0359	0.91		**Lag/CN Method,**

Summary for Subcatchment 18S: Subcat to Point B

Runoff = 22.91 cfs @ 12.72 hrs, Volume= 3.844 af, Depth= 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Rainfall=2.70"

Area (ac)	CN	Description
52.205	77	Woods, Good, HSG D
0.898	98	Paved parking, HSG D
53.103	77	Weighted Average
52.205		98.31% Pervious Area
0.898		1.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
47.5	3,073	0.0324	1.08		**Lag/CN Method,**

Summary for Subcatchment 19S: Subcat for Swale - 2

Runoff = 1.35 cfs @ 12.03 hrs, Volume= 0.085 af, Depth= 1.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Rainfall=2.70"

	Area (ac)	CN	Description
	0.400	98	Water Surface, HSG C
*	0.144	74	>75% Grass cover, Good, HSG C
	0.544	92	Weighted Average
	0.144		26.47% Pervious Area
	0.400		73.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	313	0.1239	2.27		**Lag/CN Method,**

Summary for Subcatchment 20S: Wetlands

Runoff = 4.95 cfs @ 12.31 hrs, Volume= 0.563 af, Depth= 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Rainfall=2.70"

Area (ac)	CN	Description
7.773	77	Woods, Good, HSG D
7.773		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.6	1,002	0.0286	0.81		**Lag/CN Method,**

Summary for Subcatchment 23S: Point D

Runoff = 44.54 cfs @ 12.48 hrs, Volume= 6.047 af, Depth= 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Rainfall=2.70"

Area (sf)	CN	Description
3,639,264	77	Woods, Good, HSG D
3,639,264		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.3	3,135	0.0772	1.67		**Lag/CN Method,**

Summary for Subcatchment 24S: DA for 25R

Runoff = 0.46 cfs @ 12.55 hrs, Volume= 0.066 af, Depth= 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Rainfall=2.70"

Area (ac)	CN	Description
0.916	77	Woods, Good, HSG D
0.916		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
36.2	1,580	0.0192	0.73		**Lag/CN Method,**

Summary for Subcatchment 25S: Rerouted Area

Runoff = 0.95 cfs @ 12.26 hrs, Volume= 0.100 af, Depth= 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Rainfall=2.70"

Area (ac)	CN	Description
1.380	77	Woods, Good, HSG D
1.380		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.9	734	0.0260	0.73		**Lag/CN Method,**

Summary for Subcatchment 26S: Subcat for Swale - 2

Runoff = 0.78 cfs @ 12.03 hrs, Volume= 0.049 af, Depth= 1.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Rainfall=2.70"

	Area (ac)	CN	Description
*	0.234	98	Paved parking, HSG D
	0.107	74	>75% Grass cover, Good, HSG C
	0.341	90	Weighted Average
	0.107		31.38% Pervious Area
	0.234		68.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	293	0.1266	2.08		**Lag/CN Method,**

Summary for Subcatchment 27S: DA for Point F

Runoff = 2.27 cfs @ 12.66 hrs, Volume= 0.365 af, Depth= 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Rainfall=2.70"

Area (ac)	CN	Description
5.040	77	Woods, Good, HSG D
5.040		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
44.0	2,185	0.0219	0.83		**Lag/CN Method,**

Summary for Subcatchment 29S: Rerouted Area B

Runoff = 0.64 cfs @ 12.21 hrs, Volume= 0.063 af, Depth= 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Rainfall=2.70"

Area (sf)	CN	Description
37,749	77	Woods, Good, HSG D
37,749		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	599	0.0260	0.70		**Lag/CN Method,**

Summary for Subcatchment 34S: Subcat for Swale - 4

Runoff = 0.62 cfs @ 12.03 hrs, Volume= 0.039 af, Depth= 1.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Rainfall=2.70"

	Area (ac)	CN	Description
*	0.072	74	>75% Grass cover, Good, HSG C
*	0.189	98	Paved parking, HSG C
	0.261	91	Weighted Average
	0.072		27.59% Pervious Area
	0.189		72.41% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	292	0.1265	2.17		**Lag/CN Method,**

Summary for Reach 8R: Level Spreader

Inflow Area = 19.937 ac, 92.58% Impervious, Inflow Depth > 2.17" for 1-Year event
Inflow = 2.57 cfs @ 17.79 hrs, Volume= 3.609 af
Outflow = 2.57 cfs @ 17.80 hrs, Volume= 3.608 af, Atten= 0%, Lag= 0.7 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 0.67 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 0.42 fps, Avg. Travel Time= 1.9 min

Peak Storage= 185 cf @ 17.80 hrs
Average Depth at Peak Storage= 0.05'
Bank-Full Depth= 1.00' Flow Area= 105.0 sf, Capacity= 439.80 cfs

75.00' x 1.00' deep channel, n= 0.030
Side Slope Z-value= 30.0 '/' Top Width= 135.00'
Length= 48.0' Slope= 0.0100 '/'
Inlet Invert= 558.00', Outlet Invert= 557.52'

Summary for Reach 15R: Dry Swale - 1

Inflow Area = 0.918 ac, 72.44% Impervious, Inflow Depth = 1.79" for 1-Year event
Inflow = 1.91 cfs @ 12.09 hrs, Volume= 0.137 af
Outflow = 1.58 cfs @ 12.14 hrs, Volume= 0.137 af, Atten= 18%, Lag= 3.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.40 fps, Min. Travel Time= 6.3 min
Avg. Velocity = 0.72 fps, Avg. Travel Time= 21.0 min

Peak Storage= 595 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.26'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 87.10 cfs

2.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 904.0' Slope= 0.0190 '/'
Inlet Invert= 572.17', Outlet Invert= 555.00'

Summary for Reach 18R: Dry Swale - 3

Inflow Area =	0.544 ac, 73.53% Impervious, Inflow Depth = 1.88"	for 1-Year event	
Inflow =	1.35 cfs @ 12.03 hrs, Volume=	0.085 af	
Outflow =	1.11 cfs @ 12.08 hrs, Volume=	0.085 af,	Atten= 18%, Lag= 2.6 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.75 fps, Min. Travel Time= 5.2 min
Avg. Velocity = 0.48 fps, Avg. Travel Time= 19.2 min

Peak Storage= 349 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.10'
Bank-Full Depth= 1.00' Flow Area= 8.0 sf, Capacity= 54.76 cfs

6.00' x 1.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 550.0' Slope= 0.0273 '/'
Inlet Invert= 548.05', Outlet Invert= 533.01'

‡

Summary for Reach 20R: Dry Swale - 4

Inflow Area = 0.805 ac, 73.17% Impervious, Inflow Depth = 1.85" for 1-Year event
Inflow = 1.66 cfs @ 12.06 hrs, Volume= 0.124 af
Outflow = 1.61 cfs @ 12.08 hrs, Volume= 0.124 af, Atten= 3%, Lag= 1.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.99 fps, Min. Travel Time= 1.7 min
Avg. Velocity = 0.57 fps, Avg. Travel Time= 5.7 min

Peak Storage= 160 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.31'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 66.01 cfs

2.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 198.0' Slope= 0.0109 '/'
Inlet Invert= 532.35', Outlet Invert= 530.19'

Summary for Reach 21R: Point C

Inflow Area = 4.001 ac, 15.42% Impervious, Inflow Depth = 1.07" for 1-Year event
Inflow = 2.88 cfs @ 12.30 hrs, Volume= 0.356 af
Outflow = 2.88 cfs @ 12.31 hrs, Volume= 0.356 af, Atten= 0%, Lag= 0.4 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.02 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 0.67 fps, Avg. Travel Time= 1.9 min

Peak Storage= 111 cf @ 12.31 hrs
Average Depth at Peak Storage= 0.15'
Bank-Full Depth= 2.00' Flow Area= 26.0 sf, Capacity= 240.09 cfs

9.00' x 2.00' deep channel, n= 0.024
Side Slope Z-value= 2.0 '/' Top Width= 17.00'
Length= 77.4' Slope= 0.0136 '/'
Inlet Invert= 526.65', Outlet Invert= 525.60'

‡

Summary for Reach 23R: Rerouting Ditch 1

Inflow Area = 1.380 ac, 0.00% Impervious, Inflow Depth = 0.87" for 1-Year event
Inflow = 0.95 cfs @ 12.26 hrs, Volume= 0.100 af
Outflow = 0.95 cfs @ 12.27 hrs, Volume= 0.100 af, Atten= 0%, Lag= 0.7 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.06 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 0.73 fps, Avg. Travel Time= 3.9 min

Peak Storage= 79 cf @ 12.27 hrs
Average Depth at Peak Storage= 0.19'
Bank-Full Depth= 1.00' Flow Area= 4.0 sf, Capacity= 20.18 cfs

2.00' x 1.00' deep channel, n= 0.025 Earth, clean & winding
Side Slope Z-value= 2.0 '/' Top Width= 6.00'
Length= 171.0' Slope= 0.0137 '/'
Inlet Invert= 536.00', Outlet Invert= 533.66'

Summary for Reach 25R: Ditch

Inflow Area = 0.916 ac, 0.00% Impervious, Inflow Depth = 0.87" for 1-Year event
Inflow = 0.46 cfs @ 12.55 hrs, Volume= 0.066 af
Outflow = 0.45 cfs @ 12.59 hrs, Volume= 0.066 af, Atten= 1%, Lag= 2.5 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.25 fps, Min. Travel Time= 3.5 min
Avg. Velocity = 0.51 fps, Avg. Travel Time= 8.6 min

Peak Storage= 95 cf @ 12.59 hrs
Average Depth at Peak Storage= 0.16'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 60.53 cfs

2.00' x 2.00' deep channel, n= 0.025
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 262.2' Slope= 0.0064 '/'
Inlet Invert= 540.67', Outlet Invert= 539.00'

Summary for Reach 29R: Dry Swale - 2

Inflow Area = 1.259 ac, 71.41% Impervious, Inflow Depth = 1.77" for 1-Year event
Inflow = 1.96 cfs @ 12.11 hrs, Volume= 0.186 af
Outflow = 1.94 cfs @ 12.14 hrs, Volume= 0.186 af, Atten= 1%, Lag= 1.6 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.62 fps, Min. Travel Time= 1.7 min
Avg. Velocity = 0.80 fps, Avg. Travel Time= 5.7 min

Peak Storage= 202 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.29'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 90.04 cfs

2.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 273.0' Slope= 0.0203 '/'
Inlet Invert= 553.62', Outlet Invert= 548.08'

Summary for Reach 30R: Rerouted Ditch below Culvert

Inflow Area = 2.247 ac, 0.00% Impervious, Inflow Depth = 0.87" for 1-Year event
Inflow = 1.56 cfs @ 12.24 hrs, Volume= 0.163 af
Outflow = 1.56 cfs @ 12.26 hrs, Volume= 0.163 af, Atten= 0%, Lag= 0.9 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.81 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 0.99 fps, Avg. Travel Time= 3.6 min

Peak Storage= 117 cf @ 12.26 hrs
Average Depth at Peak Storage= 0.23'
Bank-Full Depth= 1.00' Flow Area= 4.0 sf, Capacity= 25.17 cfs

2.00' x 1.00' deep channel, n= 0.013
Side Slope Z-value= 2.0 '/' Top Width= 6.00'
Length= 212.0' Slope= 0.0058 '/'
Inlet Invert= 533.54', Outlet Invert= 532.32'

Summary for Pond 2P: Forebay

Inflow Area = 16.859 ac, 98.41% Impervious, Inflow Depth = 2.21" for 1-Year event
Inflow = 21.45 cfs @ 12.10 hrs, Volume= 3.107 af
Outflow = 21.33 cfs @ 12.11 hrs, Volume= 3.105 af, Atten= 1%, Lag= 0.8 min
Primary = 5.53 cfs @ 12.03 hrs, Volume= 2.601 af
Secondary = 15.94 cfs @ 12.11 hrs, Volume= 0.503 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 561.00' Surf.Area= 3,802 sf Storage= 3,789 cf
Peak Elev= 565.19' @ 12.11 hrs Surf.Area= 5,780 sf Storage= 23,758 cf (19,969 cf above start)
Flood Elev= 568.00' Surf.Area= 7,249 sf Storage= 42,057 cf (38,268 cf above start)

Plug-Flow detention time= 74.0 min calculated for 3.018 af (97% of inflow)
Center-of-Mass det. time= 41.1 min (806.9 - 765.8)

Volume	Invert	Avail.Storage	Storage Description
#1	558.00'	49,579 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
558.00	2,536	269.1	0.0	0	0	2,536
559.00	2,944	279.8	40.0	1,095	1,095	3,078
560.00	3,366	290.5	40.0	1,261	2,356	3,641
561.00	3,802	301.2	40.0	1,433	3,789	4,225
562.00	4,252	312.0	100.0	4,025	7,814	4,835
563.00	4,716	322.7	100.0	4,482	12,296	5,462
564.00	5,194	333.4	100.0	4,953	17,249	6,110
565.00	5,687	344.1	100.0	5,439	22,687	6,779
566.00	6,193	354.8	100.0	5,938	28,626	7,469
567.00	6,714	365.5	100.0	6,452	35,077	8,180
568.00	7,249	376.2	100.0	6,980	42,057	8,912
569.00	7,798	386.9	100.0	7,522	49,579	9,666

Device	Routing	Invert	Outlet Devices
#1	Primary	558.00'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 558.00' / 558.00' S= 0.0000 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Secondary	565.00'	**60.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 3.0' Crest Height

Primary OutFlow Max=5.52 cfs @ 12.03 hrs HW=565.14' TW=561.73' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 5.52 cfs @ 7.02 fps)

Secondary OutFlow Max=15.93 cfs @ 12.11 hrs HW=565.19' TW=561.96' (Dynamic Tailwater)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 15.93 cfs @ 1.42 fps)

Summary for Pond 3P: Gravel Wetland

Inflow Area = 17.988 ac, 95.60% Impervious, Inflow Depth = 2.17" for 1-Year event
Inflow = 23.38 cfs @ 12.10 hrs, Volume= 3.258 af
Outflow = 9.25 cfs @ 12.54 hrs, Volume= 3.242 af, Atten= 60%, Lag= 26.4 min
Primary = 9.25 cfs @ 12.54 hrs, Volume= 3.242 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 561.00' Surf.Area= 22,959 sf Storage= 27,438 cf
Peak Elev= 562.63' @ 12.54 hrs Surf.Area= 24,553 sf Storage= 66,078 cf (38,640 cf above start)
Flood Elev= 568.00' Surf.Area= 30,084 sf Storage= 212,684 cf (185,246 cf above start)

Plug-Flow detention time= 272.0 min calculated for 2.611 af (80% of inflow)
Center-of-Mass det. time= 119.1 min (926.5 - 807.4)

Volume	Invert	Avail.Storage	Storage Description
#1	558.00'	243,305 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
558.00	22,771	626.2	0.0	0	0	22,771
559.00	22,834	626.9	40.0	9,121	9,121	23,401
560.00	22,897	627.7	40.0	9,146	18,267	24,034
561.00	22,959	628.5	40.0	9,171	27,438	24,667
562.00	23,935	639.2	100.0	23,445	50,884	25,919
563.00	24,924	649.9	100.0	24,428	75,312	27,192
564.00	25,928	660.6	100.0	25,424	100,736	28,486
565.00	26,947	671.3	100.0	26,436	127,172	29,801
566.00	27,978	682.1	100.0	27,461	154,633	31,146
567.00	29,024	692.8	100.0	28,499	183,132	32,504
568.00	30,084	703.5	100.0	29,552	212,684	33,883
569.00	31,161	714.3	100.0	30,621	243,305	35,293

Device	Routing	Invert	Outlet Devices
#1	Primary	558.00'	**36.0" Round Culvert** L= 20.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 558.00' / 558.00' S= 0.0000 '/' Cc= 0.900 n= 0.013, Flow Area= 7.07 sf
#2	Device 1	561.00'	**12.0" Vert. Orifice/Grate X 2.00** C= 0.600
#3	Device 2	558.00'	**12.0" Vert. Orifice/Grate** C= 0.600
#4	Device 1	562.50'	**60.0" x 30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 2	562.50'	**60.0" x 30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Secondary	564.00'	**100.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 5.0' Crest Height

Primary OutFlow Max=9.25 cfs @ 12.54 hrs HW=562.63' TW=559.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 9.25 cfs of 56.41 cfs potential flow)
  ├─**2=Orifice/Grate** (Passes 7.04 cfs of 8.03 cfs potential flow)
  │ ├─**3=Orifice/Grate** (Orifice Controls 4.82 cfs @ 6.14 fps)
  │ └─**5=Orifice/Grate** (Weir Controls 2.21 cfs @ 1.16 fps)
  └─**4=Orifice/Grate** (Weir Controls 2.21 cfs @ 1.16 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=561.00' TW=558.00' (Dynamic Tailwater)
└─**6=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 4P: DP-1

Inflow Area = 19.937 ac, 92.58% Impervious, Inflow Depth > 2.33" for 1-Year event
Inflow = 27.87 cfs @ 12.10 hrs, Volume= 3.874 af
Outflow = 2.57 cfs @ 17.78 hrs, Volume= 3.609 af, Atten= 91%, Lag= 340.8 min
Primary = 2.57 cfs @ 17.78 hrs, Volume= 3.609 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 559.83' @ 17.78 hrs Surf.Area= 51,404 sf Storage= 90,751 cf
Flood Elev= 565.00' Surf.Area= 62,400 sf Storage= 384,495 cf

Plug-Flow detention time= 494.7 min calculated for 3.608 af (93% of inflow)
Center-of-Mass det. time= 446.5 min (1,346.5 - 900.0)

Volume	Invert	Avail.Storage	Storage Description
#1	558.00'	651,999 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
558.00	47,688	883.6	0	0	47,688
559.00	49,705	899.0	48,693	48,693	50,047
560.00	51,750	914.4	50,724	99,417	52,448
561.00	53,824	929.8	52,784	152,201	54,888
562.00	55,926	945.2	54,872	207,072	57,370
563.00	58,056	960.6	56,988	264,060	59,893
564.00	60,214	976.1	59,132	323,192	62,470
565.00	62,400	991.5	61,304	384,495	65,075
566.00	64,615	1,006.9	63,504	448,000	67,720
567.00	66,858	1,022.3	65,733	513,733	70,405
568.00	69,129	1,037.7	67,990	581,723	73,132
569.00	71,429	1,053.2	70,276	651,999	75,915

Device	Routing	Invert	Outlet Devices
#1	Primary	558.00'	**48.0" Round Culvert** L= 663.9' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 558.00' / 551.36' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 12.57 sf
#2	Device 1	558.00'	**9.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	562.50'	**12.0" Vert. Orifice/Grate** C= 0.600

#4	Secondary	568.00'	**45.0 deg x 100.0' long x 1.00' rise Sharp-Crested Vee/Trap Weir** Cv= 2.56 (C= 3.20)

Primary OutFlow Max=2.57 cfs @ 17.78 hrs HW=559.83' TW=558.13' (Dynamic Tailwater)
└─**1=Culvert** (Passes 2.57 cfs of 15.55 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 2.57 cfs @ 5.81 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=558.00' TW=0.00' (Dynamic Tailwater)
└─**4=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

Summary for Pond 13P: Det. Pond - 2

Inflow Area = 1.259 ac, 71.41% Impervious, Inflow Depth = 1.77" for 1-Year event
Inflow = 1.94 cfs @ 12.14 hrs, Volume= 0.186 af
Outflow = 0.13 cfs @ 14.75 hrs, Volume= 0.181 af, Atten= 93%, Lag= 156.4 min
Primary = 0.13 cfs @ 14.75 hrs, Volume= 0.181 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 538.86' @ 14.75 hrs Surf.Area= 6,075 sf Storage= 4,804 cf
Flood Elev= 541.00' Surf.Area= 8,791 sf Storage= 20,626 cf

Plug-Flow detention time= 484.7 min calculated for 0.181 af (98% of inflow)
Center-of-Mass det. time= 470.0 min (1,294.2 - 824.3)

Volume	Invert	Avail.Storage	Storage Description
#1	538.00'	20,626 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
538.00	5,054	387.0	0	0	5,054
539.00	6,243	405.8	5,638	5,638	6,305
540.00	7,489	424.7	6,857	12,495	7,621
541.00	8,791	423.9	8,131	20,626	8,049

Device	Routing	Invert	Outlet Devices
#1	Primary	538.00'	**15.0" Round Culvert** L= 94.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 538.00' / 537.00' S= 0.0106 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	538.00'	**2.4" Vert. Orifice/Grate** C= 0.600
#3	Device 1	538.90'	**4.0" Vert. Orifice/Grate** C= 0.600
#4	Device 1	539.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.13 cfs @ 14.75 hrs HW=538.86' TW=533.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.13 cfs of 2.87 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.13 cfs @ 4.21 fps)
  ├─**3=Orifice/Grate** (Controls 0.00 cfs)
  └─**4=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 15P: Culvert at Entr.

Inflow Area = 4.001 ac, 15.42% Impervious, Inflow Depth = 1.07" for 1-Year event
Inflow = 3.00 cfs @ 12.24 hrs, Volume= 0.356 af
Outflow = 2.88 cfs @ 12.30 hrs, Volume= 0.356 af, Atten= 4%, Lag= 3.9 min
Primary = 2.88 cfs @ 12.30 hrs, Volume= 0.356 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 529.84' @ 12.30 hrs Surf.Area= 240 sf Storage= 247 cf

Plug-Flow detention time= 0.4 min calculated for 0.355 af (100% of inflow)
Center-of-Mass det. time= 0.4 min (858.5 - 858.1)

Volume	Invert	Avail.Storage	Storage Description
#1	527.17'	1,407 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
527.17	6	14.0	0	0	6
528.00	44	35.0	18	18	90
529.00	121	58.1	79	98	268
530.00	266	92.9	189	286	693
531.00	555	117.6	402	688	1,120
532.00	897	157.4	719	1,407	2,001

Device	Routing	Invert	Outlet Devices
#1	Primary	527.17'	**18.0" Round Culvert X 2.00** L= 52.8' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 527.17' / 526.65' S= 0.0098 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	527.17'	**18.0" W x 3.0" H Vert. Orifice/Grate** C= 0.600
#3	Device 1	530.00'	**72.0" x 72.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.88 cfs @ 12.30 hrs HW=529.84' TW=526.80' (Dynamic Tailwater)
└─**1=Culvert** (Passes 2.88 cfs of 25.08 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 2.88 cfs @ 7.69 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 17P: Box Culvert for stream

Inflow Area = 57.525 ac, 3.12% Impervious, Inflow Depth > 0.89" for 1-Year event
Inflow = 24.02 cfs @ 12.71 hrs, Volume= 4.254 af
Outflow = 24.02 cfs @ 12.71 hrs, Volume= 4.254 af, Atten= 0%, Lag= 0.0 min
Primary = 24.02 cfs @ 12.71 hrs, Volume= 4.254 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 533.00' @ 12.71 hrs Surf.Area= 413 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.0 min (916.8 - 916.8)

Volume	Invert	Avail.Storage	Storage Description
#1	533.00'	25,714 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
533.00	412	159.8	0	0	412
534.00	5,210	513.7	2,362	2,362	19,382
535.00	11,714	795.5	8,245	10,608	48,748
536.00	18,774	996.6	15,106	25,714	77,441

Device	Routing	Invert	Outlet Devices
#1	Primary	532.20'	**144.0" W x 60.0" H Box Culvert** L= 51.5' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 532.20' / 530.66' S= 0.0299 '/' Cc= 0.900 n= 0.024, Flow Area= 60.00 sf

Primary OutFlow Max=27.58 cfs @ 12.71 hrs HW=533.00' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 27.58 cfs @ 2.87 fps)

Summary for Pond 18P: Level Spreader

Inflow Area = 19.937 ac, 92.58% Impervious, Inflow Depth > 2.17" for 1-Year event
Inflow = 2.57 cfs @ 17.78 hrs, Volume= 3.609 af
Outflow = 2.57 cfs @ 17.79 hrs, Volume= 3.609 af, Atten= 0%, Lag= 0.6 min
Primary = 2.57 cfs @ 17.79 hrs, Volume= 3.609 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 558.00' Surf.Area= 2,625 sf Storage= 7,350 cf
Peak Elev= 558.13' @ 17.79 hrs Surf.Area= 2,625 sf Storage= 7,488 cf (138 cf above start)

Plug-Flow detention time= 85.9 min calculated for 3.439 af (95% of inflow)
Center-of-Mass det. time= 0.9 min (1,347.4 - 1,346.5)

Volume	Invert	Avail.Storage	Storage Description
#1	551.00'	8,400 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 21,000 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
551.00	2,625	0	0
556.00	2,625	13,125	13,125
557.00	2,625	2,625	15,750
558.00	2,625	2,625	18,375
559.00	2,625	2,625	21,000

Device	Routing	Invert	Outlet Devices
#1	Primary	558.00'	**75.0" x 35.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.57 cfs @ 17.79 hrs HW=558.13' TW=558.05' (Dynamic Tailwater)
└─**1=Orifice/Grate** (Weir Controls 2.57 cfs @ 1.07 fps)

Summary for Pond 23P:

Inflow Area =	0.805 ac, 73.17% Impervious,	Inflow Depth = 1.85"	for 1-Year event
Inflow =	1.61 cfs @ 12.08 hrs,	Volume=	0.124 af
Outflow =	1.58 cfs @ 12.10 hrs,	Volume=	0.124 af, Atten= 2%, Lag= 1.0 min
Primary =	0.22 cfs @ 12.10 hrs,	Volume=	0.091 af
Secondary =	1.37 cfs @ 12.10 hrs,	Volume=	0.033 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 531.74' @ 12.10 hrs Surf.Area= 811 sf Storage= 542 cf

Plug-Flow detention time= 12.7 min calculated for 0.124 af (100% of inflow)
Center-of-Mass det. time= 12.7 min (827.4 - 814.7)

Volume	Invert	Avail.Storage	Storage Description
#1	530.19'	789 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
530.19	56	110.4	0	0	56
531.00	317	180.9	137	137	1,695
532.01	1,044	364.9	652	789	9,691

Device	Routing	Invert	Outlet Devices
#1	Primary	530.19'	**3.0" Round Culvert** L= 17.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 530.19' / 530.00' S= 0.0110 '/' Cc= 0.900 n= 0.013, Flow Area= 0.05 sf
#2	Secondary	531.60'	**30.0 deg x 7.7' long x 0.40' rise Sharp-Crested Vee/Trap Weir** Cv= 2.61 (C= 3.26)

Primary OutFlow Max=0.22 cfs @ 12.10 hrs HW=531.74' TW=528.94' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 0.22 cfs @ 4.41 fps)

Secondary OutFlow Max=1.36 cfs @ 12.10 hrs HW=531.74' TW=528.94' (Dynamic Tailwater)
└─**2=Sharp-Crested Vee/Trap Weir** (Weir Controls 1.36 cfs @ 1.23 fps)

Summary for Pond 24P: Flow Splitter

Inflow Area =	16.505 ac,100.00% Impervious,	Inflow Depth = 2.47"	for 1-Year event
Inflow =	41.05 cfs @ 12.10 hrs,	Volume=	3.397 af
Outflow =	41.05 cfs @ 12.10 hrs,	Volume=	3.397 af, Atten= 0%, Lag= 0.0 min
Primary =	20.93 cfs @ 12.10 hrs,	Volume=	3.070 af
Secondary =	20.12 cfs @ 12.10 hrs,	Volume=	0.327 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Peak Elev= 567.10' @ 12.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	562.96'	**24.0" Round Culvert** L= 44.7' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 562.96' / 562.00' S= 0.0215 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Secondary	562.96'	**48.0" Round Culvert** L= 106.2' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 562.96' / 562.43' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 12.57 sf
#3	Device 2	565.70'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=20.92 cfs @ 12.10 hrs HW=567.10' TW=565.19' (Dynamic Tailwater)
1=Culvert (Inlet Controls 20.92 cfs @ 6.66 fps)

Secondary OutFlow Max=20.10 cfs @ 12.10 hrs HW=567.10' TW=558.64' (Dynamic Tailwater)
2=Culvert (Passes 20.10 cfs of 76.05 cfs potential flow)
3=Sharp-Crested Rectangular Weir (Weir Controls 20.10 cfs @ 3.87 fps)

Summary for Pond 28P: Ramp Culvert

Inflow Area = 0.918 ac, 72.44% Impervious, Inflow Depth = 1.79" for 1-Year event
Inflow = 1.58 cfs @ 12.14 hrs, Volume= 0.137 af
Outflow = 1.58 cfs @ 12.15 hrs, Volume= 0.137 af, Atten= 0%, Lag= 0.4 min
Primary = 1.58 cfs @ 12.15 hrs, Volume= 0.137 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 555.44' @ 12.15 hrs Surf.Area= 151 sf Storage= 54 cf
Flood Elev= 557.00' Surf.Area= 534 sf Storage= 342 cf

Plug-Flow detention time= 2.7 min calculated for 0.137 af (100% of inflow)
Center-of-Mass det. time= 1.6 min (824.3 - 822.7)

Volume	Invert	Avail.Storage	Storage Description
#1	554.61'	342 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
554.61	4	8.0	0	0	4
555.00	56	45.8	10	10	166
556.00	337	150.1	177	187	1,795
556.36	534	184.0	155	342	2,698

Device	Routing	Invert	Outlet Devices
#1	Primary	555.00'	**23.0" W x 14.0" H, R=22.0" Elliptical RCP_Elliptical 23x14** L= 30.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 555.00' / 553.62' S= 0.0460 '/' Cc= 0.900 n= 0.013, Flow Area= 1.83 sf

Primary OutFlow Max=1.57 cfs @ 12.15 hrs HW=555.44' TW=553.91' (Dynamic Tailwater)
↑—**1=RCP_Elliptical 23x14** (Inlet Controls 1.57 cfs @ 2.44 fps)

Summary for Pond 30P: Culvert 2

Inflow Area =	1.380 ac,	0.00% Impervious,	Inflow Depth = 0.87"	for 1-Year event	
Inflow =	0.95 cfs @	12.27 hrs,	Volume=	0.100 af	
Outflow =	0.95 cfs @	12.27 hrs,	Volume=	0.100 af,	Atten= 0%, Lag= 0.0 min
Primary =	0.95 cfs @	12.27 hrs,	Volume=	0.100 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 534.07' @ 12.27 hrs
Flood Elev= 534.87'

Device	Routing	Invert	Outlet Devices
#1	Primary	533.66'	**23.0" W x 14.0" H, R=22.0" Elliptical RCP_Elliptical 23x14** L= 24.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 533.66' / 533.54' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 1.83 sf

Primary OutFlow Max=0.95 cfs @ 12.27 hrs HW=534.07' TW=533.77' (Dynamic Tailwater)
↑—**1=RCP_Elliptical 23x14** (Barrel Controls 0.95 cfs @ 2.33 fps)

Summary for Pond 31P: Culvert 3

Inflow Area =	0.544 ac,	73.53% Impervious,	Inflow Depth = 1.88"	for 1-Year event	
Inflow =	1.11 cfs @	12.08 hrs,	Volume=	0.085 af	
Outflow =	1.11 cfs @	12.08 hrs,	Volume=	0.085 af,	Atten= 0%, Lag= 0.0 min
Primary =	1.11 cfs @	12.08 hrs,	Volume=	0.085 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 533.44' @ 12.08 hrs
Flood Elev= 538.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	533.00'	**23.0" W x 14.0" H, R=22.0" Elliptical RCP_Elliptical 23x14** L= 24.0' RCP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 533.00' / 532.35' S= 0.0271 '/' Cc= 0.900 n= 0.013, Flow Area= 1.83 sf

Primary OutFlow Max=1.11 cfs @ 12.08 hrs HW=533.44' TW=532.66' (Dynamic Tailwater)
↑—**1=RCP_Elliptical 23x14** (Inlet Controls 1.11 cfs @ 1.72 fps)

Summary for Link 21L: Point A

Inflow Area =	27.710 ac,	66.61% Impervious,	Inflow Depth > 1.81"	for 1-Year event	
Inflow =	6.44 cfs @	12.32 hrs,	Volume=	4.171 af	
Primary =	6.44 cfs @	12.32 hrs,	Volume=	4.171 af,	Atten= 0%, Lag= 0.0 min

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

Summary for Link 22L: Point B

Inflow Area = 57.525 ac, 3.12% Impervious, Inflow Depth > 0.89" for 1-Year event
Inflow = 24.02 cfs @ 12.71 hrs, Volume= 4.254 af
Primary = 24.02 cfs @ 12.71 hrs, Volume= 4.254 af, Atten= 0%, Lag= 0.0 min

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

Summary for Link 28L: Point F

Inflow Area = 5.040 ac, 0.00% Impervious, Inflow Depth = 0.87" for 1-Year event
Inflow = 2.27 cfs @ 12.66 hrs, Volume= 0.365 af
Primary = 2.27 cfs @ 12.66 hrs, Volume= 0.365 af, Atten= 0%, Lag= 0.0 min

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

Summary for Subcatchment 1S: Main Site

Runoff = 75.45 cfs @ 12.10 hrs, Volume= 6.414 af, Depth= 4.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (ac)	CN	Description
16.505	98	Paved parking, HSG D
16.505		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	158	0.0100	1.16		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
0.5	135	0.0025	4.18	20.51	**Pipe Channel, 130-131** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.013
0.4	110	0.0025	4.72	33.35	**Pipe Channel, 131-132** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013
0.3	79	0.0025	4.72	33.35	**Pipe Channel, 132-133** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013
0.8	246	0.0025	5.23	50.30	**Pipe Channel, 133-134** 42.0" Round Area= 9.6 sf Perim= 11.0' r= 0.88' n= 0.013
0.4	133	0.0025	5.23	50.30	**Pipe Channel, 134-135** 42.0" Round Area= 9.6 sf Perim= 11.0' r= 0.88' n= 0.013
0.6	182	0.0025	5.23	50.30	**Pipe Channel, 135-136** 42.0" Round Area= 9.6 sf Perim= 11.0' r= 0.88' n= 0.013
0.7	256	0.0025	5.72	71.82	**Pipe Channel, 136-137** 48.0" Round Area= 12.6 sf Perim= 12.6' r= 1.00' n= 0.013
0.7	233	0.0025	5.72	71.82	**Pipe Channel, 137-138** 48.0" Round Area= 12.6 sf Perim= 12.6' r= 1.00' n= 0.013
0.4	130	0.0025	5.72	71.82	**Pipe Channel, 138-139** 48.0" Round Area= 12.6 sf Perim= 12.6' r= 1.00' n= 0.013
0.3	113	0.0025	5.72	71.82	**Pipe Channel, 139-Outlet** 48.0" Round Area= 12.6 sf Perim= 12.6' r= 1.00' n= 0.013
7.4	1,775	Total			

Summary for Subcatchment 10S: Forebay Area

Runoff = 1.36 cfs @ 12.07 hrs, Volume= 0.094 af, Depth= 3.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

	Area (ac)	CN	Description
	0.268	80	>75% Grass cover, Good, HSG D
	0.086	98	Water Surface, HSG D
	0.354	84	Weighted Average
	0.268		75.71% Pervious Area
	0.086		24.29% Impervious Area

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

Summary for Subcatchment 11S: Gravel Wetland Area

Runoff = 4.90 cfs @ 12.07 hrs, Volume= 0.346 af, Depth= 3.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

	Area (ac)	CN	Description
	0.605	98	Water Surface, HSG D
	0.296	80	>75% Grass cover, Good, HSG D
	0.228	77	Woods, Good, HSG D
	1.129	89	Weighted Average
	0.524		46.41% Pervious Area
	0.605		53.59% Impervious Area

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

Summary for Subcatchment 12S: Subcat for Swale - 1

Runoff = 4.01 cfs @ 12.08 hrs, Volume= 0.297 af, Depth= 3.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

	Area (ac)	CN	Description
	0.253	74	>75% Grass cover, Good, HSG C
*	0.665	98	Paved parking, HSG C
	0.918	91	Weighted Average
	0.253		27.56% Pervious Area
	0.665		72.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	993	0.1266	2.77		**Lag/CN Method,**

Summary for Subcatchment 13S: Pond

Runoff = 8.98 cfs @ 12.07 hrs, Volume= 0.648 af, Depth= 3.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (ac)	CN	Description
1.261	98	Water Surface, HSG C
0.624	80	>75% Grass cover, Good, HSG D
0.064	77	Woods, Good, HSG D
1.949	92	Weighted Average
0.688		35.30% Pervious Area
1.261		64.70% Impervious Area

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

Summary for Subcatchment 16S: DA to Entr. Culvert

Runoff = 6.55 cfs @ 12.26 hrs, Volume= 0.676 af, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (ac)	CN	Description
3.168	77	Woods, Good, HSG D
0.028	98	Paved parking, HSG D
3.196	77	Weighted Average
3.168		99.12% Pervious Area
0.028		0.88% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.9	1,034	0.0359	0.91		**Lag/CN Method,**

Summary for Subcatchment 18S: Subcat to Point B

Runoff = 70.88 cfs @ 12.66 hrs, Volume= 11.238 af, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

	Area (ac)	CN	Description
	52.205	77	Woods, Good, HSG D
	0.898	98	Paved parking, HSG D
	53.103	77	Weighted Average
	52.205		98.31% Pervious Area
	0.898		1.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
47.5	3,073	0.0324	1.08		**Lag/CN Method,**

Summary for Subcatchment 19S: Subcat for Swale - 2

Runoff = 2.77 cfs @ 12.03 hrs, Volume= 0.181 af, Depth= 3.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

	Area (ac)	CN	Description
	0.400	98	Water Surface, HSG C
*	0.144	74	>75% Grass cover, Good, HSG C
	0.544	92	Weighted Average
	0.144		26.47% Pervious Area
	0.400		73.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	313	0.1239	2.27		**Lag/CN Method,**

Summary for Subcatchment 20S: Wetlands

Runoff = 15.41 cfs @ 12.29 hrs, Volume= 1.645 af, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (ac)	CN	Description
7.773	77	Woods, Good, HSG D
7.773		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.6	1,002	0.0286	0.81		**Lag/CN Method,**

Summary for Subcatchment 23S: Point D

Runoff = 137.55 cfs @ 12.44 hrs, Volume= 17.681 af, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (sf)	CN	Description
3,639,264	77	Woods, Good, HSG D
3,639,264		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.3	3,135	0.0772	1.67		**Lag/CN Method,**

Summary for Subcatchment 24S: DA for 25R

Runoff = 1.41 cfs @ 12.51 hrs, Volume= 0.194 af, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (ac)	CN	Description
0.916	77	Woods, Good, HSG D
0.916		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
36.2	1,580	0.0192	0.73		**Lag/CN Method,**

Summary for Subcatchment 25S: Rerouted Area

Runoff = 2.96 cfs @ 12.23 hrs, Volume= 0.292 af, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (ac)	CN	Description
1.380	77	Woods, Good, HSG D
1.380		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.9	734	0.0260	0.73		**Lag/CN Method,**

Summary for Subcatchment 26S: Subcat for Swale - 2

Runoff = 1.67 cfs @ 12.03 hrs, Volume= 0.107 af, Depth= 3.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

	Area (ac)	CN	Description
*	0.234	98	Paved parking, HSG D
	0.107	74	>75% Grass cover, Good, HSG C
	0.341	90	Weighted Average
	0.107		31.38% Pervious Area
	0.234		68.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	293	0.1266	2.08		**Lag/CN Method,**

Summary for Subcatchment 27S: DA for Point F

Runoff = 7.01 cfs @ 12.61 hrs, Volume= 1.067 af, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (ac)	CN	Description
5.040	77	Woods, Good, HSG D
5.040		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
44.0	2,185	0.0219	0.83		**Lag/CN Method,**

Summary for Subcatchment 29S: Rerouted Area B

Runoff = 1.98 cfs @ 12.20 hrs, Volume= 0.183 af, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (sf)	CN	Description
37,749	77	Woods, Good, HSG D
37,749		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	599	0.0260	0.70		**Lag/CN Method,**

Summary for Subcatchment 34S: Subcat for Swale - 4

Runoff = 1.31 cfs @ 12.03 hrs, Volume= 0.084 af, Depth= 3.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

	Area (ac)	CN	Description
*	0.072	74	>75% Grass cover, Good, HSG C
*	0.189	98	Paved parking, HSG C
	0.261	91	Weighted Average
	0.072		27.59% Pervious Area
	0.189		72.41% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	292	0.1265	2.17		**Lag/CN Method,**

Summary for Reach 8R: Level Spreader

Inflow Area = 19.937 ac, 92.58% Impervious, Inflow Depth > 4.29" for 10-Year event
Inflow = 3.75 cfs @ 17.22 hrs, Volume= 7.119 af
Outflow = 3.75 cfs @ 17.23 hrs, Volume= 7.118 af, Atten= 0%, Lag= 0.6 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 0.77 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 0.55 fps, Avg. Travel Time= 1.4 min

Peak Storage= 232 cf @ 17.23 hrs
Average Depth at Peak Storage= 0.06'
Bank-Full Depth= 1.00' Flow Area= 105.0 sf, Capacity= 439.80 cfs

75.00' x 1.00' deep channel, n= 0.030
Side Slope Z-value= 30.0 '/' Top Width= 135.00'
Length= 48.0' Slope= 0.0100 '/'
Inlet Invert= 558.00', Outlet Invert= 557.52'

Summary for Reach 15R: Dry Swale - 1

Inflow Area = 0.918 ac, 72.44% Impervious, Inflow Depth = 3.89" for 10-Year event
Inflow = 4.01 cfs @ 12.08 hrs, Volume= 0.297 af
Outflow = 3.47 cfs @ 12.13 hrs, Volume= 0.297 af, Atten= 13%, Lag= 2.8 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.05 fps, Min. Travel Time= 4.9 min
Avg. Velocity = 0.87 fps, Avg. Travel Time= 17.3 min

Peak Storage= 1,028 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.40'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 87.10 cfs

2.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 904.0' Slope= 0.0190 '/'
Inlet Invert= 572.17', Outlet Invert= 555.00'

Summary for Reach 18R: Dry Swale - 3

Inflow Area =	0.544 ac,	73.53% Impervious,	Inflow Depth = 3.99"	for 10-Year event
Inflow =	2.77 cfs @	12.03 hrs, Volume=	0.181 af	
Outflow =	2.41 cfs @	12.07 hrs, Volume=	0.181 af,	Atten= 13%, Lag= 2.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.34 fps, Min. Travel Time= 3.9 min
Avg. Velocity = 0.57 fps, Avg. Travel Time= 16.1 min

Peak Storage= 565 cf @ 12.07 hrs
Average Depth at Peak Storage= 0.16'
Bank-Full Depth= 1.00' Flow Area= 8.0 sf, Capacity= 54.76 cfs

6.00' x 1.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 550.0' Slope= 0.0273 '/'
Inlet Invert= 548.05', Outlet Invert= 533.01'

‡

Summary for Reach 20R: Dry Swale - 4

Inflow Area = 0.805 ac, 73.17% Impervious, Inflow Depth = 3.96" for 10-Year event
Inflow = 3.59 cfs @ 12.05 hrs, Volume= 0.265 af
Outflow = 3.52 cfs @ 12.07 hrs, Volume= 0.265 af, Atten= 2%, Lag= 1.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.52 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 0.70 fps, Avg. Travel Time= 4.7 min

Peak Storage= 277 cf @ 12.07 hrs
Average Depth at Peak Storage= 0.47'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 66.01 cfs

2.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 198.0' Slope= 0.0109 '/'
Inlet Invert= 532.35', Outlet Invert= 530.19'

Summary for Reach 21R: Point C

Inflow Area = 4.001 ac, 15.42% Impervious, Inflow Depth = 2.82" for 10-Year event
Inflow = 8.29 cfs @ 12.24 hrs, Volume= 0.942 af
Outflow = 8.29 cfs @ 12.24 hrs, Volume= 0.942 af, Atten= 0%, Lag= 0.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.00 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 0.84 fps, Avg. Travel Time= 1.5 min

Peak Storage= 214 cf @ 12.24 hrs
Average Depth at Peak Storage= 0.29'
Bank-Full Depth= 2.00' Flow Area= 26.0 sf, Capacity= 240.09 cfs

9.00' x 2.00' deep channel, n= 0.024
Side Slope Z-value= 2.0 '/' Top Width= 17.00'
Length= 77.4' Slope= 0.0136 '/'
Inlet Invert= 526.65', Outlet Invert= 525.60'

‡

Summary for Reach 23R: Rerouting Ditch 1

Inflow Area = 1.380 ac, 0.00% Impervious, Inflow Depth = 2.54" for 10-Year event
Inflow = 2.96 cfs @ 12.23 hrs, Volume= 0.292 af
Outflow = 2.95 cfs @ 12.24 hrs, Volume= 0.292 af, Atten= 0%, Lag= 0.8 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.94 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 0.98 fps, Avg. Travel Time= 2.9 min

Peak Storage= 172 cf @ 12.24 hrs
Average Depth at Peak Storage= 0.37'
Bank-Full Depth= 1.00' Flow Area= 4.0 sf, Capacity= 20.18 cfs

2.00' x 1.00' deep channel, n= 0.025 Earth, clean & winding
Side Slope Z-value= 2.0 '/' Top Width= 6.00'
Length= 171.0' Slope= 0.0137 '/'
Inlet Invert= 536.00', Outlet Invert= 533.66'

Summary for Reach 25R: Ditch

Inflow Area = 0.916 ac, 0.00% Impervious, Inflow Depth = 2.54" for 10-Year event
Inflow = 1.41 cfs @ 12.51 hrs, Volume= 0.194 af
Outflow = 1.40 cfs @ 12.54 hrs, Volume= 0.194 af, Atten= 1%, Lag= 1.6 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.80 fps, Min. Travel Time= 2.4 min
Avg. Velocity = 0.67 fps, Avg. Travel Time= 6.5 min

Peak Storage= 205 cf @ 12.54 hrs
Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 60.53 cfs

2.00' x 2.00' deep channel, n= 0.025
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 262.2' Slope= 0.0064 '/'
Inlet Invert= 540.67', Outlet Invert= 539.00'

Summary for Reach 29R: Dry Swale - 2

Inflow Area = 1.259 ac, 71.41% Impervious, Inflow Depth = 3.85" for 10-Year event
Inflow = 4.33 cfs @ 12.11 hrs, Volume= 0.404 af
Outflow = 4.30 cfs @ 12.12 hrs, Volume= 0.404 af, Atten= 1%, Lag= 1.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.33 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 0.98 fps, Avg. Travel Time= 4.7 min

Peak Storage= 353 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.45'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 90.04 cfs

2.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 273.0' Slope= 0.0203 '/'
Inlet Invert= 553.62', Outlet Invert= 548.08'

Summary for Reach 30R: Rerouted Ditch below Culvert

Inflow Area = 2.247 ac, 0.00% Impervious, Inflow Depth = 2.54" for 10-Year event
Inflow = 4.88 cfs @ 12.22 hrs, Volume= 0.475 af
Outflow = 4.87 cfs @ 12.24 hrs, Volume= 0.475 af, Atten= 0%, Lag= 0.7 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.99 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 1.33 fps, Avg. Travel Time= 2.7 min

Peak Storage= 259 cf @ 12.24 hrs
Average Depth at Peak Storage= 0.43'
Bank-Full Depth= 1.00' Flow Area= 4.0 sf, Capacity= 25.17 cfs

2.00' x 1.00' deep channel, n= 0.013
Side Slope Z-value= 2.0 '/' Top Width= 6.00'
Length= 212.0' Slope= 0.0058 '/'
Inlet Invert= 533.54', Outlet Invert= 532.32'

Summary for Pond 2P: Forebay

Inflow Area = 16.859 ac, 98.41% Impervious, Inflow Depth = 3.79" for 10-Year event
Inflow = 27.95 cfs @ 12.10 hrs, Volume= 5.323 af
Outflow = 27.83 cfs @ 12.11 hrs, Volume= 5.320 af, Atten= 0%, Lag= 0.7 min
Primary = 5.36 cfs @ 11.70 hrs, Volume= 4.011 af
Secondary = 23.18 cfs @ 12.11 hrs, Volume= 1.309 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 561.00' Surf.Area= 3,802 sf Storage= 3,789 cf
Peak Elev= 565.24' @ 12.11 hrs Surf.Area= 5,806 sf Storage= 24,063 cf (20,274 cf above start)
Flood Elev= 568.00' Surf.Area= 7,249 sf Storage= 42,057 cf (38,268 cf above start)

Plug-Flow detention time= 61.2 min calculated for 5.232 af (98% of inflow)
Center-of-Mass det. time= 40.1 min (795.9 - 755.8)

Volume	Invert	Avail.Storage	Storage Description
#1	558.00'	49,579 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
558.00	2,536	269.1	0.0	0	0	2,536
559.00	2,944	279.8	40.0	1,095	1,095	3,078
560.00	3,366	290.5	40.0	1,261	2,356	3,641
561.00	3,802	301.2	40.0	1,433	3,789	4,225
562.00	4,252	312.0	100.0	4,025	7,814	4,835
563.00	4,716	322.7	100.0	4,482	12,296	5,462
564.00	5,194	333.4	100.0	4,953	17,249	6,110
565.00	5,687	344.1	100.0	5,439	22,687	6,779
566.00	6,193	354.8	100.0	5,938	28,626	7,469
567.00	6,714	365.5	100.0	6,452	35,077	8,180
568.00	7,249	376.2	100.0	6,980	42,057	8,912
569.00	7,798	386.9	100.0	7,522	49,579	9,666

Device	Routing	Invert	Outlet Devices
#1	Primary	558.00'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 558.00' / 558.00' S= 0.0000 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Secondary	565.00'	**60.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 3.0' Crest Height

Primary OutFlow Max=5.35 cfs @ 11.70 hrs HW=565.11' TW=561.90' (Dynamic Tailwater)
↑**1=Culvert** (Inlet Controls 5.35 cfs @ 6.81 fps)

Secondary OutFlow Max=23.18 cfs @ 12.11 hrs HW=565.24' TW=562.84' (Dynamic Tailwater)
↑**2=Sharp-Crested Rectangular Weir** (Weir Controls 23.18 cfs @ 1.62 fps)

Summary for Pond 3P: Gravel Wetland

Inflow Area = 17.988 ac, 95.60% Impervious, Inflow Depth = 3.78" for 10-Year event
Inflow = 32.38 cfs @ 12.10 hrs, Volume= 5.666 af
Outflow = 23.97 cfs @ 12.24 hrs, Volume= 5.649 af, Atten= 26%, Lag= 8.8 min
Primary = 23.97 cfs @ 12.24 hrs, Volume= 5.649 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 561.00' Surf.Area= 22,959 sf Storage= 27,438 cf
Peak Elev= 562.95' @ 12.24 hrs Surf.Area= 24,875 sf Storage= 74,094 cf (46,656 cf above start)
Flood Elev= 568.00' Surf.Area= 30,084 sf Storage= 212,684 cf (185,246 cf above start)

Plug-Flow detention time= 215.9 min calculated for 5.018 af (89% of inflow)
Center-of-Mass det. time= 104.7 min (900.5 - 795.8)

Volume	Invert	Avail.Storage	Storage Description
#1	558.00'	243,305 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
558.00	22,771	626.2	0.0	0	0	22,771
559.00	22,834	626.9	40.0	9,121	9,121	23,401
560.00	22,897	627.7	40.0	9,146	18,267	24,034
561.00	22,959	628.5	40.0	9,171	27,438	24,667
562.00	23,935	639.2	100.0	23,445	50,884	25,919
563.00	24,924	649.9	100.0	24,428	75,312	27,192
564.00	25,928	660.6	100.0	25,424	100,736	28,486
565.00	26,947	671.3	100.0	26,436	127,172	29,801
566.00	27,978	682.1	100.0	27,461	154,633	31,146
567.00	29,024	692.8	100.0	28,499	183,132	32,504
568.00	30,084	703.5	100.0	29,552	212,684	33,883
569.00	31,161	714.3	100.0	30,621	243,305	35,293

Device	Routing	Invert	Outlet Devices
#1	Primary	558.00'	**36.0" Round Culvert** L= 20.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 558.00' / 558.00' S= 0.0000 '/' Cc= 0.900 n= 0.013, Flow Area= 7.07 sf
#2	Device 1	561.00'	**12.0" Vert. Orifice/Grate X 2.00** C= 0.600
#3	Device 2	558.00'	**12.0" Vert. Orifice/Grate** C= 0.600
#4	Device 1	562.50'	**60.0" x 30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 2	562.50'	**60.0" x 30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Secondary	564.00'	**100.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 5.0' Crest Height

Primary OutFlow Max=23.97 cfs @ 12.24 hrs HW=562.95' TW=560.14' (Dynamic Tailwater)
└─**1=Culvert** (Passes 23.97 cfs of 57.09 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 9.11 cfs @ 5.80 fps)
  │ ├─**3=Orifice/Grate** (Passes < 5.28 cfs potential flow)
  │ └─**5=Orifice/Grate** (Passes < 14.86 cfs potential flow)
  └─**4=Orifice/Grate** (Weir Controls 14.86 cfs @ 2.20 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=561.00' TW=558.00' (Dynamic Tailwater)
└─**6=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 4P: DP-1

Inflow Area = 19.937 ac, 92.58% Impervious, Inflow Depth > 4.50" for 10-Year event
Inflow = 74.97 cfs @ 12.11 hrs, Volume= 7.482 af
Outflow = 3.75 cfs @ 17.21 hrs, Volume= 7.120 af, Atten= 95%, Lag= 306.3 min
Primary = 3.75 cfs @ 17.21 hrs, Volume= 7.120 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 561.48' @ 17.21 hrs Surf.Area= 54,822 sf Storage= 178,121 cf
Flood Elev= 565.00' Surf.Area= 62,400 sf Storage= 384,495 cf

Plug-Flow detention time= 623.4 min calculated for 7.120 af (95% of inflow)
Center-of-Mass det. time= 587.5 min (1,450.3 - 862.8)

Volume	Invert	Avail.Storage	Storage Description
#1	558.00'	651,999 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
558.00	47,688	883.6	0	0	47,688
559.00	49,705	899.0	48,693	48,693	50,047
560.00	51,750	914.4	50,724	99,417	52,448
561.00	53,824	929.8	52,784	152,201	54,888
562.00	55,926	945.2	54,872	207,072	57,370
563.00	58,056	960.6	56,988	264,060	59,893
564.00	60,214	976.1	59,132	323,192	62,470
565.00	62,400	991.5	61,304	384,495	65,075
566.00	64,615	1,006.9	63,504	448,000	67,720
567.00	66,858	1,022.3	65,733	513,733	70,405
568.00	69,129	1,037.7	67,990	581,723	73,132
569.00	71,429	1,053.2	70,276	651,999	75,915

Device	Routing	Invert	Outlet Devices
#1	Primary	558.00'	**48.0" Round Culvert** L= 663.9' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 558.00' / 551.36' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 12.57 sf
#2	Device 1	558.00'	**9.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	562.50'	**12.0" Vert. Orifice/Grate** C= 0.600

#4	Secondary	568.00'	**45.0 deg x 100.0' long x 1.00' rise Sharp-Crested Vee/Trap Weir** Cv= 2.56 (C= 3.20)

Primary OutFlow Max=3.75 cfs @ 17.21 hrs HW=561.48' TW=558.17' (Dynamic Tailwater)
└─**1=Culvert** (Passes 3.75 cfs of 58.14 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 3.75 cfs @ 8.48 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=558.00' TW=0.00' (Dynamic Tailwater)
└─**4=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

Summary for Pond 13P: Det. Pond - 2

Inflow Area = 1.259 ac, 71.41% Impervious, Inflow Depth = 3.85" for 10-Year event
Inflow = 4.30 cfs @ 12.12 hrs, Volume= 0.404 af
Outflow = 0.79 cfs @ 12.72 hrs, Volume= 0.399 af, Atten= 82%, Lag= 35.9 min
Primary = 0.79 cfs @ 12.72 hrs, Volume= 0.399 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 539.56' @ 12.72 hrs Surf.Area= 6,928 sf Storage= 9,329 cf
Flood Elev= 541.00' Surf.Area= 8,791 sf Storage= 20,626 cf

Plug-Flow detention time= 390.8 min calculated for 0.399 af (99% of inflow)
Center-of-Mass det. time= 381.6 min (1,181.0 - 799.3)

Volume	Invert	Avail.Storage	Storage Description
#1	538.00'	20,626 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
538.00	5,054	387.0	0	0	5,054
539.00	6,243	405.8	5,638	5,638	6,305
540.00	7,489	424.7	6,857	12,495	7,621
541.00	8,791	423.9	8,131	20,626	8,049

Device	Routing	Invert	Outlet Devices
#1	Primary	538.00'	**15.0" Round Culvert** L= 94.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 538.00' / 537.00' S= 0.0106 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	538.00'	**2.4" Vert. Orifice/Grate** C= 0.600
#3	Device 1	538.90'	**4.0" Vert. Orifice/Grate** C= 0.600
#4	Device 1	539.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.79 cfs @ 12.72 hrs HW=539.56' TW=533.74' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.79 cfs of 5.72 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.18 cfs @ 5.82 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 0.30 cfs @ 3.38 fps)
  └─**4=Orifice/Grate** (Weir Controls 0.31 cfs @ 0.81 fps)

Summary for Pond 15P: Culvert at Entr.

Inflow Area = 4.001 ac, 15.42% Impervious, Inflow Depth = 2.82" for 10-Year event
Inflow = 8.29 cfs @ 12.24 hrs, Volume= 0.942 af
Outflow = 8.29 cfs @ 12.24 hrs, Volume= 0.942 af, Atten= 0%, Lag= 0.0 min
Primary = 8.29 cfs @ 12.24 hrs, Volume= 0.942 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 530.16' @ 12.24 hrs Surf.Area= 306 sf Storage= 333 cf

Plug-Flow detention time= 0.5 min calculated for 0.942 af (100% of inflow)
Center-of-Mass det. time= 0.5 min (832.0 - 831.5)

Volume	Invert	Avail.Storage	Storage Description
#1	527.17'	1,407 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
527.17	6	14.0	0	0	6
528.00	44	35.0	18	18	90
529.00	121	58.1	79	98	268
530.00	266	92.9	189	286	693
531.00	555	117.6	402	688	1,120
532.00	897	157.4	719	1,407	2,001

Device	Routing	Invert	Outlet Devices
#1	Primary	527.17'	**18.0" Round Culvert X 2.00** L= 52.8' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 527.17' / 526.65' S= 0.0098 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	527.17'	**18.0" W x 3.0" H Vert. Orifice/Grate** C= 0.600
#3	Device 1	530.00'	**72.0" x 72.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=8.29 cfs @ 12.24 hrs HW=530.16' TW=526.94' (Dynamic Tailwater)
1=Culvert (Passes 8.29 cfs of 27.35 cfs potential flow)
2=Orifice/Grate (Orifice Controls 3.06 cfs @ 8.16 fps)
3=Orifice/Grate (Weir Controls 5.23 cfs @ 1.33 fps)

Summary for Pond 17P: Box Culvert for stream

Inflow Area = 57.525 ac, 3.12% Impervious, Inflow Depth = 2.57" for 10-Year event
Inflow = 74.83 cfs @ 12.62 hrs, Volume= 12.306 af
Outflow = 74.75 cfs @ 12.65 hrs, Volume= 12.306 af, Atten= 0%, Lag= 1.8 min
Primary = 74.75 cfs @ 12.65 hrs, Volume= 12.306 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 533.76' @ 12.65 hrs Surf.Area= 3,542 sf Storage= 1,301 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.1 min (878.2 - 878.1)

Volume	Invert	Avail.Storage	Storage Description
#1	533.00'	25,714 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
533.00	412	159.8	0	0	412
534.00	5,210	513.7	2,362	2,362	19,382
535.00	11,714	795.5	8,245	10,608	48,748
536.00	18,774	996.6	15,106	25,714	77,441

Device	Routing	Invert	Outlet Devices
#1	Primary	532.20'	**144.0" W x 60.0" H Box Culvert** L= 51.5' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 532.20' / 530.66' S= 0.0299 '/' Cc= 0.900 n= 0.024, Flow Area= 60.00 sf

Primary OutFlow Max=74.75 cfs @ 12.65 hrs HW=533.76' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 74.75 cfs @ 4.00 fps)

Summary for Pond 18P: Level Spreader

Inflow Area = 19.937 ac, 92.58% Impervious, Inflow Depth > 4.29" for 10-Year event
Inflow = 3.75 cfs @ 17.21 hrs, Volume= 7.120 af
Outflow = 3.75 cfs @ 17.22 hrs, Volume= 7.119 af, Atten= 0%, Lag= 0.5 min
Primary = 3.75 cfs @ 17.22 hrs, Volume= 7.119 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 558.00' Surf.Area= 2,625 sf Storage= 7,350 cf
Peak Elev= 558.17' @ 17.22 hrs Surf.Area= 2,625 sf Storage= 7,527 cf (177 cf above start)

Plug-Flow detention time= 50.8 min calculated for 6.949 af (98% of inflow)
Center-of-Mass det. time= 0.8 min (1,451.1 - 1,450.3)

Volume	Invert	Avail.Storage	Storage Description
#1	551.00'	8,400 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 21,000 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
551.00	2,625	0	0
556.00	2,625	13,125	13,125
557.00	2,625	2,625	15,750
558.00	2,625	2,625	18,375
559.00	2,625	2,625	21,000

Device	Routing	Invert	Outlet Devices
#1	Primary	558.00'	**75.0" x 35.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.75 cfs @ 17.22 hrs HW=558.17' TW=558.06' (Dynamic Tailwater)
└─**1=Orifice/Grate** (Weir Controls 3.75 cfs @ 1.21 fps)

Summary for Pond 23P:

Inflow Area = 0.805 ac, 73.17% Impervious, Inflow Depth = 3.96" for 10-Year event
Inflow = 3.52 cfs @ 12.07 hrs, Volume= 0.265 af
Outflow = 3.47 cfs @ 12.08 hrs, Volume= 0.265 af, Atten= 1%, Lag= 0.8 min
Primary = 0.22 cfs @ 12.08 hrs, Volume= 0.154 af
Secondary = 3.24 cfs @ 12.08 hrs, Volume= 0.111 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 531.85' @ 12.08 hrs Surf.Area= 905 sf Storage= 637 cf

Plug-Flow detention time= 12.0 min calculated for 0.265 af (100% of inflow)
Center-of-Mass det. time= 12.0 min (803.2 - 791.2)

Volume	Invert	Avail.Storage	Storage Description
#1	530.19'	789 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
530.19	56	110.4	0	0	56
531.00	317	180.9	137	137	1,695
532.01	1,044	364.9	652	789	9,691

Device	Routing	Invert	Outlet Devices
#1	Primary	530.19'	**3.0" Round Culvert** L= 17.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 530.19' / 530.00' S= 0.0110 '/' Cc= 0.900 n= 0.013, Flow Area= 0.05 sf
#2	Secondary	531.60'	**30.0 deg x 7.7' long x 0.40' rise Sharp-Crested Vee/Trap Weir** Cv= 2.61 (C= 3.26)

Primary OutFlow Max=0.22 cfs @ 12.08 hrs HW=531.85' TW=530.14' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 0.22 cfs @ 4.57 fps)

Secondary OutFlow Max=3.24 cfs @ 12.08 hrs HW=531.85' TW=530.14' (Dynamic Tailwater)
└─**2=Sharp-Crested Vee/Trap Weir** (Weir Controls 3.24 cfs @ 1.64 fps)

Summary for Pond 24P: Flow Splitter

Inflow Area = 16.505 ac,100.00% Impervious, Inflow Depth = 4.66" for 10-Year event
Inflow = 75.45 cfs @ 12.10 hrs, Volume= 6.414 af
Outflow = 75.45 cfs @ 12.10 hrs, Volume= 6.414 af, Atten= 0%, Lag= 0.0 min
Primary = 26.66 cfs @ 12.10 hrs, Volume= 5.229 af
Secondary = 48.79 cfs @ 12.10 hrs, Volume= 1.185 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Peak Elev= 568.34' @ 12.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	562.96'	**24.0" Round Culvert** L= 44.7' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 562.96' / 562.00' S= 0.0215 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Secondary	562.96'	**48.0" Round Culvert** L= 106.2' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 562.96' / 562.43' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 12.57 sf
#3	Device 2	565.70'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=26.65 cfs @ 12.10 hrs HW=568.34' TW=565.24' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 26.65 cfs @ 8.48 fps)

Secondary OutFlow Max=48.75 cfs @ 12.10 hrs HW=568.34' TW=559.54' (Dynamic Tailwater)
↑—**2=Culvert** (Passes 48.75 cfs of 97.98 cfs potential flow)
  ↑—**3=Sharp-Crested Rectangular Weir** (Weir Controls 48.75 cfs @ 5.31 fps)

Summary for Pond 28P: Ramp Culvert

Inflow Area = 0.918 ac, 72.44% Impervious, Inflow Depth = 3.89" for 10-Year event
Inflow = 3.47 cfs @ 12.13 hrs, Volume= 0.297 af
Outflow = 3.46 cfs @ 12.14 hrs, Volume= 0.297 af, Atten= 0%, Lag= 0.4 min
Primary = 3.46 cfs @ 12.14 hrs, Volume= 0.297 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 555.69' @ 12.14 hrs Surf.Area= 224 sf Storage= 99 cf
Flood Elev= 557.00' Surf.Area= 534 sf Storage= 342 cf

Plug-Flow detention time= 1.7 min calculated for 0.297 af (100% of inflow)
Center-of-Mass det. time= 1.2 min (799.5 - 798.3)

Volume	Invert	Avail.Storage	Storage Description
#1	554.61'	342 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
554.61	4	8.0	0	0	4
555.00	56	45.8	10	10	166
556.00	337	150.1	177	187	1,795
556.36	534	184.0	155	342	2,698

Device	Routing	Invert	Outlet Devices
#1	Primary	555.00'	**23.0" W x 14.0" H, R=22.0" Elliptical RCP_Elliptical 23x14** L= 30.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 555.00' / 553.62' S= 0.0460 '/' Cc= 0.900 n= 0.013, Flow Area= 1.83 sf

Primary OutFlow Max=3.46 cfs @ 12.14 hrs HW=555.69' TW=554.07' (Dynamic Tailwater)
└─**1=RCP_Elliptical 23x14** (Inlet Controls 3.46 cfs @ 3.11 fps)

Summary for Pond 30P: Culvert 2

Inflow Area =	1.380 ac,	0.00% Impervious,	Inflow Depth = 2.54"	for 10-Year event
Inflow =	2.95 cfs @	12.24 hrs, Volume=	0.292 af	
Outflow =	2.95 cfs @	12.24 hrs, Volume=	0.292 af,	Atten= 0%, Lag= 0.0 min
Primary =	2.95 cfs @	12.24 hrs, Volume=	0.292 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 534.46' @ 12.24 hrs
Flood Elev= 534.87'

Device	Routing	Invert	Outlet Devices
#1	Primary	533.66'	**23.0" W x 14.0" H, R=22.0" Elliptical RCP_Elliptical 23x14** L= 24.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 533.66' / 533.54' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 1.83 sf

Primary OutFlow Max=2.95 cfs @ 12.24 hrs HW=534.46' TW=533.97' (Dynamic Tailwater)
└─**1=RCP_Elliptical 23x14** (Barrel Controls 2.95 cfs @ 3.11 fps)

Summary for Pond 31P: Culvert 3

Inflow Area =	0.544 ac,	73.53% Impervious,	Inflow Depth = 3.99"	for 10-Year event
Inflow =	2.41 cfs @	12.07 hrs, Volume=	0.181 af	
Outflow =	2.41 cfs @	12.07 hrs, Volume=	0.181 af,	Atten= 0%, Lag= 0.0 min
Primary =	2.41 cfs @	12.07 hrs, Volume=	0.181 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 533.68' @ 12.07 hrs
Flood Elev= 538.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	533.00'	**23.0" W x 14.0" H, R=22.0" Elliptical RCP_Elliptical 23x14** L= 24.0' RCP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 533.00' / 532.35' S= 0.0271 '/' Cc= 0.900 n= 0.013, Flow Area= 1.83 sf

Primary OutFlow Max=2.40 cfs @ 12.07 hrs HW=533.68' TW=532.82' (Dynamic Tailwater)
└─**1=RCP_Elliptical 23x14** (Inlet Controls 2.40 cfs @ 2.18 fps)

Summary for Link 21L: Point A

Inflow Area =	27.710 ac,	66.61% Impervious,	Inflow Depth > 3.79"	for 10-Year event
Inflow =	18.29 cfs @	12.29 hrs, Volume=	8.763 af	
Primary =	18.29 cfs @	12.29 hrs, Volume=	8.763 af,	Atten= 0%, Lag= 0.0 min

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

Summary for Link 22L: Point B

Inflow Area = 57.525 ac, 3.12% Impervious, Inflow Depth = 2.57" for 10-Year event
Inflow = 74.75 cfs @ 12.65 hrs, Volume= 12.306 af
Primary = 74.75 cfs @ 12.65 hrs, Volume= 12.306 af, Atten= 0%, Lag= 0.0 min

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

Summary for Link 28L: Point F

Inflow Area = 5.040 ac, 0.00% Impervious, Inflow Depth = 2.54" for 10-Year event
Inflow = 7.01 cfs @ 12.61 hrs, Volume= 1.067 af
Primary = 7.01 cfs @ 12.61 hrs, Volume= 1.067 af, Atten= 0%, Lag= 0.0 min

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

Summary for Subcatchment 1S: Main Site

Runoff = 134.52 cfs @ 12.10 hrs, Volume= 11.636 af, Depth= 8.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
16.505	98	Paved parking, HSG D
16.505		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	158	0.0100	1.16		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
0.5	135	0.0025	4.18	20.51	**Pipe Channel, 130-131** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.013
0.4	110	0.0025	4.72	33.35	**Pipe Channel, 131-132** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013
0.3	79	0.0025	4.72	33.35	**Pipe Channel, 132-133** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013
0.8	246	0.0025	5.23	50.30	**Pipe Channel, 133-134** 42.0" Round Area= 9.6 sf Perim= 11.0' r= 0.88' n= 0.013
0.4	133	0.0025	5.23	50.30	**Pipe Channel, 134-135** 42.0" Round Area= 9.6 sf Perim= 11.0' r= 0.88' n= 0.013
0.6	182	0.0025	5.23	50.30	**Pipe Channel, 135-136** 42.0" Round Area= 9.6 sf Perim= 11.0' r= 0.88' n= 0.013
0.7	256	0.0025	5.72	71.82	**Pipe Channel, 136-137** 48.0" Round Area= 12.6 sf Perim= 12.6' r= 1.00' n= 0.013
0.7	233	0.0025	5.72	71.82	**Pipe Channel, 137-138** 48.0" Round Area= 12.6 sf Perim= 12.6' r= 1.00' n= 0.013
0.4	130	0.0025	5.72	71.82	**Pipe Channel, 138-139** 48.0" Round Area= 12.6 sf Perim= 12.6' r= 1.00' n= 0.013
0.3	113	0.0025	5.72	71.82	**Pipe Channel, 139-Outlet** 48.0" Round Area= 12.6 sf Perim= 12.6' r= 1.00' n= 0.013
7.4	1,775	Total			

Summary for Subcatchment 10S: Forebay Area

Runoff = 2.81 cfs @ 12.07 hrs, Volume= 0.200 af, Depth= 6.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
0.268	80	>75% Grass cover, Good, HSG D
0.086	98	Water Surface, HSG D
0.354	84	Weighted Average
0.268		75.71% Pervious Area
0.086		24.29% Impervious Area

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

Summary for Subcatchment 11S: Gravel Wetland Area

Runoff = 9.47 cfs @ 12.07 hrs, Volume= 0.694 af, Depth= 7.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
0.605	98	Water Surface, HSG D
0.296	80	>75% Grass cover, Good, HSG D
0.228	77	Woods, Good, HSG D
1.129	89	Weighted Average
0.524		46.41% Pervious Area
0.605		53.59% Impervious Area

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

Summary for Subcatchment 12S: Subcat for Swale - 1

Runoff = 7.56 cfs @ 12.08 hrs, Volume= 0.583 af, Depth= 7.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

	Area (ac)	CN	Description
	0.253	74	>75% Grass cover, Good, HSG C
*	0.665	98	Paved parking, HSG C
	0.918	91	Weighted Average
	0.253		27.56% Pervious Area
	0.665		72.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	993	0.1266	2.77		**Lag/CN Method,**

Summary for Subcatchment 13S: Pond

Runoff = 16.77 cfs @ 12.07 hrs, Volume= 1.257 af, Depth= 7.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
1.261	98	Water Surface, HSG C
0.624	80	>75% Grass cover, Good, HSG D
0.064	77	Woods, Good, HSG D
1.949	92	Weighted Average
0.688		35.30% Pervious Area
1.261		64.70% Impervious Area

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

Summary for Subcatchment 16S: DA to Entr. Culvert

Runoff = 15.19 cfs @ 12.25 hrs, Volume= 1.577 af, Depth= 5.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
3.168	77	Woods, Good, HSG D
0.028	98	Paved parking, HSG D
3.196	77	Weighted Average
3.168		99.12% Pervious Area
0.028		0.88% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.9	1,034	0.0359	0.91		**Lag/CN Method,**

Summary for Subcatchment 18S: Subcat to Point B

Runoff = 164.85 cfs @ 12.62 hrs, Volume= 26.198 af, Depth= 5.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

	Area (ac)	CN	Description
	52.205	77	Woods, Good, HSG D
	0.898	98	Paved parking, HSG D
	53.103	77	Weighted Average
	52.205		98.31% Pervious Area
	0.898		1.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
47.5	3,073	0.0324	1.08		**Lag/CN Method,**

Summary for Subcatchment 19S: Subcat for Swale - 2

Runoff = 5.16 cfs @ 12.03 hrs, Volume= 0.351 af, Depth= 7.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

	Area (ac)	CN	Description
	0.400	98	Water Surface, HSG C
*	0.144	74	>75% Grass cover, Good, HSG C
	0.544	92	Weighted Average
	0.144		26.47% Pervious Area
	0.400		73.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	313	0.1239	2.27		**Lag/CN Method,**

Summary for Subcatchment 20S: Wetlands

Runoff = 35.64 cfs @ 12.28 hrs, Volume= 3.835 af, Depth= 5.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
7.773	77	Woods, Good, HSG D
7.773		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.6	1,002	0.0286	0.81		**Lag/CN Method,**

Summary for Subcatchment 23S: Point D

Runoff = 319.56 cfs @ 12.42 hrs, Volume= 41.217 af, Depth= 5.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (sf)	CN	Description
3,639,264	77	Woods, Good, HSG D
3,639,264		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.3	3,135	0.0772	1.67		**Lag/CN Method,**

Summary for Subcatchment 24S: DA for 25R

Runoff = 3.27 cfs @ 12.51 hrs, Volume= 0.452 af, Depth= 5.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
0.916	77	Woods, Good, HSG D
0.916		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
36.2	1,580	0.0192	0.73		**Lag/CN Method,**

Summary for Subcatchment 25S: Rerouted Area

Runoff = 6.87 cfs @ 12.23 hrs, Volume= 0.681 af, Depth= 5.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
1.380	77	Woods, Good, HSG D
1.380		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.9	734	0.0260	0.73		**Lag/CN Method,**

Summary for Subcatchment 26S: Subcat for Swale - 2

Runoff = 3.18 cfs @ 12.03 hrs, Volume= 0.213 af, Depth= 7.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

	Area (ac)	CN	Description
*	0.234	98	Paved parking, HSG D
	0.107	74	>75% Grass cover, Good, HSG C
	0.341	90	Weighted Average
	0.107		31.38% Pervious Area
	0.234		68.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	293	0.1266	2.08		**Lag/CN Method,**

Summary for Subcatchment 27S: DA for Point F

Runoff = 16.28 cfs @ 12.57 hrs, Volume= 2.486 af, Depth= 5.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
5.040	77	Woods, Good, HSG D
5.040		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
44.0	2,185	0.0219	0.83		**Lag/CN Method,**

Summary for Subcatchment 29S: Rerouted Area B

Runoff = 4.60 cfs @ 12.19 hrs, Volume= 0.428 af, Depth= 5.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (sf)	CN	Description
37,749	77	Woods, Good, HSG D
37,749		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	599	0.0260	0.70		**Lag/CN Method,**

Summary for Subcatchment 34S: Subcat for Swale - 4

Runoff = 2.47 cfs @ 12.03 hrs, Volume= 0.166 af, Depth= 7.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

	Area (ac)	CN	Description
*	0.072	74	>75% Grass cover, Good, HSG C
*	0.189	98	Paved parking, HSG C
	0.261	91	Weighted Average
	0.072		27.59% Pervious Area
	0.189		72.41% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	292	0.1265	2.17		**Lag/CN Method,**

Summary for Reach 8R: Level Spreader

Inflow Area = 19.937 ac, 92.58% Impervious, Inflow Depth > 7.83" for 100-Year event
Inflow = 8.35 cfs @ 14.29 hrs, Volume= 13.008 af
Outflow = 8.35 cfs @ 14.29 hrs, Volume= 13.005 af, Atten= 0%, Lag= 0.5 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.05 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 0.70 fps, Avg. Travel Time= 1.1 min

Peak Storage= 381 cf @ 14.29 hrs
Average Depth at Peak Storage= 0.10'
Bank-Full Depth= 1.00' Flow Area= 105.0 sf, Capacity= 439.80 cfs

75.00' x 1.00' deep channel, n= 0.030
Side Slope Z-value= 30.0 '/' Top Width= 135.00'
Length= 48.0' Slope= 0.0100 '/'
Inlet Invert= 558.00', Outlet Invert= 557.52'

‡


Summary for Reach 15R: Dry Swale - 1

Inflow Area = 0.918 ac, 72.44% Impervious, Inflow Depth = 7.62" for 100-Year event
Inflow = 7.56 cfs @ 12.08 hrs, Volume= 0.583 af
Outflow = 6.75 cfs @ 12.12 hrs, Volume= 0.583 af, Atten= 11%, Lag= 2.4 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.69 fps, Min. Travel Time= 4.1 min
Avg. Velocity = 1.06 fps, Avg. Travel Time= 14.2 min

Peak Storage= 1,651 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.58'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 87.10 cfs

2.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 904.0' Slope= 0.0190 '/'
Inlet Invert= 572.17', Outlet Invert= 555.00'

Summary for Reach 18R: Dry Swale - 3

Inflow Area =	0.544 ac, 73.53% Impervious, Inflow Depth = 7.74"	for 100-Year event	
Inflow =	5.16 cfs @ 12.03 hrs, Volume=	0.351 af	
Outflow =	4.65 cfs @ 12.06 hrs, Volume=	0.351 af, Atten= 10%, Lag= 1.7 min	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.99 fps, Min. Travel Time= 3.1 min
Avg. Velocity = 0.69 fps, Avg. Travel Time= 13.2 min

Peak Storage= 857 cf @ 12.06 hrs
Average Depth at Peak Storage= 0.24'
Bank-Full Depth= 1.00' Flow Area= 8.0 sf, Capacity= 54.76 cfs

6.00' x 1.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 550.0' Slope= 0.0273 '/'
Inlet Invert= 548.05', Outlet Invert= 533.01'

‡

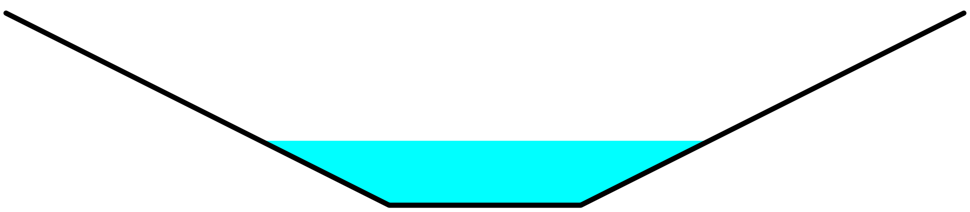
Summary for Reach 20R: Dry Swale - 4

Inflow Area = 0.805 ac, 73.17% Impervious, Inflow Depth = 7.70" for 100-Year event
Inflow = 6.94 cfs @ 12.05 hrs, Volume= 0.516 af
Outflow = 6.82 cfs @ 12.06 hrs, Volume= 0.516 af, Atten= 2%, Lag= 0.8 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.03 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 0.85 fps, Avg. Travel Time= 3.9 min

Peak Storage= 445 cf @ 12.06 hrs
Average Depth at Peak Storage= 0.67'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 66.01 cfs

2.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 198.0' Slope= 0.0109 '/'
Inlet Invert= 532.35', Outlet Invert= 530.19'



Summary for Reach 21R: Point C

Inflow Area = 4.001 ac, 15.42% Impervious, Inflow Depth = 6.28" for 100-Year event
Inflow = 18.29 cfs @ 12.24 hrs, Volume= 2.093 af
Outflow = 18.29 cfs @ 12.24 hrs, Volume= 2.093 af, Atten= 0%, Lag= 0.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.00 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.05 fps, Avg. Travel Time= 1.2 min

Peak Storage= 354 cf @ 12.24 hrs
Average Depth at Peak Storage= 0.46'
Bank-Full Depth= 2.00' Flow Area= 26.0 sf, Capacity= 240.09 cfs

9.00' x 2.00' deep channel, n= 0.024
Side Slope Z-value= 2.0 '/' Top Width= 17.00'
Length= 77.4' Slope= 0.0136 '/'
Inlet Invert= 526.65', Outlet Invert= 525.60'

‡

Summary for Reach 23R: Rerouting Ditch 1

Inflow Area = 1.380 ac, 0.00% Impervious, Inflow Depth = 5.92" for 100-Year event
Inflow = 6.87 cfs @ 12.23 hrs, Volume= 0.681 af
Outflow = 6.85 cfs @ 12.24 hrs, Volume= 0.681 af, Atten= 0%, Lag= 0.6 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.76 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 1.23 fps, Avg. Travel Time= 2.3 min

Peak Storage= 312 cf @ 12.24 hrs
Average Depth at Peak Storage= 0.58'
Bank-Full Depth= 1.00' Flow Area= 4.0 sf, Capacity= 20.18 cfs

2.00' x 1.00' deep channel, n= 0.025 Earth, clean & winding
Side Slope Z-value= 2.0 '/' Top Width= 6.00'
Length= 171.0' Slope= 0.0137 '/'
Inlet Invert= 536.00', Outlet Invert= 533.66'

Summary for Reach 25R: Ditch

Inflow Area = 0.916 ac, 0.00% Impervious, Inflow Depth = 5.92" for 100-Year event
Inflow = 3.27 cfs @ 12.51 hrs, Volume= 0.452 af
Outflow = 3.26 cfs @ 12.52 hrs, Volume= 0.452 af, Atten= 0%, Lag= 0.7 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.31 fps, Min. Travel Time= 1.9 min
Avg. Velocity = 0.83 fps, Avg. Travel Time= 5.3 min

Peak Storage= 369 cf @ 12.52 hrs
Average Depth at Peak Storage= 0.48'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 60.53 cfs

2.00' x 2.00' deep channel, n= 0.025
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 262.2' Slope= 0.0064 '/'
Inlet Invert= 540.67', Outlet Invert= 539.00'

Summary for Reach 29R: Dry Swale - 2

Inflow Area = 1.259 ac, 71.41% Impervious, Inflow Depth = 7.58" for 100-Year event
Inflow = 8.43 cfs @ 12.10 hrs, Volume= 0.795 af
Outflow = 8.38 cfs @ 12.12 hrs, Volume= 0.795 af, Atten= 1%, Lag= 0.8 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.02 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 1.19 fps, Avg. Travel Time= 3.8 min

Peak Storage= 569 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.64'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 90.04 cfs

2.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 273.0' Slope= 0.0203 '/'
Inlet Invert= 553.62', Outlet Invert= 548.08'

Summary for Reach 30R: Rerouted Ditch below Culvert

Inflow Area = 2.247 ac, 0.00% Impervious, Inflow Depth = 5.92" for 100-Year event
Inflow = 11.33 cfs @ 12.22 hrs, Volume= 1.108 af
Outflow = 11.31 cfs @ 12.23 hrs, Volume= 1.108 af, Atten= 0%, Lag= 0.5 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.07 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.67 fps, Avg. Travel Time= 2.1 min

Peak Storage= 473 cf @ 12.23 hrs
Average Depth at Peak Storage= 0.67'
Bank-Full Depth= 1.00' Flow Area= 4.0 sf, Capacity= 25.17 cfs

2.00' x 1.00' deep channel, n= 0.013
Side Slope Z-value= 2.0 '/' Top Width= 6.00'
Length= 212.0' Slope= 0.0058 '/'
Inlet Invert= 533.54', Outlet Invert= 532.32'

Summary for Pond 2P: Forebay

Inflow Area = 16.859 ac, 98.41% Impervious, Inflow Depth = 6.30" for 100-Year event
Inflow = 36.64 cfs @ 12.10 hrs, Volume= 8.855 af
Outflow = 36.51 cfs @ 12.11 hrs, Volume= 8.851 af, Atten= 0%, Lag= 0.6 min
Primary = 5.22 cfs @ 10.36 hrs, Volume= 5.329 af
Secondary = 32.14 cfs @ 12.11 hrs, Volume= 3.522 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 561.00' Surf.Area= 3,802 sf Storage= 3,789 cf
Peak Elev= 565.30' @ 12.11 hrs Surf.Area= 5,835 sf Storage= 24,399 cf (20,611 cf above start)
Flood Elev= 568.00' Surf.Area= 7,249 sf Storage= 42,057 cf (38,268 cf above start)

Plug-Flow detention time= 59.5 min calculated for 8.764 af (99% of inflow)
Center-of-Mass det. time= 45.6 min (793.1 - 747.5)

Volume	Invert	Avail.Storage	Storage Description
#1	558.00'	49,579 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
558.00	2,536	269.1	0.0	0	0	2,536
559.00	2,944	279.8	40.0	1,095	1,095	3,078
560.00	3,366	290.5	40.0	1,261	2,356	3,641
561.00	3,802	301.2	40.0	1,433	3,789	4,225
562.00	4,252	312.0	100.0	4,025	7,814	4,835
563.00	4,716	322.7	100.0	4,482	12,296	5,462
564.00	5,194	333.4	100.0	4,953	17,249	6,110
565.00	5,687	344.1	100.0	5,439	22,687	6,779
566.00	6,193	354.8	100.0	5,938	28,626	7,469
567.00	6,714	365.5	100.0	6,452	35,077	8,180
568.00	7,249	376.2	100.0	6,980	42,057	8,912
569.00	7,798	386.9	100.0	7,522	49,579	9,666

Device	Routing	Invert	Outlet Devices
#1	Primary	558.00'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 558.00' / 558.00' S= 0.0000 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Secondary	565.00'	**60.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 3.0' Crest Height

Primary OutFlow Max=5.21 cfs @ 10.36 hrs HW=565.05' TW=562.00' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 5.21 cfs @ 6.64 fps)

Secondary OutFlow Max=32.11 cfs @ 12.11 hrs HW=565.30' TW=563.16' (Dynamic Tailwater)
↑—**2=Sharp-Crested Rectangular Weir** (Weir Controls 32.11 cfs @ 1.80 fps)

Summary for Pond 3P: Gravel Wetland

Inflow Area = 17.988 ac, 95.60% Impervious, Inflow Depth = 6.37" for 100-Year event
Inflow = 45.42 cfs @ 12.09 hrs, Volume= 9.545 af
Outflow = 37.40 cfs @ 12.15 hrs, Volume= 9.521 af, Atten= 18%, Lag= 3.2 min
Primary = 37.40 cfs @ 12.15 hrs, Volume= 9.521 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 561.00' Surf.Area= 22,959 sf Storage= 27,438 cf
Peak Elev= 563.86' @ 14.04 hrs Surf.Area= 25,785 sf Storage= 97,074 cf (69,635 cf above start)
Flood Elev= 568.00' Surf.Area= 30,084 sf Storage= 212,684 cf (185,246 cf above start)

Plug-Flow detention time= 236.4 min calculated for 8.889 af (93% of inflow)
Center-of-Mass det. time= 147.9 min (939.7 - 791.9)

Volume	Invert	Avail.Storage	Storage Description
#1	558.00'	243,305 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
558.00	22,771	626.2	0.0	0	0	22,771
559.00	22,834	626.9	40.0	9,121	9,121	23,401
560.00	22,897	627.7	40.0	9,146	18,267	24,034
561.00	22,959	628.5	40.0	9,171	27,438	24,667
562.00	23,935	639.2	100.0	23,445	50,884	25,919
563.00	24,924	649.9	100.0	24,428	75,312	27,192
564.00	25,928	660.6	100.0	25,424	100,736	28,486
565.00	26,947	671.3	100.0	26,436	127,172	29,801
566.00	27,978	682.1	100.0	27,461	154,633	31,146
567.00	29,024	692.8	100.0	28,499	183,132	32,504
568.00	30,084	703.5	100.0	29,552	212,684	33,883
569.00	31,161	714.3	100.0	30,621	243,305	35,293

Device	Routing	Invert	Outlet Devices
#1	Primary	558.00'	**36.0" Round Culvert** L= 20.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 558.00' / 558.00' S= 0.0000 '/' Cc= 0.900 n= 0.013, Flow Area= 7.07 sf
#2	Device 1	561.00'	**12.0" Vert. Orifice/Grate X 2.00** C= 0.600
#3	Device 2	558.00'	**12.0" Vert. Orifice/Grate** C= 0.600
#4	Device 1	562.50'	**60.0" x 30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 2	562.50'	**60.0" x 30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Secondary	564.00'	**100.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 5.0' Crest Height

Primary OutFlow Max=36.99 cfs @ 12.15 hrs HW=563.20' TW=562.02' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 36.99 cfs @ 5.23 fps)
  ├─**2=Orifice/Grate** (Passes < 8.22 cfs potential flow)
  │ ├─**3=Orifice/Grate** (Passes < 4.11 cfs potential flow)
  │ └─**5=Orifice/Grate** (Passes < 28.78 cfs potential flow)
  └─**4=Orifice/Grate** (Passes < 28.78 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=561.00' TW=558.00' (Dynamic Tailwater)
└─**6=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 4P: DP-1

Inflow Area = 19.937 ac, 92.58% Impervious, Inflow Depth > 8.28" for 100-Year event
Inflow = 151.85 cfs @ 12.10 hrs, Volume= 13.757 af
Outflow = 8.35 cfs @ 14.28 hrs, Volume= 13.009 af, Atten= 94%, Lag= 130.7 min
Primary = 8.35 cfs @ 14.28 hrs, Volume= 13.009 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 563.81' @ 14.28 hrs Surf.Area= 59,793 sf Storage= 311,569 cf
Flood Elev= 565.00' Surf.Area= 62,400 sf Storage= 384,495 cf

Plug-Flow detention time= 644.1 min calculated for 13.007 af (95% of inflow)
Center-of-Mass det. time= 588.4 min (1,466.1 - 877.8)

Volume	Invert	Avail.Storage	Storage Description
#1	558.00'	651,999 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
558.00	47,688	883.6	0	0	47,688
559.00	49,705	899.0	48,693	48,693	50,047
560.00	51,750	914.4	50,724	99,417	52,448
561.00	53,824	929.8	52,784	152,201	54,888
562.00	55,926	945.2	54,872	207,072	57,370
563.00	58,056	960.6	56,988	264,060	59,893
564.00	60,214	976.1	59,132	323,192	62,470
565.00	62,400	991.5	61,304	384,495	65,075
566.00	64,615	1,006.9	63,504	448,000	67,720
567.00	66,858	1,022.3	65,733	513,733	70,405
568.00	69,129	1,037.7	67,990	581,723	73,132
569.00	71,429	1,053.2	70,276	651,999	75,915

Device	Routing	Invert	Outlet Devices
#1	Primary	558.00'	**48.0" Round Culvert** L= 663.9' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 558.00' / 551.36' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 12.57 sf
#2	Device 1	558.00'	**9.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	562.50'	**12.0" Vert. Orifice/Grate** C= 0.600

#4	Secondary	568.00'	**45.0 deg x 100.0' long x 1.00' rise Sharp-Crested Vee/Trap Weir** Cv= 2.56 (C= 3.20)

Primary OutFlow Max=8.35 cfs @ 14.28 hrs HW=563.81' TW=558.29' (Dynamic Tailwater)
└─**1=Culvert** (Passes 8.35 cfs of 93.20 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 4.96 cfs @ 11.22 fps)
  └─**3=Orifice/Grate** (Orifice Controls 3.40 cfs @ 4.32 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=558.00' TW=0.00' (Dynamic Tailwater)
└─**4=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

Summary for Pond 13P: Det. Pond - 2

Inflow Area = 1.259 ac, 71.41% Impervious, Inflow Depth = 7.58" for 100-Year event
Inflow = 8.38 cfs @ 12.12 hrs, Volume= 0.795 af
Outflow = 6.51 cfs @ 12.23 hrs, Volume= 0.789 af, Atten= 22%, Lag= 6.7 min
Primary = 6.51 cfs @ 12.23 hrs, Volume= 0.789 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 539.94' @ 12.23 hrs Surf.Area= 7,405 sf Storage= 12,016 cf
Flood Elev= 541.00' Surf.Area= 8,791 sf Storage= 20,626 cf

Plug-Flow detention time= 249.7 min calculated for 0.789 af (99% of inflow)
Center-of-Mass det. time= 244.2 min (1,023.9 - 779.7)

Volume	Invert	Avail.Storage	Storage Description
#1	538.00'	20,626 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
538.00	5,054	387.0	0	0	5,054
539.00	6,243	405.8	5,638	5,638	6,305
540.00	7,489	424.7	6,857	12,495	7,621
541.00	8,791	423.9	8,131	20,626	8,049

Device	Routing	Invert	Outlet Devices
#1	Primary	538.00'	**15.0" Round Culvert** L= 94.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 538.00' / 537.00' S= 0.0106 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	538.00'	**2.4" Vert. Orifice/Grate** C= 0.600
#3	Device 1	538.90'	**4.0" Vert. Orifice/Grate** C= 0.600
#4	Device 1	539.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=6.50 cfs @ 12.23 hrs HW=539.94' TW=534.02' (Dynamic Tailwater)
└─**1=Culvert** (Passes 6.50 cfs of 6.65 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.20 cfs @ 6.52 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 0.39 cfs @ 4.49 fps)
  └─**4=Orifice/Grate** (Weir Controls 5.91 cfs @ 2.16 fps)

Summary for Pond 15P: Culvert at Entr.

Inflow Area = 4.001 ac, 15.42% Impervious, Inflow Depth = 6.28" for 100-Year event
Inflow = 18.30 cfs @ 12.24 hrs, Volume= 2.093 af
Outflow = 18.29 cfs @ 12.24 hrs, Volume= 2.093 af, Atten= 0%, Lag= 0.0 min
Primary = 18.29 cfs @ 12.24 hrs, Volume= 2.093 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 530.33' @ 12.24 hrs Surf.Area= 351 sf Storage= 389 cf

Plug-Flow detention time= 0.4 min calculated for 2.093 af (100% of inflow)
Center-of-Mass det. time= 0.4 min (810.3 - 809.9)

Volume	Invert	Avail.Storage	Storage Description
#1	527.17'	1,407 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
527.17	6	14.0	0	0	6
528.00	44	35.0	18	18	90
529.00	121	58.1	79	98	268
530.00	266	92.9	189	286	693
531.00	555	117.6	402	688	1,120
532.00	897	157.4	719	1,407	2,001

Device	Routing	Invert	Outlet Devices
#1	Primary	527.17'	**18.0" Round Culvert X 2.00** L= 52.8' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 527.17' / 526.65' S= 0.0098 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	527.17'	**18.0" W x 3.0" H Vert. Orifice/Grate** C= 0.600
#3	Device 1	530.00'	**72.0" x 72.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=18.29 cfs @ 12.24 hrs HW=530.33' TW=527.11' (Dynamic Tailwater)
└─**1=Culvert** (Passes 18.29 cfs of 28.48 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 3.15 cfs @ 8.39 fps)
  └─**3=Orifice/Grate** (Weir Controls 15.14 cfs @ 1.89 fps)

Summary for Pond 17P: Box Culvert for stream

Inflow Area = 57.525 ac, 3.12% Impervious, Inflow Depth = 5.96" for 100-Year event
Inflow = 175.13 cfs @ 12.61 hrs, Volume= 28.547 af
Outflow = 174.13 cfs @ 12.64 hrs, Volume= 28.547 af, Atten= 1%, Lag= 1.8 min
Primary = 174.13 cfs @ 12.64 hrs, Volume= 28.547 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 534.93' @ 12.64 hrs Surf.Area= 11,204 sf Storage= 9,851 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.3 min (849.1 - 848.7)

Volume	Invert	Avail.Storage	Storage Description
#1	533.00'	25,714 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
533.00	412	159.8	0	0	412
534.00	5,210	513.7	2,362	2,362	19,382
535.00	11,714	795.5	8,245	10,608	48,748
536.00	18,774	996.6	15,106	25,714	77,441

Device	Routing	Invert	Outlet Devices
#1	Primary	532.20'	**144.0" W x 60.0" H Box Culvert** L= 51.5' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 532.20' / 530.66' S= 0.0299 '/' Cc= 0.900 n= 0.024, Flow Area= 60.00 sf

Primary OutFlow Max=174.11 cfs @ 12.64 hrs HW=534.93' TW=0.00' (Dynamic Tailwater)
└—**1=Culvert** (Inlet Controls 174.11 cfs @ 5.31 fps)

Summary for Pond 18P: Level Spreader

Inflow Area = 19.937 ac, 92.58% Impervious, Inflow Depth > 7.83" for 100-Year event
Inflow = 8.35 cfs @ 14.28 hrs, Volume= 13.009 af
Outflow = 8.35 cfs @ 14.29 hrs, Volume= 13.008 af, Atten= 0%, Lag= 0.4 min
Primary = 8.35 cfs @ 14.29 hrs, Volume= 13.008 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 558.00' Surf.Area= 2,625 sf Storage= 7,350 cf
Peak Elev= 558.29' @ 14.29 hrs Surf.Area= 2,625 sf Storage= 7,650 cf (300 cf above start)

Plug-Flow detention time= 31.6 min calculated for 12.836 af (99% of inflow)
Center-of-Mass det. time= 0.6 min (1,466.7 - 1,466.1)

Volume	Invert	Avail.Storage	Storage Description
#1	551.00'	8,400 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 21,000 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
551.00	2,625	0	0
556.00	2,625	13,125	13,125
557.00	2,625	2,625	15,750
558.00	2,625	2,625	18,375
559.00	2,625	2,625	21,000

Device	Routing	Invert	Outlet Devices
#1	Primary	558.00'	**75.0" x 35.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=8.35 cfs @ 14.29 hrs HW=558.29' TW=558.10' (Dynamic Tailwater)
1=Orifice/Grate (Weir Controls 8.35 cfs @ 1.59 fps)

Summary for Pond 23P:

Inflow Area =	0.805 ac, 73.17% Impervious,	Inflow Depth = 7.70"	for 100-Year event		
Inflow =	6.82 cfs @	12.06 hrs,	Volume=	0.516 af	
Outflow =	6.73 cfs @	12.08 hrs,	Volume=	0.516 af,	Atten= 1%, Lag= 0.7 min
Primary =	0.23 cfs @	12.05 hrs,	Volume=	0.231 af	
Secondary =	6.50 cfs @	12.08 hrs,	Volume=	0.285 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 532.00' @ 12.08 hrs Surf.Area= 1,038 sf Storage= 782 cf

Plug-Flow detention time= 11.1 min calculated for 0.516 af (100% of inflow)
Center-of-Mass det. time= 11.1 min (783.7 - 772.6)

Volume	Invert	Avail.Storage	Storage Description
#1	530.19'	789 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
530.19	56	110.4	0	0	56
531.00	317	180.9	137	137	1,695
532.01	1,044	364.9	652	789	9,691

Device	Routing	Invert	Outlet Devices
#1	Primary	530.19'	**3.0" Round Culvert** L= 17.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 530.19' / 530.00' S= 0.0110 '/' Cc= 0.900 n= 0.013, Flow Area= 0.05 sf
#2	Secondary	531.60'	**30.0 deg x 7.7' long x 0.40' rise Sharp-Crested Vee/Trap Weir** Cv= 2.61 (C= 3.26)

Primary OutFlow Max=0.23 cfs @ 12.05 hrs HW=531.99' TW=530.27' (Dynamic Tailwater)
1=Culvert (Outlet Controls 0.23 cfs @ 4.73 fps)

Secondary OutFlow Max=6.49 cfs @ 12.08 hrs HW=532.00' TW=530.29' (Dynamic Tailwater)
2=Sharp-Crested Vee/Trap Weir (Orifice Controls 6.49 cfs @ 2.08 fps)

Summary for Pond 24P: Flow Splitter

Inflow Area =	16.505 ac,100.00% Impervious,	Inflow Depth = 8.46"	for 100-Year event		
Inflow =	134.52 cfs @	12.10 hrs,	Volume=	11.636 af	
Outflow =	134.52 cfs @	12.10 hrs,	Volume=	11.636 af,	Atten= 0%, Lag= 0.0 min
Primary =	33.99 cfs @	12.10 hrs,	Volume=	8.656 af	
Secondary =	100.53 cfs @	12.10 hrs,	Volume=	2.980 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Peak Elev= 570.34' @ 12.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	562.96'	**24.0" Round Culvert** L= 44.7' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 562.96' / 562.00' S= 0.0215 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Secondary	562.96'	**48.0" Round Culvert** L= 106.2' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 562.96' / 562.43' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 12.57 sf
#3	Device 2	565.70'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=33.98 cfs @ 12.10 hrs HW=570.34' TW=565.30' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 33.98 cfs @ 10.82 fps)

Secondary OutFlow Max=100.46 cfs @ 12.10 hrs HW=570.34' TW=561.61' (Dynamic Tailwater)
└─**2=Culvert** (Passes 100.46 cfs of 140.16 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 100.46 cfs @ 7.05 fps)

Summary for Pond 28P: Ramp Culvert

Inflow Area = 0.918 ac, 72.44% Impervious, Inflow Depth = 7.62" for 100-Year event
Inflow = 6.75 cfs @ 12.12 hrs, Volume= 0.583 af
Outflow = 6.71 cfs @ 12.13 hrs, Volume= 0.582 af, Atten= 0%, Lag= 0.6 min
Primary = 6.71 cfs @ 12.13 hrs, Volume= 0.582 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 556.03' @ 12.13 hrs Surf.Area= 350 sf Storage= 196 cf
Flood Elev= 557.00' Surf.Area= 534 sf Storage= 342 cf

Plug-Flow detention time= 1.2 min calculated for 0.582 af (100% of inflow)
Center-of-Mass det. time= 0.9 min (780.0 - 779.1)

Volume	Invert	Avail.Storage	Storage Description
#1	554.61'	342 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
554.61	4	8.0	0	0	4
555.00	56	45.8	10	10	166
556.00	337	150.1	177	187	1,795
556.36	534	184.0	155	342	2,698

Device	Routing	Invert	Outlet Devices
#1	Primary	555.00'	**23.0" W x 14.0" H, R=22.0" Elliptical RCP_Elliptical 23x14** L= 30.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 555.00' / 553.62' S= 0.0460 '/' Cc= 0.900 n= 0.013, Flow Area= 1.83 sf

Primary OutFlow Max=6.71 cfs @ 12.13 hrs HW=556.03' TW=554.25' (Dynamic Tailwater)
└─**1=RCP_Elliptical 23x14** (Inlet Controls 6.71 cfs @ 3.96 fps)

Summary for Pond 30P: Culvert 2

Inflow Area =	1.380 ac,	0.00% Impervious,	Inflow Depth = 5.92"	for 100-Year event	
Inflow =	6.85 cfs @	12.24 hrs,	Volume=	0.681 af	
Outflow =	6.85 cfs @	12.24 hrs,	Volume=	0.681 af,	Atten= 0%, Lag= 0.0 min
Primary =	6.85 cfs @	12.24 hrs,	Volume=	0.681 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 535.14' @ 12.24 hrs
Flood Elev= 534.87'

Device	Routing	Invert	Outlet Devices
#1	Primary	533.66'	**23.0" W x 14.0" H, R=22.0" Elliptical RCP_Elliptical 23x14** L= 24.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 533.66' / 533.54' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 1.83 sf

Primary OutFlow Max=6.85 cfs @ 12.24 hrs HW=535.14' TW=534.21' (Dynamic Tailwater)
└─**1=RCP_Elliptical 23x14** (Inlet Controls 6.85 cfs @ 3.75 fps)

Summary for Pond 31P: Culvert 3

Inflow Area =	0.544 ac,	73.53% Impervious,	Inflow Depth = 7.74"	for 100-Year event	
Inflow =	4.65 cfs @	12.06 hrs,	Volume=	0.351 af	
Outflow =	4.65 cfs @	12.06 hrs,	Volume=	0.351 af,	Atten= 0%, Lag= 0.0 min
Primary =	4.65 cfs @	12.06 hrs,	Volume=	0.351 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 534.01' @ 12.06 hrs
Flood Elev= 538.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	533.00'	**23.0" W x 14.0" H, R=22.0" Elliptical RCP_Elliptical 23x14** L= 24.0' RCP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 533.00' / 532.35' S= 0.0271 '/' Cc= 0.900 n= 0.013, Flow Area= 1.83 sf

Primary OutFlow Max=4.65 cfs @ 12.06 hrs HW=534.01' TW=533.02' (Dynamic Tailwater)
└─**1=RCP_Elliptical 23x14** (Inlet Controls 4.65 cfs @ 2.77 fps)

Summary for Link 21L: Point A

Inflow Area =	27.710 ac,	66.61% Impervious,	Inflow Depth > 7.29"	for 100-Year event	
Inflow =	40.42 cfs @	12.29 hrs,	Volume=	16.840 af	
Primary =	40.42 cfs @	12.29 hrs,	Volume=	16.840 af,	Atten= 0%, Lag= 0.0 min

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

Summary for Link 22L: Point B

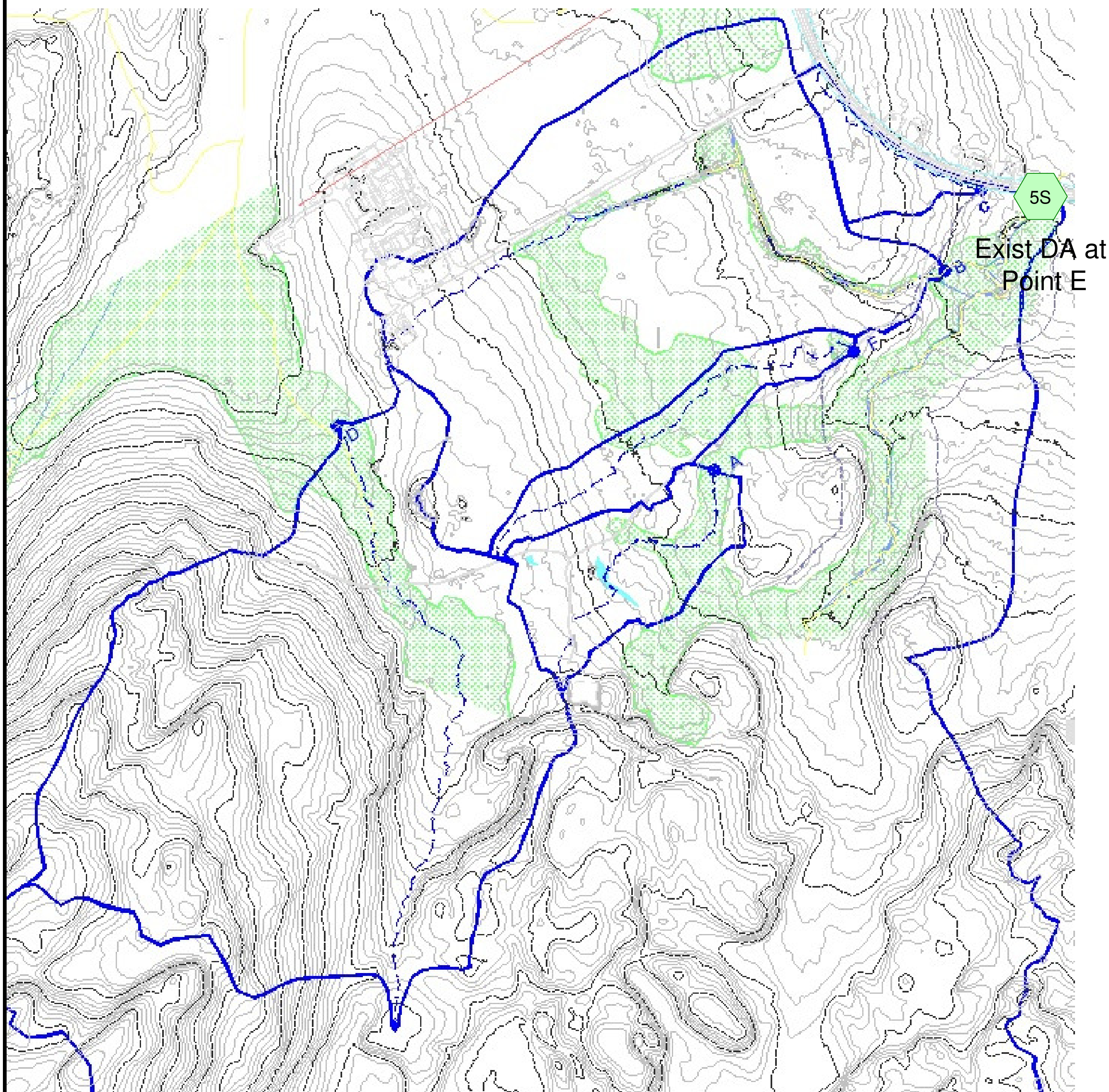
Inflow Area =	57.525 ac,	3.12% Impervious,	Inflow Depth = 5.96"	for 100-Year event	
Inflow =	174.13 cfs @	12.64 hrs,	Volume=	28.547 af	
Primary =	174.13 cfs @	12.64 hrs,	Volume=	28.547 af,	Atten= 0%, Lag= 0.0 min

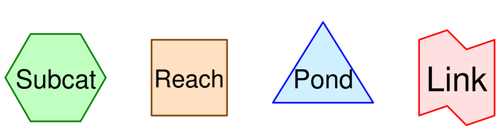
Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link 28L: Point F

Inflow Area =	5.040 ac,	0.00% Impervious,	Inflow Depth = 5.92"	for 100-Year event	
Inflow =	16.28 cfs @	12.57 hrs,	Volume=	2.486 af	
Primary =	16.28 cfs @	12.57 hrs,	Volume=	2.486 af,	Atten= 0%, Lag= 0.0 min

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





Routing Diagram for Pt E Exist_Dn_Stream
Prepared by HDR Inc, Printed 3/26/2017
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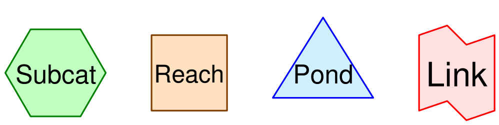
Summary for Subcatchment 5S: Exist DA at Point E

Runoff = 324.81 cfs @ 17.71 hrs, Volume= 231.369 af, Depth= 5.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
467.119	77	Woods, Good, HSG D
1.860	98	Paved parking, HSG D
468.979	77	Weighted Average
467.119		99.60% Pervious Area
1.860		0.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	80	0.0480	0.26		**Sheet Flow,** Range n= 0.130 P2= 3.30"
391.3	7,875	0.0180	0.34		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
34.5	3,919	0.0130	1.90	182.01	**Channel Flow,** Area= 96.0 sf Perim= 81.1' r= 1.18' n= 0.100 Very weedy reaches w/pools
430.9	11,874	Total			



Routing Diagram for Pt E-Prop_Dn_Stream
Prepared by HDR Inc, Printed 3/26/2017
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Summary for Subcatchment 1S: Main Site

Runoff = 134.52 cfs @ 12.10 hrs, Volume= 11.636 af, Depth= 8.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
16.505	98	Paved parking, HSG D
16.505		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	158	0.0100	1.16		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
0.5	135	0.0025	4.18	20.51	**Pipe Channel, 130-131** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.013
0.4	110	0.0025	4.72	33.35	**Pipe Channel, 131-132** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013
0.3	79	0.0025	4.72	33.35	**Pipe Channel, 132-133** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013
0.8	246	0.0025	5.23	50.30	**Pipe Channel, 133-134** 42.0" Round Area= 9.6 sf Perim= 11.0' r= 0.88' n= 0.013
0.4	133	0.0025	5.23	50.30	**Pipe Channel, 134-135** 42.0" Round Area= 9.6 sf Perim= 11.0' r= 0.88' n= 0.013
0.6	182	0.0025	5.23	50.30	**Pipe Channel, 135-136** 42.0" Round Area= 9.6 sf Perim= 11.0' r= 0.88' n= 0.013
0.7	256	0.0025	5.72	71.82	**Pipe Channel, 136-137** 48.0" Round Area= 12.6 sf Perim= 12.6' r= 1.00' n= 0.013
0.7	233	0.0025	5.72	71.82	**Pipe Channel, 137-138** 48.0" Round Area= 12.6 sf Perim= 12.6' r= 1.00' n= 0.013
0.4	130	0.0025	5.72	71.82	**Pipe Channel, 138-139** 48.0" Round Area= 12.6 sf Perim= 12.6' r= 1.00' n= 0.013
0.3	113	0.0025	5.72	71.82	**Pipe Channel, 139-Outlet** 48.0" Round Area= 12.6 sf Perim= 12.6' r= 1.00' n= 0.013
7.4	1,775	Total			

Summary for Subcatchment 9S: DA to Point E

Runoff = 259.51 cfs @ 17.71 hrs, Volume= 184.858 af, Depth= 5.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (sf)	CN	Description
16,322,075	77	Woods, Good, HSG D
16,322,075		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	80	0.0480	0.26		**Sheet Flow,** Range n= 0.130 P2= 3.30"
391.3	7,875	0.0180	0.34		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
34.5	3,919	0.0130	1.90	182.01	**Channel Flow,** Area= 96.0 sf Perim= 81.1' r= 1.18' n= 0.100 Very weedy reaches w/pools
430.9	11,874	Total			

Summary for Subcatchment 10S: Forebay Area

Runoff = 2.81 cfs @ 12.07 hrs, Volume= 0.200 af, Depth= 6.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
0.268	80	>75% Grass cover, Good, HSG D
0.086	98	Water Surface, HSG D
0.354	84	Weighted Average
0.268		75.71% Pervious Area
0.086		24.29% Impervious Area

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

Summary for Subcatchment 11S: Gravel Wetland Area

Runoff = 9.47 cfs @ 12.07 hrs, Volume= 0.694 af, Depth= 7.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

	Area (ac)	CN	Description
	0.605	98	Water Surface, HSG D
	0.296	80	>75% Grass cover, Good, HSG D
	0.228	77	Woods, Good, HSG D
	1.129	89	Weighted Average
	0.524		46.41% Pervious Area
	0.605		53.59% Impervious Area

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

Summary for Subcatchment 12S: Subcat for Swale - 1

Runoff = 7.56 cfs @ 12.08 hrs, Volume= 0.583 af, Depth= 7.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

	Area (ac)	CN	Description
	0.253	74	>75% Grass cover, Good, HSG C
*	0.665	98	Paved parking, HSG C
	0.918	91	Weighted Average
	0.253		27.56% Pervious Area
	0.665		72.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	993	0.1266	2.77		**Lag/CN Method,**

Summary for Subcatchment 13S: Pond

Runoff = 16.77 cfs @ 12.07 hrs, Volume= 1.257 af, Depth= 7.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

	Area (ac)	CN	Description
	1.261	98	Water Surface, HSG C
	0.624	80	>75% Grass cover, Good, HSG D
	0.064	77	Woods, Good, HSG D
	1.949	92	Weighted Average
	0.688		35.30% Pervious Area
	1.261		64.70% Impervious Area

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

Summary for Subcatchment 16S: DA to Entr. Culvert

Runoff = 15.19 cfs @ 12.25 hrs, Volume= 1.577 af, Depth= 5.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
3.168	77	Woods, Good, HSG D
0.028	98	Paved parking, HSG D
3.196	77	Weighted Average
3.168		99.12% Pervious Area
0.028		0.88% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.9	1,034	0.0359	0.91		**Lag/CN Method,**

Summary for Subcatchment 18S: Subcat to Point B

Runoff = 164.85 cfs @ 12.62 hrs, Volume= 26.198 af, Depth= 5.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
52.205	77	Woods, Good, HSG D
0.898	98	Paved parking, HSG D
53.103	77	Weighted Average
52.205		98.31% Pervious Area
0.898		1.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
47.5	3,073	0.0324	1.08		**Lag/CN Method,**

Summary for Subcatchment 19S: Subcat for Swale - 2

Runoff = 5.16 cfs @ 12.03 hrs, Volume= 0.351 af, Depth= 7.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

	Area (ac)	CN	Description
	0.400	98	Water Surface, HSG C
*	0.144	74	>75% Grass cover, Good, HSG C
	0.544	92	Weighted Average
	0.144		26.47% Pervious Area
	0.400		73.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	313	0.1239	2.27		**Lag/CN Method,**

Summary for Subcatchment 20S: Wetlands

Runoff = 35.64 cfs @ 12.28 hrs, Volume= 3.835 af, Depth= 5.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
7.773	77	Woods, Good, HSG D
7.773		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.6	1,002	0.0286	0.81		**Lag/CN Method,**

Summary for Subcatchment 23S: Point D

Runoff = 319.56 cfs @ 12.42 hrs, Volume= 41.217 af, Depth= 5.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (sf)	CN	Description
3,639,264	77	Woods, Good, HSG D
3,639,264		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.3	3,135	0.0772	1.67		**Lag/CN Method,**

Summary for Subcatchment 24S: DA for 25R

Runoff = 3.27 cfs @ 12.51 hrs, Volume= 0.452 af, Depth= 5.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
0.916	77	Woods, Good, HSG D
0.916		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
36.2	1,580	0.0192	0.73		**Lag/CN Method,**

Summary for Subcatchment 25S: Rerouted Area

Runoff = 6.87 cfs @ 12.23 hrs, Volume= 0.681 af, Depth= 5.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
1.380	77	Woods, Good, HSG D
1.380		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.9	734	0.0260	0.73		**Lag/CN Method,**

Summary for Subcatchment 26S: Subcat for Swale - 2

Runoff = 3.18 cfs @ 12.03 hrs, Volume= 0.213 af, Depth= 7.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

	Area (ac)	CN	Description
*	0.234	98	Paved parking, HSG D
	0.107	74	>75% Grass cover, Good, HSG C
	0.341	90	Weighted Average
	0.107		31.38% Pervious Area
	0.234		68.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	293	0.1266	2.08		**Lag/CN Method,**

Summary for Subcatchment 27S: DA for Point F

Runoff = 16.28 cfs @ 12.57 hrs, Volume= 2.486 af, Depth= 5.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (ac)	CN	Description
5.040	77	Woods, Good, HSG D
5.040		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
44.0	2,185	0.0219	0.83		**Lag/CN Method,**

Summary for Subcatchment 29S: Rerouted Area B

Runoff = 4.60 cfs @ 12.19 hrs, Volume= 0.428 af, Depth= 5.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

Area (sf)	CN	Description
37,749	77	Woods, Good, HSG D
37,749		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	599	0.0260	0.70		**Lag/CN Method,**

Summary for Subcatchment 34S: Subcat for Swale - 4

Runoff = 2.47 cfs @ 12.03 hrs, Volume= 0.166 af, Depth= 7.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.70"

	Area (ac)	CN	Description
*	0.072	74	>75% Grass cover, Good, HSG C
*	0.189	98	Paved parking, HSG C
	0.261	91	Weighted Average
	0.072		27.59% Pervious Area
	0.189		72.41% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	292	0.1265	2.17		**Lag/CN Method,**

Summary for Reach 8R: Level Spreader

Inflow Area = 19.937 ac, 92.58% Impervious, Inflow Depth > 7.83" for 100-Year event
Inflow = 8.35 cfs @ 14.29 hrs, Volume= 13.008 af
Outflow = 8.35 cfs @ 14.29 hrs, Volume= 13.005 af, Atten= 0%, Lag= 0.5 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.05 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 0.70 fps, Avg. Travel Time= 1.1 min

Peak Storage= 381 cf @ 14.29 hrs
Average Depth at Peak Storage= 0.10'
Bank-Full Depth= 1.00' Flow Area= 105.0 sf, Capacity= 439.80 cfs

75.00' x 1.00' deep channel, n= 0.030
Side Slope Z-value= 30.0 '/' Top Width= 135.00'
Length= 48.0' Slope= 0.0100 '/'
Inlet Invert= 558.00', Outlet Invert= 557.52'

‡

Summary for Reach 15R: Dry Swale - 1

Inflow Area = 0.918 ac, 72.44% Impervious, Inflow Depth = 7.62" for 100-Year event
Inflow = 7.56 cfs @ 12.08 hrs, Volume= 0.583 af
Outflow = 6.75 cfs @ 12.12 hrs, Volume= 0.583 af, Atten= 11%, Lag= 2.4 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.69 fps, Min. Travel Time= 4.1 min
Avg. Velocity = 1.06 fps, Avg. Travel Time= 14.2 min

Peak Storage= 1,651 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.58'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 87.10 cfs

2.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 904.0' Slope= 0.0190 '/'
Inlet Invert= 572.17', Outlet Invert= 555.00'

Summary for Reach 18R: Dry Swale - 3

Inflow Area = 0.544 ac, 73.53% Impervious, Inflow Depth = 7.74" for 100-Year event
Inflow = 5.16 cfs @ 12.03 hrs, Volume= 0.351 af
Outflow = 4.65 cfs @ 12.06 hrs, Volume= 0.351 af, Atten= 10%, Lag= 1.7 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.99 fps, Min. Travel Time= 3.1 min
Avg. Velocity = 0.69 fps, Avg. Travel Time= 13.2 min

Peak Storage= 857 cf @ 12.06 hrs
Average Depth at Peak Storage= 0.24'
Bank-Full Depth= 1.00' Flow Area= 8.0 sf, Capacity= 54.76 cfs

6.00' x 1.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 550.0' Slope= 0.0273 '/'
Inlet Invert= 548.05', Outlet Invert= 533.01'

‡

Summary for Reach 20R: Dry Swale - 4

Inflow Area = 0.805 ac, 73.17% Impervious, Inflow Depth = 7.70" for 100-Year event
Inflow = 6.94 cfs @ 12.05 hrs, Volume= 0.516 af
Outflow = 6.82 cfs @ 12.06 hrs, Volume= 0.516 af, Atten= 2%, Lag= 0.8 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.03 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 0.85 fps, Avg. Travel Time= 3.9 min

Peak Storage= 445 cf @ 12.06 hrs
Average Depth at Peak Storage= 0.67'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 66.01 cfs

2.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 198.0' Slope= 0.0109 '/'
Inlet Invert= 532.35', Outlet Invert= 530.19'

Summary for Reach 21R: Point C

Inflow Area = 4.001 ac, 15.42% Impervious, Inflow Depth = 6.28" for 100-Year event
Inflow = 18.29 cfs @ 12.24 hrs, Volume= 2.093 af
Outflow = 18.29 cfs @ 12.24 hrs, Volume= 2.093 af, Atten= 0%, Lag= 0.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.00 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.05 fps, Avg. Travel Time= 1.2 min

Peak Storage= 354 cf @ 12.24 hrs
Average Depth at Peak Storage= 0.46'
Bank-Full Depth= 2.00' Flow Area= 26.0 sf, Capacity= 240.09 cfs

9.00' x 2.00' deep channel, n= 0.024
Side Slope Z-value= 2.0 '/' Top Width= 17.00'
Length= 77.4' Slope= 0.0136 '/'
Inlet Invert= 526.65', Outlet Invert= 525.60'

‡

Summary for Reach 23R: Rerouting Ditch 1

Inflow Area = 1.380 ac, 0.00% Impervious, Inflow Depth = 5.92" for 100-Year event
Inflow = 6.87 cfs @ 12.23 hrs, Volume= 0.681 af
Outflow = 6.85 cfs @ 12.24 hrs, Volume= 0.681 af, Atten= 0%, Lag= 0.6 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.76 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 1.23 fps, Avg. Travel Time= 2.3 min

Peak Storage= 312 cf @ 12.24 hrs
Average Depth at Peak Storage= 0.58'
Bank-Full Depth= 1.00' Flow Area= 4.0 sf, Capacity= 20.18 cfs

2.00' x 1.00' deep channel, n= 0.025 Earth, clean & winding
Side Slope Z-value= 2.0 '/' Top Width= 6.00'
Length= 171.0' Slope= 0.0137 '/'
Inlet Invert= 536.00', Outlet Invert= 533.66'

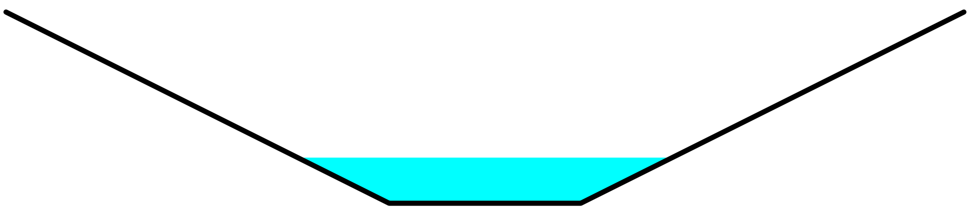
Summary for Reach 25R: Ditch

Inflow Area = 0.916 ac, 0.00% Impervious, Inflow Depth = 5.92" for 100-Year event
Inflow = 3.27 cfs @ 12.51 hrs, Volume= 0.452 af
Outflow = 3.26 cfs @ 12.52 hrs, Volume= 0.452 af, Atten= 0%, Lag= 0.7 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.31 fps, Min. Travel Time= 1.9 min
Avg. Velocity = 0.83 fps, Avg. Travel Time= 5.3 min

Peak Storage= 369 cf @ 12.52 hrs
Average Depth at Peak Storage= 0.48'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 60.53 cfs

2.00' x 2.00' deep channel, n= 0.025
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 262.2' Slope= 0.0064 '/'
Inlet Invert= 540.67', Outlet Invert= 539.00'



Summary for Reach 29R: Dry Swale - 2

Inflow Area = 1.259 ac, 71.41% Impervious, Inflow Depth = 7.58" for 100-Year event
Inflow = 8.43 cfs @ 12.10 hrs, Volume= 0.795 af
Outflow = 8.38 cfs @ 12.12 hrs, Volume= 0.795 af, Atten= 1%, Lag= 0.8 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.02 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 1.19 fps, Avg. Travel Time= 3.8 min

Peak Storage= 569 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.64'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 90.04 cfs

2.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 273.0' Slope= 0.0203 '/'
Inlet Invert= 553.62', Outlet Invert= 548.08'

Summary for Reach 30R: Rerouted Ditch below Culvert

Inflow Area = 2.247 ac, 0.00% Impervious, Inflow Depth = 5.92" for 100-Year event
Inflow = 11.33 cfs @ 12.22 hrs, Volume= 1.108 af
Outflow = 11.31 cfs @ 12.23 hrs, Volume= 1.108 af, Atten= 0%, Lag= 0.5 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.07 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.67 fps, Avg. Travel Time= 2.1 min

Peak Storage= 473 cf @ 12.23 hrs
Average Depth at Peak Storage= 0.67'
Bank-Full Depth= 1.00' Flow Area= 4.0 sf, Capacity= 25.17 cfs

2.00' x 1.00' deep channel, n= 0.013
Side Slope Z-value= 2.0 '/' Top Width= 6.00'
Length= 212.0' Slope= 0.0058 '/'
Inlet Invert= 533.54', Outlet Invert= 532.32'

Summary for Pond 2P: Forebay

Inflow Area = 16.859 ac, 98.41% Impervious, Inflow Depth = 6.30" for 100-Year event
Inflow = 36.64 cfs @ 12.10 hrs, Volume= 8.855 af
Outflow = 36.51 cfs @ 12.11 hrs, Volume= 8.851 af, Atten= 0%, Lag= 0.6 min
Primary = 5.22 cfs @ 10.36 hrs, Volume= 5.329 af
Secondary = 32.14 cfs @ 12.11 hrs, Volume= 3.522 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 561.00' Surf.Area= 3,802 sf Storage= 3,789 cf
Peak Elev= 565.30' @ 12.11 hrs Surf.Area= 5,835 sf Storage= 24,399 cf (20,611 cf above start)
Flood Elev= 568.00' Surf.Area= 7,249 sf Storage= 42,057 cf (38,268 cf above start)

Plug-Flow detention time= 59.5 min calculated for 8.764 af (99% of inflow)
Center-of-Mass det. time= 45.6 min (793.1 - 747.5)

Volume	Invert	Avail.Storage	Storage Description
#1	558.00'	49,579 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
558.00	2,536	269.1	0.0	0	0	2,536
559.00	2,944	279.8	40.0	1,095	1,095	3,078
560.00	3,366	290.5	40.0	1,261	2,356	3,641
561.00	3,802	301.2	40.0	1,433	3,789	4,225
562.00	4,252	312.0	100.0	4,025	7,814	4,835
563.00	4,716	322.7	100.0	4,482	12,296	5,462
564.00	5,194	333.4	100.0	4,953	17,249	6,110
565.00	5,687	344.1	100.0	5,439	22,687	6,779
566.00	6,193	354.8	100.0	5,938	28,626	7,469
567.00	6,714	365.5	100.0	6,452	35,077	8,180
568.00	7,249	376.2	100.0	6,980	42,057	8,912
569.00	7,798	386.9	100.0	7,522	49,579	9,666

Device	Routing	Invert	Outlet Devices
#1	Primary	558.00'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 558.00' / 558.00' S= 0.0000 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Secondary	565.00'	**60.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 3.0' Crest Height

Primary OutFlow Max=5.21 cfs @ 10.36 hrs HW=565.05' TW=562.00' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 5.21 cfs @ 6.64 fps)

Secondary OutFlow Max=32.11 cfs @ 12.11 hrs HW=565.30' TW=563.16' (Dynamic Tailwater)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 32.11 cfs @ 1.80 fps)

Summary for Pond 3P: Gravel Wetland

Inflow Area =	17.988 ac,	95.60% Impervious,	Inflow Depth = 6.37"	for 100-Year event
Inflow =	45.42 cfs @	12.09 hrs, Volume=	9.545 af	
Outflow =	37.40 cfs @	12.15 hrs, Volume=	9.521 af,	Atten= 18%, Lag= 3.2 min
Primary =	37.40 cfs @	12.15 hrs, Volume=	9.521 af	
Secondary =	0.00 cfs @	0.00 hrs, Volume=	0.000 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 561.00' Surf.Area= 22,959 sf Storage= 27,438 cf
Peak Elev= 563.86' @ 14.04 hrs Surf.Area= 25,785 sf Storage= 97,074 cf (69,635 cf above start)
Flood Elev= 568.00' Surf.Area= 30,084 sf Storage= 212,684 cf (185,246 cf above start)

Plug-Flow detention time= 236.4 min calculated for 8.889 af (93% of inflow)
Center-of-Mass det. time= 147.9 min (939.7 - 791.9)

Volume	Invert	Avail.Storage	Storage Description
#1	558.00'	243,305 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
558.00	22,771	626.2	0.0	0	0	22,771
559.00	22,834	626.9	40.0	9,121	9,121	23,401
560.00	22,897	627.7	40.0	9,146	18,267	24,034
561.00	22,959	628.5	40.0	9,171	27,438	24,667
562.00	23,935	639.2	100.0	23,445	50,884	25,919
563.00	24,924	649.9	100.0	24,428	75,312	27,192
564.00	25,928	660.6	100.0	25,424	100,736	28,486
565.00	26,947	671.3	100.0	26,436	127,172	29,801
566.00	27,978	682.1	100.0	27,461	154,633	31,146
567.00	29,024	692.8	100.0	28,499	183,132	32,504
568.00	30,084	703.5	100.0	29,552	212,684	33,883
569.00	31,161	714.3	100.0	30,621	243,305	35,293

Device	Routing	Invert	Outlet Devices
#1	Primary	558.00'	**36.0" Round Culvert** L= 20.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 558.00' / 558.00' S= 0.0000 '/' Cc= 0.900 n= 0.013, Flow Area= 7.07 sf
#2	Device 1	561.00'	**12.0" Vert. Orifice/Grate X 2.00** C= 0.600
#3	Device 2	558.00'	**12.0" Vert. Orifice/Grate** C= 0.600
#4	Device 1	562.50'	**60.0" x 30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 2	562.50'	**60.0" x 30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Secondary	564.00'	**100.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 5.0' Crest Height

Primary OutFlow Max=36.99 cfs @ 12.15 hrs HW=563.20' TW=562.02' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 36.99 cfs @ 5.23 fps)
  ├─**2=Orifice/Grate** (Passes < 8.22 cfs potential flow)
  │ ├─**3=Orifice/Grate** (Passes < 4.11 cfs potential flow)
  │ └─**5=Orifice/Grate** (Passes < 28.78 cfs potential flow)
  └─**4=Orifice/Grate** (Passes < 28.78 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=561.00' TW=558.00' (Dynamic Tailwater)
└─**6=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 4P: DP-1

Inflow Area = 19.937 ac, 92.58% Impervious, Inflow Depth > 8.28" for 100-Year event
Inflow = 151.85 cfs @ 12.10 hrs, Volume= 13.757 af
Outflow = 8.35 cfs @ 14.28 hrs, Volume= 13.009 af, Atten= 94%, Lag= 130.7 min
Primary = 8.35 cfs @ 14.28 hrs, Volume= 13.009 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 563.81' @ 14.28 hrs Surf.Area= 59,793 sf Storage= 311,569 cf
Flood Elev= 565.00' Surf.Area= 62,400 sf Storage= 384,495 cf

Plug-Flow detention time= 644.1 min calculated for 13.007 af (95% of inflow)

Center-of-Mass det. time= 588.4 min (1,466.1 - 877.8)

Volume	Invert	Avail.Storage	Storage Description
#1	558.00'	651,999 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
558.00	47,688	883.6	0	0	47,688
559.00	49,705	899.0	48,693	48,693	50,047
560.00	51,750	914.4	50,724	99,417	52,448
561.00	53,824	929.8	52,784	152,201	54,888
562.00	55,926	945.2	54,872	207,072	57,370
563.00	58,056	960.6	56,988	264,060	59,893
564.00	60,214	976.1	59,132	323,192	62,470
565.00	62,400	991.5	61,304	384,495	65,075
566.00	64,615	1,006.9	63,504	448,000	67,720
567.00	66,858	1,022.3	65,733	513,733	70,405
568.00	69,129	1,037.7	67,990	581,723	73,132
569.00	71,429	1,053.2	70,276	651,999	75,915

Device	Routing	Invert	Outlet Devices
#1	Primary	558.00'	**48.0" Round Culvert** L= 663.9' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 558.00' / 551.36' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 12.57 sf
#2	Device 1	558.00'	**9.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	562.50'	**12.0" Vert. Orifice/Grate** C= 0.600
#4	Secondary	568.00'	**45.0 deg x 100.0' long x 1.00' rise Sharp-Crested Vee/Trap Weir** Cv= 2.56 (C= 3.20)

Primary OutFlow Max=8.35 cfs @ 14.28 hrs HW=563.81' TW=558.29' (Dynamic Tailwater)
└─**1=Culvert** (Passes 8.35 cfs of 93.20 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 4.96 cfs @ 11.22 fps)
  └─**3=Orifice/Grate** (Orifice Controls 3.40 cfs @ 4.32 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=558.00' TW=0.00' (Dynamic Tailwater)
└─**4=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

Summary for Pond 13P: Det. Pond - 2

Inflow Area =	1.259 ac,	71.41% Impervious,	Inflow Depth = 7.58"	for 100-Year event	
Inflow =	8.38 cfs @	12.12 hrs,	Volume=	0.795 af	
Outflow =	6.51 cfs @	12.23 hrs,	Volume=	0.789 af,	Atten= 22%, Lag= 6.7 min
Primary =	6.51 cfs @	12.23 hrs,	Volume=	0.789 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 539.94' @ 12.23 hrs Surf.Area= 7,405 sf Storage= 12,016 cf
Flood Elev= 541.00' Surf.Area= 8,791 sf Storage= 20,626 cf

Plug-Flow detention time= 249.7 min calculated for 0.789 af (99% of inflow)
Center-of-Mass det. time= 244.2 min (1,023.9 - 779.7)

Volume	Invert	Avail.Storage	Storage Description
#1	538.00'	20,626 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
538.00	5,054	387.0	0	0	5,054
539.00	6,243	405.8	5,638	5,638	6,305
540.00	7,489	424.7	6,857	12,495	7,621
541.00	8,791	423.9	8,131	20,626	8,049

Device	Routing	Invert	Outlet Devices
#1	Primary	538.00'	**15.0" Round Culvert** L= 94.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 538.00' / 537.00' S= 0.0106 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	538.00'	**2.4" Vert. Orifice/Grate** C= 0.600
#3	Device 1	538.90'	**4.0" Vert. Orifice/Grate** C= 0.600
#4	Device 1	539.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=6.50 cfs @ 12.23 hrs HW=539.94' TW=534.02' (Dynamic Tailwater)
└─**1=Culvert** (Passes 6.50 cfs of 6.65 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.20 cfs @ 6.52 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 0.39 cfs @ 4.49 fps)
  └─**4=Orifice/Grate** (Weir Controls 5.91 cfs @ 2.16 fps)

Summary for Pond 15P: Culvert at Entr.

Inflow Area = 4.001 ac, 15.42% Impervious, Inflow Depth = 6.28" for 100-Year event
Inflow = 18.30 cfs @ 12.24 hrs, Volume= 2.093 af
Outflow = 18.29 cfs @ 12.24 hrs, Volume= 2.093 af, Atten= 0%, Lag= 0.0 min
Primary = 18.29 cfs @ 12.24 hrs, Volume= 2.093 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 530.33' @ 12.24 hrs Surf.Area= 351 sf Storage= 389 cf

Plug-Flow detention time= 0.4 min calculated for 2.093 af (100% of inflow)
Center-of-Mass det. time= 0.4 min (810.3 - 809.9)

Volume	Invert	Avail.Storage	Storage Description
#1	527.17'	1,407 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
527.17	6	14.0	0	0	6
528.00	44	35.0	18	18	90
529.00	121	58.1	79	98	268
530.00	266	92.9	189	286	693
531.00	555	117.6	402	688	1,120
532.00	897	157.4	719	1,407	2,001

Device	Routing	Invert	Outlet Devices
#1	Primary	527.17'	**18.0" Round Culvert X 2.00** L= 52.8' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 527.17' / 526.65' S= 0.0098 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	527.17'	**18.0" W x 3.0" H Vert. Orifice/Grate** C= 0.600
#3	Device 1	530.00'	**72.0" x 72.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=18.29 cfs @ 12.24 hrs HW=530.33' TW=527.11' (Dynamic Tailwater)
└─**1=Culvert** (Passes 18.29 cfs of 28.48 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 3.15 cfs @ 8.39 fps)
  └─**3=Orifice/Grate** (Weir Controls 15.14 cfs @ 1.89 fps)

Summary for Pond 17P: Box Culvert for stream

Inflow Area = 57.525 ac, 3.12% Impervious, Inflow Depth = 5.96" for 100-Year event
Inflow = 175.13 cfs @ 12.61 hrs, Volume= 28.547 af
Outflow = 174.13 cfs @ 12.64 hrs, Volume= 28.547 af, Atten= 1%, Lag= 1.8 min
Primary = 174.13 cfs @ 12.64 hrs, Volume= 28.547 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 534.93' @ 12.64 hrs Surf.Area= 11,204 sf Storage= 9,851 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.3 min (849.1 - 848.7)

Volume	Invert	Avail.Storage	Storage Description
#1	533.00'	25,714 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
533.00	412	159.8	0	0	412
534.00	5,210	513.7	2,362	2,362	19,382
535.00	11,714	795.5	8,245	10,608	48,748
536.00	18,774	996.6	15,106	25,714	77,441

Device	Routing	Invert	Outlet Devices
#1	Primary	532.20'	**144.0" W x 60.0" H Box Culvert** L= 51.5' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 532.20' / 530.66' S= 0.0299 '/' Cc= 0.900 n= 0.024, Flow Area= 60.00 sf

Primary OutFlow Max=174.11 cfs @ 12.64 hrs HW=534.93' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 174.11 cfs @ 5.31 fps)

Summary for Pond 18P: Level Spreader

Inflow Area = 19.937 ac, 92.58% Impervious, Inflow Depth > 7.83" for 100-Year event
Inflow = 8.35 cfs @ 14.28 hrs, Volume= 13.009 af
Outflow = 8.35 cfs @ 14.29 hrs, Volume= 13.008 af, Atten= 0%, Lag= 0.4 min
Primary = 8.35 cfs @ 14.29 hrs, Volume= 13.008 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 558.00' Surf.Area= 2,625 sf Storage= 7,350 cf
Peak Elev= 558.29' @ 14.29 hrs Surf.Area= 2,625 sf Storage= 7,650 cf (300 cf above start)

Plug-Flow detention time= 31.6 min calculated for 12.836 af (99% of inflow)
Center-of-Mass det. time= 0.6 min (1,466.7 - 1,466.1)

Volume	Invert	Avail.Storage	Storage Description
#1	551.00'	8,400 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 21,000 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
551.00	2,625	0	0
556.00	2,625	13,125	13,125
557.00	2,625	2,625	15,750
558.00	2,625	2,625	18,375
559.00	2,625	2,625	21,000

Device	Routing	Invert	Outlet Devices
#1	Primary	558.00'	**75.0" x 35.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=8.35 cfs @ 14.29 hrs HW=558.29' TW=558.10' (Dynamic Tailwater)
1=Orifice/Grate (Weir Controls 8.35 cfs @ 1.59 fps)

Summary for Pond 23P:

Inflow Area = 0.805 ac, 73.17% Impervious, Inflow Depth = 7.70" for 100-Year event
Inflow = 6.82 cfs @ 12.06 hrs, Volume= 0.516 af
Outflow = 6.73 cfs @ 12.08 hrs, Volume= 0.516 af, Atten= 1%, Lag= 0.7 min
Primary = 0.23 cfs @ 12.05 hrs, Volume= 0.231 af
Secondary = 6.50 cfs @ 12.08 hrs, Volume= 0.285 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 532.00' @ 12.08 hrs Surf.Area= 1,038 sf Storage= 782 cf

Plug-Flow detention time= 11.1 min calculated for 0.516 af (100% of inflow)
Center-of-Mass det. time= 11.1 min (783.7 - 772.6)

Volume	Invert	Avail.Storage	Storage Description
#1	530.19'	789 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
530.19	56	110.4	0	0	56
531.00	317	180.9	137	137	1,695
532.01	1,044	364.9	652	789	9,691

Device	Routing	Invert	Outlet Devices
#1	Primary	530.19'	**3.0" Round Culvert** L= 17.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 530.19' / 530.00' S= 0.0110 '/' Cc= 0.900 n= 0.013, Flow Area= 0.05 sf
#2	Secondary	531.60'	**30.0 deg x 7.7' long x 0.40' rise Sharp-Crested Vee/Trap Weir** Cv= 2.61 (C= 3.26)

Primary OutFlow Max=0.23 cfs @ 12.05 hrs HW=531.99' TW=530.27' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 0.23 cfs @ 4.73 fps)

Secondary OutFlow Max=6.49 cfs @ 12.08 hrs HW=532.00' TW=530.29' (Dynamic Tailwater)
└─**2=Sharp-Crested Vee/Trap Weir** (Orifice Controls 6.49 cfs @ 2.08 fps)

Summary for Pond 24P: Flow Splitter

Inflow Area = 16.505 ac,100.00% Impervious, Inflow Depth = 8.46" for 100-Year event
Inflow = 134.52 cfs @ 12.10 hrs, Volume= 11.636 af
Outflow = 134.52 cfs @ 12.10 hrs, Volume= 11.636 af, Atten= 0%, Lag= 0.0 min
Primary = 33.99 cfs @ 12.10 hrs, Volume= 8.656 af
Secondary = 100.53 cfs @ 12.10 hrs, Volume= 2.980 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 570.34' @ 12.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	562.96'	**24.0" Round Culvert** L= 44.7' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 562.96' / 562.00' S= 0.0215 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Secondary	562.96'	**48.0" Round Culvert** L= 106.2' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 562.96' / 562.43' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 12.57 sf
#3	Device 2	565.70'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=33.98 cfs @ 12.10 hrs HW=570.34' TW=565.30' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 33.98 cfs @ 10.82 fps)

Secondary OutFlow Max=100.46 cfs @ 12.10 hrs HW=570.34' TW=561.61' (Dynamic Tailwater)
└─**2=Culvert** (Passes 100.46 cfs of 140.16 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 100.46 cfs @ 7.05 fps)

Summary for Pond 28P: Ramp Culvert

Inflow Area = 0.918 ac, 72.44% Impervious, Inflow Depth = 7.62" for 100-Year event
Inflow = 6.75 cfs @ 12.12 hrs, Volume= 0.583 af
Outflow = 6.71 cfs @ 12.13 hrs, Volume= 0.582 af, Atten= 0%, Lag= 0.6 min
Primary = 6.71 cfs @ 12.13 hrs, Volume= 0.582 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 556.03' @ 12.13 hrs Surf.Area= 350 sf Storage= 196 cf
Flood Elev= 557.00' Surf.Area= 534 sf Storage= 342 cf

Plug-Flow detention time= 1.2 min calculated for 0.582 af (100% of inflow)
Center-of-Mass det. time= 0.9 min (780.0 - 779.1)

Volume	Invert	Avail.Storage	Storage Description
#1	554.61'	342 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
554.61	4	8.0	0	0	4
555.00	56	45.8	10	10	166
556.00	337	150.1	177	187	1,795
556.36	534	184.0	155	342	2,698

Device	Routing	Invert	Outlet Devices
#1	Primary	555.00'	**23.0" W x 14.0" H, R=22.0" Elliptical RCP_Elliptical 23x14** L= 30.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 555.00' / 553.62' S= 0.0460 '/' Cc= 0.900 n= 0.013, Flow Area= 1.83 sf

Primary OutFlow Max=6.71 cfs @ 12.13 hrs HW=556.03' TW=554.25' (Dynamic Tailwater)
└─**1=RCP_Elliptical 23x14** (Inlet Controls 6.71 cfs @ 3.96 fps)

Summary for Pond 30P: Culvert 2

Inflow Area = 1.380 ac, 0.00% Impervious, Inflow Depth = 5.92" for 100-Year event
Inflow = 6.85 cfs @ 12.24 hrs, Volume= 0.681 af
Outflow = 6.85 cfs @ 12.24 hrs, Volume= 0.681 af, Atten= 0%, Lag= 0.0 min
Primary = 6.85 cfs @ 12.24 hrs, Volume= 0.681 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 535.14' @ 12.24 hrs
Flood Elev= 534.87'

Device	Routing	Invert	Outlet Devices
#1	Primary	533.66'	**23.0" W x 14.0" H, R=22.0" Elliptical RCP_Elliptical 23x14** L= 24.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 533.66' / 533.54' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 1.83 sf

Primary OutFlow Max=6.85 cfs @ 12.24 hrs HW=535.14' TW=534.21' (Dynamic Tailwater)
└─**1=RCP_Elliptical 23x14** (Inlet Controls 6.85 cfs @ 3.75 fps)

Summary for Pond 31P: Culvert 3

Inflow Area = 0.544 ac, 73.53% Impervious, Inflow Depth = 7.74" for 100-Year event
Inflow = 4.65 cfs @ 12.06 hrs, Volume= 0.351 af
Outflow = 4.65 cfs @ 12.06 hrs, Volume= 0.351 af, Atten= 0%, Lag= 0.0 min
Primary = 4.65 cfs @ 12.06 hrs, Volume= 0.351 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 534.01' @ 12.06 hrs
Flood Elev= 538.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	533.00'	**23.0" W x 14.0" H, R=22.0" Elliptical RCP_Elliptical 23x14** L= 24.0' RCP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 533.00' / 532.35' S= 0.0271 '/' Cc= 0.900 n= 0.013, Flow Area= 1.83 sf

Primary OutFlow Max=4.65 cfs @ 12.06 hrs HW=534.01' TW=533.02' (Dynamic Tailwater)
└─**1=RCP_Elliptical 23x14** (Inlet Controls 4.65 cfs @ 2.77 fps)

Summary for Link 21L: Point A

Inflow Area = 27.710 ac, 66.61% Impervious, Inflow Depth > 7.29" for 100-Year event
Inflow = 40.42 cfs @ 12.29 hrs, Volume= 16.840 af
Primary = 40.42 cfs @ 12.29 hrs, Volume= 16.840 af, Atten= 0%, Lag= 0.0 min

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

Summary for Link 22L: Point B

Inflow Area = 57.525 ac, 3.12% Impervious, Inflow Depth = 5.96" for 100-Year event
Inflow = 174.13 cfs @ 12.64 hrs, Volume= 28.547 af
Primary = 174.13 cfs @ 12.64 hrs, Volume= 28.547 af, Atten= 0%, Lag= 0.0 min

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

Summary for Link 28L: Point F

Inflow Area = 5.040 ac, 0.00% Impervious, Inflow Depth = 5.92" for 100-Year event
Inflow = 16.28 cfs @ 12.57 hrs, Volume= 2.486 af
Primary = 16.28 cfs @ 12.57 hrs, Volume= 2.486 af, Atten= 0%, Lag= 0.0 min

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

Summary for Link 29L: Point E

Inflow Area =	468.979 ac,	4.45% Impervious,	Inflow Depth > 6.01"	for 100-Year event
Inflow =	279.40 cfs @	17.71 hrs, Volume=	234.824 af	
Primary =	279.40 cfs @	17.71 hrs, Volume=	234.824 af,	Atten= 0%, Lag= 0.0 min

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

Appendix D – Operation and Maintenance Plan & MSGP NOI

11 Stanwix Street | Suite 800 | Pittsburgh, PA 15222
T 412.497.6000

Operation and Maintenance

For

Clear River Energy Center

Town of Burrillville
Providence County, Rhode Island

PREPARED FOR:
Invenergy Thermal Development LLC
Chicago, IL 60606

PREPARED BY:
HDR Engineering, Inc.
Pittsburgh, PA 15222

SUBMITTED TO:
Rhode Island Department of Environmental Management
Office of Water Resources
235 Promenade Street, Room 260
Providence, Rhode Island 02908

HDR Project No. 10021318

March 2017

Contents

11 Stanwix Street | Suite 800 | Pittsburgh, PA 15222
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1.1 Introduction

An essential component of a successful stormwater system is the ongoing operation and maintenance of the various components of the stormwater drainage, control, and conveyance systems. Failure to provide effective maintenance can reduce the hydraulic capacity and the pollutant removal efficiency of stormwater practices.

The operation and maintenance (O&M) program discussed in this plan is intended to address O&M concerns proactively. On going maintenance is a vital part of ensuring the operational success of stormwater management facilities and is critical to achieving an extended service life of continuous operation as designed.

1.2 Responsible Party for Maintenance

Name:	John Niland, PE
	Invenergy Thermal Development LLC.
Address:	One South Wacker Drive, Suite 1800
	Chicago, IL 60606
Phone Number:	781-424-3223
Email:	jniland@invenergyllc.com

1.3 Potential Pollutants and Sources

1.3.1 Ultra Low Sulfur Distillate Oil

Fuel oil is stored in a 2,000,000 gallon storage tank. Both the tank and the fuel oil forwarding pumps will be located outdoors but within contained areas that allow controlled release of wastewater from these areas or containment of oil spills.

1.3.2 Aqueous Ammonia (19%)

Aqueous ammonia for use in the selective catalytic reduction system is stored in a 27,000 gallon tank. Both the tank and the ammonia forwarding pumps are located outdoors within a contained area that collects storm water and ammonia spills allows controlled release of clean storm water from this area or containment of accidental spills of the chemical.

1.3.3 Glycol Anti-freeze

Glycol is used as an anti-freeze in the closed cycle cooling water system and is delivered and stored in drums. Drums will be stored indoors in a curbed area to collect accidental spills.

1.3.4 Aqueous Ammonia

Aqueous ammonia for steam cycle water treatment is stored indoors in totes in a curbed containment area in the steam turbine building. The containment allows collection of any accidental spills of the chemical. Totes sizes range from 200 to 400 gallons. The concentration of the aqueous ammonia will be determined during detailed design of the system.

1.3.5 Corrosion Inhibitor

Corrosion inhibitors may be added added to the recirculated waters of the combustion turbine evaporators. These chemicals would be stored indoors in totes located in a curbed area of the water treatment building. The curbed area allows containment of spills of the chemical. Totes sizes are typically 200 to 400 gallons.

1.3.6 Sodium Hypochlorite (12.5%)

Sodium hypochlorite will be used to treat potable water. The chemical will be stored indoors in totes or a bulk storage tank located in a curbed area in the water treatment building. The curbed area allows containment of spills of the chemical. Totes sizes are typically 200 to 400 gallons. The volume of the optional bulk storage tank would be determined during detailed design.

1.4 General Maintenance

The following general maintenance task will be performed on a as-needed basis:

- Trash racks will be inspected and cleaned of any derbies.
- Trash and recycling receptacles will be collected on a regular basis.
- Roads and parking lots will be swept on an as-needed basis (at least annually). Debris must be disposed of in accordance with the appropriate practice and applicable regulatory standards. Appendix A of the *Rules and Regulations for Composting Facilities and Solid Waste Management Facilities,* which is entitled “Management of Street Sweepings in Rhode Island,” should be reviewed. For further information, contact the DEM Office of Waste Management.
- Deicing of the roads and parking lot will the contracted out so no salt will be stored on site.
- Calcium chloride will be used for deicing when needed.
- Emergency snow will be stored under the condensers. See BMP Locations Map at the end of this report.
- Asphalt based sealants will be used on the Driveway and Parking Lot.
- There is an onsite wastewater treatment system (OWTSs) on the project site. Invenergy will perform regular inspections in accordance with the procedures of *Septic System Checkup: The Rhode Island Manual for Inspections.*

1.5 Fuel Oil Containment Berm –Storm Water Management

An oil water separator (OWS) will be installed at the facility to process oily wastewater. The OWS will be utilized to separate oily residue from wastewater for off-site disposal. The treated wastewater discharged from the OWS will have oil content less than 10 mg/L.

The fuel oil storage tank will be contained in a bermed area to contain accidental or catastrophic spill of oil. Storm water collected in this berm will be contained with normally closed drain valves for controlled release to the OWS. After a rainstorm, these areas shall be checked for a major oil leak. If there is not a large quantity of oil that exceeds the spill capacity of the OWS mixed with the rainwater, the drain valve shall be opened and the wastewater released to the OWS. In the event of a major oil spill, the oil can be cleaned up locally or with multiple controlled releases to the OWS so as not to exceed the emergency spill capacity of the OWS.

1.6 Annual Maintenance Tasks and Post Storm Event Inspection

The following text describes required annual maintenance tasks for the gravel WVTS and dry swale. These are the only two types of post-construction BMPs at the project site.

No pesticides or fertilizers will be applied to vegetation in the proposed BMPs..

Inspections, per the Rhode Island Stormwater Design and Installation Manual, will be performed annually and approximately 48 hours after a major storm event. For the purposes of this plan, major storm events are considered to be 1-year, 24-hour Type III precipitation event (i.e., storm events that generate 2.7 inches of rain or more per RISDISM).

1.6.1 Gravel Wet Vegetated Treatment System

The maintenance objectives for these practices include preserving the hydraulic function and removal efficiency of the WVTS and maintaining structural integrity. The slopes of the basin or WVTS should be inspected for erosion and gullying. Reinforce existing riprap if riprap is found to be deficient, erosion is present at the outfalls of any control structures, or the existing riprap has been compromised. All structural components, which include, but are not limited to, trash racks, access gates, valves, pipes, weir walls, orifice structures, and spillway structures, should be inspected and any deficiencies should be reported. This includes a visual inspection of all stormwater control structures for damage and/or accumulation of sediment. Sediment should be removed from the forebay when design depth has been reduced by 50%. All material, including any trash and/or debris from all areas within the extents of the WVTS area including trash rack and flow control structures, should be disposed of in accordance with all federal and local regulations.

Any areas within the extents of the stormwater facility that are subject to erosion or gullying should be replenished with the original design material and re-vegetated according to design drawings. Slope protection material should be placed in areas prone to erosion. Embankment stability should be inspected for seepage and burrowing animals.

Mow the grass around the perimeter of the WVTS at least 4 times annually. Vegetation along the maintenance access roads should be mowed annually. Prune all dead or dying vegetation within the extents of the WVTS, remove all herbaceous vegetation root stock when overcrowding the maintenance access to the facility, remove any vegetation that has a negative impact on stormwater flowage through the facility, and trim any overgrown vegetation within the basin. Any invasive vegetation encroaching upon the perimeter of the facility should be pruned or removed if it is prohibiting access to the facility, compromising sight visibility and/or compromising original design vegetation. Replace any/all original vegetation that has died off or has not fully established, as determined at the time of the inspection. WVTS vegetation should be reinforced to its original design standards if less than 50% of the original vegetation is established after two years.

The inspection forms from RISDISM, located at the end of the this O&M Manual, are to be used to document inspections of the BMPs. Completed forms are to be maintained as part of this document for the time period specified in the project's RIPDES permit.

1.6.2 Dry Swales (Conveyance and Treatment Swales)

Inspect dry swales on an annual basis and after storms of greater than or equal to the 1-year, 24-hour Type III precipitation event. Both the structural and vegetative components should be inspected and repaired. When sediment accumulates to a depth of approximately 3 inches, it should be removed, and the swale should be reconfigured to its original dimensions.

The vegetation in the dry swale should be mowed as required to maintain heights in the 4-6 inch range, with mandatory mowing once heights exceed 10 inches. At a minimum, each swale should be mowed at least once per year.

If the surface of the dry swale becomes clogged to the point that standing water is observed on the surface 48 hours after precipitation events, the bottom should be roto-tilled or cultivated to break up any hard-packed sediment, and then reseeded. Trash and debris should be removed and properly disposed of.

Check dams should be inspected annually or after major storm events for evidence of flow going around the check dams, evidence of erosion, or accumulated sediments and repaired as necessary.

The Open Channel & Dry Swale inspection form at the end of this O&M Manual is to be used to document inspections of the swales. Completed forms are to be maintained as part of this document for the time period specified in the project's RIPDES permit.

1.7 Inspections

1.7.1 Quarterly Routine Facility Inspections

Invenergy will conduct routine facility inspections quarterly throughout the year.

Routine facility inspections will include all areas where industrial materials or activities are exposed to storm water and all storm water control measures used to comply with permit requirements. At least once each calendar year, a routine facility inspection will be conducted during a period when storm water discharge is occurring.

1.7.2 Annual Comprehensive Site Inspection

Invenergy will conduct a comprehensive site inspection annually.

Personnel Responsible: At least one member of the Environmental Department (Environmental Director, Environmental Engineer, ISO 14001 Specialist)

Invenergy's annual comprehensive site inspection will include all areas where industrial materials or activities are exposed to storm water and areas where spills and leaks have occurred within the past 3 years. Inspector(s) will look for:

- Industrial materials, residue or trash on the ground that could contaminate or be washed away in storm water
- Leaks or spills from industrial equipment, drums, barrels, tanks or similar containers
- Offsite tracking of industrial materials or sediment where vehicles enter or exit the site
- Tracking or blowing of raw, final, or waste materials from areas of no

exposure to exposed areas
- Control measures needing replacement, maintenance, or repair

Results of previous visual and analytical monitoring will be taken into consideration during the evaluation. Based on the results of the annual evaluation, Invenergy will modify this Plan as necessary.

A report documenting each Comprehensive Site Inspection will include:

- The date of the inspection
- The name(s) and title(s) of the personnel making the inspection
- Findings from the examination and inspection of the site
- Major observations relating to implementation of the Plan
- Description of incidents of noncompliance or, if there, are no such incidents, a ce1tification that the facility is in compliance with the Plan and General Permit
- A discussion of any non-compliance situations observed and the response/action(s) needed (If no situations of non-compliance are observed, a statement certifying that the facility is in compliance with the General Permit will be included)
- Identification of the changes required in the Plan as a result of the site compliance evaluation Means to track implementation of required actions (e.g., via independent log or through monthly inspections)
- A statement, signed and ce1tified in accordance with Part X.G of the Multi-Sector General Permit for Storm Water Discharge Associated with Industrial Activity

Corrective actions identified during an inspection will be documented. Invenergy will submit an annual report to the Department of Environmental Management including the findings from the annual comprehensive site inspection and any corrective action documentation. Invenergy will submit the annual report for each calendar year no later than February 15th.

1.7.3 Corrective Action Plan

If any of the following conditions occur, Invenergy will be required to conduct corrective action. Invenergy will submit corrective action documentation in an annual report to the Department of Environmental Management.

- Invenergy finds during the routine facility inspection, quarterly visual assessment, or comprehensive site inspection that the control measures Invenergy has implemented (such as procedures, practices, or structures put in place to prevent or reduce the discharge of pollutants to the waters of the state; storm water and otherwise) are not being properly operated and maintained.

- An unauthorized release or discharge occurs (e.g. spill, leak, or discharge of non-storm water not authorized by the Multi-Sector General Permit or other RIPDES permit)
- An inspection or evaluation of the facility by an EPA official, State, or local entity determines that modifications to the control measures are necessary to meet storm water limitations in the Multi-Sector General Permit
- It is determined (by Invenergy or the Director of the Department of Environmental Management) that the control measures are not stringent enough for Invenergy's storm water discharges to meet applicable water quality standards

Within 24 hours of a corrective action, Invenergy will document the following information:

- Invenergy Identification of the condition triggering the need for corrective action review
- Description of the problem identified
- Date the problem was identified

Within 14 days of a corrective action, Invenergy will document the following

Information:

- Summary of the corrective action taken or to be taken
- Notice of whether Storm Water Management Plan modifications are required as a result of this discovery or corrective action
- Date corrective action initiated
- Date corrective action completed or expected to be completed

1.7.4 Annual Reporting

Invenergy will submit an annual report to the Department of Environmental Management including the findings from the annual comprehensive site inspection and any corrective action documentation. Invenergy will submit the annual report for each calendar year no later than February 15th. If corrective action is not yet completed at the time of submission, Invenergy will include the status of any outstanding corrective action(s) with the annual report.

The annual report will include the following information:

- Facility Name
- RIPDES permit number
- Facility physical address
- Contact person, name, title, and phone number

1.8 Easements

Easements for construction and maintenance of the proposed power plant have been obtained from underlying property owners. No maintenance easements are needed.

1.9 Source of Ongoing Funding for Maintenance

The project will be operated by Clear River Energy LLC. Funding for BMP operation and maintenance will be a line item in the overall plant operations budget. Project operations will be funded through revenue from the electric generation.

1.10 Minimum Vegetative Cover Requirements

Lawns are a significant feature of urban landscapes. Estimates of turf and lawn coverage in the United States are as high as 30 million acres, which, if lawns were classified as a crop, would rank as the fifth largest in the country after corn, soybeans, wheat, and hay (Swann and Schueler, 2000). This large area of managed landscape has the potential to contribute to urban runoff pollution due to over fertilization, overwatering, over application of pesticides, and direct disposal of lawn clippings, leaves, and trimmings. Also, erosion from bare patches of poorly managed lawns contribute sediment to watercourses, and disposal of lawn clippings in landfills can reduce the capacity of these facilities to handle other types of waste.

1.10.1 Lawn conversion

Grasses require more water and attention than alternative groundcovers, flowers, shrubs, or trees. Alternatives to turf are especially recommended for problem areas such as lawn edges, frost pockets, shady spots, steep slopes, and soggy areas. Vegetation that is best suited to the local conditions should be selected.

1.10.2 Soil building

Grounds operation and maintenance should incorporate soil evaluation every 1 to 3 years to determine suitability for supporting a lawn, and to determine how to optimize growing conditions. Consider testing soil characteristics such as pH, fertility, compaction, texture, and earthworm content.

1.8.3 Grass selection

Grass seed is available in a wide range of cultivated varieties, so homeowners, landscapers, and grounds managers are able to choose the grass type that grows well in their particular climate, matches site conditions, and is consistent with the property owner's desired level of maintenance. When choosing ground cover, consideration should be given to seasonal variations in rainfall and temperature. Table G-3 lists turfgrass types and their level of tolerance to drought:

Table G-3 Drought Tolerance of Turfgrass Types

Turfgrass Type	Drought Tolerance
Fine-leaved Fescues	High
Tall Fescue	↓
Kentucky Bluegrass	
Perennial Ryegrass	
Bentgrasses	Low

1.8.4 Mowing and thatch management

To prevent insects and weed problems, property owners should mow high, mow frequently, and keep mower blades sharp. Lawns should not be cut shorter than 2 to 3 inches, because weeds can grow more easily in short grasses. Grass can be cut lower in the spring and fall to stimulate root growth, but not shorter than 1 ½ inches.

1.8.5 Fertilization

If fertilizing is desired, consider the following points:

- Most lawns require little or no fertilizer to remain healthy. Fertilize no more than twice a year - once in May-June, and once in September-October;
- Fertilizers are rated on their labeling by three numers (e.g., 10-10-10 or 12-4-8), which refer to their Nitrogen (N) – Phosphorus (P) – Potassium (K) concentrations. Fertilize at a rate of no more than ½ pound of nitrogen per 1000 square feet, which can be determined by dividing 50 by the percentage of nitrogen in the fertilizer;
- Apply fertilizer carefully to avoid spreading on impervious surfaces such as paved walkways, patios, driveways, etc., where the nutrient can be easily washed into stormdrains or directly into surface waters;
- To encourage more complete uptake, use slow-release fertilizers that is those that contain 50 percent or more water-insoluble nitrogen (WIN);
- Grass blades retain 30-40 percent of nutrients applied in fertilizers. Reduce fertilizer applications by 30 percent, or eliminate the spring application of fertilizer and leave clippings on the lawn where they will degrade and release stored nutrients back to the soil; and
- Fertilizer should not be applied when rain is expected. Not only does the rain decrease fertilizer effectiveness, it also increases the risk of surface and ground water contamination.

1.8.6 Weed management

A property owner must decide how many weeds can be tolerated before action is taken to eradicate them. To the extent practicable, weeds should be dug or pulled out. If patches of weeds are present, they can be covered for a few days with a black plastic sheet; a technique called solarization. Solarization kills the weeds while leaving the grass intact. If weeds blanket a large enough area, the patch can be covered with clear plastic for several weeks, effectively “cooking” the weeds and their seeds. The bare area left behind after weeding should be reseeded to prevent weeds from growing back. As a last resort, homeowners can use chemical herbicides to spot-treat weeds.

1.8.7 Pest management

Effective pest management begins with maintenance of a healthy, vigorous lawn that is naturally disease resistant. Property owners should monitor plants for obvious damage and check for the presence of pest organisms. Learn to distinguish beneficial insects and arachnids, such as green lacewings, ladybugs, and most spiders, from ones that will damage plants.

When damage is detected or when harmful organisms are present, property owners should determine the level of damage the plant is able to tolerate. No action should be taken if the plant can maintain growth and fertility. If controls are needed, there are a variety of low-impact pest management controls and practices to choose from, including the following:

- Visible insects can be removed by hand (with gloves or tweezers) and placed in soapy water or vegetable oil. Alternatively, insects can be sprayed off a plant with water, or in some cases vacuumed off of larger plants;
- Store-bought traps, such as species-specific, pheromone-based traps or colored sticky cards, can be used;
- Sprinkling the ground surface with abrasive diatomaceous earth can prevent infestations by soft-bodied insects and slugs. Slugs can also be trapped by falling or crawling into small cups set in the ground flush with the surface and filled with beer;
- In cases where microscopic parasites, such as bacteria and fungi, are causing damage to plants, the affected plant material can be removed and disposed of. (Pruning equipment should be disinfected with bleach to prevent spreading the disease organism);
- Small mammals and birds can be excluded using fences, netting, tree trunk guards, and, as a last resort, trapping. (In some areas trapping is illegal. Property owners should check local codes if this type of action is desired); and
- Property owners can encourage/attract beneficial organisms, such as bats, birds, green lacewings, ladybugs, praying mantis, ground beetles, parasitic nematodes, trichogramma wasps, seedhead weevils, and spiders that prey on detrimental pest species. These desirable organisms can be introduced directly or can be attracted to the area by providing food and/or habitat.

If chemical pesticides are used, property owners should try to select the least toxic, water soluble, and volatile pesticides possible. All selected pesticides should be screened for their potential to harm water resources. Although organophosphate pesticides, such as diazinon and chlorpyrifos, are popular because they target a broad range of pests and are less expensive than newer, less toxic pesticides, they rank among the worst killers of wildlife, and often pose the greatest health risk. Synthetic pyrethroids are more selective, and typically much less toxic than organophosphates, yet they can harm beneficial insects. When possible, pesticides that pose the least risk to human health and the environment should be chosen. A list of popular pesticides, along with their uses, their toxicity to humans and wildlife, EPA's toxicity rating, and alternatives to the listed chemicals, is available from *The Audubon Guide to Home Pesticides*, (http://www.audubon.org/bird/pesticides/).

1.8.8 Sensible irrigation

Most New England lawns will survive without irrigation. Grasses will normally go dormant in warm, dry periods (June-September) and resume growth when moister is more plentiful. However, if watering is desired, consider the following points:

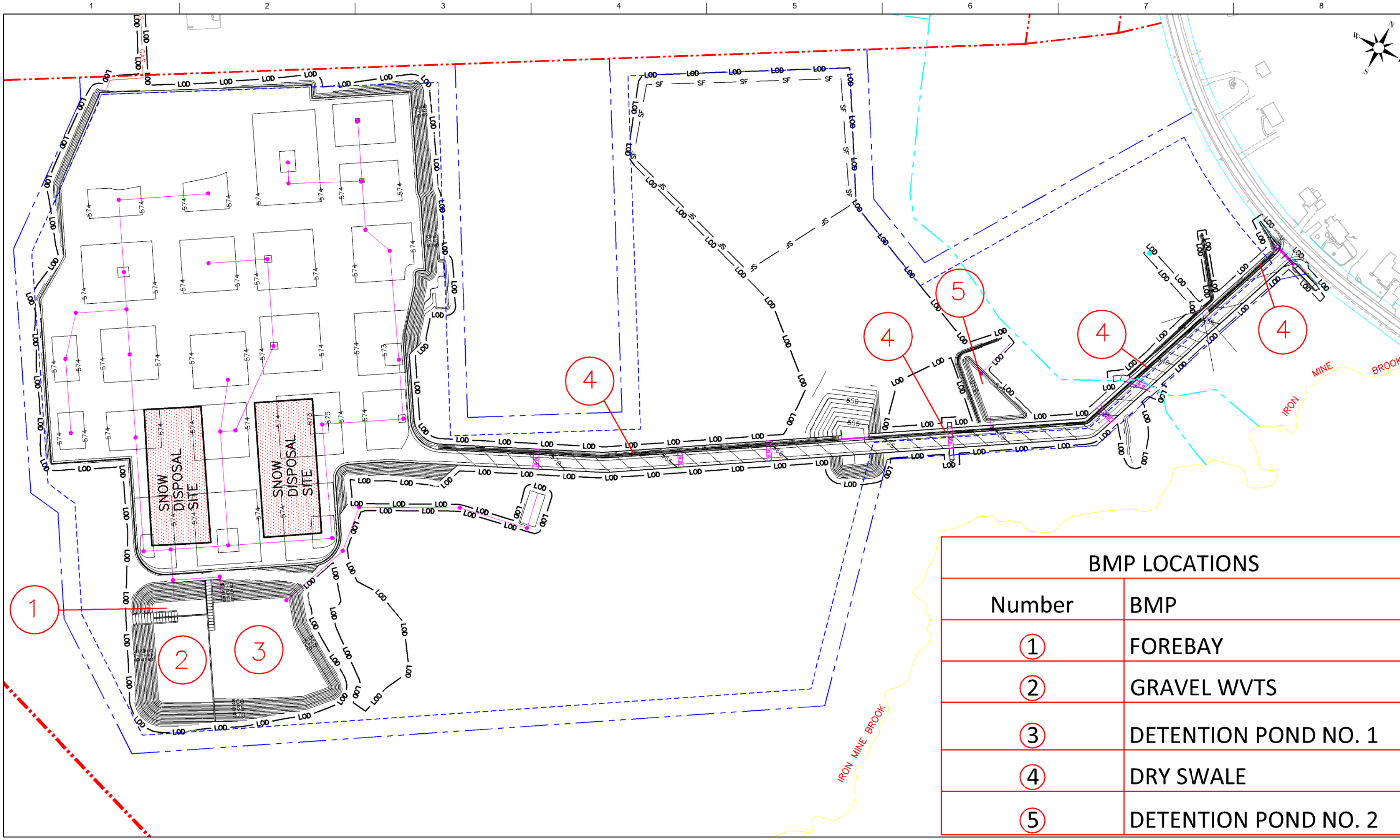
Established lawns need no more than one inch of water per week (including precipitation) to prevent dormancy in dry periods. Watering at this rate should wet soil to approximately 4-6 inches and will encourage analogous root growth. If possible, use timers to water before 9:00 a.m., preferably in the early morning to avoid evaporative loss. Use drought-resistant grasses (see “grass selection” above) and cut grass at 2-3 inches to encourage deeper rooting and heartier lawns.

1.11 Access and Safety

Gravel WVTS and the dry swale are accessible from the project’s access road and power plant site area. Long-term access to the project will be from Wallum Lake Road. Due to the location and nature of these BMPs, no access or safety issues are anticipated.

BMP Locations

11 Stanwix Street | Suite 800 | Pittsburgh, PA 15222
T 412.497.6000



BMP LOCATIONS	
Number	BMP
1	FOREBAY
2	GRAVEL WVTS
3	DETENTION POND NO. 1
4	DRY SWALE
5	DETENTION POND NO. 2

HDR

ISSUE	DATE	DESCRIPTION
3	3/27/2017	REVISION
2	2/17/2017	REVISION
1	8/17/2016	SOIL EROSION SEDIMENT CONTROL PLAN

PROJECT MANAGER: C. JACOBS
PROJECT NUMBER: 10021318

CLEAR RIVER ENERGY LLC
CLEAR RIVER ENERGY CENTER
WALLUM LAKE ROAD LOT NO.
135-002, 137-002, 137-003, 137-021,
153-001, 153-002
TOWN OF BURRILLVILLE,
PROVIDENCE COUNTY, RHODE ISLAND

BMP LOCATIONS

FILENAME: EXHIBIT_1.dwg
SCALE: NTS

SHEET
EXHIBIT 1

Forms

11 Stanwix Street | Suite 800 | Pittsburgh, PA 15222
T 412.497.6000

Open Channel & Dry Swale Operation, Maintenance, and Management Inspection Checklist

Project ____

Location: ____

Site Status: ____

Date: ____

Time: ____

Inspector: ____

Maintenance Item	Satisfactory/ Unsatisfactory	Comments
A Debris Cleanout	**(Annual, After Major Storms)**	
Contributing areas clean of debris		
B Check Dams or Energy Dissipators	**(Annual, After Major Storms)**	
No evidence of flow going around structures		
No evidence of erosion at downstream toe		
Soil permeability		
Groundwater / bedrock		
C Vegetation	**(Annual, After Major Storms)**	
Mowing done when needed		
Minimum mowing depth not exceeded		
No evidence of erosion		
Fertilized per specification		
D Dewatering	**(Annual, After Major Storms)**	
Dewaters between storms		
5. Sediment deposition	**(Annual, After Major Storms)**	
Clean of sediment		
6. Outlet/Overflow Spillway	**(Annual, After Major Storms)**	
Good condition, no need for repairs		
No evidence of erosion		

Maintenance Item	Satisfactory/ Unsatisfactory	Comments

Comments:

Actions to be Taken:

Stormwater Basin/WVTS Operation,
Maintenance, and Management Inspection Checklist

Project ______________________________

Location: ______________________________

Site Status: ______________________________

Date: ______________________________

Time: ______________________________

Inspector: ______________________________

Maintenance Item	Satisfactory/ Unsatisfactory	Comments
A. Embankment and emergency spillway	**(Annual, After Major Storms)**	
1. Vegetation and ground cover adequate		
2. Embankment erosion		
3. Animal burrows		
4. Unauthorized planting		
5. Cracking, bulging, or sliding of dam		
a. Upstream face		
b. Downstream face		
c. At or beyond toe		
downstream		
upstream		
d. Emergency spillway		
6. Basin, toe & chimney drains clear and functioning		
7. Seeps/leaks on downstream face		
8. Slope protection or riprap failure		
9. Vertical/horizontal alignment of top of dam “As-Built”		
10. Emergency spillway clear of obstructions and debris		
B Riser and principal spillway	**(Annual, After Major Storms)**	
Type: Reinforced concrete ____ Corrugated Pipe ____ Masonry ____ 1. Low-flow orifice obstructed		

Maintenance Item	Satisfactory/ Unsatisfactory	Comments
2. Low-flow trash rack. a. Debris removal necessary		
b. Corrosion control		
3. Weir trash rack maintenance a. Debris removal necessary		
b. corrosion control		
4. Excessive sediment accumulation inside riser		
5. Concrete/masonry condition riser and barrels a. cracks or displacement		
b. Minor spalling (<1")		
c. Major spalling (rebars exposed)		
d. Joint failures		
e. Water tightness		
6. Metal pipe condition		
7. Control valve a. Operational/exercised		
b. Chained and locked		
8. Basin drain valve a. Operational/exercised		
b. Chained and locked		
9. Outfall channels functioning		
C Permanent Pool (WVTS/Wet Basins)	**(Semi-annually)**	
1. Undesirable vegetative growth		
2. Floating or floatable debris removal required		
3. Visible pollution		
4. Shoreline problem		
5. Other (specify)		
D Sediment Forebays	**(Semi-annually)**	
1. Sedimentation noted		
2. Sediment cleanout when depth < 50% design depth		
E Dry Basin Areas	**(Annual, After Major Storms)**	
1. Vegetation adequate		
2. Undesirable vegetative growth		

Maintenance Item	Satisfactory/ Unsatisfactory	Comments
3. Undesirable woody vegetation		
4. Low-flow channels clear of obstructions		
5. Standing water or wet spots		
6. Sediment and/or trash accumulation		
F Condition of Outfalls	**(Annual , After Major Storms)**	
1. Riprap failures		
2. Slope erosion		
3. Storm drain pipes		
4.Endwalls / Headwalls		
5. Other (specify)		
G Other	**(Semi-annually)**	
1. Encroachment on basin, WVTS or easement area		
2. Complaints from residents		
3. Aesthetics a. Grass growing required		
b. Graffiti removal needed		
c. Other (specify)		
4. Conditions of maintenance access routes		
5. Signs of hydrocarbon build-up		
6. Any public hazards (specify)		
H Emergent Vegetation	**(Annual)**	
1. Vegetation healthy and growing WVTS maintaining 50% surface area coverage of emergent plants after the second growing season. (If unsatisfactory, reinforcement plantings needed)		
2. Dominant emergent plants: Survival of desired emergent plant species Distribution according to planting plan?		
3. Evidence of invasive species		

Maintenance Item	Satisfactory/ Unsatisfactory	Comments
4. Maintenance of adequate water depths for desired emergent plant species		
5. Harvesting of emergent plantings needed		
6. Have sediment accumulations reduced pool volume significantly or are plants “choked” with sediment		
7. Eutrophication level of the WVTS		

Comments:

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Actions to be Taken:

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RHODE ISLAND
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
235 Promenade Street, Providence, RI 02908-5767 TDD 401-222-4462

Dear Applicant:

Section 46-12-15(b) of the Rhode Island General laws of 1956, Title 46, Chapter 12 entitled Water Pollution, as amended, prohibits the discharge of pollutants into waters of the State. The only exceptions are discharges in compliance with the terms and conditions of a Rhode Island Pollutant Discharge Elimination System (RIPDES) Permit issued in accordance with State Regulations.

Rule 31 of the RIPDES Regulation, as amended on February 5, 2003, requires all discharges of Storm Water Associated with Industrial Activity to obtain a RIDPES permit. To be covered by the Multi-Sector General Permit for Storm Water Discharge Associated with Industrial Activity issued in March 2006, applicants must complete a Notice of Intent (NOI) Form. Enclosed with this letter is a copy of the NOI Form. Provided all required information is submitted and it is determined that a general permit is appropriate for the site, a letter of authorization to discharge will be sent from the Office Water Resources (OWR).

A non-refundable application fee of $400 is due at the time the NOI is submitted to this office in the form of a check or money order, payable to the General Treasurer of the State of Rhode Island. Note: this fee is required <u>only if</u> both a NOI **and** a SWMP are required to be submitted. The review for completeness of the application will not be made until the fee is paid. The check or money order and the attached Application(s) Fee Form (also available online at: http://www.dem.ri.gov/programs/benviron/water/permits/ripdes/pdfs/apfeenew.pdf) must be submitted to:

Department of Environmental Management
Office of Management Services
235 Promenade Street
Providence, RI 02908

Return the completed NOI form to:

Department of Environmental Management
Office of Water Resources
RIPDES Program
235 Promenade Street
Providence, RI 02908

Any questions about the General Permit or the NOI Form should be directed to the RIPDES Program Staff, Permitting Section at (401) 222-4700 ext. 7605 or 7726.

Sincerely,

Eric A. Beck, P.E.
Supervising Sanitary Engineer

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

Office of Water Resources

DEM USE ONLY
Date NOI Received __________
Date Fee Received __________
RIPDES# RIR __________

RI POLLUTANT DISCHARGE ELIMINATION SYSTEM (RIPDES)

NOTICE OF INTENT (NOI)

FOR STORM WATER DISCHARGES ASSOCIATED WITH INDUSTRIAL ACTIVITY UNDER THE RIPDES MULTI-SECTOR GENERAL PERMIT

(Revised 7/13)

MARK ONLY ONE ITEM:

☐ Existing RIPDES Authorization No. RIR__________ ☒ New Permittee (after April 2011)

I. OWNER

Name: Clear River Energy LLC			
Mailing Address: One South Wacker Drive, Suite 1900			
City: Chicago	State: IL	Zip: 60606	Phone: (781) 424-3223
Fax : ( )	E-mail Address: jniland@invenergy.com		
Contact Person: John Niland	Title: Director of Business		

Ownership (please circle one):

PRI- Private PUB-Public BPP-Public/Private STA-State FED-Federal Other____________

II. OPERATOR (If Different from Owner)

Name: Same as above			
Mailing Address:			
City:	State:	Zip:	Phone: ( )
Fax : ( )	E-mail Address:		
Contact Person:	Title:		

Ownership (please circle one):

PRI- Private PUB-Public BPP-Public/Private STA-State FED-Federal Other____________

III. FACILITY INFORMATION

Facility Name: Clear River Energy Center			
Street Address: Wallum Lake Road (RI Route 100)			
City: Burrillville	State: RI	Zip: 02830	Phone:
Latitude (to nearest 15 sec.) 41 Deg. 57 Min. 54.33 Sec.	Longitude (to nearest 15 sec.) 71 Deg. 45 Min. 15.15 Sec.		
Total Area of Site 36.1 Acres	Total Area of Impervious Surface ____________ Acres		Runoff Coefficient:
Existing Quantitative Data ☐ YES ☒ NO	Number of Outfalls N/A		

Existing storm water management controls:

☐ Oil/Water Separator ☐ Berms ☐ Containment ☐ Overhead Coverage

☐ Retention Facilities ☐ Chemical Treatment ☐ Leachate Collection ☐ Recycling

☐ Other (please specify):

IV. RECEIVING WATER INFORMATION

☒ Ultimate Receiving Water Name: Iron Mine Brook Water Body ID#: RI0001002R-16

☐ Unnamed stream or wetlands connected to named surface water. Name: ____________________

☐ Unnamed stream or wetlands not connected to named surface water.

Is the Receiving Water an Impaired Water Body? ☒ YES ☐ NO

Is there an EPA approved TMDL in place? ☒ YES ☐ NO

List all applicable pollutants causing impairments: Lead, non-native aquatic vegetation, enterococcus

Watershed Code: B Name of Watershed: Clear River

☐ Separate Storm Sewer System MS4 Owner/Operator: ____________________

V. INDUSTRIAL ACTIVITY INFORMATION

Provide the 4-digit Standard Industrial Classification (SIC) codes or the 2-letter Activity Codes that best represent the principal products produced or services rendered by your facility and major co-located activities:

Primary SE__ __ __ Secondary (if applicable) __ __ __ __

Applicable sector(s) of industrial activity, as designated in Part I.B.1 of the MSGP (choose up to 3):

☐ Sector A	☐ Sector F	☐ Sector K	☐ Sector P	☐ Sector U	☐ Sector Z
☐ Sector B	☐ Sector G	☐ Sector L	☐ Sector Q	☐ Sector V	☐ Sector AA
☐ Sector C	☐ Sector H	☐ Sector M	☐ Sector R	☐ Sector W	☐ Sector AB
☐ Sector D	☐ Sector I	☐ Sector N	☐ Sector S	☐ Sector X	☐ Sector AC
☐ Sector E	☐ Sector J	☒ Sector O	☐ Sector T	☐ Sector Y	☐ Sector AD

VI. REGULATORY INFORMATION

☐ RCRA Permit # ______________ ☐ RIPDES Permit # ______________

☐ Subject to Categorical Effluent Guidelines (Table 2) ☐ Presence of Pollutants listed in Tables 5-8

☒ Subject to Monitoring of Benchmarks (Table 3) Iron

VII. OWNER/OPERATOR CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, I certify that the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. I am aware that it is the responsibility of the owner/operator to implement and amend the SWMP as appropriate in accordance with the requirements of the General Permit.

I further certify that a copy of this Notice of Intent (NOI) was submitted and received by the appropriate MS4 Operator* on the date of _________________ 20_ _.

OWNER:
Print Name ______________________________________

Print Title ______________________________________

Signature ______________________________________ Date ______________

OPERATOR:
Print Name ______________________________________

Print Title ______________________________________

Signature ______________________________________ Date ______________

* Refer to RIDEM website for Contact List of stormwater coordinators for each Municipality and RIDOT: http://www.dem.ri.gov/programs/benviron/water/permits/ripdes/stwater/index.htm

VIII. SWMP DEVELOPMENT CERTIFICATION

Note: This section needs to be filled out for discharges of storm water associated with industrial activity which were previously authorized under the 2006 Multi-Sector General Permit or applied for authorization after the expiration date of the previous permit and submitted a SWMP (All others must prepare and submit a SWMP for review as per the permit requirements.) The purpose of this certification is to document that a site specific SWMP was prepared consistent with the requirements of the Multi-Sector General Permit prior to filing the NOI. This certification does not alleviate or in any way limit the liability and sole responsibility of the Owner/Operator to properly implement the SWMP and to amend the SWMP as may be required.

I certify under penalty of law that a site specific SWMP was prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for implementing the SWMP, the SWMP is, to the best of my knowledge and belief, true, accurate, and complete at the time this certification is made and has been developed in accordance to the requirements of the Permit. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Print Name ______________________________________

Print Title ______________________________________

Signature ______________________________________ Date ______________

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

Office of Water Resources

INSTRUCTIONS FOR THE RI POLLUTANT DISCHARGE ELIMINATION SYSTEM (RIPDES)
NOTICE OF INTENT (NOI) – FOR STORM WATER DISCHARGES ASSOCIATED WITH INDUSTRIAL ACTIVITY UNDER THE RIPDES MULTI-SECTOR GENERAL PERMIT
(Revised 07/08/13)

WHO MUST FILE A NOTICE OF INTENT (NOI) FORM

Discharges of storm water associated with industrial activity to Waters of the State are prohibited without a Rhode Island Pollutant Discharge Elimination System (RIPDES) permit. The owner or operator of an industrial activity that has such a storm water discharge must submit a Notice of Intent (NOI) to obtain coverage under the RIPDES Storm Water General Permit. If you have questions about whether you need a permit under the RIPDES Storm Water program contact the Rhode Island Department of Environmental Management, Office of Water Resources at (401) 222-4700.

An originally signed NOI form must be sent to:
RI Department of Environmental Management
Office of Water Resources
RIPDES Program
Permitting Section
235 Promenade Street
Providence, Rhode Island 02908

Please be sure to keep a copy for your files.

FEES

If you are required to submit a SWMP to accompany the NOI, a $400 non-refundable fee is required to be submitted. Please follow the directions on the attached Application Fee Form (also available online at http://www.dem.ri.gov/programs/benviron/water/permits/ripdes/pdfs/apfeenew.pdf). Note that all facilities are subject to an annual fee in accordance with the *Rules and Regulations Governing the Establishment of Various Fees* (available online at: http://www.dem.ri.gov/pubs/regs/regs/water/feereg05.pdf).

COMPLETING THE FORM

You must type or print in the appropriate areas only. Abbreviate if necessary to save space.

For facilities with discharges of storm water associated with industrial activity, please check off the box that best describes your facility. If you have an existing RIPDES Storm Water Authorization, please include the permit number. A New Permittee is defined as one of the following: a facility commencing to discharge on or after April 2011 (which is the expiration date of the previous industrial stormwater general permit), and/or a facility not previously permitted under the April 2006 MSGP. Note: If you are a New Permittee and have not previously submitted a Storm Water Management Plan (SWMP) then you are required to submit a StWMP for review along with the NOI.

Section I - Owner Information
Give the legal name of the person, firm, public (municipal) organization, or any other entity that owns the facility described in this application (RIPDES Rules 3 & 12). The name of the owner may or may not be the same as the name of the facility. Do not use a colloquial name. Enter the complete address and telephone number of the owner. Circle the appropriate choice to indicate the legal status of the owner of the facility.

Section II - Operator Information
If the operator is the same as the owner, enter "Same as Owner". Give the legal name of the person, firm, public (municipal) organization, or any other entity that operates the facility described in this application (RIPDES Rules 3 & 12). The name of the operator may or may not be the same as that of the facility. The operator is the legal entity that controls the facility's operation, rather than the plant or site manager. Do not use a colloquial name. Enter the complete address and telephone number of the operator. Circle the appropriate choice to indicate the legal status of the owner of the facility.

Section III - Facility Information
Enter the facility's official or legal name and complete street address and telephone number. Indicate the latitude and longitude of the approximate center of the facility to the nearest 15 seconds as determined from a United States Geological Survey (USGS) Quadrangle Map. Enter the total area of the site (acres) and the total area of the impervious surface (acres), and the runoff

coefficient for the site. Please indicate if there is any existing quantitative data regarding storm water runoff from the site by checking "YES" or "NO". If "YES", please submit the relevant information. Please indicate the number of outfalls that contain storm water discharge associated with industrial activity. Check the appropriate box(es) to indicate the types of storm water management controls at the facility.

http://www.dem.ri.gov/programs/benviron/water/permits/ripdes/stwater/graphics/watersh.jpghttp://www.dem.ri.gov/programs/benviron/water/permits/ripdes/stwater/graphics/watersh.jpg
http://www.dem.ri.gov/programs/benviron/water/permits/ripdes/stwater/graphics/watersh.jpg)

Section IV – Receiving Waters Information

If the storm water discharges to a separate storm sewer system check the box and enter the name of the operator of the storm sewer system and enter the name of the ultimate surface water. If the site discharges storm water directly to a surface water body check the box and enter the name of the receiving water. If the receiving water is an unnamed stream or wetlands that is either connected to a named surface water check the box and enter the name of surface water; or if the receiving water is an unnamed stream or wetlands not connected to named surface water check the box. Determine the water body ID number and if the receiving water body is impaired:

- Step 1: Go to:

http://www.dem.ri.gov/maps/index.htm

- Step 2: Select Environmental Resource Map.

- Step 3: Open the "DEM Water Quality and Impairments" Folder listed under the LAYERS heading.

- Step 4: Select "Stream WQ Assessment", "Pond WQ Assessment" or "Estuary WQ Assessment" as applicable for your discharge, by checking the square box and clicking on the "Refresh Map" button.

- Step 5: Activate the appropriate layer by selecting the circle next to the applicable "WQ assessment" water body type (stream, pond, estuarine).

- Step 6: Click on left hand legend the "Togle between Legend and Layers List" icon (top left icon), legend with water quality categories pops-up on the right. Water classes 5 and 4A, indicate impaired water bodies scheduled for a TMDL and impaired water bodies with EPA approved TMDLs respectively.

- Step 7: Select the Zoom from icons listed on the left hand legend and zoom in to the area in the vicinity of your industrial facility and ultimate receiving water body.

- Step 8: Open the "Transportation" folder listed under the LAYERS heading and select "Primary Roads" or "All Roads" then click on refresh button.

- Step 8: Select the information feature (**i** icon in red circle) on the left hand legend, and click on the receiving water body on the vicinity of the ultimate discharging point. Information regarding the receiving water body will be shown on the bottom of the screen, such as the name of the water body, water body ID number, and Integrated Report Category (IRCat), water classes 5 and 4A, indicate impaired water bodies scheduled for a TMDL and impaired water bodies with EPA approved TMDLs respectively.

Enter the name and code of the watershed that receives the storm water runoff. Available at:

http://www.dem.ri.gov/maps/mapfile/watershed.jpg
(RI Watersheds)).

Section V - Industrial Activity Information

List your primary and secondary 4-digit standard industrial classification (SIC) codes or 2-character Activity Codes that best describe the principle products or services provided at the facility or site identified in Section III of this application. Use the following 2-character codes for industrial activities defined in RIPDES Rule 31(b)(15(i)-(xi)) that do not have SIC codes to accurately describe them;
HZ = Hazardous waste treatment, storage or disposal facilities, including those that are operating under interim status or a permit subtitle C of RCRA [40 CFR 122.26 b)(14)(iv)];
LF = Landfills, land application sites and open dumps that receive or have received any industrial waste, including those that are subject to regulation under subtitle D of RCRA [40 CFR 122.26 b)(14)(v)];
SE = Steam electric power generating facilities, including coal handling sites [40 CFR 122.26 b)(14)(vii)];
TW = Treatment works treating domestic sewage or any other sewage sludge or wastewater treatment device or system, used in the storage, treatment, recycling, and reclamation of municipal or domestic sewage [40 CFR 122.26 b)(14)(ix)]; or
Alternatively, if your facility or site was specifically designated by the RIPDES permitting authority, enter AD.

Using Table 1 (enclosed), indicate the SIC code for your industry. Select up to three (3) additional applicable sectors of industrial activity with associated discharges that you seek to have covered under this permit.

Co-located Activities. If the permittee has co-located industrial activities on-site that are described in a sector(s) other than the primary sector, the permittee must comply with all other applicable sector-specific conditions found in Part VI for the co-located industrial activities. The extra sector-specific requirements are applied only to those areas of the facility where the extra-sector activities occur. An activity at a facility is not considered co-located if the activity, when considered separately, does not meet the description of a category of industrial activity covered by the storm water regulations, and identified by this general permit SIC code list. For example, unless the permittee is actually hauling substantial amounts of freight or materials with the facility's own truck fleet or are providing a trucking service to outsiders, simple maintenance of vehicles used at the facility is unlikely to meet the SIC code group 42 description of a motor freight transportation facility. Even though Sector P may not apply, the runoff from the vehicle maintenance facility would likely still be considered storm water associated with industrial activity. As such, the SWMP must still address the runoff from the vehicle maintenance facility—although not necessarily with the same degree of detail as required by Sector P—but the permittee would not be required to monitor as per Sector P.

Section VI - Regulatory Information

If there is a RCRA permit issued for the facility, check the box and list the permit number(s).

If there are other RIPDES permits issued for the facility, check the box and list the permit number(s). If an application has been submitted but no permit number has been assigned, enter *"new application"* in the space provided for the RIPDES Permit number.

If the facility is subject to Categorical Effluent Guidelines in Table 2 (enclosed), check the appropriate box and attach a list of appropriate parameters.

Check the appropriate box if you know or have reason to believe that pollutants from Tables 4 through 7 (enclosed) are present at your facility and attach a list of those pollutants. Base your determination that a pollutant is present at your facility on your knowledge of the raw materials, material management practices, maintenance chemicals, history of spills and releases, intermediate and final products and byproducts, and any previous analyses known of the effluent or similar effluent.

If your facility is subject to benchmark monitoring listed in Table 3 (enclosed) check the appropriate box.

Section VII – Owner/Operator Certification

State and Federal statutes provide for severe penalties for submitting false information on this application form. State and Federal regulations require this application to be signed as follows (RIPDES Rule 12):

For a corporation: by a responsible corporate officer, which means: (i) president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision making functions, or (ii) the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

- *For a partnership or sole proprietorship:* by a general partner or the proprietor;
- *For a Municipality, State, Federal or other public facility:* by either a principal executive officer or ranking elected official.

*Note that this section also requires certification that a copy of the Notice of Intent (NOI) was sent to and received by the appropriate MS4 Owner/Operator. Please provide the date it was received.

Section VIII –SWMP Development Certification

This section needs to be filled out for discharges of storm water associated with industrial activity which were authorized under the 2006 MSGP or facilities not authorized under the 2006 MSGP that applied after the previous permit expired and submitted a SWMP as part of their application.* The purpose of this certification is for the person or persons who prepared the SWMP to document that a site specific SWMP was prepared consistent with the requirements of the General Permit prior to filing the NOI. This certification does not alleviate or in any way limit the liability and sole responsibility of the Owner/Operator to properly implement the SWMP and to amend the SWMP as may be required.

* For New Permittees or previously unpermitted facilities or discharges, the submission of a SWMP to accompany the NOI for review is required as per the permit requirements. (Signed certification is optional.)

Table 1. Sectors of Industrial Activity Covered by This Permit		
Subsector (May be subject to more than one sector/subsector)	**SIC Code or Activity Code[1]**	**Activity Represented**
SECTOR A: TIMBER PRODUCTS		
A1	2421	General Sawmills and Planing Mills
A2	2491	Wood Preserving
A3	2411	Log Storage and Handling
A4	2426	Hardwood Dimension and Flooring Mills
	2429	Special Product Sawmills, Not Elsewhere Classified
	2431-2439 (except 2434)	Millwork, Veneer, Plywood, and Structural Wood (see Sector W)
	2448	Wood Pallets and Skids
	2449	Wood Containers, Not Elsewhere Classified
	2451, 2452	Wood Buildings and Mobile Homes
	2493	Reconstituted Wood Products
	2499	Wood Products, Not Elsewhere Classified
A5	2441	Nailed and Lock Corner Wood Boxes and Shook
SECTOR B: PAPER AND ALLIED PRODUCTS		
B1	2631	Paperboard Mills
B2	2611	Pulp Mills
	2621	Paper Mills
	2652-2657	Paperboard Containers and Boxes
	2671-2679	Converted Paper and Paperboard Products, Except Containers and Boxes
SECTOR C: CHEMICALS AND ALLIED PRODUCTS		
C1	2873-2879	Agricultural Chemicals
C2	2812-2819	Industrial Inorganic Chemicals
C3	2841-2844	Soaps, Detergents, and Cleaning Preparations; Perfumes, Cosmetics, and Other Toilet Preparations
C4	2821-2824	Plastics Materials and Synthetic Resins, Synthetic Rubber, Cellulosic and Other Manmade Fibers Except Glass
C5	2833-2836	Medicinal Chemicals and Botanical Products; Pharmaceutical Preparations; in vitro and in vivo Diagnostic Substances; and Biological Products, Except Diagnostic Substances
	2851	Paints, Varnishes, Lacquers, Enamels, and Allied Products
	2861-2869	Industrial Organic Chemicals
	2891-2899	Miscellaneous Chemical Products
	3952 (limited to list of inks and paints)	Inks and Paints, Including China Painting Enamels, India Ink, Drawing Ink, Platinum Paints for Burnt Wood or Leather Work, Paints for China Painting, Artist's Paints and Artist's Watercolors
	2911	Petroleum Refining

Table 1. Sectors of Industrial Activity Covered by This Permit		
Subsector (May be subject to more than one sector/subsector)	**Permit SIC Code or Activity Code**	**Activity Represented**
SECTOR D: ASPHALT PAVING AND ROOFING MATERIALS AND LUBRICANTS		
D1	2951, 2952	Asphalt Paving and Roofing Materials
D2	2992, 2999	Miscellaneous Products of Petroleum and Coal
SECTOR E: GLASS, CLAY, CEMENT, CONCRETE, AND GYPSUM PRODUCTS		
E1	3251-3259	Structural Clay Products
	3261-3269	Pottery and Related Products
E2	3271-3275	Concrete, Gypsum, and Plaster Products
E3	3211	Flat Glass
	3221, 3229	Glass and Glassware, Pressed or Blown
	3231	Glass Products Made of Purchased Glass
	3241	Hydraulic Cement
	3281	Cut Stone and Stone Products
	3291-3299	Abrasive, Asbestos, and Miscellaneous Nonmetallic Mineral Products
SECTOR F: PRIMARY METALS		
F1	3312-3317	Steel Works, Blast Furnaces, and Rolling and Finishing Mills
F2	3321-3325	Iron and Steel Foundries
F3	3351-3357	Rolling, Drawing, and Extruding of Nonferrous Metals
F4	3363-3369	Nonferrous Foundries (Castings)
F5	3331-3339	Primary Smelting and Refining of Nonferrous Metals
	3341	Secondary Smelting and Refining of Nonferrous Metals
	3398, 3399	Miscellaneous Primary Metal Products
SECTOR G: METAL MINING (ORE MINING AND DRESSING)		
G1	1021	Copper Ore and Mining Dressing Facilities
G2	1011	Iron Ores
	1021	Copper Ores
	1031	Lead and Zinc Ores
	1041, 1044	Gold and Silver Ores
	1061	Ferroalloy Ores, Except Vanadium
	1081	Metal Mining Services
	1094, 1099	Miscellaneous Metal Ores
SECTOR H: COAL MINES AND COAL MINING-RELATED FACILITIES		
H1	1221-1241	Coal Mines and Coal Mining-Related Facilities
SECTOR I: OIL AND GAS EXTRACTION AND REFINING		
I1	1311	Crude Petroleum and Natural Gas
	1321	Natural Gas Liquids
	1381-1389	Oil and Gas Field Services
SECTOR J: MINERAL MINING AND DRESSING		
J1	1442	Construction Sand and Gravel
	1446	Industrial Sand
J2	1411	Dimension Stone
	1422-1429	Crushed and Broken Stone, Including Rip Rap
	1481	Nonmetallic Minerals Services, Except Fuels
	1499	Miscellaneous Nonmetallic Minerals, Except Fuels
J3	1455, 1459	Clay, Ceramic, and Refractory Materials
	1474-1479	Chemical and Fertilizer Mineral Mining

Table 1. Sectors of Industrial Activity Covered by This Permit		
Subsector (May be subject to more than one sector/subsector)	**Permit SIC Code or Activity Code**	**Activity Represented**
SECTOR K: HAZARDOUS WASTE TREATMENT, STORAGE, OR DISPOSAL FACILITIES		
K1	HZ	Hazardous Waste Treatment, Storage, or Disposal Facilities, including those that are operating under interim status or a permit under subtitle C of RCRA
SECTOR L: LANDFILLS, LAND APPLICATION SITES, AND OPEN DUMPS		
L1	LF	All Landfill, Land Application Sites and Open Dumps
L2	LF	All Landfill, Land Application Sites and Open Dumps, except Municipal Solid Waste Landfill (MSWLF) Areas Closed in Accordance with 40 CFR 258.60
SECTOR M: AUTOMOBILE SALVAGE YARDS		
M1	5015	Automobile Salvage Yards
SECTOR N: SCRAP RECYCLING FACILITIES		
N1	5093	Scrap Recycling and Waste Recycling Facilities
SECTOR O: STEAM ELECTRIC GENERATING FACILITIES		
O1	SE	Steam Electric Generating Facilities, including coal handling sites
SECTOR P: LAND TRANSPORTATION AND WAREHOUSING		
P1	4011, 4013	Railroad Transportation
	4111-4173	Local and Highway Passenger Transportation
	4212-4231	Motor Freight Transportation and Warehousing
	4311	United States Postal Service
	5171	Petroleum Bulk Stations and Terminals
SECTOR Q: WATER TRANSPORTATION		
Q1	4412-4498	Water Transportation Facilities
	4499 *	Water Transportation Facilities Not Elsewhere Classified *except facilities engaged in marine wrecking ships for scrap, marine salvaging and ship dismantling.
SECTOR R: SHIP AND BOAT BUILDING AND REPAIRING YARDS		
R1	3731, 3732	Ship and Boat Building or Repairing Yards
SECTOR S: AIR TRANSPORTATION FACILITIES		
S1	4512-4581	Air Transportation Facilities
SECTOR T: TREATMENT WORKS		
T1	TW	Treatment Works treating domestic sewage or any other sewage sludge or wastewater treatment device or system, used in the storage, treatment, recycling, and reclamation of municipal or domestic sewage, including land dedicated to the disposal of sewage sludge that are located within the confines of the facility, with a design flow of 1.0 mgd or more, or required to have an approved pretreatment program under 40 CFR Part 403. Not included are farm lands, domestic gardens or lands used for sludge management where sludge is beneficially reused and which are not physically located in the confines of the facility, or areas that are in compliance with section 405 of the CWA

Table 1. Sectors of Industrial Activity Covered by This Permit		
Subsector (May be subject to more than one sector/subsector)	**Permit SIC Code or Activity Code**	**Activity Represented**
SECTOR U: FOOD AND KINDRED PRODUCTS		
U1	2041-2048	Grain Mill Products
U2	2074-2079	Fats and Oils Products
U3	2011-2015	Meat Products
	2021-2026	Dairy Products
	2032-2038	Canned, Frozen, and Preserved Fruits, Vegetables, and Food Specialties
	2051-2053	Bakery Products
	2061-2068	Sugar and Confectionery Products
	2082-2087	Beverages
	2091-2099	Miscellaneous Food Preparations and Kindred Products
	2111-2141	Tobacco Product
SECTOR V: TEXTILE MILLS, APPAREL, AND OTHER FABRIC PRODUCT MANUFACTURING; LEATHER AND LEATHER PRODUCTS		
V1	2211-2299	Textile Mill Products
	2311-2399	Apparel and Other Finished Products Made from Fabrics and Similar Materials
	3131-3199	Leather and Leather Products (note: see Sector Z1 for Leather Tanning and Finishing)
SECTOR W: FURNITURE AND FIXTURES		
W1	2434	Wood Kitchen Cabinets
	2511-2599	Furniture and Fixtures
SECTOR X: PRINTING AND PUBLISHING		
X1	2711-2796	Printing, Publishing, and Allied Industries
SECTOR Y: RUBBER, MISCELLANEOUS PLASTIC PRODUCTS, AND MISCELLANEOUS MANUFACTURING INDUSTRIES		
Y1	3011	Tires and Inner Tubes
	3021	Rubber and Plastics Footwear
	3052, 3053	Gaskets, Packing and Sealing Devices, and Rubber and Plastic Hoses and Belting
	3061, 3069	Fabricated Rubber Products, Not Elsewhere Classified
Y2	3081-3089	Miscellaneous Plastics Products
	3931	Musical Instruments
	3942-3949	Dolls, Toys, Games, and Sporting and Athletic Goods
	3951-3955 (except 3952 – see Sector C)	Pens, Pencils, and Other Artists' Materials
	3961, 3965	Costume Jewelry, Costume Novelties, Buttons, and Miscellaneous Notions, Except Precious Metal
	3991-3999	Miscellaneous Manufacturing Industries
SECTOR Z: LEATHER TANNING AND FINISHING		
Z1	3111	Leather Tanning and Finishing
SECTOR AA: FABRICATED METAL PRODUCTS		
AA1	3411-3499 (except 3479)	Fabricated Metal Products, Except Machinery and Transportation Equipment, and Coating, Engraving, and Allied Services.
	3911-3915	Jewelry, Silverware, and Plated Ware
AA2	3479	Fabricated Metal Coating and Engraving

Table 1. Sectors of Industrial Activity Covered by This Permit		
Subsector (May be subject to more than one sector/subsector)	**Permit SIC Code or Activity Code**	**Activity Represented**
SECTOR AB: TRANSPORTATION EQUIPMENT, INDUSTRIAL OR COMMERCIAL MACHINERY		
AB1	3511-3599 (except 3571-3579)	Industrial and Commercial Machinery, Except Computer and Office Equipment (see Sector AC)
	3711-3799 (except 3731, 3732)	Transportation Equipment Except Ship and Boat Building and Repairing (see Sector R)
SECTOR AC: ELECTRONIC, ELECTRICAL, PHOTOGRAPHIC, AND OPTICAL GOODS		
AC1	3571-3579	Computer and Office Equipment
	3812-3873	Measuring, Analyzing, and Controlling Instruments; Photographic and Optical Goods, Watches, and Clocks
	3612-3699	Electronic and Electrical Equipment and Components, Except Computer Equipment
SECTOR AD: NON-CLASSIFIED FACILITIES		
AD1		Other stormwater discharges designated by the Director as needing a permit (see 40 CFR 122.26(a)(9)(i)(C) & (D)) or any facility discharging stormwater associated with industrial activity not described by any of Sectors A-AC. NOTE: Facilities may not elect to be covered under Sector AD. Only the Director may assign a facility to Sector AD.

TABLE 2 – EFFLUENT GUIDELINES APPLICABLE TO DISCHARGES THAT MAY BE ELIGIBLE FOR PERMIT COVERAGE

Effluent Guideline	New source performance standards included in effluent guidelines?	Sectors with Affected Facilities
Runoff from material storage piles at cement manufacturing facilities [40 CFR Part 411 Subpart C (established February 23, 1977)].	Yes	E
Contaminated runoff from phosphate fertilizer manufacturing facilities [40 CFR Part 418 Subpart A (established April 8, 1974)].	Yes	C
Coal pile runoff at steam electric generating facilities [40 CFR Part 423 (established November 19, 1982)].	Yes	O
Discharges resulting from spray down or intentional wetting of logs at wet deck storage areas [40 CFR Part 429, Subpart I (established January 26, 1981)].	Yes	A
Mine dewatering discharges at crushed stone mines [40 CFR Part 436, Subpart B].	No	J
Mine dewatering discharges at construction sand and gravel mines [40 CFR Part 436, Subpart C].	No	J
Mine dewatering discharges at industrial sand mines [40 CFR Part 436, Subpart D].	No	J
Runoff from asphalt emulsion facilities [40 CFR Part 443, Subpart A (established July 24, 1975)].	Yes	D
Runoff from landfillls, [40 CFR Part 445, Subparts A and B (established February 2, 2000)].	Yes	K & L

TABLE 3 – INDUSTRY SECTORS/SUB-SECTORS SUBJECT TO BENCHMARK MONITORING

MSGP Sector[1]	Industry Sub-Sector	Required Parameters for Benchmark Monitoring
A	General Sawmills and Planning Mills	COD, TSS, Zinc.
	Wood Preserving Facilities	Arsenic, Copper.
	Log Storage and Handling	TSS.
	Hardwood Dimension and Flooring Mills	COD, TSS.
B	Paperboard Mills	COD.
C	Industrial Inorganic Chemicals	Aluminum, Iron, Nitrate + Nitrite N.
	Plastics, Synthetic Resins, etc.	Zinc.
	Soaps, Detergents, Cosmetics, Perfumes	Nitrate + Nitrite N, Zinc.
	Agricultural Chemicals	Nitrate + Nitrite N, Lead, Iron, Zinc, Phosphorus.
D	Asphalt Paving and Roofing Materials	TSS.
E	Clay Products	Aluminum.
	Concrete Products	TSS, Iron.
F	Steel Works, Blast Furnaces, and Rolling and Finishing Mills.	Aluminum, Zinc.
	Iron and Steel Foundries	Aluminum, TSS, Copper, Iron, Zinc.
	Non-Ferrous Rolling and Drawing	Copper, Zinc.
	Non-Ferrous Foundries (Castings)	Copper, Zinc.
G[2]	Copper Ore Mining and Dressing	COD, TSS, Nitrate + Nitrite N
H	Coal Mines and coal-Mining Related Facilities….	TSS, Aluminum, Iron
J	Dimension Stone, Crushed Stone, and Nonmetallic Minerals (except fuels)	TSS.
	Sand and Gravel Mining	Nitrate + Nitrite N, TSS.
K	Hazardous Waste Treatment Storage or Disposal	Ammonia, Magnesium, COD, Arsenic, Cadmium, Cyanide, Lead, Mercury, Selenium, Silver.
L	Landfills, Land Application Sites, and Open Dumps	Iron, TSS.
M	Automobile Salvage Yards	TSS, Aluminum, Iron, Lead.
N	Scrap Recycling and Waste Recycling Facilities	Copper, Aluminum, Iron, Lead, Zinc, TSS, COD.
	Facilities where shredding activities and/or shredding materials are exposed to stormwater	PCBs (Arochlors 1016, 1221, 1232, 1242, 1248, 1252, 1260), Oil and Grease
O	Steam Electric Generating Facilities	Iron.
Q	Water Transportation Facilities	Aluminum, Iron, Lead, Zinc.
R	Boat building and Repair Facilities	Aluminum, Iron, Lead, Zinc.
S	Airports with Deicing Activities[3]	BOD, COD, Ammonia, pH.
U	Grain Mill Products	TSS.
	Fats and Oils	BOD, COD, Nitrate + Nitrite N, TSS.
Y	Rubber Products	Zinc.
AA	Fabricated Metal Products Except Coating	Iron, Aluminum, Zinc, Nitrate + Nitrite N.
	Fabricated Metal Coating and Engraving	Zinc, Nitrate + Nitrite N.

[1] Table does not include parameters for compliance monitoring under effluent limitations guidelines.
[2] See Sector G (Part 6.G) for additional monitoring discharges from waste rock and overburden piles from active ore mining or dressing facilities.
[3] Monitoring requirement is for airports with deicing activities that utilize more than 100 tons of urea or more than 10,000 gallons of ethylene glycol per year.

TABLE 4- ORGANIC TOXIC POLLUTANTS

Volatiles

acrolein
acrylonitrile
benzene
bromoform
carbon tetrachloride
chlorobenzene
chlorodibromomethane
chloroethane
2-chloroethylvinyl ether
chloroform
dichlorobromomethane
1,1-dichloroethane
1,2-dichloroethane
1,1-dichloroethylene
1,2-dichloropropane
1,3-dichloropropylene
ethylbenzene
methyl bromide
methyl chloride
methylene chloride
1,1,2,2-tetrachloroethane
tetrachloroethylene
toluene
1,2-trans-dichloroethylene
1,1,1-trichloroethane
1,1,2-trichloroethane
trichloroethylene
vinyl chloride

Acid Compounds

2-chlorophenol
2,4-dichlorophenol
2,4-dimethylphenol
4,6-dinitro-o-cresol
2,4-dinitrophenol
2-nitrophenol
4-nitrophenol
p-chloro-m-cresol
pentachlorophenol
phenol
2,4,6-trichlorophenol

Base/Neutral Compounds

acenaphthene *
acenaphthylene *
anthracene *
benzidine
benzo(a)anthracene *
benzo(a)pyrene *
3,4-benzofluoranthene *
benzo(ghi)perylene *
benzo(k)fluoranthene *
bis(2-chloroethoxy)methane
bis(2-chloroethyl)ether
bis(2-chloroisopropyl)ether
bis(2-ethylhexyl)phthalate
4-bromophenyl phenyl ether
butylbenzyl phthalate
2-chloronaphthalene
4-chlorophenyl phenyl ether
chrysene *
dibenzo (a,h)anthracene *
1,2-dichlorobenzene
1,3-dichlorobenzene
1,4-dichlorobenzene
3,3'-dichlorobenzidine
diethyl phthalate
dimethyl phthalate
di-n-butyl phthalate
2,4-dinitrotoluene
2,6-dinitrotoluene
di-n-octyl phthalate
1,2-diphenylhydrazine (as azobenzene)
fluoranthene *
fluorene *
hexachlorobenzene
hexachlorobutadiene
hexachlorocyclopentadiene
hexachloroethane
indeno(1,2,3-cd)pyrene *
isophorone
naphthalene *
nitrobenzene
N-nitrosodimethylamine
N-nitrosodi-n-propylamine
N-nitrosodiphenylamine
phenanthrene *
pyrene *
1,2,4-trichlorobenzene
* = Polynuclear Aromatic Hydrocarbons

Pesticides

aldrin
alpha-BHC
beta-BHC
gamma-BHC
delta-BHC
chlordane
4,4'-DDT
4,4'-DDE
4,4'-DDD
dieldrin
alpha-endosulfan
beta-endosulfan
endosulfan sulfate
endrin
endrin aldelyde
heptachlor
heptachlor epoxide
PCB-1242
PCB-1254
PCB-1221
PCB-1232
PCB-1248
PCB-1260
PCB-1016
toxaphene

TABLE 5 - TOXIC METALS, CYANIDE & PHENOL

Antimony, Total
Arsenic, Total
Beryllium, Total
Cadmium, Total
Chromium, Total
Chromium, Hexavalent
Copper, Total
Lead, Total
Mercury, Total
Nickel, Total
Selenium, Total
Silver, Total
Thallium, Total
Zinc, Total
Cyanide, Total
Phenols, Total

TABLE 6 - CONVENTIONAL & NON-CONVENTIONAL POLLUTANTS

Bromide
Chlorine, Total Residual
Color
Fecal Coliform
Fluoride
Nitrate-Nitrite
Nitrogen, Total Organic
Oil & Grease
Phosphorus, Total
Radioactivity
Sulfate
Sulfide
Sulfite
Surfactants
Aluminum, Total
Barium, Total
Boron, Total
Cobalt, Total
Iron, Total
Magnesium, Total
Molybdenum, Total
Manganese, Total
Tin, Total
Titanium, Total

TABLE 7 - HAZARDOUS SUBSTANCES & ASBESTOS

Toxic Pollutants

Asbestos
TCDD

Hazardous Substances

Acetaldehyde
Allyl alcohol
Allyl chloride
Amyl Acetate
Aniline
Benzonitrile
Benzyl Chloride
Butyl acetate
Butylamine
Captan
Carbaryl
Carbofuran
Carbon disulfide
Chlorpyrifos
Coumaphos
Cresol
Crotonaldehyde
Cyclohexane
2,4-D (2,4-Dichlorophenoxy acetic acid)
Diazinon
Dicamba
Dichlone
2,2-Dichloropropionic acid
Dichlorvos
Diethyl amine
Dimethyl amine
Dintrobenzene
Diquat
Disulfoton
Diuron
Epichlorohydrin
Ethion
Ethylene diamine
Ethylene dibromide
Formaldehyde
Furfural
Guthion
Isoprene
Isopropanolamine
Dodecylbenzenesulfonate
Kelthane
Kepone
Malathion
Mercaptodimethur
Methoxychlor
Methyl mercaptan
Methyl methacrylate
Methyl parathion
Mevinphos
Mexacarbate
Monoethyl amine
Monomethyl amine
Naled
Napthenic acid
Nitrotoluene
Parathion
Phenolsulfanate
Phosgene
Propargite
Propylene oxide
Pyrethrins
Quinoline
Resorcinol
Strontium
Strychnine
Styrene
2,4,5-T (2,4,5-Trichlorophenoxy acetic acid)
TDE (Tetrachlorodiphenylethane)
2,4,5-TP [2-(2,4,5-Trichlorophenoxy) propanoic acid]
Trichlorofan
Triethanolamine dodecylbenzenesulfonate
Triethylamine
Trimethylamine
Uranium
Vanadium
Vinyl acetate
Xylene
Xylenol

Appendix E – Soil Erosion and Sediment Control (SESC) Plan

11 Stanwix Street | Suite 800 | Pittsburgh, PA 15222
T 412.497.6000

Soil Erosion and Sediment Control Plan
For:
Clear River Energy Center

Wallum Lake Road (RI Route 100)

Burrillville, RI

Assessor's Plat and Lot Number TBD

Owner:	Clear River Energy LLC Attention: John Niland, P.E. Director of Business Development One South Wacker Drive, Suite 1900 Chicago, IL 60606 (781) 424-3223 jniland@invenergyllc.com
Operator: *TO BE DETERMINED UPON CONTRACT AWARD*	Company Name Name Address City, State, Zip Code Telephone Number Email Address
Estimated Project Dates:	Start Date: EPC Limited Notice to Proceed, 7/2016
	Completion Date: Substantial Completion 5/2019
SESC Plan Prepared By:	HDR Engineering, Inc. Alexander E. Deuson, P.E. 11 Stanwix Street, Suite 800 Pittsburg, PA 15222 (412) 497-6261 alexander.deuson@hdrinc.com Rhode Island Licensed PE, RI PE #11618

SESC Plan Preparation Date:	March 27, 2017
SESC Plan Revision Date:	

OWNER CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under the direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete.

I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. I am aware that it is the responsibility of the site owner and operator to implement and amend the Soil Erosion and Sediment Control Plan as appropriate in accordance with the requirements of the RIPDES Construction General Permit.

Owner Signature: Date

Owner Name: John Niland, P.E.

Owner Title: Director of Business Development

Company Name: Clear River Energy LLC

Address: One South Wacker Drive, Suite 1900, Chicago, IL 60606

Phone Number: (781) 424-3223

Email Address: jniland@invenergyllc.com

OPERATOR CERTIFICATION

Upon contract award, the OPERATOR must sign this certification statement before construction may begin.

I certify under penalty of law that this document and all attachments were prepared under the direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete.

I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. I am aware that it is the responsibility of the owner/operator to implement and amend the Soil Erosion and Sediment Control Plan as appropriate in accordance with the requirements of the RIPDES Construction General Permit.

Operator Signature: Date

Contractor Representative: TBD

Contractor Title: TBD

Contractor Company Name: TBD

Address: TBD

Phone Number: TBD

Email Address: TBD

TABLE OF CONTENTS

This Table of Contents is structured to be automatically populated by Microsoft Word. Upon final completion of this template, "right-click" anywhere in the Table of Contents, select "Update Field", and then "Update entire table". Page numbers will automatically be synced with the changed document.

INTRODUCTION

This Construction Site Soil Erosion and Sediment Control Plan (SESC Plan) has been prepared for Clear River Energy LLC for the Clear River Energy Center. In accordance with the RIDEM Rhode Island Pollutant Discharge Elimination System (RIPDES) General Permit for Stormwater Discharge Associated with Construction Activity (RIPDES Construction General Permit ("CGP")), projects that disturb one (1) or more acres require the preparation of a SESC Plan. This SESC Plan provides guidance for complying with the terms and conditions of the RIPDES Construction General Permit and Minimum Standard 10 of the RI Stormwater Design and Installation Standards Manual. In addition, this SESC Plan is also consistent with Part D of the *RI SESC Handbook* entitled "Soil Erosion and Sediment Control Plans". This document does not negate or eliminate the need to understand and adhere to all applicable RIPDES regulations.

The purpose of erosion, runoff, and sedimentation control measures is to prevent pollutants from leaving the construction site and entering waterways or environmentally sensitive areas during and after construction. This SESC Plan has been prepared prior to the initiation of construction activities to address anticipated worksite conditions. The control measures depicted on the site plan and described in this narrative should be considered the minimum measures required to control erosion, sedimentation, and stormwater runoff at the site. Since construction is a dynamic process with changing site conditions, it is the operator's responsibility to manage the site during each construction phase so as to prevent pollutants from leaving the site. This may require the operator to revise and amend the SESC Plan during construction to address varying site and/or weather conditions, such as by adding or realigning erosion or sediment controls to ensure the SESC Plan remains compliant with the RIPDES Construction General Permit. Records of these changes must be added to the amendment log attached to the SESC Plan, and to the site plans as "red-lined" drawings. Please Note: **Even if practices are correctly installed on a site according to the approved plan, the site is only in compliance when erosion, runoff, and sedimentation are effectively controlled throughout the entire site.**

It is the responsibility of the site owner and the site operator to maintain the SESC Plan at the site, including all attachments, amendments and inspection records, and to make all records available for inspection by RIDEM during and after construction. (RIPDES CGP - Part III.G)

The site owner, the site operator, and the designated site inspector are required to review the SESC Plan and sign the Party Certification pages (Section 8). The primary contractor (if different) and all subcontractors (if applicable) involved in earthwork or exterior construction activities are also required to review the SESC Plan and sign the certification pages before construction begins.

Any questions regarding the SESC Plan, control measures, inspection requirements, or any other facet of this document may be addressed to the RIDEM Office of Water Resources, at 401-222-4700 or via email: water@dem.ri.gov.

ADDITIONAL RESOURCES

Rhode Island Department of Environmental Management
Office of Water Resources
235 Promenade Street
Providence, RI 02908-5767
phone: 401-222-4700
email: water@dem.ri.gov

RIDEM *RI Stormwater Design and Installation Standards Manual* (RISDISM) (as amended)
http://www.dem.state.ri.us/programs/benviron/water/permits/ripdes/stwater/t4guide/desman.htm

RI Soil Erosion and Sediment Control Handbook
http://www.dem.state.ri.us/soilerosion2014final.pdf

RIDEM 2013 RIPDES Construction General Permit
http://www.dem.ri.gov/pubs/regs/regs/water/ripdesca.pdf

Rhode Island Department of Transportation *Standard Specifications for Road and Bridge Design and Other Specifications* and *Standard Details*
http://www.dot.ri.gov/business/bluebook.php

RIDEM Office of Water Resources Coordinated Stormwater Permitting website
http://www.dem.state.ri.us/programs/benviron/water/permits/swcoord/index.htm

RIDEM RIPDES Stormwater website
http://www.dem.state.ri.us/programs/benviron/water/permits/ripdes/stwater/index.htm

RIDEM Water Quality website (for 303(d) and TMDL listings)
http://www.dem.ri.gov/programs/benviron/water/quality/index.htm

RIDEM Rhode Island Natural Heritage Program
http://www.dem.ri.gov/programs/bpoladm/plandev/heritage/index.htm

RIDEM Geographic Data Viewer – Environmental Resource Map
http://www.dem.ri.gov/maps/index.htm

Natural Resources Conservation Service - Rhode Island Soil Survey Program
http://www.ri.nrcs.usda.gov/technical/soils.html

EPA NPDES – Stormwater Discharges from Construction Activities webpage:
http://water.epa.gov/polwaste/npdes/stormwater/Stormwater-Discharges-From-Construction-Activities.cfm

EPA Construction Site Stormwater Runoff Control BMP Menu
http://water.epa.gov/polwaste/npdes/swbmp/Construction-Site-Stormwater-Run-Off-Control.cfm

SECTION 1: SITE DESCRIPTION

1.1 Project/Site Information

Project/Site Name:

- Clear River Energy Center
- This project will entail the construction of a power plant facility and accompanying access road and retaining walls, storm water management features and temporary construction staging area. The site is located in northeast Providence County.

Project Street/Location:

- Wallum Lake Road (R.I. Route 100), Burrillville, RI

Provide construction site estimates of the total area of the site and the total area of the site that is expected to undergo soil disturbance.

The following are estimates of the construction site area:

- Total Project Area 36.1 acres
- Total Project Area to be Disturbed 36.1 acres

1.2 Receiving Waters

RIPDES CGP - Parts IV.A.7 & IV.A.8

List the separate storm sewer system or drainage system that stormwater from the site could discharge to and the waterbody(s) that receive discharges from each storm sewer or drainage system.

List/description of separate storm sewer systems or drainage systems that may be impacted during construction and the water bodies that receive discharges from each storm sewer or drainage system:

- There are no separate storm sewer systems or drainage systems that are impacted by this development. Iron Mine Brook and an unnamed tributary to Dry Arm Brook are the receiving waters from this development and both ultimately drain into Clear River.

List the water body(s) that have the potential to receive stormwater from the site or that have the potential to be impacted by construction, including streams, rivers, lakes, coastal waters, and wetlands. Note any stream crossings, if applicable.

List/description of receiving waters that may be impacted during construction:

- Dry Arm Brook – a warm water Category 3 stream as classified by RIDEM
- Iron Mine Brook – an unassessed Category 3 stream as classified by RIDEM

If any of the water bodies above are impaired (303(d) listed) and/or subject to Total Maximum Daily Loads (TMDLs), list the pollutants causing the impairment and any specific requirements in the TMDL(s) that are applicable to construction sites. Visit http://www.dem.ri.gov/programs/benviron/water/quality/index.htm for more information and a list of Rhode Island impaired waters and TMDL Studies. (See also the RIDEM RIPDES Construction General Permit Notice of Intent instructions which can be found at the following link: http://www.dem.ri.gov/pubs/regs/regs/water/ripdesca.pdf)

Are any of the receiving waters in the vicinity of the proposed construction project listed as being impaired or subject to a TMDL?

☐ Yes ☒ No

If yes, List/provide description of 303(d)/TMDL waters and applicable TMDL requirements that must be addressed during construction:

- N/A

1.3 Natural Heritage Area Information

RIPDES CGP - Part III.H

Each project authorized under the RIPDES Construction General Permit must determine if the site is within or directly discharges to a Natural Heritage Area (NHA). DEM Natural Heritage Areas include known occurrences of state and federal rare, threatened and endangered species. Review RIDEM NHA maps to determine if there are natural heritage areas on or near the construction site that may be impacted during construction. (See also the RIDEM Notice of Intent instructions which can be found at the following link: http://www.dem.ri.gov/pubs/regs/regs/water/ripdesca.pdf)

Are there any Natural Heritage Areas being disturbed by the construction activity or will discharges be directed to the Natural Heritage Area as a result of the construction activity?

☐ Yes ☒ No

If yes, describe or refer to documentation which determines the likelihood of an impact on this area and the steps that will be taken to address any impacts.

- N/A

1.4 Historic Preservation/Cultural Resources

The National Historic Preservation Act, and any state, local, and tribal historic preservation laws apply to construction activities. As with endangered species, some permits may specifically require you to assess the potential impact of your stormwater discharges on historic properties. However, whether or not this is stated as a condition for permit coverage, the National Historic Preservation Act and any applicable state or tribal laws apply to you. Contact the Rhode Island Historic Preservation Officer (http://www.preservation.ri.gov/) or your Tribal Historic Preservation Officer (http://grants.cr.nps.gov/THPO_Review/index.cfm) for more information.

Are there any historic properties, historic cemeteries or cultural resources on or near the construction site?

☐ Yes ☒ No

Describe how this determination was made and summarize state or tribal review comments:

- This determination was made through a review of Rhode Island Environmental Resource digital maps and a review of an Environmental Critical Issues analysis performed by ESS Group, Inc. in October 2014 for the site.

If yes, describe or refer to documentation which determines the likelihood of an impact on this historic property, historic cemetery or cultural resource and the steps taken to address that impact including any conditions or mitigation measures that were approved by other parties.

- N/A

1.5 Site Features and Constraints

Constraints are identified to ensure a comprehensive understanding of the project and surrounding areas. The first goal in the low impact development (LID) site planning and design process is to avoid disturbance of natural features. This includes identification and preservation of natural areas that can be used in the protection of water resources. It is important to understand that minimizing the hydrologic alteration of a site is just as important as stormwater treatment for resource protection. Therefore, describe all site features and sensitive resources that exist at the site such as floodplains, steep slopes (>15%), areas with the potential to receive run-on from off-site areas, erodible soils, wetlands, hydric soils, surface waters, and their riparian buffers, specimen trees, natural vegetation, forest areas, stream crossings, historic properties, historic cemeteries or cultural resources that are to be preserved. ***This includes those site features that should be avoided within the designated limits of disturbance.*** *These areas are often identified on a constraints map or in a separate constraints report. For additional discussion on this topic refer to Appendix F. Site Constraint Map of the RI SESC Handbook.*

List All Site Constraints and Sensitive Areas that require avoidance and protection through the implementation of control measures:

- This site is constrained by biological wetlands and existing forested areas. These boundaries are shown on the plan sheets and a separate constraints map does not appear to be warranted. These areas will be protected by the installation of construction safety fencing along the limits of disturbance boundaries as shown on the plans. The final constraint is Wallum Lake Road (R.I. Route 100 which will be protected by the installation of a rock construction exit.

- The constraints are shown on sheet 01C901 thru 01C904, Existing Conditions and Constraints Map.

SECTION 2: EROSION, RUNOFF, AND SEDIMENT CONTROL

RIPDES Construction General Permit – Part III.J.1

The purpose of erosion controls is to prevent sediment from being detached and moved by wind or the action of raindrop, sheet, rill, gully, and channel erosion. Properly installed and maintained erosion controls are the primary defense against sediment pollution.

Runoff controls are used to slow the velocity of concentrated water flows. By intercepting and diverting stormwater runoff to a stabilized outlet or treatment practice or by converting concentrated flows to sheet flow erosion and sedimentation are reduced.

Sediment controls are the last line of defense against moving sediment. The purpose is to prevent sediment from leaving the construction site and entering environmentally sensitive areas.

This section describes the set of control measures that will be installed before and during the construction project to avoid, mitigate, and reduce impacts associated with construction activity. Specific control measures and their applicability are contained in Section Four: Erosion Control Measures, Section Five: Runoff Control Measures, and Section Six: Sediment Control Measures of the *RI SESC Handbook*. The *RI SESC Handbook* can be found at the following address:

http://www.dem.ri.gov/soilerosion2014final.pdf.

2.1 Avoid and Protect Sensitive Areas and Natural Features

Per RI Stormwater Design and Installation Standards Manual 3.3.7.1:

Areas of existing and remaining vegetation and areas that are to be protected as identified in the Section 1.6 of the SESC Plan must be clearly identified on the SESC Site Plans for each Phase of Construction. Prior to any land disturbance activities commencing on the site, the Contractor shall physically mark limits of disturbance (LOD) on the site and any areas to be protected within the site, so that workers can clearly identify the areas to be protected.

Describe and illustrate on SESC Site Plans natural features identified earlier and how each will be protected during construction activity. Examples of areas to be protected include vegetated buffers, forests, stands of trees on the perimeter and within the site, large diameter trees, areas designated for infiltration (QPAs), bioretention, rain gardens, and OWTS leachfields. Protection for stands of trees and individual trees to be preserved must be specified and such protection must comply with the RI SESC Handbook and extend to the drip line.

Describe and illustrate on SESC Site Plans based on Constraints Map, the areas that will be disturbed with each phase of construction and the control measures (signs, fences, etc.) that will be used to protect those areas that should not be disturbed. ***This includes marking for limits of disturbance at the perimeter and areas within the limits of disturbance.*** *Acceptable measures include but are not limited to construction fencing (plastic mesh, snow fence, chain link fence etc.) appropriate for the site, boundary markers using construction tape, flagged stakes, etc. for low density use, sediment barriers such as silt fence, compost socks with flagging where also required for sediment control, and signage. The narrative portion of the plan and SESC Site Plans must highlight measures to prevent soil compaction in areas designated as Qualified Pervious Areas (QPAs) and infiltration practices to protect infiltration capacity.*

Feature Requiring Protection	Construction Phase #	Method of Protection	Sheet #
Biological Wetlands	Phase I	Construction Fence	01C905 thru 01C909
Wooded areas outside LOD	Phase I	Construction Fence	01C905 thru 01C909
Wallum Lake Road	Phase I	Rock Const. Exit	01C907

2.2 Minimize Area of Disturbance

Per RI Stormwater Design and Installation Standards Manual 3.3.7.2:

Will >5 acres be disturbed in order to complete this project?

☒ Yes ☐ No

If yes, phasing must be utilized at this site.

Will <5 acres be disturbed or will disturbance activities be completed within a six (6) month window?

☐ Yes ☒ No

If yes, phasing is not required as long as all other performance criteria will be met and phasing is not necessary to protect sensitive or highly vulnerable areas.

Provide discussion regarding the need to phase or not to phase construction activity in this instance.

Based on the answers to the above questions will phasing be required for this project?

☐ Yes ☒ No

If yes, and phasing is required, describe phasing plan as prompted below.

If No, provide substantive reasons why this was determined to be infeasible.
Due to the cut/fill nature of this development in creating a 17+ acre flat site for the facility, stripping and stockpiling topsoil in order to access desirable soils for fill, it will be very difficult to define distinct boundaries for phasing of the grading operations. Cut materials from the main portion of the site will also be used to build the entrance road. Phasing of construction will be recommended to the contractor and noted on the plans for the contractor to develop a plan of action that will minimize exposed unstabilized earth during mass grading if possible. If any semblance of construction phasing exists in the plans, it will be that the construction staging/soil stockpile area will be constructed first followed by excavation of basin "A". Then the main facility site will be mass graded. The road construction will include construction of retaining walls to minimize disturbance to wetland areas and timing of this will be contractor driven which could also affect any potential construction phase timing.

PHASING PLAN
For each phase of the construction project, provide site estimates of the total area of the project phase, and the total area of the project phase that is expected to undergo soil disturbance.

The following are estimates of each phase of the construction project:

(Copy and paste this section for projects with multiple phases)

Phase No. or Identifier	
Total Area of Phase	acres
Area to be Disturbed	acres

Description of Construction Sequencing for Phase

Proper sequencing of construction activities is essential to maximize the effectiveness of erosion, runoff, and sediment control measures. Construction sequencing of construction activities for each phase must address the following elements:

1. *Installation of control measures identifying limits of disturbance and areas internal to the site that require protection before start of land disturbance.*

2. *Installation of all erosion, runoff, and sediment controls and temporary pollution prevention measures that are required to be in place and functional before any earthwork begins. This shall be done in accordance with the RI SESC Handbook and/or the RI Department of Transportation Standard Specifications for Road and Bridge Construction (as amended). Upon acceptable completion of site preparation and installation of erosion, runoff, and sediment controls and temporary pollution prevention measures, site construction activities may commence.*
3. *The phasing plan shall address the use of phasing to manage and limit increases in runoff rates and volumes during construction. Designated phases and timing of construction should also address the impacts to important or sensitive habitats.*
4. *Upon commencement of site construction activities, the operator shall initiate appropriate stabilization practices on all disturbed areas as soon as possible, but not more than fourteen (14) days after the construction activity in that area has temporarily or permanently ceased. Such temporary or permanent soil stabilization measures must be installed prior to initiating land disturbance in subsequent phases.*
5. *Routine inspection and maintenance and/or modification of erosion, runoff, and sediment controls and temporary pollution prevention measures while earthwork is ongoing is required.*
6. *Final site stabilization of any disturbed areas after earthwork has been completed and removal of temporary erosion, runoff, and sediment controls and temporary pollution prevention measures.*
7. *Activation of post-construction stormwater treatment conveyances and practices.*

2.3 Minimize the Disturbance of Steep Slopes

Per RI Stormwater Design and Installation Standards Manual 3.3.7.3:

Are steep slopes (>15%) present within the proposed project area?

☒ Yes ☐ No

If yes, steep slopes must be identified on SESC Site Plans.

If yes, also list the specific control measures that will be used to control surface runoff and reduce erosion potential on steep slopes during construction including references to SESC Site Plans where the locations of such control measures are shown. Examples include limiting the number of steep slopes that are disturbed at one time, implementing land grading techniques such as reverse slope benches, diversions, stair steps, and terraced landforms, installation of retaining walls for stabilization of challenging slopes, prevention of soil movement, and slope protection, applying materials for temporary and permanent protection of slopes to prevent erosion such as stone aggregates, rip-rap, erosion control blankets, appropriate spacing of sediment barriers as a function of barrier size, slope, and slope length, geotextile, cellular confinement systems, mattresses (gabions and others), and articulating blocks.

There is a small area on the western edge of the site that may contain some slopes in excess of 15%. It is a small hill within the area of the facility footprint and it will not be protected as this hump will be one of the first areas removed during mass grading operations and removal will eliminate the area with steep slopes.

2.4 Preserve Topsoil

Per RI Stormwater Design and Installation Standards Manual 3.3.7.4:

Site owners and operators must preserve existing topsoil on the construction site to the maximum extent feasible and as necessary to support healthy vegetation, promote soil stabilization, and increase stormwater infiltration rates in the post-construction phase of the project.

Will existing topsoil be preserved at the site?

☒ Yes ☐ No

If Yes, describe how topsoil will be preserved at the site by describing the techniques that will be implemented to achieve appropriate depths of topsoil (4 inch minimum) and identify the locations where topsoil will be restored on SESC Site Plans.

Topsoil for the facility site will be stripped and temporarily stockpiled in the area noted on the plans. At the end of construction, topsoil will be installed on the areas to receive final seeding to a minimum depth of 4”. Remaining topsoil is planned to be removed from the construction staging area and transported offsite to an area to be determined in the future. The construction staging area will then have all gravels removed, soil tilled to alleviate any compaction and then be reforested and grassed and allowed to return to natural habitat.

If No, provide substantive reasons why this was determined to be infeasible.

N/A

Soil compaction must be minimized by maintaining limits of disturbance throughout construction. In instances where site soils are compacted the site owner and operator must restore infiltration capacity of the compacted soils by tilling or scarifying compacted soils and amending soils as necessary to ensure a minimum depth of topsoil is available in these areas. In areas where infiltrating stormwater treatment practices are located compacted soils must be amended such that they will comply the design infiltration rates established in the *RI Stormwater Design and Installation Standards Manual*.

Identify the methods that will be used to restore and amend topsoil at the site. Include references to plan notes and SESC Site Plan sheet numbers where this information is made available for the site operator.

The construction staging area is the only area where this section might apply. Upon demobilization, the construction staging area will have all graveled areas removed and remaining soil will be tilled and a 4” layer of topsoil will be applied from the stockpile being removed. The area will then be grassed and reforested to allow it to return to a natural state.

2.5 Stabilize Soils

Per RI Stormwater Design and Installation Standards Manual 3.3.7.5:

Upon completion and acceptance of site preparation and initial installation of erosion, runoff, and sediment controls and temporary pollution prevention measures, the operator shall initiate appropriate temporary or permanent stabilization practices during all phases of construction on all disturbed areas as soon as possible, but not more than fourteen (14) days after the construction activity in that area has temporarily or permanently ceased.

Any disturbed areas that will not have active construction activity occurring within 14 days must be stabilized using the control measures depicted in the SESC Site Plans, in accordance with the *RI SESC Handbook*, and per manufacturer product specifications.

Only areas that can be reasonably expected to have active construction work being performed within 14 days of disturbance will be cleared/grubbed at any one time. It is NOT acceptable to clear and grub the entire construction site if portions will not be active within the 14-day time frame. Proper phasing of clearing and grubbing activities shall include temporary stabilization techniques for areas cleared and grubbed that will not be active within the 14-day time frame.

All disturbed soils exposed prior to October 15 of any calendar year shall be seeded by that date if vegetative measures are the intended soil stabilization method. Any such areas that do not have adequate vegetative stabilization, as determined by the site operator or designated inspector, by November 15, must be stabilized through the use of non-vegetative erosion control measures. If work continues within any of these areas during the period from October 15 through April 15, care must be taken to ensure that only the area required for that day's work is exposed, and all erodible soil must be restabilized within 5 working days. In limited circumstances, stabilization may not be required if the intended function of a specific area of the site necessitates that it remain disturbed (i.e. construction of a motocross track).

Describe controls (i.e., temporary seeding with native vegetation, hydroseeding, mulching, application of rolled erosion control products, etc.) including design specifications and details that will be implemented to stabilize exposed soils where construction activities have temporarily or permanently ceased.

Temporary Vegetative Control Measures

- Areas of the site that will be free of construction activities for more than 14 days will receive temporary seeding/mulching and fertilizer in accordance with the Rhode Island Soil Erosion and Sediment Control Handbook

Temporary Non-Vegetative Control Measures

- Areas that may require temporary non-vegetative controls will be field determined if needed as construction proceeds and contractor develops grading operations plan.

- Specific locations are TBD at this time.

Permanent Vegetative Control Measures

- Permanent vegetative control measure will be used on the perimeter of the site on constructed slopes, along the new access road and areas where stockpiled topsoil is redistributed.

Permanent Non-Vegetative Control Measures

- Permanent non-vegetative control measures will be implemented within basin "B" once it is converted into the permanent water quality/detention basin.

2.6 Protect Storm Drain Outlets

Per RI Stormwater Design and Installation Standards Manual 3.3.7.7:

Temporary or permanent outlet protection must be used to prevent scour and erosion at discharge points through the protection of the soil surface, reduction in discharge velocities, and through the promotion of infiltration. Outlets often have high velocity, high volume flows, and require strong materials that will withstand the forces of stormwater. Storm drain outlet control measures also offer a last line of protection against sediment entering environmentally sensitive areas.

All stormwater outlets that may discharge sediment-laden stormwater flow from the construction site must be protected using the control practices depicted on the approved plan set and in accordance with the *RI SESC Handbook*.

Describe controls, including design specifications and details, which will be implemented to protect outlets discharging stormwater from the project.

Will temporary or permanent point source discharges be generated at the site as the result of construction of sediment traps or basins, diversions, and conveyance channels?

☒ Yes ☐ No

If Yes, describe the method(s) of outlet protection specified for each instance where a point source discharge will be generated. In addition, specifically reference SESC Site Plan Sheet Numbers which identify where the outlets will be constructed at the site and the corresponding control measures that will be utilized for their protection including any associated specifications required for their installation and maintenance.

Basin "A" (temporary sediment basin) will have a discharge outlet as shown on sheet 01C923, this outlet will have rip-rap outlet protection as detailed on the plan. Basin "B" (initially used as a sediment basin to be converted to a water quality/storm water management detention basin will have an outlet where the pipe enters a stone bed below surrounding grade and allowed to bubble up to the ground surface. Basin B is shown on sheets 01C912, 01C924 & 01C925.

If No, discuss rationale for not including these elements in the SESC Plan.

N/A

2.7 Establish Temporary Controls for the Protection of Post-Construction Stormwater Treatment Practices

Per RI Stormwater Design and Installation Standards Manual 3.3.7.8:

Temporary measures shall be installed to protect permanent or long-term stormwater control and treatment measures as they are installed and throughout the construction phase of the project so that they will function properly when they are brought online.

Examples of temporary control measures that can be used to protect permanent stormwater control measures include: establishing temporary sediment barriers around infiltrating practices, ensuring proper material staging areas and equipment routing (i.e. do not allow construction equipment to compact areas where infiltrating practices will be installed), and by conducting final cleaning of structural long term practices after construction is completed.

List and describe all post-construction stormwater treatment practices that will be installed during the construction process. Next, outline how these measures will be protected during the construction phase of the project to ensure that they will function appropriately once they are brought online.

Will long-term stormwater treatment practices be installed at the site?

☒ Yes ☐ No

If Yes, describe the specific long-term stormwater treatment practices that will require protection from sedimentation and compaction. In addition, specifically reference SESC Site Plan Sheet Numbers which identify the location of these practices and the corresponding control measures that will be utilized for their protection including any associated specifications required for their installation and maintenance.

Basin "B" will be converted to the final storm water control feature when the site is stabilized and no protection during construction will be necessary. There is an additional detention basin to be constructed adjacent to the construction staging area that will serve as a detention basin for the access road when it is constructed. A "dry swale" is being used along the road for water quality treatment prior to the water entering the detention basin.

If No, discuss rationale for not including these elements in the SESC Plan.

N/A

2.8 Divert or Manage Run-on from Up-gradient Areas

Per RI Stormwater Design and Installation Standards Manual 3.3.7.10:

Is stormwater from off-site areas anticipated to flow onto the project area or onto areas where soils will be disturbed?

☐ Yes ☒ No

If Yes, describe the specific runoff control measures (i.e., check dams, water bars, diversions, perimeter dikes, lined waterways, vegetated waterways, temporary line channels, sediment barriers, pipe slope drains, etc.) that will be utilized at the site including references to the SESC Site Plan Sheet Numbers, design specifications and details. See the RI SESC Handbook,Section Five: Runoff Control Measures for additional guidance.

Pre-Construction and Post Construction sub-watershed maps are included for each phase in this SESC Plan submittal.

Structural control measures will be used to limit stormwater flow from coming onto the project area, and to divert and slow on-site stormwater flow that is expected to impact exposed soils for the purpose of minimizing erosion, runoff, and the discharge of pollutants from the site.

Control measures shall be installed as depicted on the approved plan set and in accordance with the *RI SESC Handbook* or the *RI Department of Transportation Standard Specifications for Road and Bridge Construction*. **Run-on and Run-off Management**				
Construction Phase #	On-site or Off-site Run-on?	Control measure	Identified on Sheet #	Detail(s) is/are on Sheet #
N/A				

If No, discuss rationale for not including these elements in the SESC Plan.

On the northwest side of the site, construction grading will be cutting down below the grade that is falling away from the construction site. From the limits of disturbance, offsite water in the area will flow away from our site. If any offsite water flowing onto the Main Facility site occurs, it will be miniscule and have no impact on the construction site. At the southeast corner of the construction staging area there will be a detention basin constructed during site grading to provide detention for the new entrance road. Adjacent to this basin will be a diversion ditch constructed to prevent offsite stormwater from entering the basin. This ditch is part of the stormwater management plan and is not part of the SESC plan.

2.9 Retain Sediment Onsite through Structural and Non-Structural Practices

Per RI Stormwater Design and Installation Standards Manual 3.3.7.12:

Once the erosion control measures and the run-on diversions are identified and located on the plans, the next step to site planning is sediment control and sediment management. Sediment barriers, inlet protection, construction entrances, stockpile containment, temporary sediment traps, and temporary sediment basins must be integrated into the SESC Plan if applicable. Refer to the RI SESC Handbook Section Six: Sediment Control Measures for additional guidance.

Per RI Stormwater Design and Installation Standards Manual 3.3.7.9:

SEDIMENT BARRIERS must be installed along the perimeter areas of the site that will receive stormwater from disturbed areas. This also may include the use of sediment barriers along the contour of disturbed slopes to maintain sheet flow and minimize rill and gully erosion during construction. Installation and maintenance of sediment barriers must be completed in accordance with the maintenance requirements specified by the product manufacturer or the *RI SESC Handbook*.

Will sediment barriers be utilized at the toe of slopes and other downgradient areas subject to stormwater impacts and erosion during construction?

☒ Yes ☐ No

If Yes, Describe the rationale for selecting control measures to serve as sediment barriers at the toe of slopes and other down gradient areas subject to stormwater impacts during construction. Describe the specific sediment barriers that will be used at the site in the table provided.

Beyond the use of sediment basins, silt fencing will be the primary sediment barrier used at the toe of slopes and along linear aspects of the construction (access road and gas line construction). Silt fence that is running down a slope and not along a contour will be installed using J-hook method every third foot of elevation change along the path to minimize flow velocity along the silt fence and provide areas for siltation to occur. Silt fence will be constructed along the limits of disturbance fencing with the separation from the LOD fencing being field determined by the contractor. Some areas will require the silt fence to be installed right against the LOD fencing and other areas there will be flexibility to place the silt fence 3' away from the LOD fencing.

If No, discuss rationale for not including these elements in the SESC Plan.

N/A

Describe rationale for whether or sediment barriers are required at regular intervals along slopes in order to minimize the creation of concentrated flow paths (i.e. rilling, gully erosion) and to encourage sheet flow.

Keep in mind that sediment barriers can be placed at the toe, top, face, and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow. The description of the selected control measures must focus on sediment barrier spacing as a function of slope length and steepness. Refer to the RI SESC Handbook, Section Six: Sediment Control Measure, Straw Wattles, Compost Tubes, and Fiber Rolls Control Measure for additional information on acceptable spacing distances.

Will sediment barriers be utilized along the contour of slopes to maintain sheet flow and minimize rill and gully erosion during construction?

☐ Yes ☒ No

If Yes, list the specific sediment barriers that will be used at the site in the table provided. Describe the rationale for the locations and spacing frequency selected by the designer based on slope length and steepness. For additional guidance refer to the RI SESC Handbook or sediment barrier manufacturer's specifications.

SEDIMENT BARRIERS			
Construction Phase #	Sediment Barrier Type	Sediment Barrier is Labeled on Sheet #	Detail is on Sheet #
N/A			

If No, discuss rationale for not including these elements in the SESC Plan.

Due to the layout of the site, overland storm water flow will be toward the temporary sediment Basin "A". Any sediment barriers installed would be in the way of construction operations. Overland flow will be collected by a diversion ditch at the top of the sediment basin to direct flow to the south end of the basin. Although not anticipated to be needed, check dams will be installed in this diversion ditch to slow the flow velocity in the ditch, if needed. The existing gradient across the grading area toward the basin is between 1% and 2%. This relatively flat grade will help to minimize erosion and as the site is graded the slope approaches 0% with future drainage areas having a grade of 1% that will drain toward the storm drain inlets that will be installed.

Per RI Stormwater Design and Installation Standards Manual 3.3.7.6:

INLET PROTECTION will be utilized to prevent soil and debris from entering storm drain inlets. These measures are usually temporary and are implemented before a site is disturbed. ALL stormwater inlets &/or catch basins that are operational during construction and have the potential to receive sediment-laden stormwater flow from the construction site must be protected using control measures outlined in the *RI SESC Handbook*.

For more information on inlet protection refer to the *RI SESC Handbook*, Inlet Protection control measure.

Maintenance

The operator must clean, or remove and replace the inlet protection measures as sediment accumulates, the filter becomes clogged, and/or as performance is compromised. Accumulated sediment adjacent to the inlet protection measures should be removed by the end of the same work day in which it is found or by the end of the following work day if removal by the same work day is not feasible.

Describe controls, including design specifications and details, which will be implemented to protect all inlets receiving stormwater from the project during the entire duration of the project. For more information on inlet protection refer to the RI SESC Handbook Inlet Protection control measure.

Do inlets exist adjacent to or within the project area that require temporary protection?

☒ Yes ☐ No

If Yes, describe the method(s) of inlet protection, including maintenance requirements and complete the table provided.

The following lists the proposed storm drain inlet types selected from Section Six of the *RI SESC Handbook*. Each row is unique for each phase and inlet protection type.

INLET PROTECTION			
Construction Phase #	Inlet Protection Type	Inlet Protection is labeled on Sheet #	Detail(s) is/are on Sheet #
III	Filter Fabric Drop Inlet Protection	01C914 thru 01C917	01C922
IV	Filter Fabric Inlet inserts	01C918 thru 01C921 after paving	N/A

If No, discuss rationale for not including these elements in the SESC Plan.

N/A

CONSTRUCTION ENTRANCES will be used in conjunction with the stabilization of construction roads to reduce the amount of sediment tracking off the project. This project has avoided placing construction entrances on poorly drained soils where possible. Where poorly drained soils could not be eliminated, the detail includes subsurface drainage.

Any construction site access point must employ the control measures on the approved SESC site plans and in accordance with the *RI SESC Handbook*. Construction entrances shall be used in conjunction with the stabilization of construction roads to reduce the amount of mud picked up by construction vehicles. All construction access roads shall be constructed prior to any roadway accepting construction traffic.

The site owner and operator must:

1. Restrict vehicle use to properly designated exit points.
2. Use properly designed and constructed construction entrances at all points that exit onto paved roads so that sediment removal occurs prior to vehicle exit.
3. When and where necessary, use additional controls to remove sediment from vehicle tires prior to exit (i.e. wheel washing racks, rumble strips, and rattle plates).
4. Where sediment has been tracked out from the construction site onto the surface of off-site streets, other paved areas, and sidewalks, the deposited sediment must be removed by the end of the same work day in which the track out occurs. Track-out must be removed by sweeping, shoveling, or vacuuming these surfaces, or by using other similarly effective means of sediment removal.

Will construction entrances be utilized at the proposed construction site?

☒ Yes ☐ No

If Yes, indicate location(s) of vehicle entrance(s) and exit(s), and stabilization practices used to prevent sediment from being tracked off-site in the table provided. See also RI SESC Handbook, Section Six, Construction Entrances Measure.

CONSTRUCTION ENTRANCE			
Construction Phase #	Soil Type at the Entrance	Entrance is located on Sheet #	Detail is on Sheet #
Phase I	Soils are C/D classification	01C907	01C922

If No, discuss rationale.

N/A

STOCKPILE CONTAINMENT will be used onsite to minimize or eliminate the discharge of soil, topsoil, base material or rubble, from entering drainage systems or surface waters. All stockpiles must be located within the limit of disturbance, protected from run-on with the use of temporary sediment barriers and provided with cover or stabilization to avoid contact with precipitation and wind where and when practical.

Stock pile management consists of procedures and practices designed to minimize or eliminate the discharge of stockpiled material (soil, topsoil, base material, rubble) from entering drainage systems or surface waters.

For any stockpiles or land clearing debris composed, in whole or in part, of sediment or soil, you must comply with the following requirements:

1. Locate piles within the designated limits of disturbance.
2. Protect from contact with stormwater (including run-on) using a temporary perimeter sediment barrier.
3. Where practicable, provide cover or appropriate temporary vegetative or structural stabilization to avoid direct contact with precipitation or to minimize sediment discharge.
4. NEVER hose down or sweep soil or sediment accumulated on pavement or other impervious surfaces into any stormwater conveyance, storm drain inlet, or surface water.
5. To the maximum extent practicable, contain and securely protect from wind.

Describe materials expected to be stockpiled or stored on-site and procedures for storage of materials to minimize exposure of the materials to stormwater and to eliminate the discharge of stockpiled material from entering drainage systems and surface waters. Refer to the RI SESC Handbook, Stockpile and Staging Area Management Control Measure for additional guidance. Complete the table provided.

STOCKPILE CONTAINMENT

Construction Phase #	Run-on measures necessary? (yes/no)	Stabilization or Cover Type	Stockpile Containment Measure	Sheet #
Phase I	no	Temporary mulch/seeding	silt fence at base	01C906 & 01C907

CONSTRUCTED SEDIMENT STRUCTURES

If each common drainage location receives water from an area with less than one (1) acre disturbed at a time, this section can be deleted and no sediment traps or basins are required. However, it is important to remember that there is still a requirement to retain sediment on-site. Therefore, if it is in the best professional judgment of the designer, that there is a condition or circumstance which may require structural controls (per Section 3.3.7.13 of the RI Stormwater Design and Installation Standards Manual), this section can be used.

TEMPORARY SEDIMENT TRAPS will be utilized onsite. There will be no disturbed drainage areas greater than one acre that will be exposed for longer than six months. Design and sizing calculations in accordance with the *RI SESC Handbook*, Section Six are found in __N/A___ of this SESC Plan. A summary of the calculations are provided below:

For Disturbed Areas 1 to 5 Acres – Those areas with a common drainage location that serves an area between one (1) and five (5) acres disturbed at one time, a temporary sediment trap must be provided where attainable and where the sediment trap is only intended to be used for a period of six (6) months or less. For longer term projects with a common drainage location that serves between one (1) and five (5) acres disturbed at one time, a temporary sediment basin must be provided where attainable. Temporary sediment trapping practices must be designed in accordance with the RI SESC Handbook and must be sized to have a total storage volume capable of storing one (1) inch of runoff from the contributing area or one hundred and thirty four (134) cubic yards per acre of drainage area. A minimum of fifty percent (50%) of the total volume shall be storage below the outlet (wet storage). See RISDISM 3.3.7.12 for requirements and RI SESC Handbook, Section Six: Temporary Sediment Traps Measure for design details.

Are temporary sediment traps required at the site?

☐ Yes ☒ No

If Yes, complete the table provided. If an area greater than one acre will be exposed for longer than 6 months and a sediment trap is proposed, explain why the sediment basin was not attainable.

SEDIMENT TRAPS				
Construction Phase #	Exposed Area (acres)	Trap #	Sheet #	Detail found on Sheet#
N/A				

Trap #	Wet Storage Volume (cu.ft)	Dry Storage Volume (cu.ft.)	Cleanout Depth (ft)	Provide Reference to Location of Supporting Design and Sizing Calculations
N/A				

All traps will be functional and installed prior to disturbance in the contributing drainage area. Access for sediment removal is provided on the plans with cleanout depth requirements. The removed sediment will be utilized onsite or disposed of properly off-site.

If No, discuss rationale.

Sediment will be contained by the use of temporary sediment basins, all areas not served by the basins will be controlled through use of silt fencing.

TEMPORARY SEDIMENT BASIN(S) will be utilized onsite. Every effort must be made to prevent erosion and control it near the source.

If the following criterion does not apply to your proposed construction project, then this section may be eliminated from the plan.

For Disturbed Areas of 1 to 5 Acres – Those areas with a common drainage location that serves an area between one (1) and five (5) acres disturbed at one time for longer than six (6) months.

For Disturbed Areas > 5 Acres – Those areas with a common drainage location that serves an area with greater than five (5) acres disturbed at one time, a temporary (or permanent) sediment basin must be provided where attainable until final stabilization of the site is complete. Temporary sediment basins must be designed in accordance with the RI SESC Handbook. The volume of wet storage shall be at least twice the sediment storage volume and shall have a minimum depth of two (2) feet. Sediment storage volume must accommodate a minimum of one year of predicted sediment load as calculated using the sediment volume formula in the RI SESC Handbook. In addition to sediment storage volume and wet storage volume, the sediment basin shall provide adequate residence storage volume to provide a minimum 10 hours residence time for a ten (10) -year frequency, twenty four (24) hour duration, Type III distribution storm. To the maximum extent practicable, outlet structures must be utilized that withdraw water from the surface of temporary sedimentation basins for the purpose of minimizing the discharge of pollutants. Exceptions may include periods of extended cold weather, where alternative outlets are required during frozen periods. If such a device is infeasible for portions of or the entire construction period justification must be made in the SESC Plan. Describe the reasons sediment basins are required for this project. They may include physical conditions, land ownership, construction operations etc. For design details see RI SESC Handbook Section Six: Temporary Sediment Basins Measure.

Are temporary sediment basins required at the site?

☒ Yes ☐ No

If No, discuss rationale.

N/A

If Yes, complete the table provided.

There will be disturbed areas greater than 5 acres and/or disturbed areas greater than one acre but exposed for longer than six months. The basins have been located to intercept runoff only from disturbed areas and minimize interference with other construction activities and construction of utilities. They have been located outside of any natural buffers. The dam height is less than six feet and holds less than fifteen (15) acre-ft.

Modeling, Design and Sizing calculations in accordance with the *RI SESC Handbook*, Section Six are found in Appendices A & B of this SESC Plan. The designs were also prepared to satisfy Section

3.3.7.13 of the Stormwater Manual and will control Temporary Increases in Stormwater Velocity, Volume, and Peak Flows. A summary of the assumptions and calculations are provided below:

TEMPORARY SEDIMENT BASINS				
Construction Phase #	Exposed Area (acres)	Basin #	Sheet #	Detail found on Sheet#
I	3.20	A	01C906	01C923
II	7.23	B	01C912	01C924 & 01C925

Provide the following tables for each temporary sediment basin. Each basin shall be designed to contain sediment and runoff from the 10-year Type III distribution storm.

SEDIMENT BASIN #A **Pre-Development**					
Pre-Construction Cover Type	Contributing Area (acres)	Soil Type	Curve Number	Tc (minutes)	10- Year Type III (cfs, at time t, acre feet)
Drg Area 1, Forest	3.68	C/D	79	21.6	7.65 cfs, 0.833 af
Drg Area 2, Forest	4.97	C/D	79	19.1	10.86 cfs, 1.125 af
Drg Area 3, Basin-Newly Graded	3.20	C/D	94	10	12.89 cfs, 1.122 af
Total Pre-Construction Volume (cuft):					**134,165 cf**
During Construction					
Construction Cover Type	Contributing Area	Erosion Rates	Curve Number	Tc (minutes)	10-Year Type III (cfs, at time t, acre feet)
Drg Area 1, newly graded	5.11	50 tons/ac/yr	94	12.3	19.2 cfs, 1.792 af
Drg Area 2, newly graded	5.40	50 tons/ac/yr	94	12.3	20.3 cfs, 1.894 af
Drg Area 3, newly graded	4.90	50 tons/ac/yr	94	10	12.9 cfs, 1.122 af
Total Runoff Volume During Construction (cuft):					**209,436 cf**
Basin #A					
Pre-Construction Peak	Wet Storage Volume (cuft)	Sediment Storage Volume (cuft)	Residence Storage Volume	Outlet Max Discharge Rate (cfs)	Emergency Spillway Discharge Capacity

Discharge (cfs)			(cuft)		(cfs)
26.02	154,313	14,840	88,725	0.85	5.66
SEDIMENT BASIN #B Pre-Development					
Pre-Construction Cover Type	Contributing Area (acres)	Soil Type	Curve Number	Tc (minutes)	10- Year Type III (cfs, at time t, acre feet)
Drg Area 6, Forest Fair Cond	7.23	C/D	79	10	20.12 cfs, 1.636 af
Total Pre-Construction Volume (cuft):					**Insert Text**
During Construction					
Construction Cover Type	Contributing Area	Erosion Rates	Curve Number	Tc (minutes)	10-Year Type III (cfs, at time t, acre feet)
Drg Area 4, Newly Graded	8.14	50 tons/ac/yr	94	12.3 cfs	30.63 cfs, 2.855 af
Drg Area 5, Newly Graded	8.85	50 tons/ac/yr	94	11.5	34.1 cfs, 3.104 af
Drg Area 6, Newly Graded	7.23	50 tons/ac/yr	94	10	29.1 cfs, 2.536 af
Total Runoff Volume During Construction (cuft):					**Insert Text**
Basin #B					
Pre-Construction Peak Discharge (cfs)	Wet Storage Volume (cuft)	Sediment Storage Volume (cuft)	Residence Storage Volume (cuft)	Outlet Max Discharge Rate (cfs)	Emergency Spillway Discharge Capacity (cfs)
20.1	328,072	14,430	392,773	0.85	45.4

Discuss if baffles will be required in order to create effective flow length. The details should contain sediment storage markers.

No baffles are required, W & L requirements are met in basin B. See calcs in Appendices A & B. There is adequate sediment storage volume in each basin in excess of requirements. Semi-Annual cleaning of sediment will sufficiently maintain the basins and sediment storage markers are not warranted.

Describe the surface outlets. Identify whether or not these devices will be infeasible to use during periods of extended cold weather. If periods of extended cold weather are anticipated to be an issue, provide the operator with instructions for discharging from the basin using an alternate method during this period of *time. In addition, instruct the operator to document the justification for not using a surface outlet device during frozen periods in the inspection reports associated with these instances.*

Surface outlet consists of a Faircloth Skimmer in each basin sized to allow a max flow of 0.85 cfs. A 10 year storm event does not reach the primary inlet elevation of the outlet structure in either basin A or basin B.

All sediment basins will be functional and installed prior to disturbance in the contributing drainage area. Access for sediment removal is provided on the plans with cleanout depth specifications. The removed sediment will be utilized onsite or properly disposed of off-site.

2.10 Properly Design Constructed Stormwater Conveyance Channels

Conveyances are required to be designed for inlets to temporary sediment basins. The construction site planner must use best professional judgment to determine if additional conveyance design is required for run-on control or in any other location where velocity control is required.

Are temporary stormwater conveyance practices required in order to properly manage runoff within the proposed construction project?

☒ Yes ☐ No

If Yes, describe the specific control measures that will be used at the site. Provide or attach design calculations associated with each proposed conveyance measure, demonstrating that each one is designed and sized to handle the peak flow from a 10-year, 24-hour, Type III design storm. Note where within the site plans each specified conveyance is depicted, including specifications and construction details.

This site utilizes temporary diversion ditches to transport storm water to the desired inlet point of the sediment basins. Typically, the ditches have slopes in the 0.5% to 1.0% range to minimize velocity of flow in the channels. The ditches are shown on sheets 01C910 and 01C912 with details provided on 01C922.

The conveyance will be maintained as depicted on SESC Site Plans and in accordance with the *RI SESC Handbook* and if applicable.

If No, discuss rationale for not including conveyance measures in the SESC Plan.

N/A

2.11 Erosion, Runoff, and Sediment Control Measure List

Complete the following table for each Phase of construction where Erosion, Runoff, and Sediment Control Measures are located. This table is to be used as part of the SESC Plan Inspection Report – please fill out accordingly.

It is expected that this table and corresponding Inspection Reports will be amended as needed throughout the construction project as control measures are added or modified.

Phase No. I		
Location/Station	**Control Measure Description/Reference**	**Maintenance Requirement**
Perimeter of Site along all Limits of Disturbance	Silt Fence. Section Six, Sediment Control Measures – RI SESC Handbook	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the wattle if sediment accumulates to at least ½ the height of the silt fence
East Side of Facility Site, Sediment Basin A	Temporary Sediment Basin. Section Six, Sediment Control Measures – RI SESC Handbook	Basin is to be maintained by the removal of sediment semi-annually or when sedimentation depth reaches 3 inches in the bottom of the basin
Main Entrance off of Wallum Lake Road (RI Route 100)	Stone Construction Entrance. Section Six, Sediment Control Measures, Construction Entrances – RI SESC Handbook	The entrance shall be maintained in a condition which will prevent tracking or flowing of sediment onto paved surfaces. Provide periodic top dressing with additional stone or additional length as conditions demand. Repair any measures used to trap sediment as needed. Immediately remove all sediment spilled, dropped, washed or tracked onto paved surfaces. Roads adjacent to a construction site shall be cleaned as needed on a daily basis in accordance with RI SESC Handbood guidelines.
South end of Sediment Basin A	Two Rows of Silt Fence to break up slope long slope. Section Six, Sediment Control Measures – RI SESC Handbook	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the wattle if sediment accumulates to at least ½ the height of the silt fence
Around Soil Stockpile Area	Silt Fence. Section Six, Sediment Control Measures – RI SESC Handbook	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the wattle if sediment accumulates to at least ½ the height of the silt fence

Phase No. II		
Location/Station	**Control Measure Description/Reference**	**Maintenance Requirement**
Throughout site as storm system is installed.Silt Fence Drop	Silt Fence. Section Six, Sediment Control Measures, Silt Fence -	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed.

Inlet Protection	*RI SESC Handbook*.	Cleanout of accumulated sediment behind the silt if sediment accumulates to at least ½ the height of the silt fence
East side of main facility site, Sediment Basin B	Temporary Sediment Basin. Section Six, Sediment Control Measures – RI SESC Handbook	Basin is to be maintained by the removal of sediment annually or when sedimentation depth reaches 3 inches in the bottom of the basin

Phase No. III		
Location/Station	**Control Measure Description/Reference**	**Maintenance Requirement**
Site Storm Drain Inlets	Filter Fabric Inlet Filter. Section Six, Sediment Control Measures - *RI SESC Handbook*.	Inspect the fabric barrier after each rain event and make repairs as needed. Remove sediment from the pool area as necessary with care not to undercut or damage the filter fabric. Upon stabilization of the drainage area, remove all materials and unstable sediment and dispose of properly. Bring the adjacent area of the drop inlet to grade, smooth and compact and stabilize in the appropriate manner to the site.
Off-sie utlity installations	Silt Fence. Section Six, Sediment Control Measures, Silt Fence - *RI SESC Handbook*.	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the silt if sediment accumulates to at least ½ the height of the silt fence

SECTION 3: CONSTRUCTION ACTIVITY POLLUTION PREVENTION

Per RI Stormwater Design and Installation Standards Manual 3.3.7.14:

The purpose of construction activity pollution prevention is to prevent day to day construction activities from causing pollution.

This section describes the key pollution prevention measures that must be implemented to avoid and reduce the discharge of pollutants in stormwater. Example control measures include the proper management of waste, material handling and storage, and equipment/vehicle fueling/washing/maintenance operations.

Where applicable, include *RI SESC Handbook* or the *RI Department of Transportation Standard Specifications for Road and Bridge Construction* (as amended) specifications.

3.1 Existing Data of Known Discharges from Site

Per RIPDES Construction General Permit – Part III.I:

List and provide existing data (if available) on the quality of any known discharges from the site. Examples include discharges from existing stormwater collection systems, discharges from industrial areas of the site, etc.

Are there known discharges from the project area?

☐ Yes ☒ No

Describe how this determination was made:

- Site is currently undeveloped land covered in native vegetation and trees.

If yes, list discharges and locations:

- N/A

Is there existing data on the quality of the known discharges?

☐ Yes ☒ No

If yes, provide data:

- N/A

3.2 Prohibited Discharges

Per RI SESC Handbook – Part D

The following discharges are prohibited at the construction site:

- Contaminated groundwater, unless specifically authorized by the DEM. These types of discharges may only be authorized under a separate DEM RIPDES permit.
- Wastewater from washout of concrete, unless the discharge is contained and managed by appropriate control measures.
- Wastewater from washout and cleanout of stucco, paint, form release oils, curing compounds, and other construction materials.
- Fuels, oils, or other pollutants used in vehicle and equipment operation and maintenance. Proper storage and spill prevention practices must be utilized at all construction sites.
- Soaps or solvents used in vehicle and equipment washing.
- Toxic or hazardous substances from a spill or other release.

All types of waste generated at the site shall be disposed of in a manner consistent with State Law and/or regulations.

Will any of the above listed prohibited discharges be generated at the site?

☒ Yes ☐ No

If Yes, provide a list of those that will be generated at the site and provide a discussion of how they will be managed, including references to the specific SESC Site Plans where such control measures are specified.

Prohibited discharges anticipated on this site:

1. **Concrete washout** – concrete washout will be captured in a concrete washout pit to be constructed during SESC Phase I installation. The pit will be located in construction staging area. If contractor determines that more than one pit will be needed for construction operations, then additional pits can be installed in the same general area of the construction staging area. Pits are to be inspected daily for overall condition, performance and remaining capacity. Maintenance of the washout pits are to be performed in accordance with the Rhode Island Soil Erosion and Sediment Control Handbook, Section 3 – Concrete Washouts.
2. **Vehicle Fueling, Maintenance and Washing** – areas for vehicle fueling and maintenance are identified within the construction staging area that will be constructed during SESC Phase I installation. A berm or sandbags will be used around the area to contain any pollutants and prevent storm water contamination. Drip pads and/or absorbent material will be utilized and the contractor will have spill cleanup materials readily available for use if needed. Employees and subcontractors are to be trained in proper fueling and cleanup procedures. Contractor shall refer to the Rhode Island Soil Erosion and Sediment Control Handbook, Section 3 – Vehicle Fueling, Maintenance and Washing for all appropriate operational and maintenance procedures that may apply to operations at this site.
3. **Hazardous Materials** – an area for hazardous materials storage is denoted within the construction staging area. This area is for storage of any other hazardous material not associated with vehicles. A berm or sandbags shall be used around the area to contain any spills. All materials are to be stored, handled and disposed of in accordance with manufacturers specifications and all federal, state and local ordinances.

All prohibited discharges will be captured in a manner meeting Rhode Island requirements. Concrete washout will be captured in a concrete washout pit to be constructed during Phase I installation. Fuels, oils and other pollutants will be contained within an equipment maintenance location to be determined by the contractor within the construction staging area shown on sheet SESC-2. Other discharges (if any)remain to be determined.

If No, discuss rationale.

N/A

3.3 Proper Waste Disposal

Per RI SESC Handbook – Part D

Building materials and other construction site wastes must be properly managed and disposed of in a manner consistent with State Law and/or regulations.

- A waste collection area shall be designated on the site that does not receive a substantial amount of runoff from upland areas and does not drain directly to a waterbody or storm drain.
- All waste containers shall be covered to avoid contact with wind and precipitation.
- Waste collection shall be scheduled frequently enough to prevent containers from overfilling.

- All construction site wastes shall be collected, removed, and disposed of in accordance with applicable regulatory requirements and only at authorized disposal sites.

- Equipment and containers shall be checked for leaks, corrosion, support or foundation failure, or other signs of deterioration. Those that are found to be defective shall be immediately repaired or replaced.

Is waste disposal a significant element of the proposed project?

☒ Yes ☐ No

If Yes, identify potential building materials and other construction wastes and document how these wastes will be properly managed and disposed of at the construction site (i.e., trash disposal, sanitary wastes, recycling, and proper material handling). Include references to the specific SESC Site Plans where such control measures are specified.

Anticipated wastes for this project include refuse concrete, municipal wastes (rubbish), scrap steel, erosion control devices, and construction related plastic. All wastes shall attempt to be recycled at a DEM approved facility first; failing recycling, all wastes shall be disposed of an a DEM approved refuse site.

All waste disposal will be done in accordance with the Rhode Island Soil Erosion and Sediment Control Handbook, Section 3 – Waste Management.

If No, discuss rationale.

N/A

3.4 Spill Prevention and Control

Per RI SESC Handbook – Part D

All chemicals and/or hazardous waste material must be stored properly and legally in covered areas, with containment systems constructed in or around the storage areas. Areas must be designated for materials delivery and storage. All areas where potential spills can occur and their accompanying drainage points must be described. The owner and operator must establish spill prevention and control measures to reduce the chance of spills, stop the source of spills, contain and clean-up spills, and dispose of materials contaminated by spills. The operator must establish and make highly visible location(s) for the storage of spill prevention and control equipment and provide training for personnel responsible for spill prevention and control on the construction site.

Are spill prevention and control measures required for this particular project?

☒ Yes ☐ No

If Yes, describe all areas where potential spills can occur, and their accompanying drainage points, and describe the spill prevention and control plan to reduce the chance of spills, stop the source of spills, contain and clean up spills, dispose of materials contaminated by spills, and train personnel responsible for spill prevention and control. Provide the method of establishing and making highly visible the location(s) for the storage of spill prevention equipment. Refer to the RI SESC Handbook, Spill Prevention and Control Plan for guidance.

- All chemicals and/or hazardous waste materials must be stored within the hazardous materials storage area designated within the construction staging area. This area will be covered and surrounded by a berm to allow for containment of any spills. The storage area is shown on sheet 01C907. The contractor will provide spill cleanup materials in the area.

Employees and subcontractors will be trained in proper handling techniques and spill cleanup procedures before construction commences. Spills could occur anywhere on site during construction and the contractor will submit to the owner a "Spill Prevention and Control Plan" for approval prior to commencement of construction activities. Any materials collected from clean-up of spills will be disposed of in a manner approved by federal, state and local regulations. Refer to Appendix "G" of the Rhode Island Soil Erosion and Sediment Control Handbook for additional details.

If No, discuss rationale.

N/A

3.5 Control of Allowable Non-Stormwater Discharges

Per RIPDES Construction General Permit – Part III.J.2.e:

Discharges not comprised of stormwater are allowed under the RIPDES Construction General Permit but are limited to the following: discharges which result from the washdown of vehicles where no detergents are used; external building wash-down where no detergents are used; the use of water to control dust; firefighting activities; fire hydrant flushing; natural springs; uncontaminated groundwater; lawn watering; potable water sources including waterline flushing; irrigation drainage; pavement wash waters where spills or leaks of toxic or hazardous materials have not occurred (unless all spilled materials have been removed) and where detergents are not used; and foundation or footing drains where flows are not contaminated with process materials such as solvents, or contaminated by contact with soils where spills or leaks of toxic or hazardous materials has occurred. If any of these discharges may reasonably be expected to be present and to be mixed with stormwater discharges, they must be specifically listed here.

Are there allowable non-Stormwater discharges present on or near the project area?

☐ Yes ☒ No

If yes, list the sources of allowable non-Stormwater discharge(s) associated with construction activity. For each of the allowable non-stormwater discharge(s) identified, describe the controls and measures that will be implemented at those locations to minimize pollutant contamination of these discharges and to separate them from temporary discharges of stormwater during construction.

List of allowable non-stormwater discharge(s) and the associated control measure(s):

- N/A

If any existing or proposed discharges consist of contaminated groundwater, such discharges are not authorized under the RIPDES Construction General Permit. These discharges must be permitted separately by seeking coverage to treat and discharge under a separate RIPDES individual permit or under the RIPDES Remediation General Permit. Contact the RIDEM Office of Water Resources RIPDES Permitting Program at 401-222-4700 for application requirements and additional information.

Are there any known or proposed contaminated discharges, including anticipated contaminated dewatering operations, planned on or near the project area?

☐ Yes ☒ No

If yes, list the discharge types and the RIPDES individual permit number(s) or RIPDES Remediation General Permit Authorization number(s) associated with these discharges.

- Discharge Type and RIPDES Individual Permit number : N/A
- Discharge Type and RIPDES Remediation General Permit Authorization number: N/A

3.6 Control Dewatering Practices

Per RI SESC Handbook – Part D

Site owners and operators are prohibited from discharging groundwater or accumulated stormwater that is removed from excavations, trenches, foundations, vaults, or other similar points of accumulation, unless such waters are first effectively managed by appropriate control measures.

Examples of appropriate control measures include, but are not limited to, temporary sediment basins or sediment traps, sediment socks, dewatering tanks and bags, or filtration systems (e.g. bag or sand filters) that are designed to remove sediment. Uncontaminated, non-turbid dewatering water can be discharged without being routed to a control.

At a minimum the following discharge requirements must be met for dewatering activities:

1. Do not discharge visible floating solids or foam.
2. To the extent feasible, utilize vegetated, upland areas of the site to infiltrate dewatering water before discharge. In no case will surface waters be considered part of the treatment area.
3. At all points where dewatering water is discharged, utilize velocity dissipation devices.
4. With filter backwash water, either haul it away for disposal or return it to the beginning of the treatment process.
5. Replace and clean the filter media used in dewatering devices when the pressure differential equals or exceeds the manufacturer's specifications.
6. Dewatering practices must involve the implementation of appropriate control measures as applicable (i.e. containment areas for dewatering earth materials, portable sediment tanks and bags, pumping settling basins, and pump intake protection.)

Is it at all likely that the site operator will need to implement construction dewatering in order to complete the proposed project?

☐ Yes ☒ No

If Yes, describe all areas where construction dewatering may be required and the proposed control measures that will be used to treat and manage dewatering fluids including all proposed discharge points. Proposed control measures must comply with the RI SESC Handbook. Include references to all relevant SESC Site Plans.

- N/A

If No, discuss rationale.

No dewater activities are anticipated on the project. If any arise an appropriate plan will be developed.

3.7 Establish Proper Building Material Staging Areas

Per RI SESC Handbook – Part D

All construction materials that have the potential to contaminate stormwater must be stored properly and legally in covered areas, with containment systems constructed in or around the storage areas. Areas must be designated for materials delivery and storage. Designated areas shall be approved by the site owner/engineer. Minimization of exposure is not required in cases where the exposure to precipitation and to stormwater will not result in the discharge of pollutants, or where exposure of a specific material or product poses little risk of stormwater contamination (such as final products and materials intended for outdoor use).

Describe construction materials expected to be stored on-site and procedures for storage of materials to minimize exposure of the materials to stormwater. Include references to all relevant SESC Site Plans.

Material typical in the construction of a power plant facility will be stored onsite. These will include typical building materials such as steel, wood, drywall, insulation, plastics, piping, wiring, finishing materials such as paints and other associated materials. Contractor will provide for appropriate protection of stored materials to prevent exposure to precipitation necessary to prevent discharge of pollutants from the storage area. Storage of materials will be typically located within the construction staging area shown on Sheet 01C907.

3.8 Minimize Dust

Per RI SESC Handbook – Part D

Dust control procedures and practices shall be used to suppress dust on a construction site during the construction process, as applicable. Precipitation, temperature, humidity, wind velocity and direction will determine amount and frequency of applications. However, the best method of controlling dust is to prevent dust production. This can best be accomplished by limiting the amount of bare soil exposed at one time. Dust Control measures outlined in the *RI SESC Handbook* shall be followed. Other dust control methods include watering, chemical application, surface roughening, wind barriers, walls, and covers.

Describe dust control practices that will be used to suppress dust and limit its generation (i.e. applying water, limiting the amount of bare soil exposed at one time etc.).

Dust Control will be performed through the application of water, if needed.

3.9 Designate Washout Areas

Per RI SESC Handbook – Part D

At no time shall any material (concrete, paint, chemicals) be washed into storm drains, open ditches, streets, streams, wetlands, or any environmentally sensitive area. The site operator must ensure that construction waste is properly disposed of, to avoid exposure to precipitation, at the end of each working day.

Will washout areas be required for the proposed project?

☒ Yes ☐ No

If Yes, describe location(s) and control measures that will be used to minimize the discharge of pollutants from equipment and vehicle washing, wheel wash water, washout areas for concrete mixers, paint, stucco, etc. The recommended location(s) of washout areas should be identified, or at a minimum the locations where these washout areas should not be sited should be called out.

Concrete washout pit or pits will be established for site construction. An area for concrete washout pits is noted on sheet 01C907 Any additional washout features (i.e. paints and or chemicals) will have to be determined by the contractor as he develops his construction plan.

If No, discuss rationale.

N/A

3.10 Establish Proper Equipment/Vehicle Fueling and Maintenance Practices

Per RI SESC Handbook – Part D

Vehicle fueling shall not take place within regulated wetlands or buffer zone areas, or within 50-feet of the storm drain system. Designated areas shall be depicted on the SESC Site Plans, or shall be approved by the site owner.

Vehicle maintenance and washing shall occur off-site, or in designated areas depicted on the SESC Site Plans or approved of by the site owner. Maintenance or washing areas shall not be within regulated wetlands or buffer zone areas, or within 50-feet of the storm drain system. Maintenance areas shall be clearly designated, and barriers shall be used around the perimeter of the maintenance area to prevent stormwater contamination.

Construction vehicles shall be inspected frequently for leaks. Repairs shall take place immediately. Disposal of all used oil, antifreeze, solvents and other automotive-related chemicals shall be according to applicable regulations; at no time shall any material be washed down the storm drain or in to any environmentally sensitive area.

Describe equipment/vehicle fueling and maintenance practices that will be implemented to prevent pollutants from mixing with stormwater (e.g., secondary containment, drip pans, spill kits, etc.) Provide recommended location(s) of fueling/maintenance areas, or, at minimum, locations where fueling/maintenance should be avoided.

A fueling/maintenance area is identified within the construction staging area near the Wallum Lake Road entrance. This area is denoted on sheet 01C907. Regular maintenance should include drip pans to capture pollutants and the area will be surrounded by a berm to contain any spills that may occur as a secondary containment measure. Contractor shall keep spill kits available for use in the area as needed. All installed measures, practices and materials shall meet Rhode Island governing regulations

3.11 Chemical Treatment for Erosion and Sediment Control

Per RI SESC Handbook – Appendix J

Chemical stabilizers, polymers, and flocculants are readily available on the market and can be easily applied to construction sites for the purposes of enhancing the control of erosion, runoff, and sedimentation. The following guidelines should be adhered to for construction sites that plan to use treatment chemicals as part of their overall erosion, runoff, and sedimentation control strategy.

The U.S. Environmental Protection Agency has conducted research into the relative toxicity of chemicals commonly used for the treatment of construction stormwater discharges. The research conducted by the EPA focused on different formulations of chitosan, a cationic compound, and both cationic and anionic polyacrylamide (PAM). In summary, the studies found significant toxicity resulting from the use of chitosan and cationic PAM in laboratory conditions, and significantly less toxicity associated with using anionic PAM. EPA's research has led to the conclusion that the use of treatment chemicals for erosion, runoff, and sedimentation control requires proper operator training and appropriate usage to avoid risk to aquatic species. In the case of cationic treatment chemicals additional safeguards may be necessary.

Application/Installation Minimum Requirements

If a site operator plans to use polymers, flocculants, or other treatment chemicals during construction the SESC plan must address the following:

1. Treatment chemicals shall not be applied directly to or within 100 feet of any surface water body, wetland, or storm drain inlet.

2. Use conventional erosion, runoff, and sedimentation controls prior to and after the application of treatment chemicals. Use conventional erosion, runoff, and sedimentation controls prior to chemical addition to ensure effective treatment. Chemicals may only be applied where treated stormwater is directed to a sediment control (e.g. temporary sediment basin, temporary sediment trap or sediment barrier) prior to discharge.

3. Sites shall be stabilized as soon as possible using conventional measures to minimize the need to use chemical treatment.

4. Select appropriate treatment chemicals. Chemicals must be selected that are appropriately suited to the types of soils likely to be exposed during construction and to the expected turbidity, pH, and flow rate of stormwater flowing into the chemical treatment system or treatment area. **Soil testing is essential. Using the wrong form of chemical treatment will result in some form of performance failure and unnecessary environmental risk.**

5. Minimize discharge risk from stored chemicals. Store all treatment chemicals in leak-proof containers that are kept under storm-resistant cover and surrounded by secondary containment structures (e.g., spill berms, decks, spill containment pallets), or provide equivalent measures, designed and maintained to minimize the potential discharge of treatment chemicals in stormwater or by any other means (e.g., storing chemicals in covered areas or having a spill kit available on site).

6. Use chemicals in accordance with good engineering practices and specifications of the chemical provider/supplier. You must also use treatment chemicals and chemical treatment systems in accordance with good engineering practices, and with dosing specifications and sediment removal design specifications provided by the supplier of the applicable chemicals, or document specific departures from these practices or specifications and how they reflect good engineering practice.

Will chemical stabilizers, polymers, flocculants or other treatment chemicals be utilized on the proposed construction project?

☐ Yes ☒ No

If Yes, create a Treatment Chemical Application Plan and describe how the owner or SESC Plan preparer/designer intends to educate the designated operator prior to the application of such treatment chemicals.

Treatment Chemical Application Plan Required Elements

Insert information listed below:

1. *List Manufacturer's name and product name for each treatment chemical proposed for use at the site.*
2. *Attach a copy of applicable Material Safety Data Sheets (MSDSs) or Safety Data Sheets (SDS) for each proposed treatment chemical.*
3. *Provide the results of third party toxicity testing of the materials proposed for use at the site.*
4. *Provide a certification from the site owner and operator that all proposed treatment chemicals are the same as those used in the toxicity tests and will not be altered in any way.*
5. *Provide an explanation as to why conventional erosion, runoff, and sediment control measures, alone or in combination, will not be sufficient to prevent turbidity impacts and sedimentation in downstream receptors.*

6. *Provide a plan prepared in consultation with the chemical treatment manufacturer(s) or authorized manufacturer's representative which includes the following:*
    a. *Identification of the areas of the site where treatment chemicals will be applied and the name, location, and distance to all downstream receptors that have the potential to be impacted from the discharges from the treatment areas.*
    b. *List the expected start and end dates or specific phases of the project during which each treatment chemical will be applied.*
    c. *Provide test results for representative soils from the site, and any recommendations from the manufacturer based on the soil tests, indicating the type of treatment chemical and the recommended application rate.*
    d. *List the frequency, method, and rates of application which are designed to ensure that treatment chemical concentrations will not exceed 50% of the IC25 or NOEC toxicity values, whichever is less, for each treatment chemical proposed.*
    e. *Provide the frequency of inspection and maintenance of the treatment chemical application system.*
    f. *List the method proposed for the collection, removal, and disposal or stabilization of settled particles to prevent re-suspension.*
    g. *Describe the training that will be provided to all persons who will handle and use treatment chemicals at the construction site. Training must include appropriate, product-specific training and proper dosing requirements for each product.*

Treatment Chemical SESC Plan Weekly Inspection Report Documentation Requirements

1. Document the type and quantity of treatment chemicals applied.
2. List the date, duration of discharge, and estimated discharge rate.
3. Provide an estimate of the volume of water treated.
4. Provide an estimate of the concentration of treatment chemicals in the discharge, with supporting calculations.

3.12 Construction Activity Pollution Prevention Control Measure List

Complete the following table for each Phase of construction where Pollution Prevention Control Measures will be implemented. This table is to be used as part of the SESC Plan Inspection Report – please fill out accordingly.

It is expected that this table will be amended as needed throughout the construction project.

Phase No. I		
Location/Station	**Control Measure Description/Reference**	**Maintenance Requirement**
	Concrete Washout. Used to contain	Verify that concrete washout facility is in place prior to pouring concrete. Inspect daily to verify

Near Construction Staging Area and possibly on the main facility site as needed	concrete washout during concrete pouring operations. Section Three: Pollution Prevention and Good Housekeeping, Concrete Washouts, *RI SESC Handbook*.	continued proper performance. Check remaining capacity during pouring operations. Check for leaks periodically.
Within Construction Staging Area	Vehicle Maintenance Area. Section Three: Pollution Prevention and Good Housekeeping, Vehicle Fueling, Maintenance and Washing, *RI SESC Handbook*.	Enclose or cover stored fuel. Use a covered, paved area dedicated to vehicle maintenance and washing. Develop a spill prevention and cleanup plan. Prevent hazardous chemical leaks by properly maintaining vechles and equipmenet Properly cover and provide secondary containment for fuel drums and toxic materials. Properly handle and dispose of vehicle wastes and wash water. Train employees and subcontractors in proper procedures.

SECTION 4: CONTROL MEASURE INSTALLATION, INSPECTION, and MAINTENANCE

4.1 Installation

Per RI SESC Handbook – Part D:

Complete the installation of temporary erosion, runoff, sediment, and pollution prevention control measures by the time each phase of earth-disturbance has begun. All stormwater control measures must be installed in accordance with good judgment, including applicable design and manufacturer specifications. Installation techniques and maintenance requirements may be found in manufacturer specifications and/or the *RI SESC Handbook*.

Include references to SESC Site Plans where installation requirements are located.

Phase I (Sheets 01C905 thru 01C909) – Complete installation of LOD construction fencing, perimeter silt fencing and construction entrance and inspect these installations. If acceptable continue to install staging area, Sediment Basin A and associated diversion ditches.

Phase II (Sheet 01C910 thru 01C913) – Begin mass grading, construct Sediment Basin B, as runoff is able to be diverted into basin B from Basin A, then filling in Basin A can begin. Diversion ditches will move to the east as basin A is filled to divert runoff into basin B. Place topsoil in soil stockpile area designated and provide silt fence protection as the toe of the stockpile slope. Continue to maintain perimeter silt fence installations and construction entrance.

Phase III (01C914 thru 01C917) – Begin facility construction. As storm drainage system is installed, provide Silt Fence inlet protection. Provide silt fence protection for off site utility construction. Continue to maintain perimeter silt fences and construction entrance.

Phase IV (01C918 thru 01C921) – As areas are stabilized and paved, replace Silt Fence Inlet protection with inlet filter protection within the inlets. Complete finish grading and install permanent seeding, sodding and planting. Convert Basin B into final Water Quality/Detention Basin. Remove all temporary erosion and sediment control devices when contributing areas are stabilized. Distribute remaining topsoil over the staging areas not to remain. Clean up construction staging area to remain for future use and top dress with gravel where needed.

4.2 Monitoring Weather Conditions

Per RI SESC Handbook – Part D:

Anticipating Weather Events - Care will be taken to the best of the operator's ability to avoid disturbing large areas prior to anticipated precipitation events. Weather forecasts must be routinely checked, and in the case of an expected precipitation event of over 0.25-inches over a 24-hour period, it is highly recommended that all control measures should be evaluated and maintained as necessary, prior to the weather event. In the case of an extreme weather forecast (greater than one-inch of rain over a 24-hour period), additional erosion/sediment controls may need to be installed.

Storm Event Monitoring For Inspections - At a minimum, storm events must be monitored and tracked in order to determine when post-storm event inspections must be conducted. Inspections must be conducted and documented at least once every seven (7) calendar days and within twenty-four (24) hours after any storm event, which generates at least 0.25 inches of rainfall per twenty-four (24) hour period and/or after a significant amount of runoff or snowmelt.

In order for an operator to successfully satisfy this requirement list the weather gauge station that will be utilized to monitor weather conditions on the construction site. See www.wunderground.com or www.weather.gov for available stations.

The weather gauge station and website that will be utilized to monitor weather conditions on the construction site is as follows:

- Utilize the Whipple (KRIHARRI30 rain gage station for rainfall monitoring. Website, https://www.wunderground.com/history/airport/KSFZ/2016/09/12/DailyHistory.html?req_city=Burrillville&req_state=RI&reqdb.zip=02830&reqdb.magic=2&reqdb.wmo=99999

4.3 Inspections

Per RI SESC Handbook – Part D:

Minimum Frequency - Each of the following areas must be inspected by or under the supervision of the owner and operator at least once every seven (7) calendar days and within twenty-four (24) hours after any storm event, which generates at least 0.25 inches of rainfall per twenty-four (24) hour period and/or after a significant amount of runoff or snowmelt:

a. All areas that have been cleared, graded, or excavated and where permanent stabilization has not been achieved;

b. All stormwater erosion, runoff, and sediment control measures (including pollution prevention control measures) installed at the site;

c. Construction material, unstabilized soil stockpiles, waste, borrow, or equipment storage, and maintenance areas that are covered by this permit and are exposed to precipitation;

d. All areas where stormwater typically flows within the site, including temporary drainage ways designed to divert, convey, and/or treat stormwater;

e. All points of discharge from the site;

f. All locations where temporary soil stabilization measures have been implemented;

g. All locations where vehicles enter or exit the site.

Reductions in Inspection Frequency - If earth disturbing activities are suspended due to frozen conditions, inspections may be reduced to a frequency of once per month. The owner and operator must document the beginning and ending dates of these periods in an inspection report.

Qualified Personnel – The site owner and operator are responsible for designating personnel to conduct inspections and for ensuring that the personnel who are responsible for conducting the inspections are "qualified" to do so. A "qualified person" is a person knowledgeable in the principles and practices of erosion, runoff, sediment, and pollution prevention controls, who possesses the skills to assess conditions at the construction site that could impact stormwater quality, and the skills to assess the effectiveness of any stormwater controls selected and installed to meet the requirements of the permit.

Recordkeeping Requirements - All records of inspections, including records of maintenance and corrective actions must be maintained with the SESC Plan. Inspection records must include the date and time of the inspection, and the inspector's name, signature, and contact information.

General Notes

- A separate inspection report will be prepared for each inspection.

- The Inspection Reference Number shall be a combination of the RIPDES Construction General Permit No - consecutively numbered inspections. ex/ Inspection reference number for the **4**th inspection of a project would be: RIR10####-**4**

- Each report will be signed and dated by the Inspector and must be kept onsite.

- Each report will be signed and dated by the Site Operator.

- The corrective action log contained in each inspection report must be completed, signed, and dated by the site operator once all necessary repairs have been completed.

- It is the responsibility of the site operator to maintain a copy of the SESC Plan, copies of all completed inspection reports, and amendments as part of the SESC Plan documentation at the site during construction.

Failure to make and provide documentation of inspections and corrective actions under this part constitutes a violation of your permit and enforcement actions under 46-12 of R.I. General Laws may result.

4.4 Maintenance

Per RI SESC Handbook – Part D:

Maintenance procedures for erosion and sedimentation controls and stormwater management structures/facilities are described on the SESC Site Plans and in the *RI SESC Handbook*.

Site owners and operators must ensure that all erosion, runoff, sediment, and pollution prevention controls remain in effective operating condition and are protected from activities that would reduce their effectiveness. Erosion, runoff, sedimentation, and pollution prevention control measures must be maintained throughout the course of the project.

Note: It is recommended that the site operator designates a full-time, on-site contact person responsible for working with the site owner to resolve SESC Plan-related issues.

4.5 Corrective Actions

Per RI SESC Handbook – Part D:

If, in the opinion of the designated site inspector, corrective action is required, the inspector shall note it on the inspection report and shall inform the site operator that corrective action is necessary. The site operator must make all necessary repairs whenever maintenance of any of the control measures instituted at the site is required.

In accordance with the *RI SESC Handbook*, the site operator shall initiate work to fix the problem immediately after its discovery, and complete such work by the close of the next work day, if the problem does not require significant repair or replacement, or if the problem can be corrected through routine maintenance.

When installation of a new control or a significant repair is needed, site owners and operators must ensure that the new or modified control measure is installed and made operational by no later than seven (7) calendar days from the time of discovery where feasible. If it is infeasible to complete the installation or repair within seven (7) calendar days, the reasons why it is infeasible must be documented in the SESC Plan along with the schedule for installing the control measures and making it operational as soon as practicable after the 7-day timeframe. Such documentation of these maintenance procedures and timeframes should be described in the inspection report in which the issue was first documented. If these actions result in changes to any of the control measures outlined in the SESC Plan, site owners and operators must also modify the SESC Plan accordingly within seven (7) calendar days of completing this work.

SECTION 5: AMENDMENTS

Per RIPDES Construction General Permit – Part III.F:

This SESC Plan is intended to be a working document. It is expected that amendments will be required throughout the active construction phase of the project. **Even if practices are installed on a site according to the approved plan, the site is only in compliance when erosion, runoff, and sedimentation are effectively controlled throughout the entire site for the entire duration of the project.**

The SESC Plan shall be amended within seven (7) days whenever there is a change in design, construction, operation, maintenance or other procedure which has a significant effect on the potential for the discharge of pollutants, or if the SESC Plan proves to be ineffective in achieving its objectives (i.e. the selected control measures are not effective in controlling erosion or sedimentation).

In addition, the SESC Plan shall be amended to identify any new operator that will implement a component of the SESC Plan.

All revisions must be recorded in the Record of Amendments Log Sheet, which is contained in Attachment G of this SESC Plan, and dated red-lined drawings and/or a detailed written description must be appended to the SESC Plan. Inspection Forms must be revised to reflect all amendments. Update the Revision Date and the Version # in the footer of the Report to reflect amendments made.

All SESC Plan Amendments, except minor non-technical revisions, must be approved by the site owner and operator. Any amendments to control measures that involve the practice of engineering must be reviewed, signed, and stamped by a Professional Engineer registered in the State of RI.

The amended SESC plan must be kept on file at the site while construction is ongoing and any modifications must be documented.

Attach a copy of the Amendment Log.

Reference RI Model SESC Plan ATTACHMENT G

SECTION 6: RECORDKEEPING

RIPDES Construction General Permit – Parts III.D, III.G, III.J.3.b.iii, & V.O

It is the site owner and site operator's responsibility to have the following documents available at the construction site and immediately available for RIDEM review upon request:

- A copy of the fully signed and dated SESC Plan, which includes:
  - A copy of the General Location Map
    INCLUDED AS ATTACHMENT A
  - A copy of all SESC Site Plans
    INCLUDED AS ATTACHMENT B
  - A copy of the RIPDES Construction General Permit *(To save paper and file space, do not include in DEM/CRMC submittal, for operator copy only)*
    INCLUDED AS ATTACHMENT C
  - A copy of any regulatory permits (RIDEM Freshwater Wetlands Permit, CRMC Assent, RIDEM Water Quality Certification, RIDEM Groundwater Discharge Permit, RIDEM RIPDES Construction General Permit authorization letter, etc.)
    INCLUDED AS ATTACHMENT D
  - The signed and certified NOI form or permit application form *(if required as part of the application, see RIPDES Construction General Permit for applicability)*
    INCLUDED AS ATTACHMENT E
  - Completed Inspection Reports w/Completed Corrective Action Logs
    INCLUDED AS ATTACHMENT F
  - SESC Plan Amendment Log
    INCLUDED AS ATTACHMENT G

SECTION 7: PARTY CERTIFICATIONS

RIPDES Construction General Permit – Part V.G

All parties working at the project site are required to comply with the Soil Erosion and Sediment Control Plan (SESC Plan including SESC Site Plans) for any work that is performed on-site. The site owner, site operator, contractors and sub-contractors are encouraged to advise all employees working on this project of the requirements of the SESC Plan. A copy of the SESC Plan is available for your review at the following location: Insert Onsite Location Here, or may be obtained by contacting the site owner or site operator.

The site owner and site operator and each subcontractor engaged in activities at the construction site that could impact stormwater must be identified and sign the following certification statement.

I acknowledge that I have read and understand the terms and conditions of the Soil Erosion and Sediment Control (SESC) Plan for the above designated project and agree to follow the control measures described in the SESC Plan and SESC Site Plans.

Site Owner:
Insert Company or Organization Name
Insert Name & Title
Insert Address ______________________________
Insert City, State, Zip Code signature/date
Insert Telephone Number, Insert Fax/Email

Site Operator:
Insert Company or Organization Name
Insert Name & Title
Insert Address ______________________________
Insert City, State, Zip Code signature/date
Insert Telephone Number, Insert Fax/Email

Designated Site Inspector:
Insert Company or Organization Name
Insert Name & Title
Insert Address ______________________________
Insert City, State, Zip Code signature/date
Insert Telephone Number, Insert Fax/Email

SubContractor SESC Plan Contact:
Insert Company or Organization Name
Insert Name & Title
Insert Address ______________________________
Insert City, State, Zip Code signature/date
Insert Telephone Number, Insert Fax/Email

Insert more contact/signature lines as necessary

LIST OF APPENDICES

LIST OF ATTACHMENTS

Appendix A

Temporary Sediment Basin A

HDR

Project:		Computed:	Date:
Subject:	Basin A Calcs	Checked:	Date:
Task:		Page: 1	of: 9
Job #:		No:	

Basin A:

Contributing Area = DA#1 + DA#2 + DA#3
= 5.11 Ac + 5.40 Ac + 3.20 Ac = 13.71 Ac

Assume No Grass cover on All Areas - Worst Case.
Assume Newly Graded Area Soil type D - CN=94

Pre Developed Conditions:

DA#1 has 1.43 Acres that does not drain to Basin A
DA#1 Pre-grade = 5.11 - 1.43 = 3.68 Ac

DA#2 has 0.43 Acres that does not drain to Basin A
DA#2 Pre-grade = 5.40 - 0.43 = 4.97 Ac

Assume Wooded Grass Combination, Soil D, CN = 79
in good condition

Project:		Computed:	Date:
Subject:		Checked:	Date:
Task:		Page: 2	of: 9
Job #:		No:	

Basin A:

Sediment Storage Volume = [DA × A × DR × TE × 2000] / $\gamma \cdot 43560$

DA = 13.71 Ac = $\boxed{0.021 \text{ sq. miles}}$

A = 50, see Fig. 2 construction areas (next page)

DR = 42%, see Fig 3 (next page)
= 0.42

Based on soil type Woodbridge WoB - fine sandy loam
the soil is typically 61% sand, 7% clay, remainder is rock

TE = 80% = 0.8

Since soil is predominantly sand with some clay will use sediment density γ = 75 per figure 4. Any Topsoil would have been removed.

$$\text{Sed. Storage Volume} = \frac{(13.71 \times 50 \times 0.42 \times 0.8 \times 2000)}{75 \times 43560}$$

<u>Sed Stor Volume</u> = $\boxed{0.14 \text{ Ac-Ft/year}}$ = $\boxed{6098.4 \text{ Ft}^3/\text{yr}}$

<u>Minimum Wet Storage</u> = 0.14 X 2 = 0.38 Acre Feet

Min. Wet Storage Depth is 2'

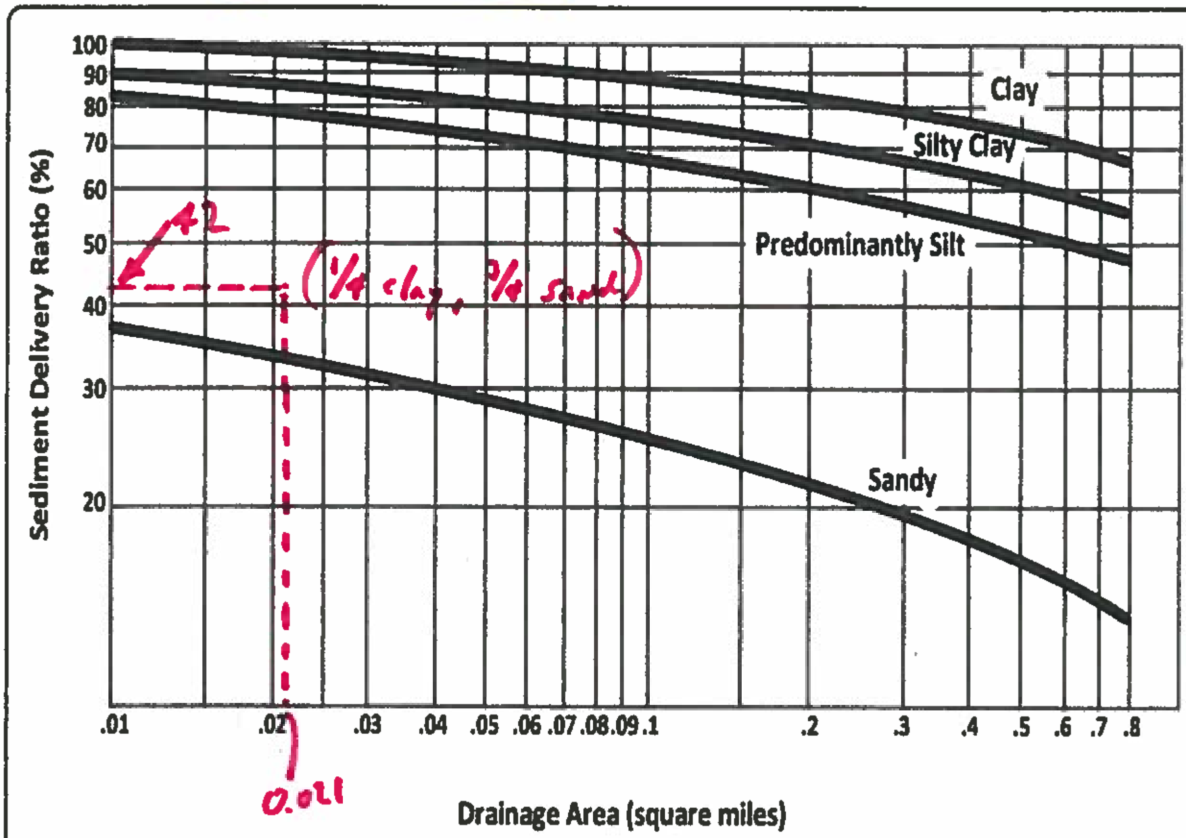
Basin A

Figure 2. Determining Erosion Rates

Land Use	Ave. Annual Erosion
Wooded area	0.2 ton/ac/yr
Developed urban areas, grassed areas, pastures, hay fields, abandoned fields with good cover	1.0 ton/ac/yr
Clean tilled cropland (corn, vegetables, etc.)	10 ton/ac/yr
Construction areas	50 ton/ac/yr

(Credit: *2002 Connecticut Guidelines for Soil Erosion and Sediment Control*)

Figure 3. Sediment Delivery Ratio vs. Drainage Area Graph



(Credit: *2002 Connecticut Guidelines for Soil Erosion and Sediment Control*)

Figure 4. Estimated Sediment Density

Soil Texture*	Sediment Density (Submerged) (lbs/cu. ft.)
Clay	40-60
Silt	55-75
Clay-silt mixtures (equal parts)	40-65
Sand-silt mixtures (equal parts)	75-95
Clay-silt sand mixtures (equal parts)	50-80
Sand	85-100
Gravel	85-125
Poorly sorted sand and gravel	95-130

*Use USDA soil data from country soil surveys or sieve analysis to determine soil texture.

Predominantly Sand
Use 75

(Credit: *2002 Connecticut Guidelines for Soil Erosion and Sediment Control*)

Residence Storage is adequate volume to provide a minimum 10 hours residence time for a 10-year frequency, 24-hour duration, Type III distribution storm. Residence time is defined as the volume weighted average time that an amount of flow will reside in a reservoir.

Flood routing is required to determine residence storage time. TR-55, or other generally accepted flood routing methods, will provide the minimum required residence storage volume and the maximum allowable principal spillway discharge.

Basin Shape: Depth, Width, and Effective Flow Length

The length, width, and depth of the basin are measured from the emergency spillway crest elevation.

The average depth shall be 4 feet or greater.

The minimum width shall be:

$$W = 10\,(Q_5)^{1/2}$$

where: W = width in feet

Q_5 = peak discharge from a 5-year frequency storm in cfs.

When the downstream area is highly sensitive to sediment impacts, the minimum width shall be:

$$W = 10\,(Q_{25})^{1/2}$$

where: W = width in feet

Q_{25} = peak discharge from a 25-year frequency storm in cfs.

The effective flow length shall be equal to at least two times the effective flow width. When site constraints prohibit the design of an adequate length, baffles are required to provide for the creation of an adequate flow length (see **Figure 5a and 5b**).

Messinger, Keith

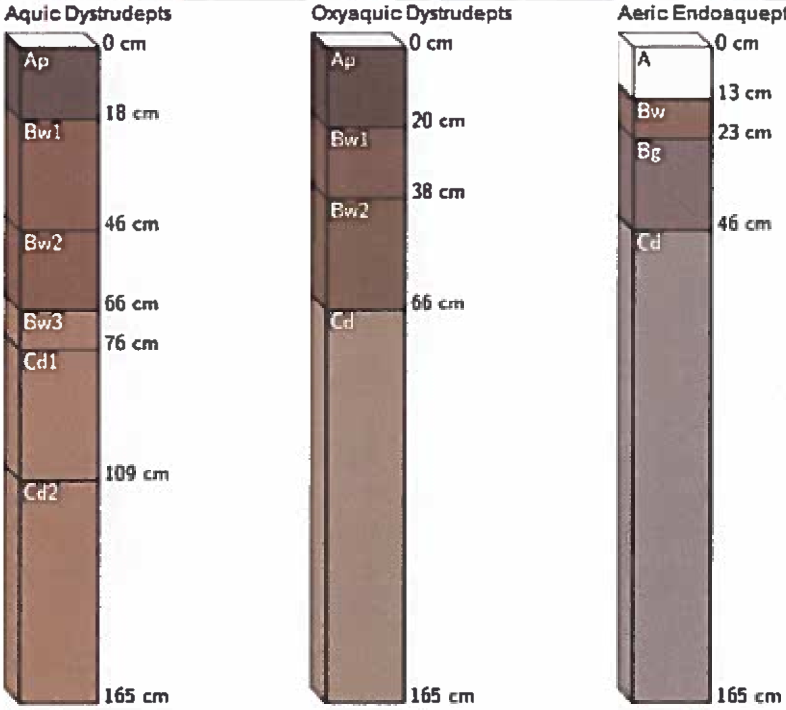
From: Bender, Rockne
Sent: Tuesday, August 30, 2016 11:55 AM
To: Messinger, Keith
Subject: CR - soils

×

Woodbridge fine sandy loam, 0 to 8 percent slopes, very stony
(SSURGO Export: 2015-09-22)

Components within map unit 286313

Woodbridge (82%) Aquic Dystrudepts | Paxton (10%) Oxyaquic Dystrudepts | Ridgebury (8%) Aeric Endoaquepts



hills / Backslope
hills / Footslope
hills / Summit

hills / Shoulder
hills / Backslope
hills / Summit

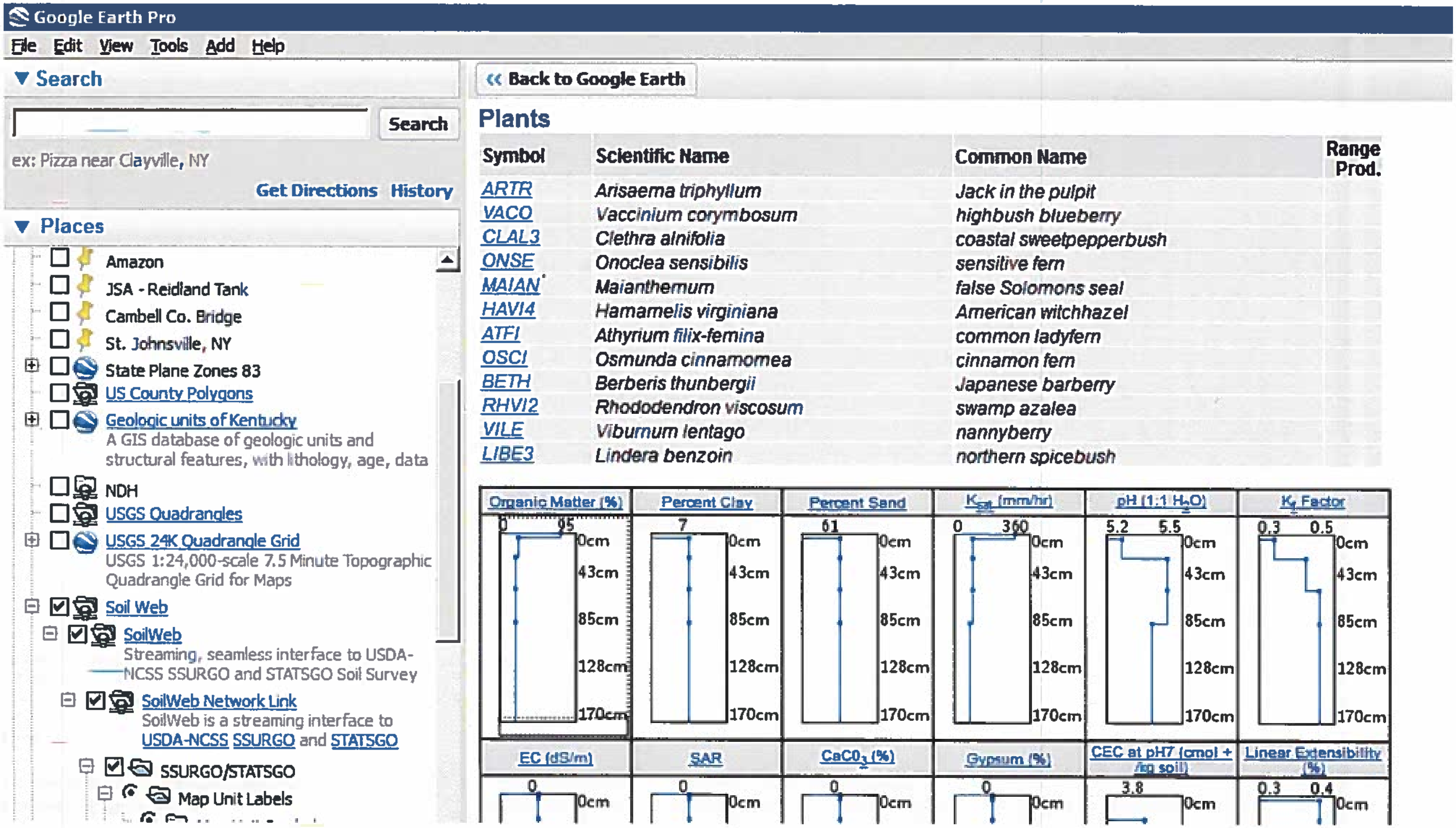
depressions

Block Diagrams: c/o NCSS Job Aids
note that these diagrams may be from multiple survey areas

1. CT-2011-05-31-09
2. CT-2011-05-31-07
3. MA-2010-09-07-03
4. CT-2011-05-31-06
5. MA-2012-02-02-17
6. MA-2010-09-07-04
7. MA-2012-02-02-11
8. MA-2012-02-02-16
9. MA-2012-02-02-03
10. MA-2012-02-02-19
11. NH-2012-02-14-01
12. MA-2010-09-10-04
13. MA-2012-02-01-10
14. MA-2012-02-02-23
15. MA-2010-09-07-08
16. MA-2012-02-03-04
17. MA-2012-02-03-06

Messinger, Keith

From: Bender, Rockne
Sent: Tuesday, August 30, 2016 12:09 PM
To: Messinger, Keith
Subject: CR-Percentage of clay & sand



6 of 9

Basin A shape:

Assumptions: Downstream wetlands = highly sensitive area

$\therefore W = 10(Q_{25})^{1/2}$

Using HydroCAD software to calc Q_{25}

Area = 13.71 Ac

Soil CN = 0.94, D soil Newly Graded Area

Tc = 12.3 minutes, Lag Method 700' Hyd Length
1.3% Avg Slope

$Q_{25} = 47.5$ cfs

$W = 10(47.5)^{1/2} = \boxed{68.9'}$

$L_{min} = 2 \times 68.9 = \boxed{137.8'}$

Basin A is approx 135' wide and 530' long.
These dimensions more than meet the requirements

3.0 STORMWATER MANAGEMENT STANDARDS AND PERFORMANCE CRITERIA

3.1 Overview

Rhode Island has seen an increase in commercial and residential development over the last several decades. Controlling stormwater from development sites is a priority with regards to impacts to receiving water bodies. This chapter presents performance standards and criteria for all new and redevelopment projects in the State of Rhode Island. Project applicants are required to meet the eleven minimum standards, as well as comply with specific criteria for the site planning process, groundwater recharge, water quality, channel protection, and peak flow control requirements. In the case of restoration or retrofitting, deviation from these standards may be appropriate at the discretion of the approving agency. All applicable development proposals must include a stormwater management site plan for review by State and local government. A plan must address all of the above minimum standards through compliance with the requirements of this manual (see checklist in Appendix A of this document).

All of the minimum standards contribute to protecting the water and habitat quality of receiving waters from the negative impacts of stormwater runoff. This is achieved by using a combination of both structural controls and non-structural practices (such as LID) as part of an effective stormwater management system. In general, when a project's stormwater management system is designed, installed, and maintained in accordance with the requirements of this manual, its runoff impacts will be presumed to be in compliance with applicable state regulatory standards and requirements. In some cases, the permitting agency may require that an applicant prepare and submit a pollutant loading analysis developed in accordance with the provisions of Appendix H in order to ascertain compliance.

This manual often refers to storm events of various kinds. Unless otherwise noted, all storm events are 24 hours in duration and utilize NRCS Type III precipitation distribution. Rainfall amounts for Rhode Island for various return frequencies are provided in Table 3-1 and shall be used for design unless otherwise specified.

Table 3-1 Design Rainfall Amounts for Rhode Island

RI County	24-hour (Type III) Rainfall Amount (inches)*						
	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Providence County	2.7	3.3	4.1	4.9	6.1	7.3	8.7
Bristol County	2.8	3.3	4.1	4.9	6.1	7.3	8.6
Newport County	2.8	3.3	4.1	4.9	6.1	7.3	8.6

Total Volume for a 10 yr storm event:

$$\frac{4.9\text{ in}}{12\text{ in/ft}} \times 13.71\text{ Ac} = 5.598\text{ Ac-Ft} = 243,860\text{ cu ft}$$

At 2' depth, pond has storage volume = 154,313 cu ft

For min 48 Hr dewater time, Q for skimmer is:

$$Q_{skim} = \frac{154313\text{ cf}}{48\text{ Hr}} \times \frac{1\text{ Hr}}{60\text{ min}} \times \frac{1\text{ min}}{60\text{ sec}} = 0.89\text{ cfs}$$

Will use 0.85 cfs for model

@ 0.85 cfs, 24 hr Type III storm 10 yr,

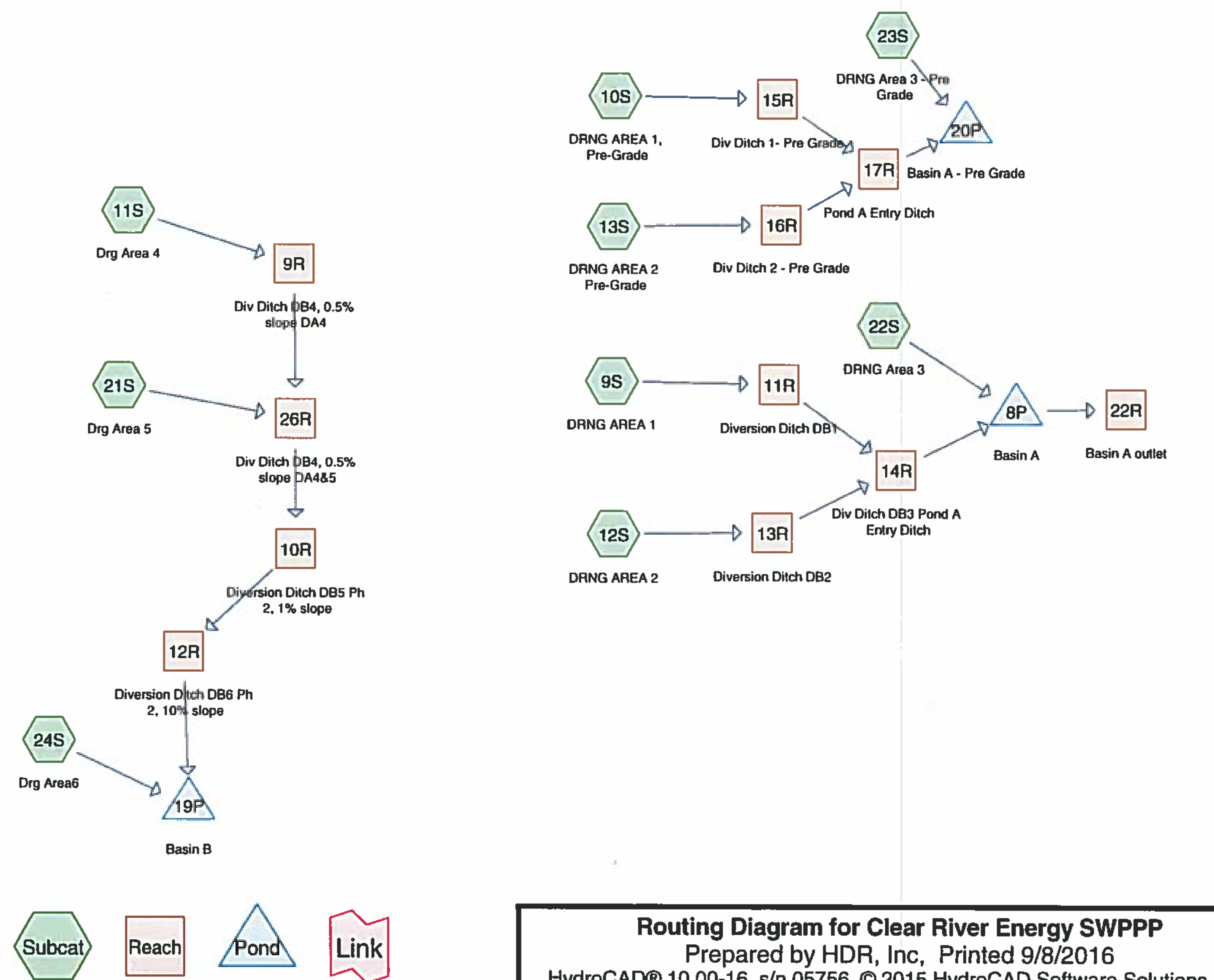
Basin A has peak elev at 565.17 achieving 2' depth above sediment storage zone. Pond dewaters at 105 Hr, meeting requirements

SEDIMENTATION BASIN A VOLUME

ELEVATION	DEPTH	AREA (sf)	AVG AREA (sf)	VOLUME (cf)	Cum Vol (cf)
563.00		73800			0
	0.20		74,200.00	14,840	
563.20		74600		Sediment Storage =	14,840
	0.80		76,200.00	60,960	
564.00		77800			75,800
	1.00		79,828.50	79,829	
565.00		81857			155,629
	0.30		45,083.00	13,525	
565.30	Primary Inlet	8309			169,153
	0.70		83,913.50	58,739	
566.00		85970			214,368
	0.50		87,021.00	43,511	
566.50	Emerg Inlet	88072			257,878
			Wet Storage (cu ft) @ 565.3 elev (2' depth) =		154,313
			Residence Storage (cu ft) @ 566.5 Elev =		88,725

Sediment Storage Req'd = 6,098 cf, 14,840 cf provided

Wet Storage Req'd = 12, 196. 8 cf or min 2' depth. This basin uses min 2' depth which allows for 154,313 cf of Wet Storage volume



Routing Diagram for Clear River Energy SWPPP
Prepared by HDR, Inc, Printed 9/8/2016
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Temporary Sediment Basin A

HydroCAD Reports

10 yr. 24 Hr. Type III Storm

Summary for Pond 8P: Basin A

[62] Hint: Exceeded Reach 14R OUTLET depth by 2.13' @ 24.57 hrs

Inflow Area = 13.710 ac, 0.00% Impervious, Inflow Depth = 4.21" for 10yr T- III event
Inflow = 50.36 cfs @ 12.17 hrs, Volume= 4.809 af
Outflow = 0.85 cfs @ 11.54 hrs, Volume= 4.469 af, Atten= 98%, Lag= 0.0 min
Primary = 0.85 cfs @ 11.54 hrs, Volume= 4.469 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-168.00 hrs, dt= 0.01 hrs
Peak Elev= 565.17' @ 20.48 hrs Surf.Area= 82,549 sf Storage= 169,594 cf

Plug-Flow detention time= 1,826.0 min calculated for 4.469 af (93% of inflow)
Center-of-Mass det. time= 1,787.8 min (2,570.5 - 782.7)

Volume	Invert	Avail.Storage	Storage Description
#1	563.00'	516,270 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
563.00	73,800	1,331.8	0	0	73,800
564.00	77,800	1,352.9	75,791	75,791	78,503
565.00	81,857	1,373.9	79,820	155,611	83,260
566.00	85,970	1,395.0	83,905	239,516	88,111
567.00	90,137	1,414.7	88,045	327,561	92,734
568.00	94,351	1,432.9	92,236	419,797	97,097
569.00	98,610	1,451.2	96,473	516,270	101,538

Device	Routing	Invert	Outlet Devices
#1	Primary	562.70'	**18.0" Round Culvert** L= 4.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 562.70' / 562.69' S= 0.0025 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	565.30'	**4.0" Vert. Orifice/Grate X 4.00** C= 0.600
#3	Device 1	566.50'	**24.0" Horiz. Emergency Inlet** C= 0.600 Limited to weir flow at low heads
#4	Device 1	563.20'	**0.850 cfs Constant Flow/Skimmer** Phase-In= 0.30'

Primary OutFlow Max=0.85 cfs @ 11.54 hrs HW=563.50' TW=563.08' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.85 cfs of 1.93 cfs potential flow)
  ├─**2=Orifice/Grate** (Controls 0.00 cfs)
  ├─**3=Emergency Inlet** (Controls 0.00 cfs)
  └─**4=Constant Flow/Skimmer** (Constant Controls 0.85 cfs)

Summary for Reach 22R: Basin A outlet

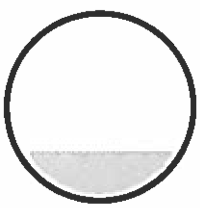
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 13.710 ac, 0.00% Impervious, Inflow Depth = 3.91" for 10yr T- III event
Inflow = 0.85 cfs @ 11.54 hrs, Volume= 4.469 af
Outflow = 0.85 cfs @ 11.55 hrs, Volume= 4.469 af, Atten= 0%, Lag= 0.6 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-168.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.33 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.43 fps, Avg. Travel Time= 0.3 min

Peak Storage= 11 cf @ 11.55 hrs
Average Depth at Peak Storage= 0.39'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 5.75 cfs

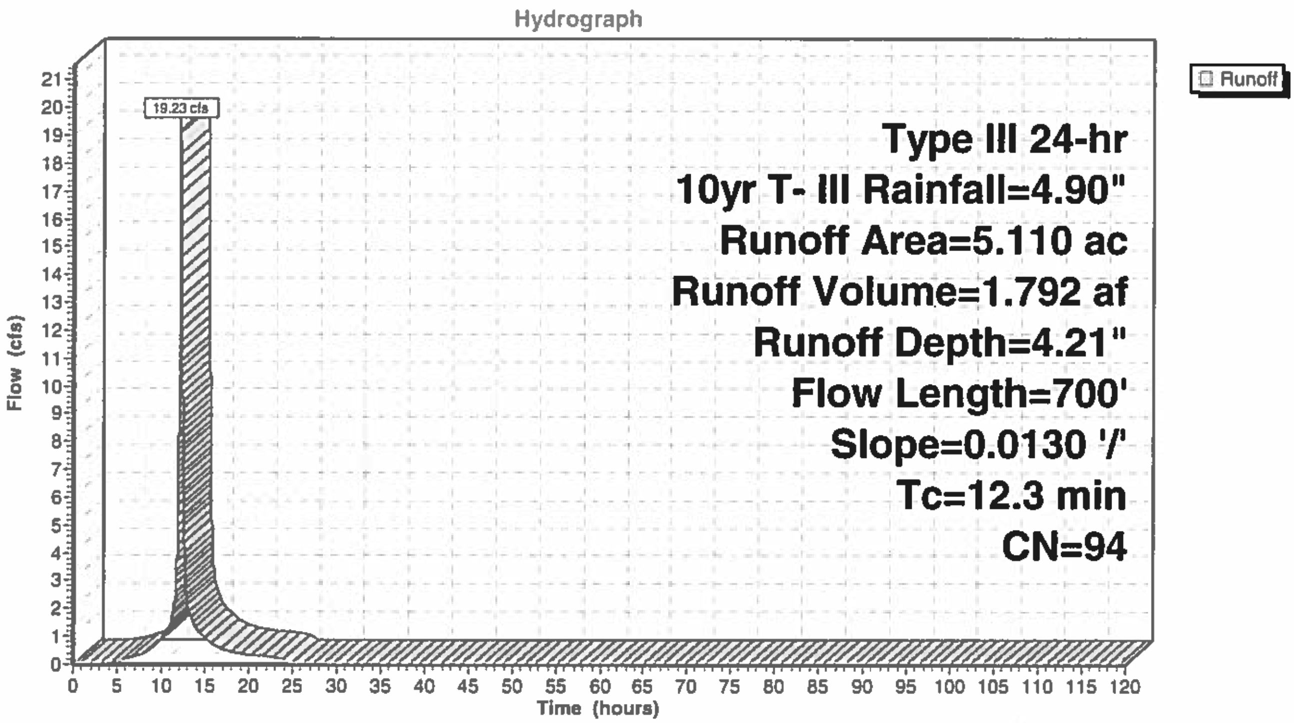
18.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 30.0' Slope= 0.0030 '/'
Inlet Invert= 562.69', Outlet Invert= 562.60'



Hydrograph for Pond 8P: Basin A

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	563.00	0.00
5.00	0.30	1,070	563.01	0.00
10.00	**2.47**	19,614	563.26	**0.18**
15.00	**2.66**	158,784	565.04	**0.85**
20.00	0.89	**169,560**	**565.17**	0.85
25.00	0.01	**165,454**	**565.12**	0.85
30.00	0.00	150,171	564.93	0.85
35.00	0.00	134,871	564.74	0.85
40.00	0.00	119,571	564.55	0.85
45.00	0.00	104,271	564.36	0.85
50.00	0.00	88,971	564.17	0.85
55.00	0.00	73,671	563.97	0.85
60.00	0.00	58,371	563.77	0.85
65.00	0.00	43,071	563.57	0.85
70.00	0.00	29,551	563.40	0.56
75.00	0.00	22,284	563.30	0.28
80.00	0.00	18,602	563.25	0.14
85.00	0.00	16,740	563.23	0.07
90.00	0.00	15,799	563.21	0.04
95.00	0.00	15,323	563.21	0.02
100.00	0.00	15,084	563.20	0.01
105.00	0.00	14,963	563.20	0.00
110.00	0.00	14,901	563.20	0.00
115.00	0.00	14,871	563.20	0.00
120.00	0.00	14,855	563.20	0.00
125.00	0.00	14,847	563.20	0.00
130.00	0.00	14,843	563.20	0.00
135.00	0.00	14,841	563.20	0.00
140.00	0.00	14,840	563.20	0.00
145.00	0.00	14,840	563.20	0.00
150.00	0.00	14,839	563.20	0.00
155.00	0.00	14,839	563.20	0.00
160.00	0.00	14,839	563.20	0.00
165.00	0.00	14,839	563.20	0.00

Subcatchment 9S: DRNG AREA 1



Summary for Reach 11R: Diversion Ditch 1

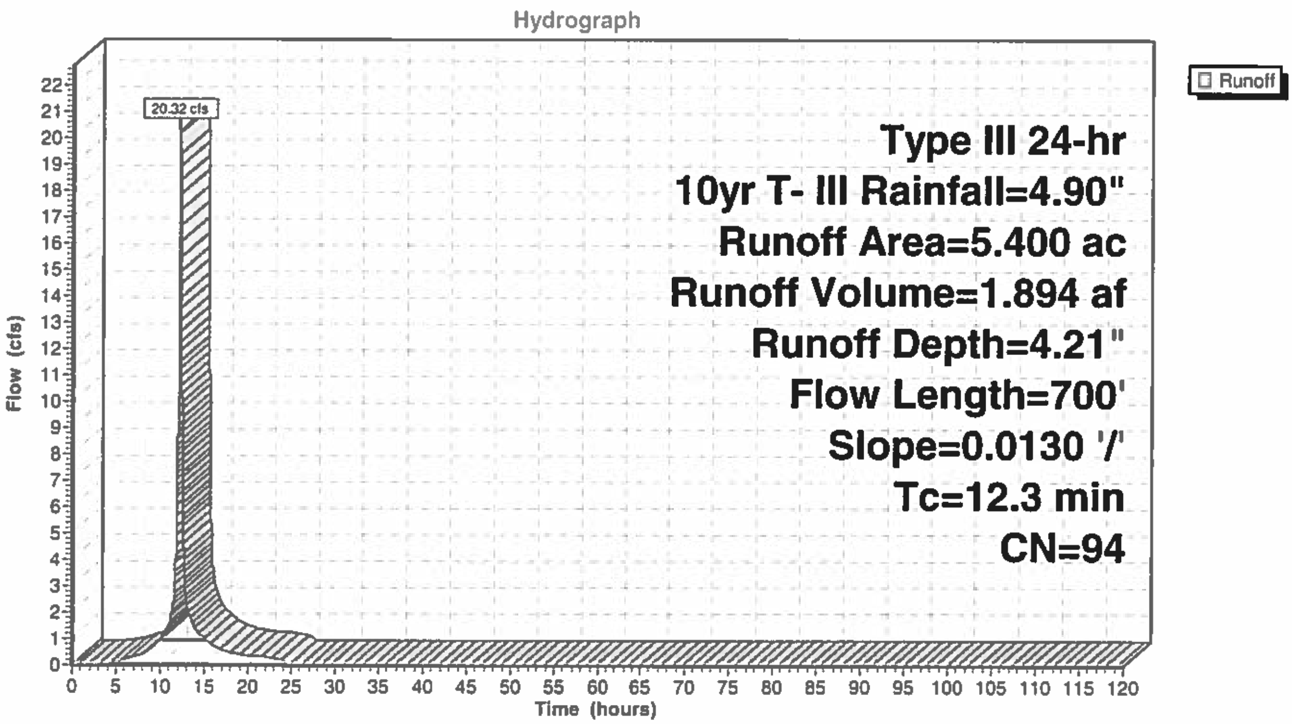
Inflow Area = 5.110 ac, 0.00% Impervious, Inflow Depth = 4.21" for 10yr T- III event
Inflow = 19.23 cfs @ 12.16 hrs, Volume= 1.792 af
Outflow = 18.63 cfs @ 12.19 hrs, Volume= 1.792 af, Atten= 3%, Lag= 1.9 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.78 fps, Min. Travel Time= 2.6 min
Avg. Velocity = 1.20 fps, Avg. Travel Time= 8.1 min

Peak Storage= 2,875 cf @ 12.19 hrs
Average Depth at Peak Storage= 1.15'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 61.77 cfs

2.00' x 2.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 584.0' Slope= 0.0051 '/'
Inlet Invert= 573.00', Outlet Invert= 570.00'

Subcatchment 12S: DRNG AREA 2



Summary for Reach 13R: Diversion Ditch 2

Inflow Area = 5.400 ac, 0.00% Impervious, Inflow Depth = 4.21" for 10yr T- III event
Inflow = 20.32 cfs @ 12.16 hrs, Volume= 1.894 af
Outflow = 20.02 cfs @ 12.18 hrs, Volume= 1.894 af, Atten= 1%, Lag= 1.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.28 fps, Min. Travel Time= 1.7 min
Avg. Velocity = 1.39 fps, Avg. Travel Time= 5.3 min

Peak Storage= 2,058 cf @ 12.18 hrs
Average Depth at Peak Storage= 1.11'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 71.17 cfs

2.00' x 2.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 440.0' Slope= 0.0068 '/'
Inlet Invert= 573.00', Outlet Invert= 570.00'

Summary for Reach 14R: Pond A Entry Ditch

[61] Hint: Exceeded Reach 11R outlet invert by 0.63' @ 12.19 hrs
[61] Hint: Exceeded Reach 13R outlet invert by 0.63' @ 12.19 hrs

Inflow Area = 10.510 ac, 0.00% Impervious, Inflow Depth = 4.21" for 10yr T- III event
Inflow = 38.62 cfs @ 12.19 hrs, Volume= 3.687 af
Outflow = 38.62 cfs @ 12.19 hrs, Volume= 3.687 af, Atten= 0%, Lag= 0.0 min

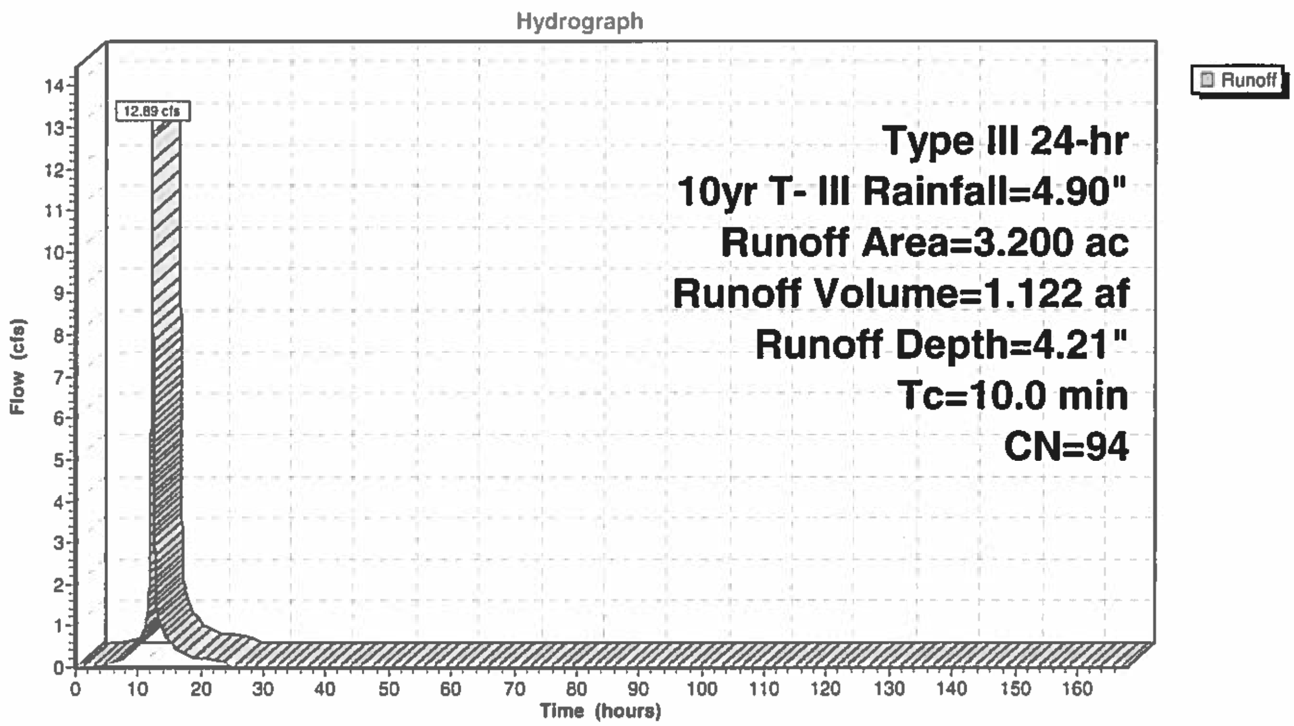
Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 10.42 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.01 fps, Avg. Travel Time= 0.2 min

Peak Storage= 119 cf @ 12.19 hrs
Average Depth at Peak Storage= 0.63'
Bank-Full Depth= 2.00' Flow Area= 20.0 sf, Capacity= 392.70 cfs

4.00' x 2.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 3.0 '/' Top Width= 16.00'
Length= 32.0' Slope= 0.2188 '/'
Inlet Invert= 570.00', Outlet Invert= 563.00'

‡

Subcatchment 22S: DRNG Area 3



Temporary Sediment Basin A

HydroCAD Reports

100 yr. 24 Hr. Type III Storm

Summary for Pond 8P: Basin A

[62] Hint: Exceeded Reach 14R OUTLET depth by 3.50' @ 16.27 hrs

Inflow Area = 13.710 ac, 0.00% Impervious, Inflow Depth = 7.98" for 100yr T- III event
Inflow = 92.95 cfs @ 12.17 hrs, Volume= 9.115 af
Outflow = 3.69 cfs @ 15.80 hrs, Volume= 8.775 af, Atten= 96%, Lag= 217.7 min
Primary = 3.69 cfs @ 15.80 hrs, Volume= 8.775 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-168.00 hrs, dt= 0.01 hrs
Peak Elev= 566.64' @ 15.80 hrs Surf.Area= 88,606 sf Storage= 294,966 cf

Plug-Flow detention time= 1,755.2 min calculated for 8.774 af (96% of inflow)
Center-of-Mass det. time= 1,732.9 min (2,500.4 - 767.5)

Volume	Invert	Avail.Storage	Storage Description
#1	563.00'	516,270 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
563.00	73,800	1,331.8	0	0	73,800
564.00	77,800	1,352.9	75,791	75,791	78,503
565.00	81,857	1,373.9	79,820	155,611	83,260
566.00	85,970	1,395.0	83,905	239,516	88,111
567.00	90,137	1,414.7	88,045	327,561	92,734
568.00	94,351	1,432.9	92,236	419,797	97,097
569.00	98,610	1,451.2	96,473	516,270	101,538

Device	Routing	Invert	Outlet Devices
#1	Primary	562.70'	**18.0" Round Culvert** L= 4.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 562.70' / 562.69' S= 0.0025 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	565.30'	**4.0" Vert. Orifice/Grate X 4.00** C= 0.600
#3	Device 1	566.50'	**24.0" Horiz. Emergency Inlet** C= 0.600 Limited to weir flow at low heads
#4	Device 1	563.20'	**0.850 cfs Constant Flow/Skimmer** Phase-In= 0.30'

Primary OutFlow Max=3.69 cfs @ 15.80 hrs HW=566.64' TW=563.56' (Dynamic Tailwater)
1=Culvert (Passes 3.69 cfs of 14.91 cfs potential flow)
- **2=Orifice/Grate** (Orifice Controls 1.82 cfs @ 5.21 fps)
- **3=Emergency Inlet** (Weir Controls 1.02 cfs @ 1.20 fps)
- **4=Constant Flow/Skimmer** (Constant Controls 0.85 cfs)

Hydrograph for Pond 8P: Basin A

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	563.00	0.00
5.00	0.97	5,665	563.08	0.00
10.00	**5.06**	43,872	563.59	0.85
15.00	**4.78**	**293,173**	**566.62**	**3.45**
20.00	1.60	**282,697**	**566.50**	**2.56**
25.00	0.01	258,516	566.22	2.31
30.00	0.00	221,382	565.79	1.80
35.00	0.00	194,833	565.47	1.11
40.00	0.00	178,207	565.27	0.85
45.00	0.00	162,907	565.09	0.85
50.00	0.00	147,607	564.90	0.85
55.00	0.00	132,307	564.71	0.85
60.00	0.00	117,007	564.52	0.85
65.00	0.00	101,707	564.33	0.85
70.00	0.00	86,407	564.14	0.85
75.00	0.00	71,107	563.94	0.85
80.00	0.00	55,807	563.74	0.85
85.00	0.00	40,507	563.54	0.85
90.00	0.00	27,966	563.38	0.50
95.00	0.00	21,480	563.29	0.25
100.00	0.00	18,195	563.24	0.13
105.00	0.00	16,534	563.22	0.06
110.00	0.00	15,695	563.21	0.03
115.00	0.00	15,271	563.21	0.02
120.00	0.00	15,057	563.20	0.01
125.00	0.00	14,949	563.20	0.00
130.00	0.00	14,895	563.20	0.00
135.00	0.00	14,867	563.20	0.00
140.00	0.00	14,853	563.20	0.00
145.00	0.00	14,846	563.20	0.00
150.00	0.00	14,843	563.20	0.00
155.00	0.00	14,841	563.20	0.00
160.00	0.00	14,840	563.20	0.00
165.00	0.00	14,840	563.20	0.00

Summary for Reach 22R: Basin A outlet

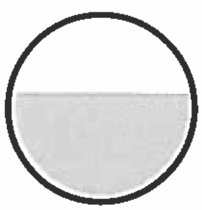
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 13.710 ac, 0.00% Impervious, Inflow Depth = 7.68" for 100yr T- III event
Inflow = 3.69 cfs @ 15.80 hrs, Volume= 8.775 af
Outflow = 3.69 cfs @ 15.80 hrs, Volume= 8.775 af, Atten= 0%, Lag= 0.1 min

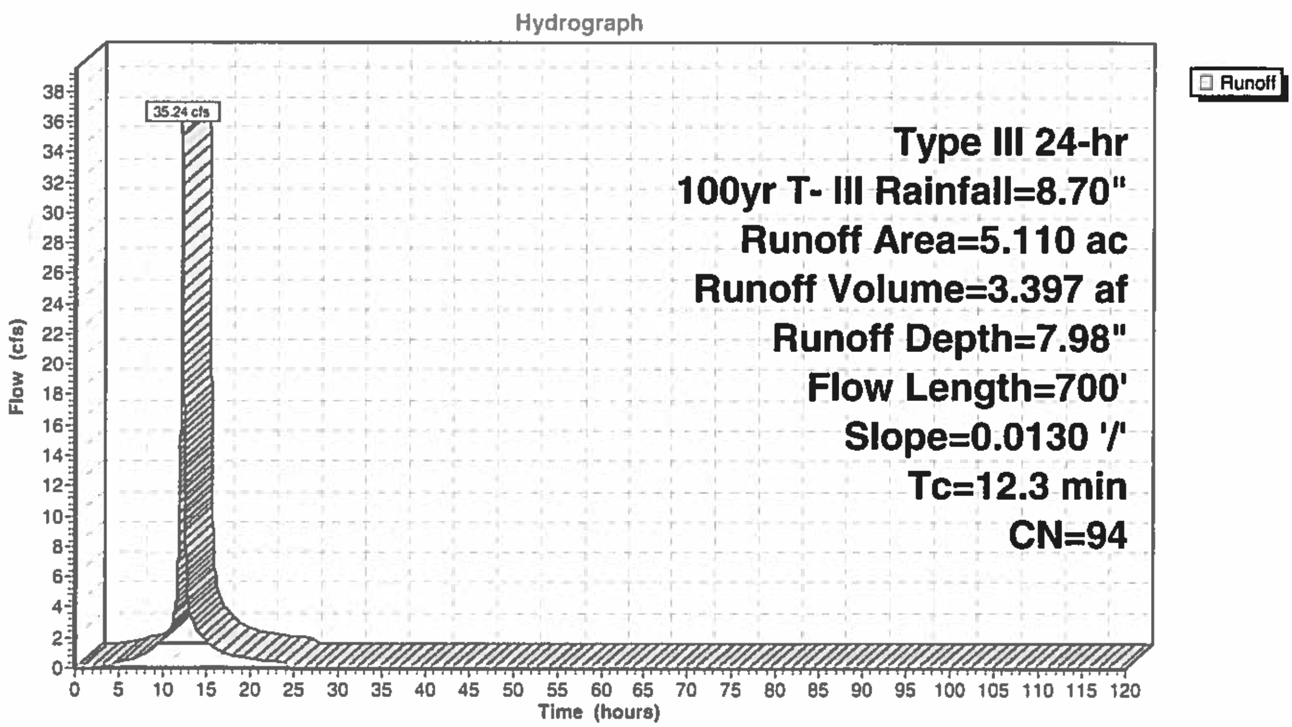
Routing by Dyn-Stor-Ind method, Time Span= 0.00-168.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.46 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.66 fps, Avg. Travel Time= 0.3 min

Peak Storage= 32 cf @ 15.80 hrs
Average Depth at Peak Storage= 0.87'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 5.75 cfs

18.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 30.0' Slope= 0.0030 '/'
Inlet Invert= 562.69', Outlet Invert= 562.60'



Subcatchment 9S: DRNG AREA 1



Summary for Reach 11R: Diversion Ditch 1

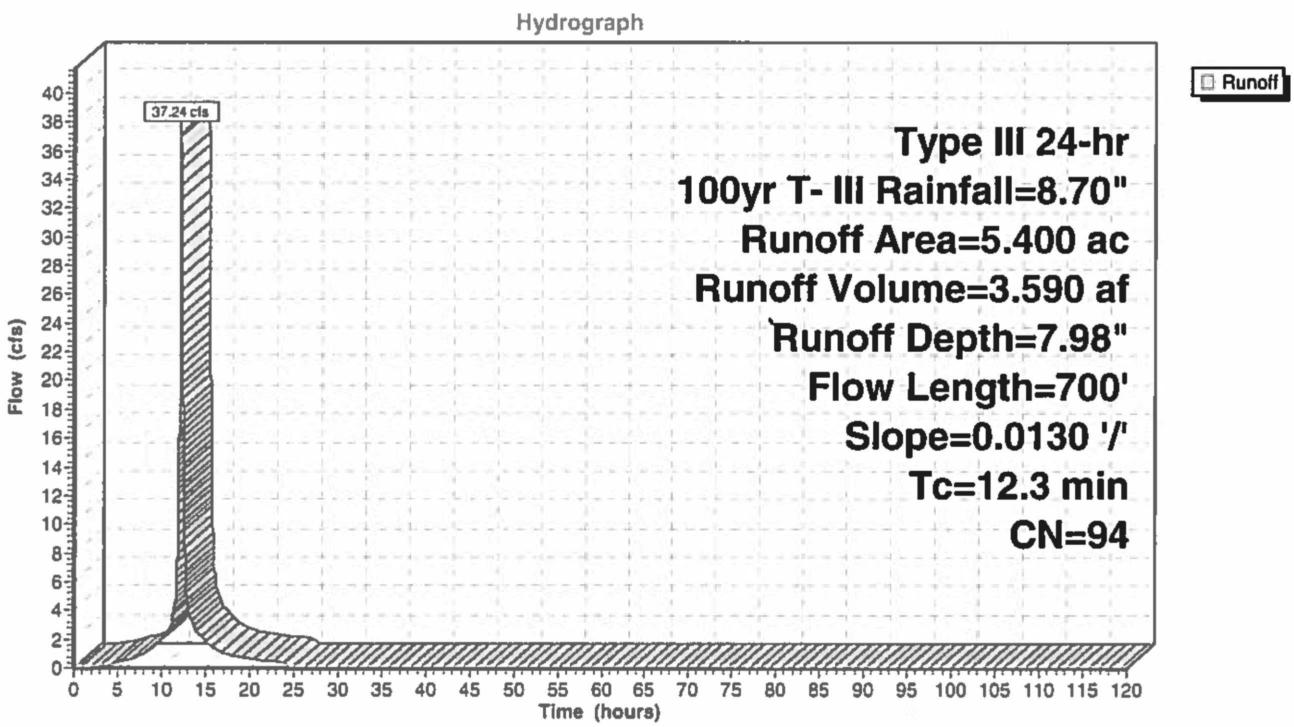
Inflow Area = 5.110 ac, 0.00% Impervious, Inflow Depth = 7.98" for 100yr T- III event
Inflow = 35.24 cfs @ 12.16 hrs, Volume= 3.397 af
Outflow = 34.40 cfs @ 12.19 hrs, Volume= 3.397 af, Atten= 2%, Lag= 1.7 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.43 fps, Min. Travel Time= 2.2 min
Avg. Velocity = 1.46 fps, Avg. Travel Time= 6.7 min

Peak Storage= 4,531 cf @ 12.19 hrs
Average Depth at Peak Storage= 1.53'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 61.77 cfs

2.00' x 2.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 584.0' Slope= 0.0051 '/'
Inlet Invert= 573.00', Outlet Invert= 570.00'

Subcatchment 12S: DRNG AREA 2



Summary for Reach 13R: Diversion Ditch 2

Inflow Area = 5.400 ac, 0.00% Impervious, Inflow Depth = 7.98" for 100yr T- III event
Inflow = 37.24 cfs @ 12.16 hrs, Volume= 3.590 af
Outflow = 36.83 cfs @ 12.18 hrs, Volume= 3.590 af, Atten= 1%, Lag= 1.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.01 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 1.69 fps, Avg. Travel Time= 4.3 min

Peak Storage= 3,233 cf @ 12.18 hrs
Average Depth at Peak Storage= 1.48'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 71.17 cfs

2.00' x 2.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 440.0' Slope= 0.0068 '/'
Inlet Invert= 573.00', Outlet Invert= 570.00'

Summary for Reach 14R: Pond A Entry Ditch

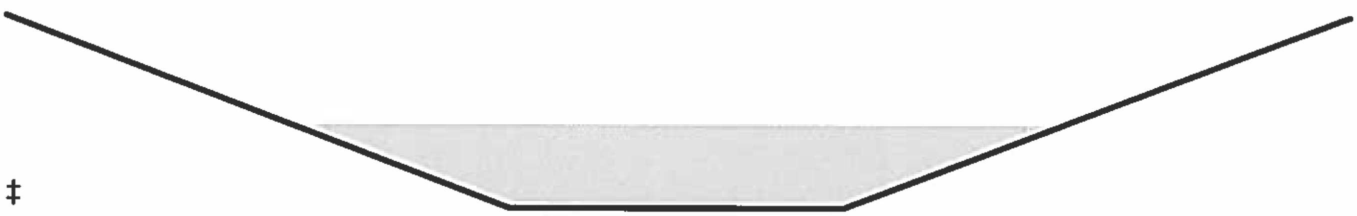
[61] Hint: Exceeded Reach 11R outlet invert by 0.87' @ 12.19 hrs
[61] Hint: Exceeded Reach 13R outlet invert by 0.87' @ 12.19 hrs

Inflow Area = 10.510 ac, 0.00% Impervious, Inflow Depth = 7.98" for 100yr T- III event
Inflow = 71.19 cfs @ 12.18 hrs, Volume= 6.988 af
Outflow = 71.19 cfs @ 12.19 hrs, Volume= 6.988 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 12.41 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 3.70 fps, Avg. Travel Time= 0.1 min

Peak Storage= 183 cf @ 12.19 hrs
Average Depth at Peak Storage= 0.87'
Bank-Full Depth= 2.00' Flow Area= 20.0 sf, Capacity= 392.70 cfs

4.00' x 2.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 3.0 '/' Top Width= 16.00'
Length= 32.0' Slope= 0.2188 '/'
Inlet Invert= 570.00', Outlet Invert= 563.00'



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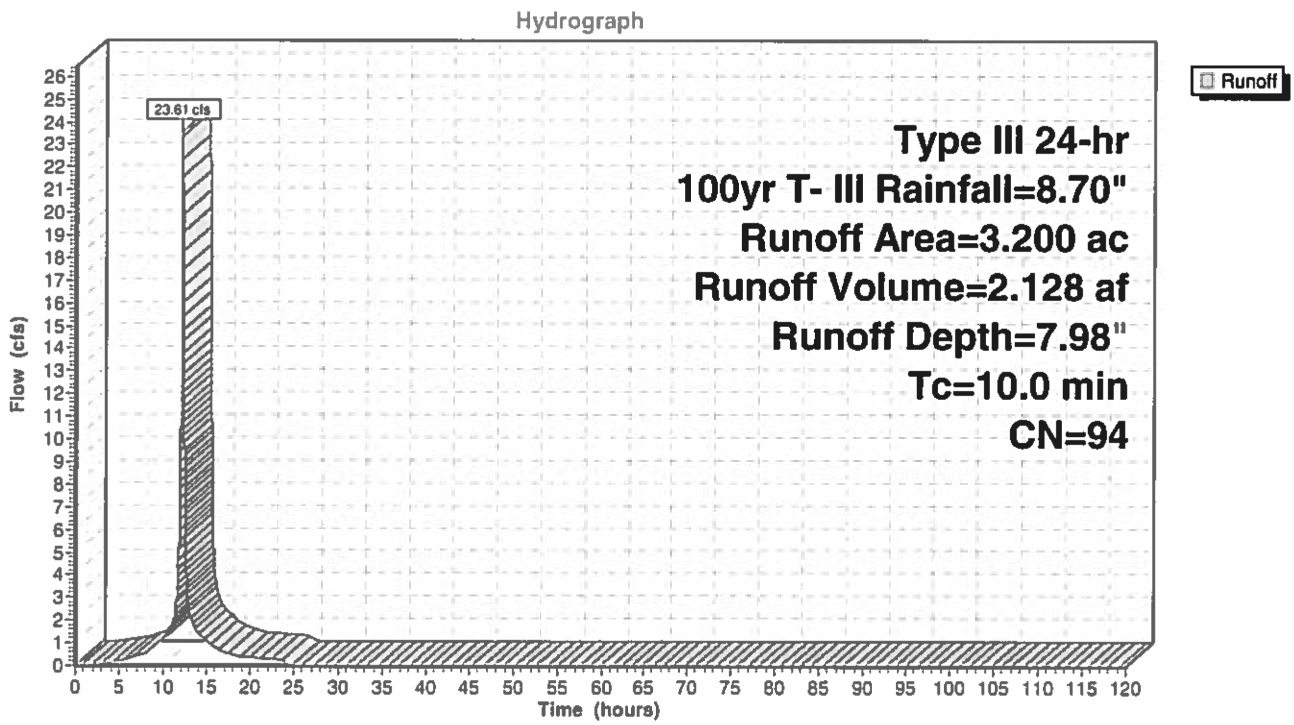
Subcatchment 22S: DRNG Area 3



Temporary Sediment Basin A

HydroCAD Reports

10 yr. 24 Hr. Type III Storm

Before Mass Grading Begins

Summary for Pond 20P: Basin A - Pre Grade

[62] Hint: Exceeded Reach 17R OUTLET depth by 1.27' @ 18.94 hrs

Inflow Area = 11.850 ac, 0.00% Impervious, Inflow Depth = 3.12" for 10yr T- III event
Inflow = 26.02 cfs @ 12.23 hrs, Volume= 3.080 af
Outflow = 0.85 cfs @ 12.18 hrs, Volume= 2.739 af, Atten= 97%, Lag= 0.0 min
Primary = 0.85 cfs @ 12.18 hrs, Volume= 2.739 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 564.32' @ 18.24 hrs Surf.Area= 79,102 sf Storage= 101,184 cf

Plug-Flow detention time= 1,163.4 min calculated for 2.739 af (89% of inflow)
Center-of-Mass det. time= 1,110.1 min (1,929.5 - 819.4)

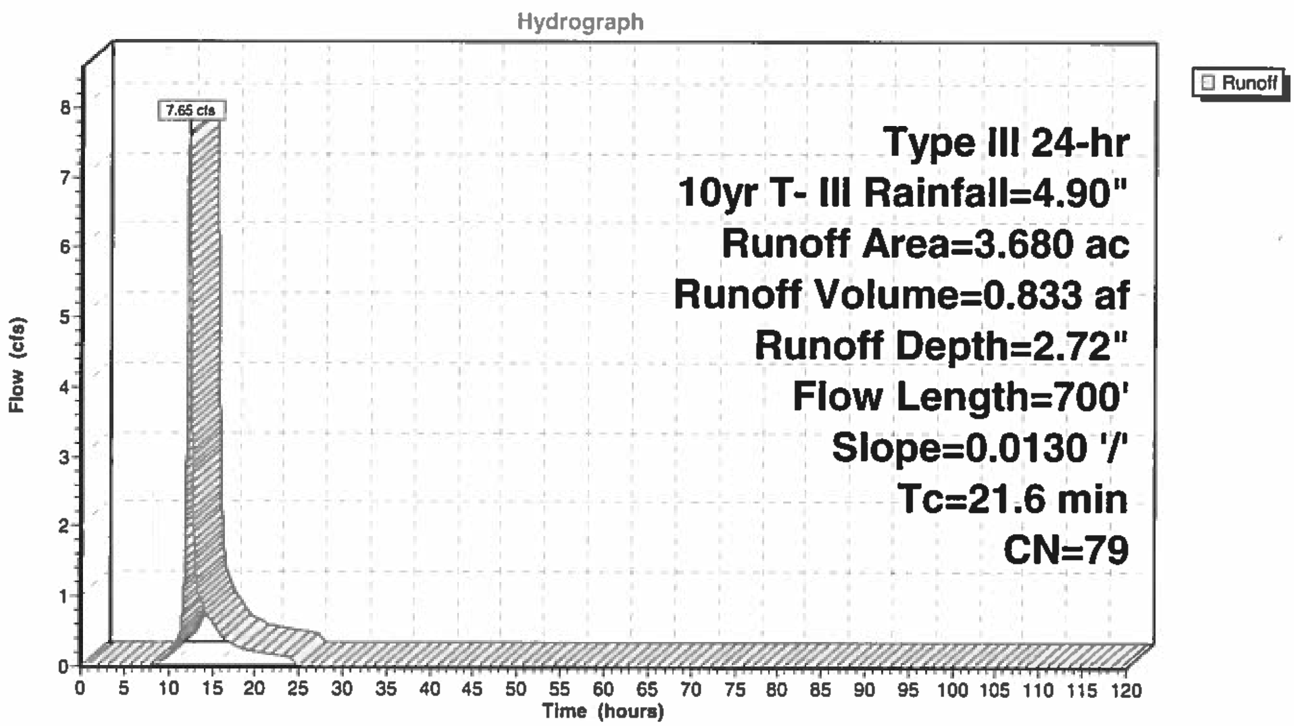
Volume	Invert	Avail.Storage	Storage Description
#1	563.00'	516,270 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
563.00	73,800	1,331.8	0	0	73,800
564.00	77,800	1,352.9	75,791	75,791	78,503
565.00	81,857	1,373.9	79,820	155,611	83,260
566.00	85,970	1,395.0	83,905	239,516	88,111
567.00	90,137	1,414.7	88,045	327,561	92,734
568.00	94,351	1,432.9	92,236	419,797	97,097
569.00	98,610	1,451.2	96,473	516,270	101,538

Device	Routing	Invert	Outlet Devices
#1	Primary	562.70'	**18.0" Round Culvert** L= 34.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 562.70' / 562.60' S= 0.0029 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	565.30'	**4.0" Vert. Orifice/Grate X 4.00** C= 0.600
#3	Device 1	566.50'	**18.0" Horiz. Emergency Inlet** C= 0.600 Limited to weir flow at low heads
#4	Device 1	563.20'	**0.850 cfs Constant Flow/Skimmer** Phase-In= 0.30'

Primary OutFlow Max=0.85 cfs @ 12.18 hrs HW=563.50' (Free Discharge)
└**1=Culvert** (Passes 0.85 cfs of 1.95 cfs potential flow)
  ├**2=Orifice/Grate** (Controls 0.00 cfs)
  ├**3=Emergency Inlet** (Controls 0.00 cfs)
  └**4=Constant Flow/Skimmer** (Constant Controls 0.85 cfs)

Subcatchment 10S: DRNG AREA 1, Pre-Grade



Summary for Reach 15R: Div Ditch 1- Pre Grade

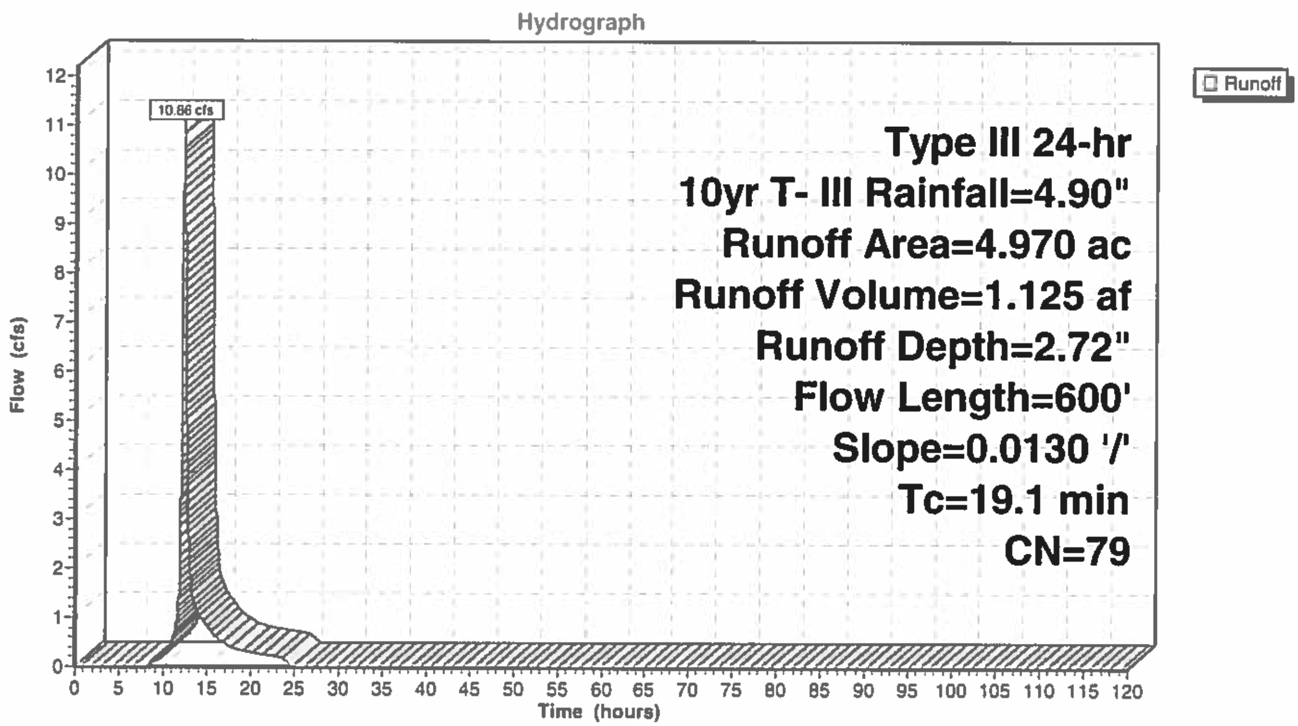
Inflow Area = 3.680 ac, 0.00% Impervious, Inflow Depth = 2.72" for 10yr T- III event
Inflow = 7.65 cfs @ 12.31 hrs, Volume= 0.833 af
Outflow = 7.49 cfs @ 12.34 hrs, Volume= 0.833 af, Atten= 2%, Lag= 2.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.97 fps, Min. Travel Time= 3.3 min
Avg. Velocity = 1.02 fps, Avg. Travel Time= 9.5 min

Peak Storage= 1,475 cf @ 12.34 hrs
Average Depth at Peak Storage= 0.73'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 61.77 cfs

2.00' x 2.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 584.0' Slope= 0.0051 '/'
Inlet Invert= 573.00', Outlet Invert= 570.00'

Subcatchment 13S: DRNG AREA 2 Pre-Grade



Summary for Reach 16R: Div Ditch 2 - Pre Grade

Inflow Area = 4.970 ac, 0.00% Impervious, Inflow Depth = 2.72" for 10yr T- III event
Inflow = 10.86 cfs @ 12.26 hrs, Volume= 1.125 af
Outflow = 10.77 cfs @ 12.29 hrs, Volume= 1.125 af, Atten= 1%, Lag= 1.7 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.63 fps, Min. Travel Time= 2.0 min
Avg. Velocity = 1.28 fps, Avg. Travel Time= 5.7 min

Peak Storage= 1,305 cf @ 12.29 hrs
Average Depth at Peak Storage= 0.82'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 71.17 cfs

2.00' x 2.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 440.0' Slope= 0.0068 '/'
Inlet Invert= 573.00', Outlet Invert= 570.00'

Summary for Reach 17R: Pond A Entry Ditch

[61] Hint: Exceeded Reach 15R outlet invert by 0.42' @ 12.31 hrs
[61] Hint: Exceeded Reach 16R outlet invert by 0.42' @ 12.31 hrs

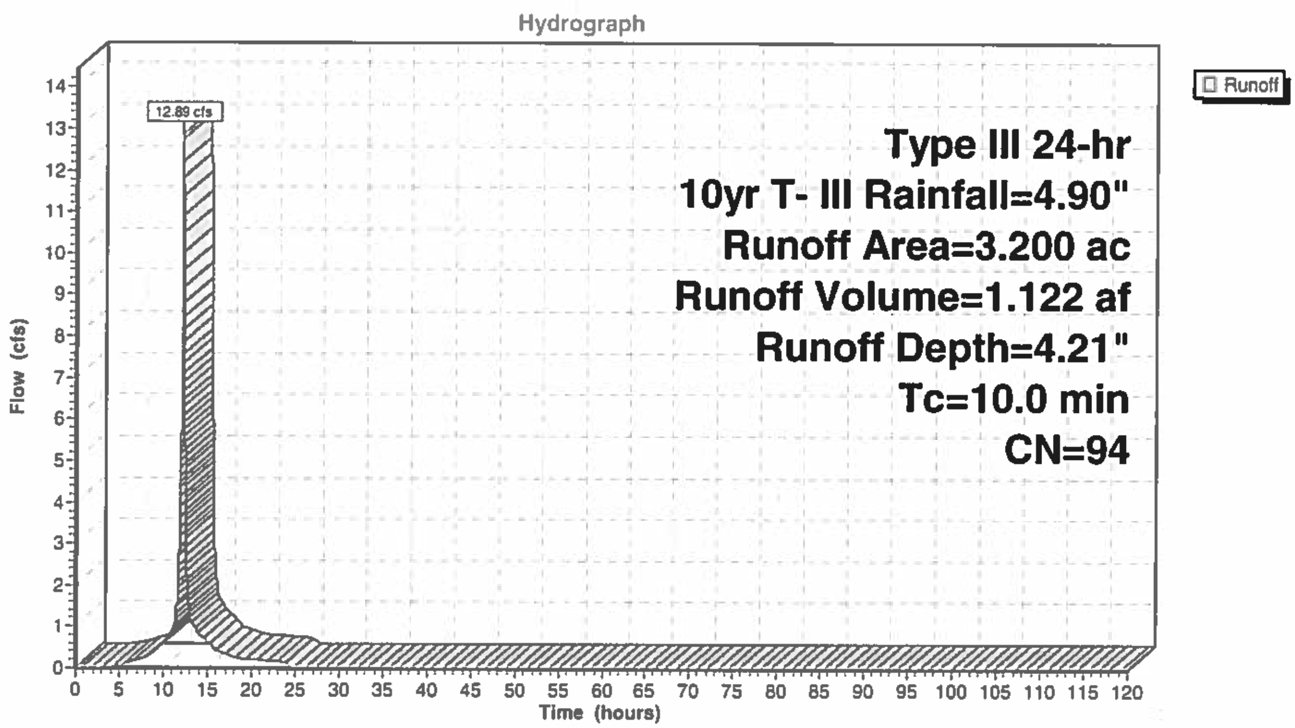
Inflow Area = 8.650 ac, 0.00% Impervious, Inflow Depth = 2.72" for 10yr T- III event
Inflow = 18.10 cfs @ 12.31 hrs, Volume= 1.958 af
Outflow = 18.10 cfs @ 12.31 hrs, Volume= 1.958 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.29 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.66 fps, Avg. Travel Time= 0.2 min

Peak Storage= 70 cf @ 12.31 hrs
Average Depth at Peak Storage= 0.42'
Bank-Full Depth= 2.00' Flow Area= 20.0 sf, Capacity= 392.70 cfs

4.00' x 2.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 3.0 '/' Top Width= 16.00'
Length= 32.0' Slope= 0.2188 '/'
Inlet Invert= 570.00', Outlet Invert= 563.00'

Subcatchment 23S: DRNG Area 3 - Pre Grade



Appendix B

Temporary Sediment Basin B

HDR

Project:		Computed:	Date:
Subject:	Basin B Calcs	Checked:	Date:
Task:		Page: 1	of: 4
Job #:		No:	

Basin B:

Contributing Area $= DA^{\#4} + DA^{\#5} + DA^{\#6}$

$= 8.14\ Ac + 8.85\ Ac + 7.23\ Ac$

$= 24.22\ Ac$

Assume No Grass Cover on All areas - worst case

Assume Newly Graded Area Soil Type D CN = 94

No Predeveloped Condition will exist for this basin.
This basin will allow relocation from Basin A to Mass Grade

Sediment Storage Volume:

DA = 24.22 Ac = 0.038 sq. miles

A = 50, same condition as Basin A

DR = 40%, see Fig 3 next page
= 0.40

Same Soil type as used in Basin A

TE = 80% = 0.8 γ = 75 as used in Basin A

$$\text{Sed Stor. Volume} = \frac{(24.22 \times 50 \times 0.40 \times 2000)}{75 \times 43560} = 0.30\ \text{Ac-ft/yr}$$

$$= \boxed{13{,}068\ \text{cu ft/yr}}$$

Min. Wet Storage = 0.30 x 2 = 0.60 Ac ft = $\boxed{26{,}136\ \text{cu ft}}$

Min. Wet Storage Depth of 2' will Control This Basin

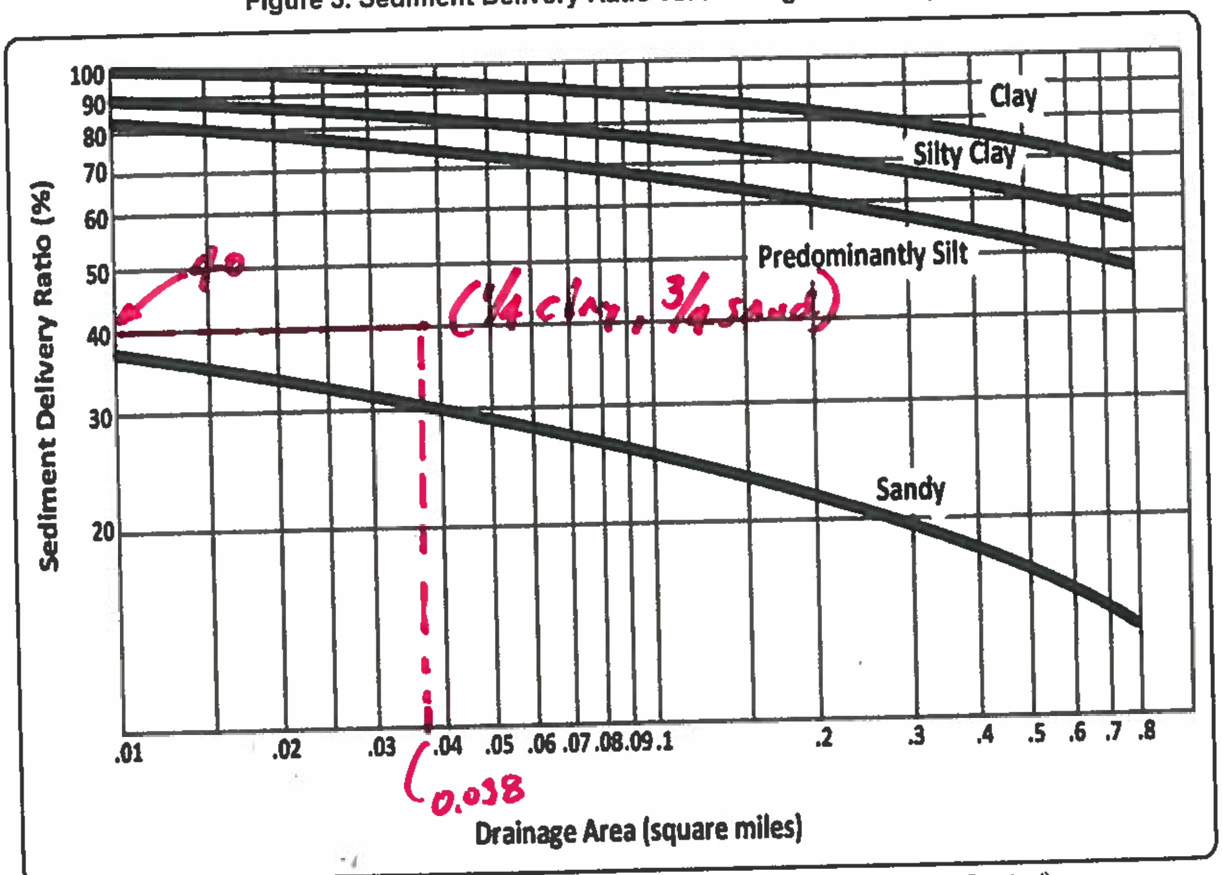
Basin B

Figure 2. Determining Erosion Rates

Land Use	Ave. Annual Erosion
Wooded area	0.2 ton/ac/yr
Developed urban areas, grassed areas, pastures, hay fields, abandoned fields with good cover	1.0 ton/ac/yr
Clean tilled cropland (corn, vegetables, etc.)	10 ton/ac/yr
Construction areas	50 ton/ac/yr

(Credit: *2002 Connecticut Guidelines for Soil Erosion and Sediment Control*)

Figure 3. Sediment Delivery Ratio vs. Drainage Area Graph



(Credit: *2002 Connecticut Guidelines for Soil Erosion and Sediment Control*)

Project:	Computed:	Date:
Subject:	Checked:	Date:
Task:	Page: 3	of: 4
Job #:	No:	

Basin B shape

Same Assumption as Basin A

$W = 10(Q_{25})^{1/2}$

Using HydroCAD to calc Q_{25}

$Q_{25} = 112.01$ cfs

$W = 10(112.01)^{1/2} = 105.8'$

$L_{min} = 2 \times 105.8 = 211.6'$

L in Basin B = 270' ± This is OK

W in Basin B = 210' ± This is OK

Project:	Computed:	Date:
Subject:	Checked:	Date:
Task:	Page: 4	of: 4
Job #:	No:	

Total Volume for a 10 yr storm event:

$$\frac{4.9\ in}{12\ in/ft} \times 24.22\ Ac = 9.890\ Ac\ ft = 430{,}801\ cu\ ft.$$

At 2' Depth above sediment storage, Basin B has 151,840 cf of avail. wet storage.

For Min 48 hr dewater time, Q for skimmer is:

$$Q_{skim} = \frac{151840\ cf}{48\ hr} \times \frac{1\ hr}{60\ min} \times \frac{1\ min}{60\ sec} = 0.88\ cfs.$$

Will use 0.85 cfs for model

@ 0.85 cfs, 24 Hr Type III storm 10yr

Basin B has a peak elev of 562.10 achieving 4' depth in Basin. This does not reach primary outlet at 562.50'. All 10yr. water will exit through the skimmer. Pond dewaters at 160 hrs. Meeting requirements

If we increase skimmer flow to 2 cfs, peak elev is 561.6 & dewatering completes at 85 hrs.

If we use 1.5 cfs, peak elev = 561.7 & dewater completes at 105 hrs

STAY WITH 0.85

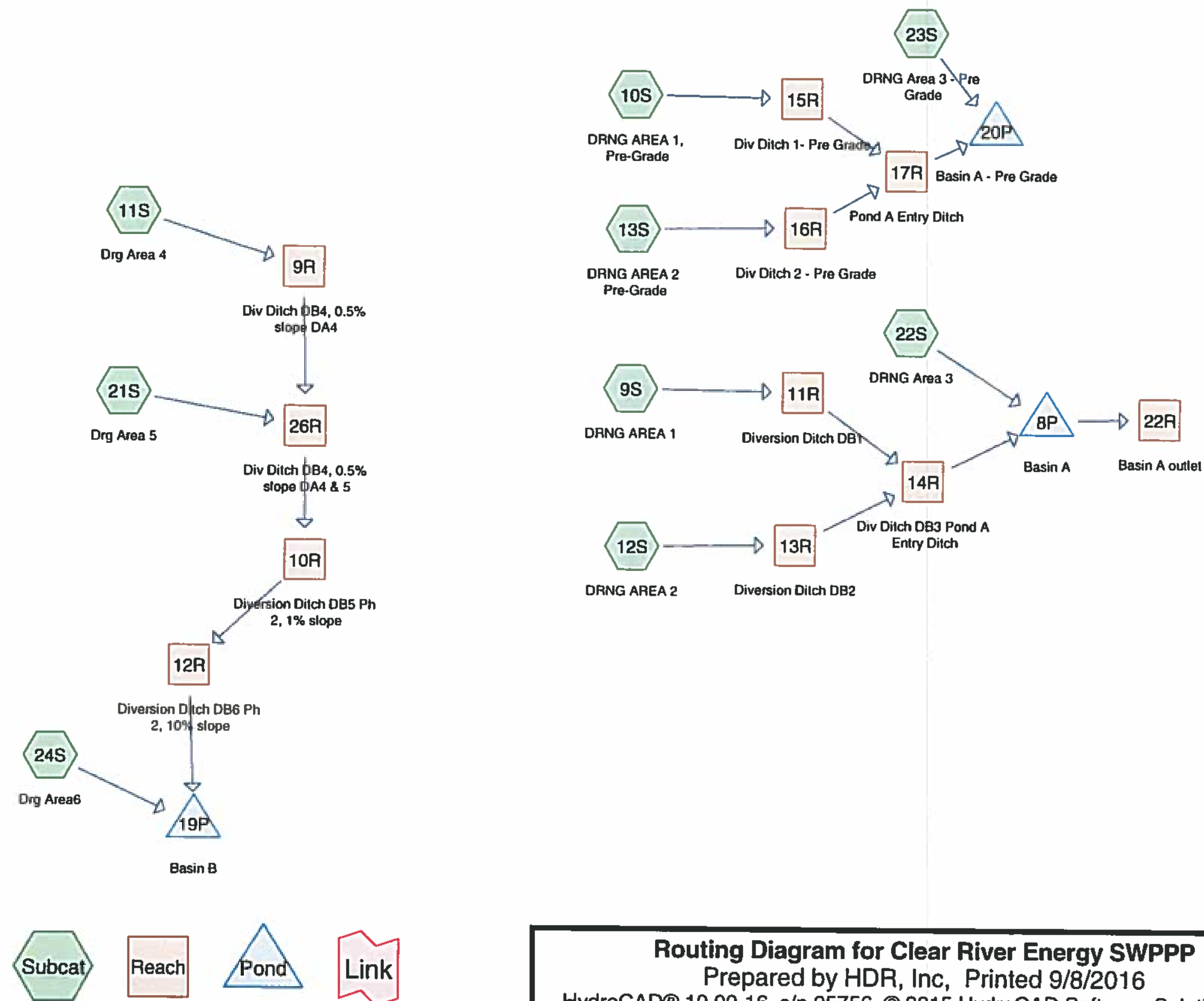
SEDIMENTATION BASIN B VOLUME

ELEVATION	DEPTH	AREA (sf)	AVG AREA (sf)	VOLUME (cf)	Cum Vol (cf)
558.00		71818			0
	0.20		72,151.00	14,430	
558.20		72484		Sediment Storage =	14,430
	0.80		73,844.00	59,075	
559.00		75204			73,505
	1.00		76,954.00	76,954	
560.00		78704			150,459
	0.20		79,055.50	15,811	
560.20		79407			166,271
	0.80		80,504.00	64,403	
561.00		82304			214,863
	1.00		84,156.50	84,157	
562.00		86009			299,019
	0.50		86,967.00	43,484	
562.50	Primary Inlet	87925			342,503
	0.50		88,883.50	44,442	
563.00		89842			343,461
	1.00		91,810.50	91,811	
564.00		93779			435,271
	1.00		95,806.00	95,806	
565.00		97833			531,077
	1.00		99,951.00	99,951	
566.00		102069			631,028
	1.00		104,247.00	104,247	
567.00	Emerg Inlet	106425			735,275

Wet Storage (cu ft) @ 560.2 elev (2' depth)	=	151,840
Total Wet Storage @ 562.5 Primary Inlet	=	328,072
Residence Storage (cu ft) @ 567.0 Elev	=	392,773

Sediment Storage Req'd = 13,068 cf, 14,430 cf provided

Wet Storage Req'd = 26,136 cf or min 2' depth. This basin uses min 2' depth which allows for 151,840 cf of Wet Storage volume



Routing Diagram for Clear River Energy SWPPP
Prepared by HDR, Inc, Printed 9/8/2016
HydroCAD® 10.00-16 s/n 05756 © 2015 HydroCAD Software Solutions LLC

Temporary Sediment Basin B

HydroCAD Reports

10 yr. 24 Hr. Type III Storm

Summary for Pond 19P: Basin B

[62] Hint: Exceeded Reach 12R OUTLET depth by 4.07' @ 24.86 hrs

Inflow Area = 24.220 ac, 0.00% Impervious, Inflow Depth = 4.21" for 10yr T- III event
Inflow = 88.14 cfs @ 12.18 hrs, Volume= 8.496 af
Outflow = 0.85 cfs @ 10.28 hrs, Volume= 8.164 af, Atten= 99%, Lag= 0.0 min
Primary = 0.85 cfs @ 10.28 hrs, Volume= 8.164 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-168.00 hrs, dt= 0.01 hrs
Peak Elev= 562.10' @ 24.14 hrs Surf.Area= 86,405 sf Storage= 324,100 cf

Plug-Flow detention time= 3,301.6 min calculated for 8.164 af (96% of inflow)
Center-of-Mass det. time= 3,278.4 min (4,062.4 - 784.0)

Volume	Invert	Avail.Storage	Storage Description
#1	558.00'	903,394 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
558.00	71,818	1,107.7	0	0	71,818
559.00	75,204	1,140.5	73,505	73,505	77,793
560.00	78,704	1,169.0	76,947	150,452	83,156
561.00	82,304	1,198.1	80,497	230,949	88,764
562.00	86,009	1,226.2	84,150	315,099	94,319
563.00	89,842	1,254.7	87,919	403,017	100,081
564.00	93,779	1,282.5	91,803	494,821	105,835
565.00	97,833	1,313.2	95,799	590,620	112,308
566.00	102,069	1,344.8	99,944	690,563	119,123
567.00	106,425	1,376.2	104,239	794,803	126,057
568.00	110,773	1,404.0	108,592	903,394	132,362

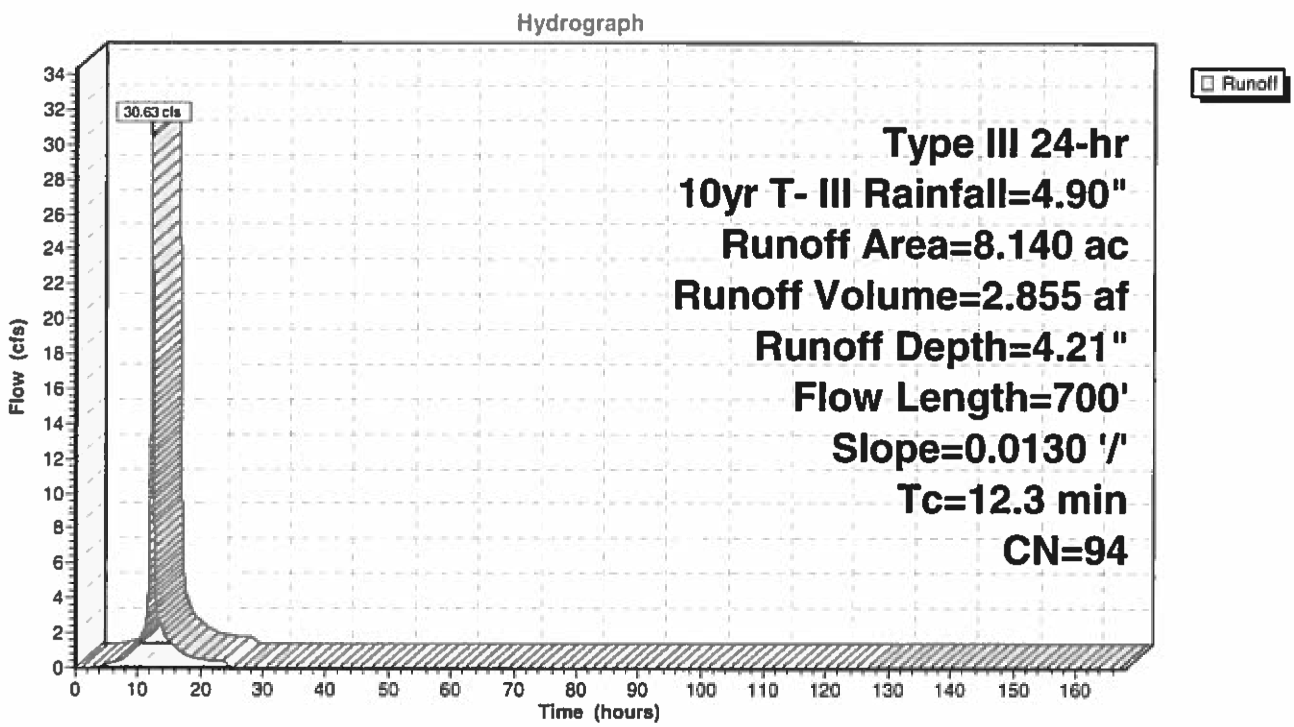
Device	Routing	Invert	Outlet Devices
#1	Primary	558.00'	**48.0" Round Culvert** L= 680.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 558.00' / 557.32' S= 0.0010 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 12.57 sf
#2	Device 1	562.50'	**12.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	567.00'	**60.0" x 60.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	558.20'	**0.850 cfs Constant Flow/Skimmer** Phase-In= 0.30'

Primary OutFlow Max=0.85 cfs @ 10.28 hrs HW=558.50' (Free Discharge)
└─1=**Culvert** (Passes 0.85 cfs of 0.87 cfs potential flow)
  ├─2=**Orifice/Grate** (Controls 0.00 cfs)
  ├─3=**Orifice/Grate** (Controls 0.00 cfs)
  └─4=**Constant Flow/Skimmer** (Constant Controls 0.85 cfs)

Hydrograph for Pond 19P: Basin B no projection

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	558.00	0.00
5.00	0.51	1,750	558.02	0.00
10.00	**4.35**	32,539	558.45	**0.69**
15.00	**4.73**	286,495	561.66	**0.85**
20.00	1.58	**317,484**	**562.03**	0.85
25.00	0.04	**322,189**	**562.08**	0.85
30.00	0.00	306,964	561.91	0.85
35.00	0.00	291,664	561.73	0.85
40.00	0.00	276,364	561.55	0.85
45.00	0.00	261,064	561.36	0.85
50.00	0.00	245,764	561.18	0.85
55.00	0.00	230,464	560.99	0.85
60.00	0.00	215,164	560.81	0.85
65.00	0.00	199,864	560.62	0.85
70.00	0.00	184,564	560.43	0.85
75.00	0.00	169,264	560.24	0.85
80.00	0.00	153,964	560.04	0.85
85.00	0.00	138,664	559.85	0.85
90.00	0.00	123,364	559.65	0.85
95.00	0.00	108,064	559.45	0.85
100.00	0.00	92,764	559.25	0.85
105.00	0.00	77,464	559.05	0.85
110.00	0.00	62,164	558.85	0.85
115.00	0.00	46,864	558.64	0.85
120.00	0.00	32,073	558.44	0.67
125.00	0.00	23,460	558.32	0.34
130.00	0.00	18,913	558.26	0.17
135.00	0.00	16,650	558.23	0.09
140.00	0.00	15,529	558.22	0.04
145.00	0.00	14,974	558.21	0.02
150.00	0.00	14,700	558.20	0.01
155.00	0.00	14,564	558.20	0.01
160.00	0.00	14,497	558.20	0.00
165.00	0.00	14,463	558.20	0.00

Subcatchment 11S: Drg Area 4



Summary for Reach 9R: Div Ditch DB4, 0.5% slope DA4

Inflow Area = 8.140 ac, 0.00% Impervious, Inflow Depth = 4.21" for 10yr T- III event
Inflow = 30.63 cfs @ 12.16 hrs, Volume= 2.855 af
Outflow = 30.18 cfs @ 12.18 hrs, Volume= 2.855 af, Atten= 1%, Lag= 1.3 min

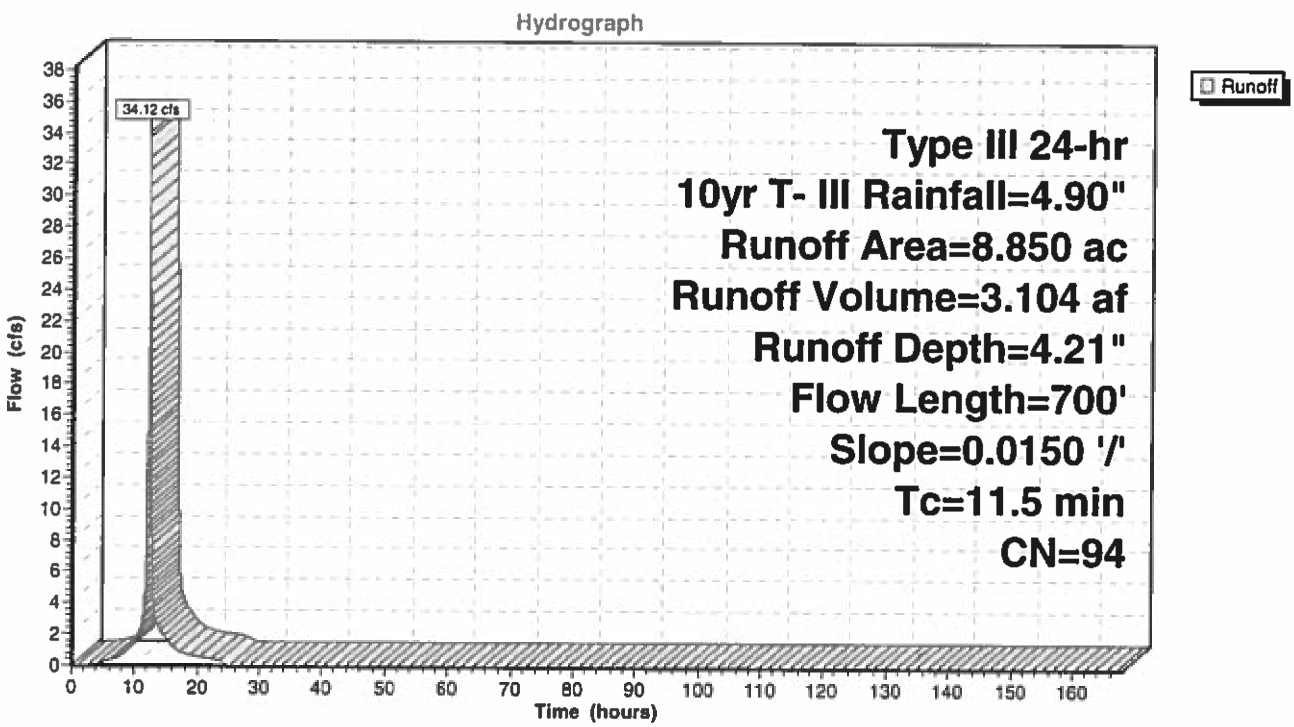
Routing by Dyn-Stor-Ind method, Time Span= 0.00-168.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.78 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 1.11 fps, Avg. Travel Time= 6.0 min

Peak Storage= 3,190 cf @ 12.18 hrs
Average Depth at Peak Storage= 1.00'
Bank-Full Depth= 2.00' Flow Area= 22.0 sf, Capacity= 121.70 cfs

5.00' x 2.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 17.00'
Length= 400.0' Slope= 0.0050 '/'
Inlet Invert= 575.00', Outlet Invert= 573.00'

‡

Subcatchment 21S: Drg Area 5



Summary for Reach 26R: Div Ditch DB4, 0.5% slope DA4 & 5

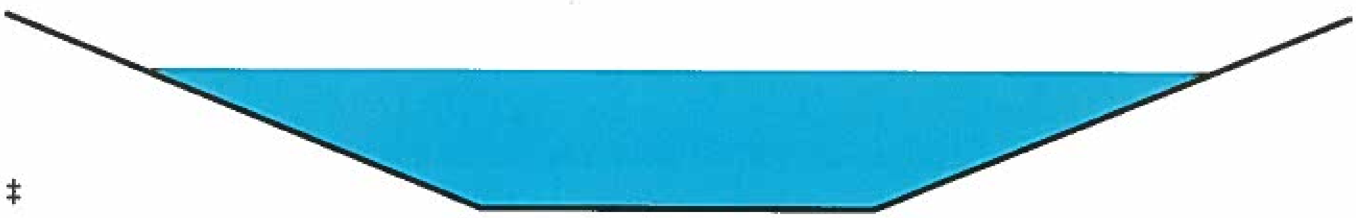
[62] Hint: Exceeded Reach 9R OUTLET depth by 0.45' @ 12.22 hrs

Inflow Area = 16.990 ac, 0.00% Impervious, Inflow Depth = 4.21" for 10yr T- III event
Inflow = 63.69 cfs @ 12.17 hrs, Volume= 5.960 af
Outflow = 62.26 cfs @ 12.19 hrs, Volume= 5.960 af, Atten= 2%, Lag= 1.6 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-168.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.62 fps, Min. Travel Time= 2.2 min
Avg. Velocity = 1.35 fps, Avg. Travel Time= 7.4 min

Peak Storage= 8,077 cf @ 12.19 hrs
Average Depth at Peak Storage= 1.44'
Bank-Full Depth= 2.00' Flow Area= 22.0 sf, Capacity= 121.70 cfs

5.00' x 2.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 17.00'
Length= 600.0' Slope= 0.0050 '/'
Inlet Invert= 573.00', Outlet Invert= 570.00'



‡

Summary for Reach 10R: Diversion Ditch DB5 Ph 2, 1% slope

[61] Hint: Exceeded Reach 26R outlet invert by 1.21' @ 12.20 hrs

Inflow Area = 16.990 ac, 0.00% Impervious, Inflow Depth = 4.21" for 10yr T- III event
Inflow = 62.26 cfs @ 12.19 hrs, Volume= 5.960 af
Outflow = 62.23 cfs @ 12.20 hrs, Volume= 5.960 af, Atten= 0%, Lag= 0.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-168.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.95 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.71 fps, Avg. Travel Time= 1.0 min

Peak Storage= 1,046 cf @ 12.20 hrs
Average Depth at Peak Storage= 1.21'
Bank-Full Depth= 2.00' Flow Area= 22.0 sf, Capacity= 172.11 cfs

5.00' x 2.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 17.00'
Length= 100.0' Slope= 0.0100 '/'
Inlet Invert= 570.00', Outlet Invert= 569.00'

‡

Summary for Reach 12R: Diversion Ditch DB6 Ph 2, 10% slope

[61] Hint: Exceeded Reach 10R outlet invert by 0.91' @ 12.20 hrs

Inflow Area = 16.990 ac, 0.00% Impervious, Inflow Depth = 4.21" for 10yr T- III event
Inflow = 62.23 cfs @ 12.20 hrs, Volume= 5.960 af
Outflow = 62.22 cfs @ 12.20 hrs, Volume= 5.960 af, Atten= 0%, Lag= 0.2 min

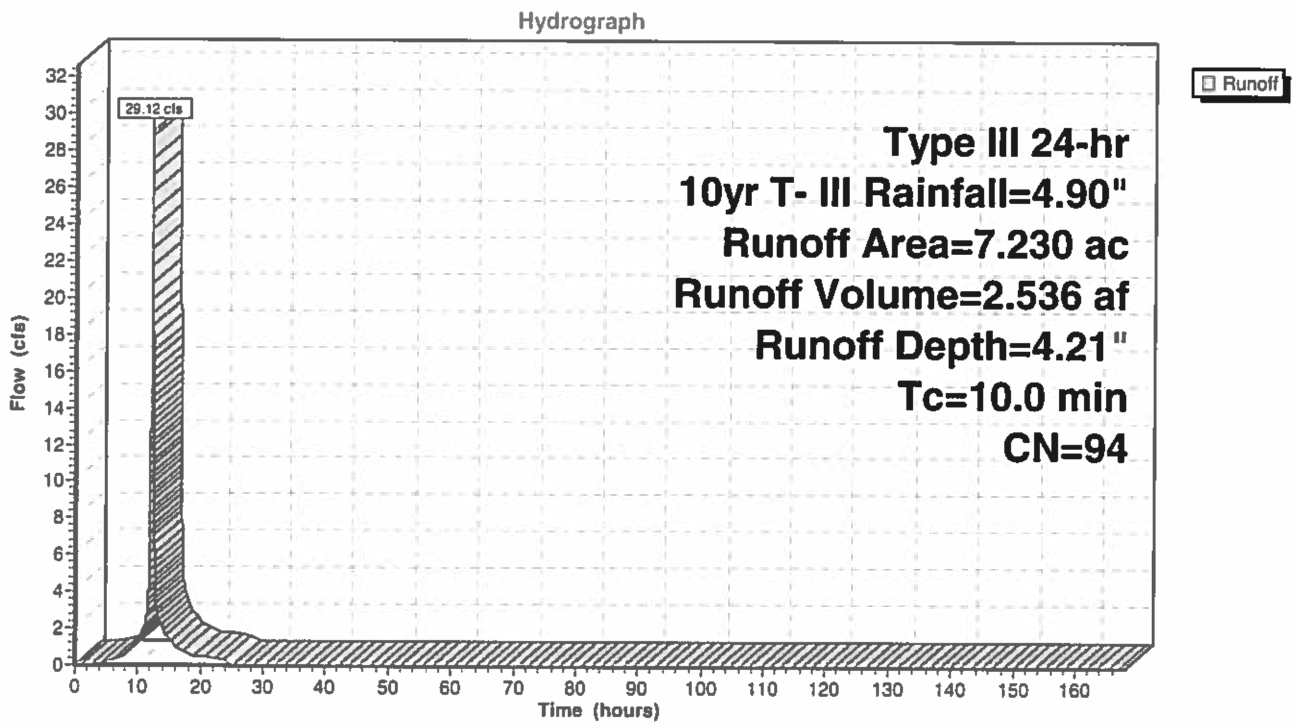
Routing by Dyn-Stor-Ind method, Time Span= 0.00-168.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.85 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.49 fps, Avg. Travel Time= 0.7 min

Peak Storage= 773 cf @ 12.20 hrs
Average Depth at Peak Storage= 0.91'
Bank-Full Depth= 2.00' Flow Area= 22.0 sf, Capacity= 299.35 cfs

5.00' x 2.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 3.0 '/' Top Width= 17.00'
Length= 110.0' Slope= 0.1000 '/'
Inlet Invert= 569.00', Outlet Invert= 558.00'

‡

Subcatchment 24S: Drg Area6



Temporary Sediment/Detention Basin B

HydroCAD Reports

100 yr. 24 Hr. Type III Storm

Summary for Pond 19P: Basin B

[62] Hint: Exceeded Reach 12R OUTLET depth by 6.21' @ 17.00 hrs

Inflow Area = 24.220 ac, 0.00% Impervious, Inflow Depth = 7.98" for 100yr T- III event
Inflow = 163.50 cfs @ 12.17 hrs, Volume= 16.103 af
Outflow = 5.32 cfs @ 16.41 hrs, Volume= 15.742 af, Atten= 97%, Lag= 254.4 min
Primary = 5.32 cfs @ 16.41 hrs, Volume= 15.742 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-168.00 hrs, dt= 0.01 hrs
Peak Elev= 564.40' @ 16.41 hrs Surf.Area= 95,371 sf Storage= 532,192 cf

Plug-Flow detention time= 2,862.3 min calculated for 15.742 af (98% of inflow)
Center-of-Mass det. time= 2,848.0 min (3,616.6 - 768.5)

Volume	Invert	Avail.Storage	Storage Description
#1	558.00'	903,394 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
558.00	71,818	1,107.7	0	0	71,818
559.00	75,204	1,140.5	73,505	73,505	77,793
560.00	78,704	1,169.0	76,947	150,452	83,156
561.00	82,304	1,198.1	80,497	230,949	88,764
562.00	86,009	1,226.2	84,150	315,099	94,319
563.00	89,842	1,254.7	87,919	403,017	100,081
564.00	93,779	1,282.5	91,803	494,821	105,835
565.00	97,833	1,313.2	95,799	590,620	112,308
566.00	102,069	1,344.8	99,944	690,563	119,123
567.00	106,425	1,376.2	104,239	794,803	126,057
568.00	110,773	1,404.0	108,592	903,394	132,362

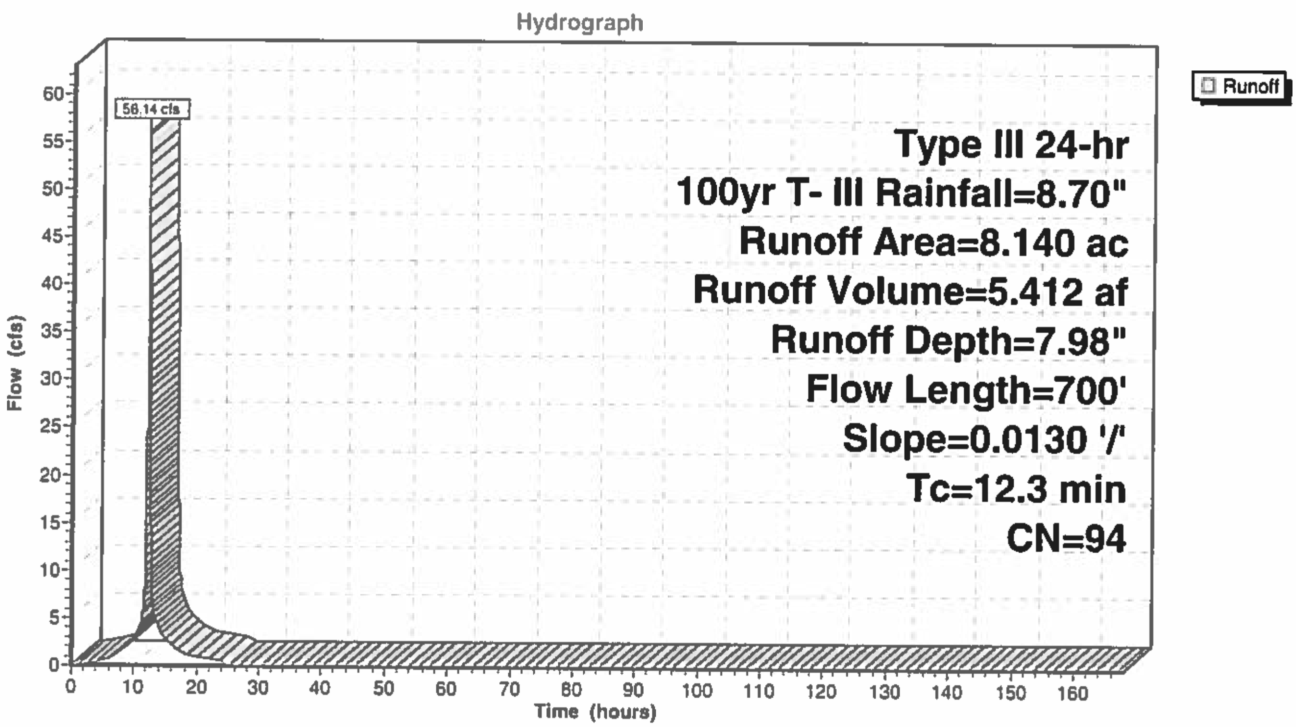
Device	Routing	Invert	Outlet Devices
#1	Primary	558.00'	**48.0" Round Culvert** L= 680.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 558.00' / 557.32' S= 0.0010 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 12.57 sf
#2	Device 1	562.50'	**12.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	567.00'	**60.0" x 60.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	558.20'	**0.850 cfs Constant Flow/Skimmer** Phase-In= 0.30'

Primary OutFlow Max=5.32 cfs @ 16.41 hrs HW=564.40' (Free Discharge)
└─**1=Culvert** (Passes 5.32 cfs of 80.18 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 4.47 cfs @ 5.69 fps)
  ├─**3=Orifice/Grate** (Controls 0.00 cfs)
  └─**4=Constant Flow/Skimmer** (Constant Controls 0.85 cfs)

Hydrograph for Pond 19P: Basin B no projection

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	558.00	0.00
5.00	1.70	9,726	558.13	0.00
10.00	**8.90**	76,204	559.04	0.85
15.00	**8.47**	**524,484**	**564.31**	**5.19**
20.00	2.83	**513,406**	**564.20**	**4.99**
25.00	0.05	466,764	563.70	4.01
30.00	0.00	411,550	563.09	2.13
35.00	0.00	383,352	562.78	1.17
40.00	0.00	365,474	562.58	0.88
45.00	0.00	350,102	562.40	0.85
50.00	0.00	334,802	562.23	0.85
55.00	0.00	319,502	562.05	0.85
60.00	0.00	304,202	561.87	0.85
65.00	0.00	288,902	561.69	0.85
70.00	0.00	273,602	561.51	0.85
75.00	0.00	258,302	561.33	0.85
80.00	0.00	243,002	561.15	0.85
85.00	0.00	227,702	560.96	0.85
90.00	0.00	212,402	560.77	0.85
95.00	0.00	197,102	560.58	0.85
100.00	0.00	181,802	560.39	0.85
105.00	0.00	166,502	560.20	0.85
110.00	0.00	151,202	560.01	0.85
115.00	0.00	135,902	559.81	0.85
120.00	0.00	120,602	559.62	0.85
125.00	0.00	105,302	559.42	0.85
130.00	0.00	90,002	559.22	0.85
135.00	0.00	74,702	559.02	0.85
140.00	0.00	59,402	558.81	0.85
145.00	0.00	44,102	558.61	0.85
150.00	0.00	30,046	558.41	0.58
155.00	0.00	22,399	558.31	0.31
160.00	0.00	18,379	558.25	0.15
165.00	0.00	16,386	558.23	0.08

Subcatchment 11S: Drg Area 4



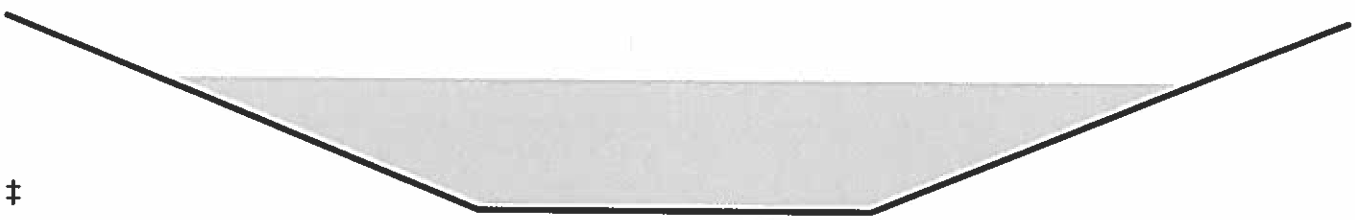
Summary for Reach 9R: Div Ditch Ph 2, 0.5% slope DA4

Inflow Area = 8.140 ac, 0.00% Impervious, Inflow Depth = 7.98" for 100yr T- III event
Inflow = 56.14 cfs @ 12.16 hrs, Volume= 5.412 af
Outflow = 55.53 cfs @ 12.18 hrs, Volume= 5.412 af, Atten= 1%, Lag= 1.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-168.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.48 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 1.37 fps, Avg. Travel Time= 4.9 min

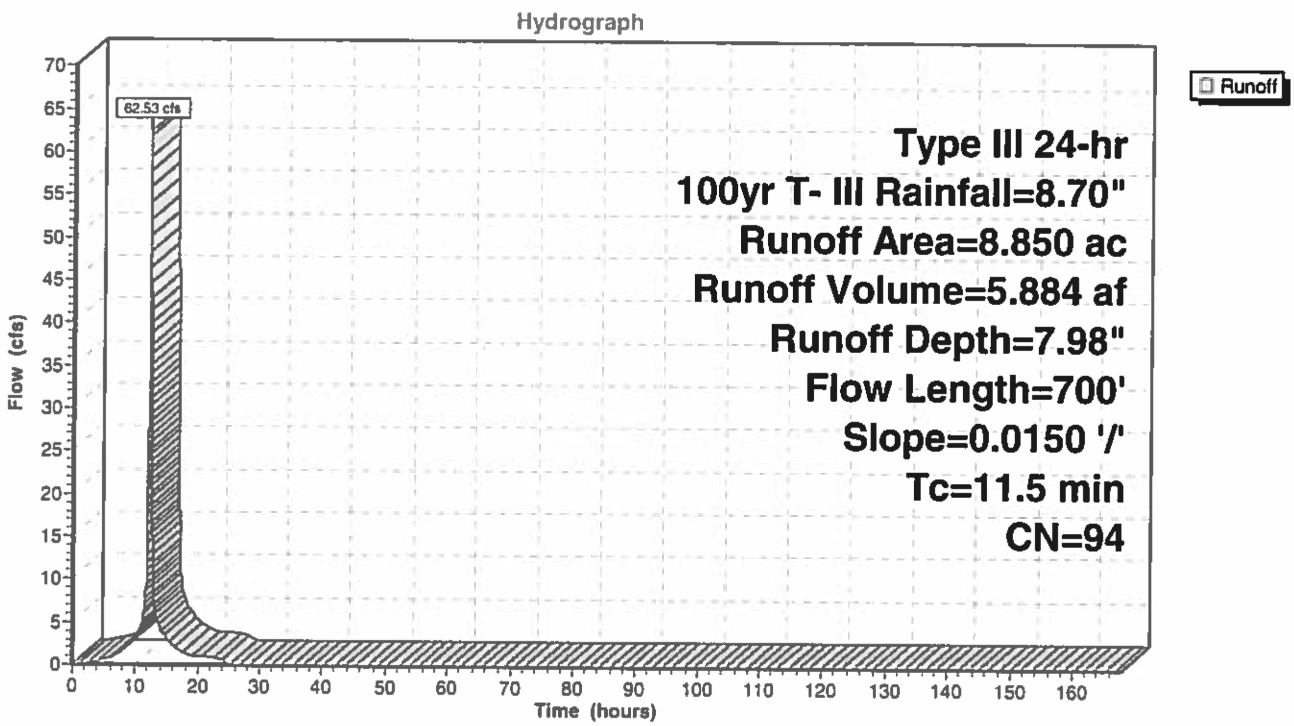
Peak Storage= 4,954 cf @ 12.18 hrs
Average Depth at Peak Storage= 1.36'
Bank-Full Depth= 2.00' Flow Area= 22.0 sf, Capacity= 121.70 cfs

5.00' x 2.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 17.00'
Length= 400.0' Slope= 0.0050 '/'
Inlet Invert= 575.00', Outlet Invert= 573.00'



‡

Subcatchment 21S: Drg Area 5



Summary for Reach 26R: Div Ditch DB4, 0.5% slope DA4 & 5

[62] Hint: Exceeded Reach 9R OUTLET depth by 0.59' @ 12.21 hrs

Inflow Area = 16.990 ac, 0.00% Impervious, Inflow Depth = 7.98" for 100yr T- III event
Inflow = 117.13 cfs @ 12.16 hrs, Volume= 11.296 af
Outflow = 115.12 cfs @ 12.19 hrs, Volume= 11.296 af, Atten= 2%, Lag= 1.4 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-168.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.45 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 1.65 fps, Avg. Travel Time= 6.1 min

Peak Storage= 12,670 cf @ 12.19 hrs
Average Depth at Peak Storage= 1.95'
Bank-Full Depth= 2.00' Flow Area= 22.0 sf, Capacity= 121.70 cfs

5.00' x 2.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 17.00'
Length= 600.0' Slope= 0.0050 '/'
Inlet Invert= 573.00', Outlet Invert= 570.00'

Summary for Reach 10R: Diversion Ditch Ph 2, 1% slope

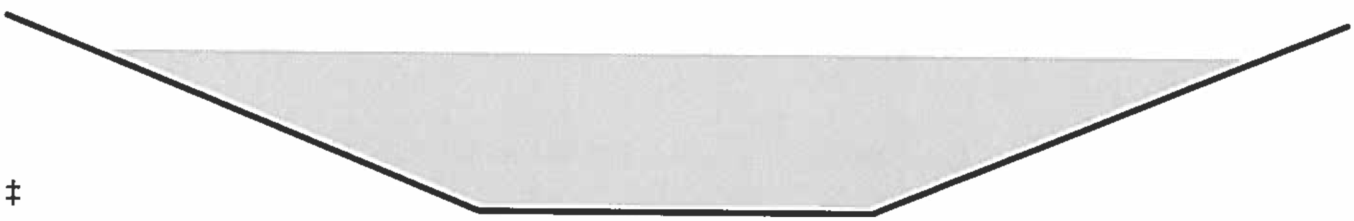
[61] Hint: Exceeded Reach 26R outlet invert by 1.65' @ 12.19 hrs

Inflow Area =	16.990 ac,	0.00% Impervious, Inflow Depth = 7.98"	for 100yr T- III event	
Inflow =	115.12 cfs @	12.19 hrs, Volume=	11.296 af	
Outflow =	115.10 cfs @	12.19 hrs, Volume=	11.296 af,	Atten= 0%, Lag= 0.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-168.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.03 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.10 fps, Avg. Travel Time= 0.8 min

Peak Storage= 1,637 cf @ 12.19 hrs
Average Depth at Peak Storage= 1.65'
Bank-Full Depth= 2.00' Flow Area= 22.0 sf, Capacity= 172.11 cfs

5.00' x 2.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 17.00'
Length= 100.0' Slope= 0.0100 '/'
Inlet Invert= 570.00', Outlet Invert= 569.00'



‡

Summary for Reach 12R: Diversion Ditch Ph 2, 10% slope

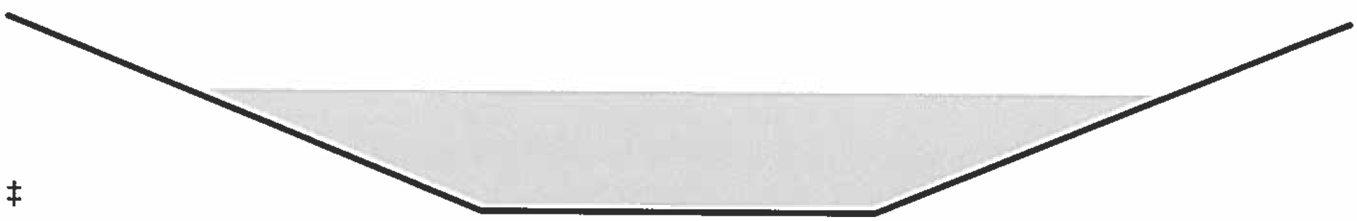
[61] Hint: Exceeded Reach 10R outlet invert by 1.25' @ 12.19 hrs

Inflow Area = 16.990 ac, 0.00% Impervious, Inflow Depth = 7.98" for 100yr T- III event
Inflow = 115.10 cfs @ 12.19 hrs, Volume= 11.296 af
Outflow = 115.08 cfs @ 12.19 hrs, Volume= 11.296 af, Atten= 0%, Lag= 0.1 min

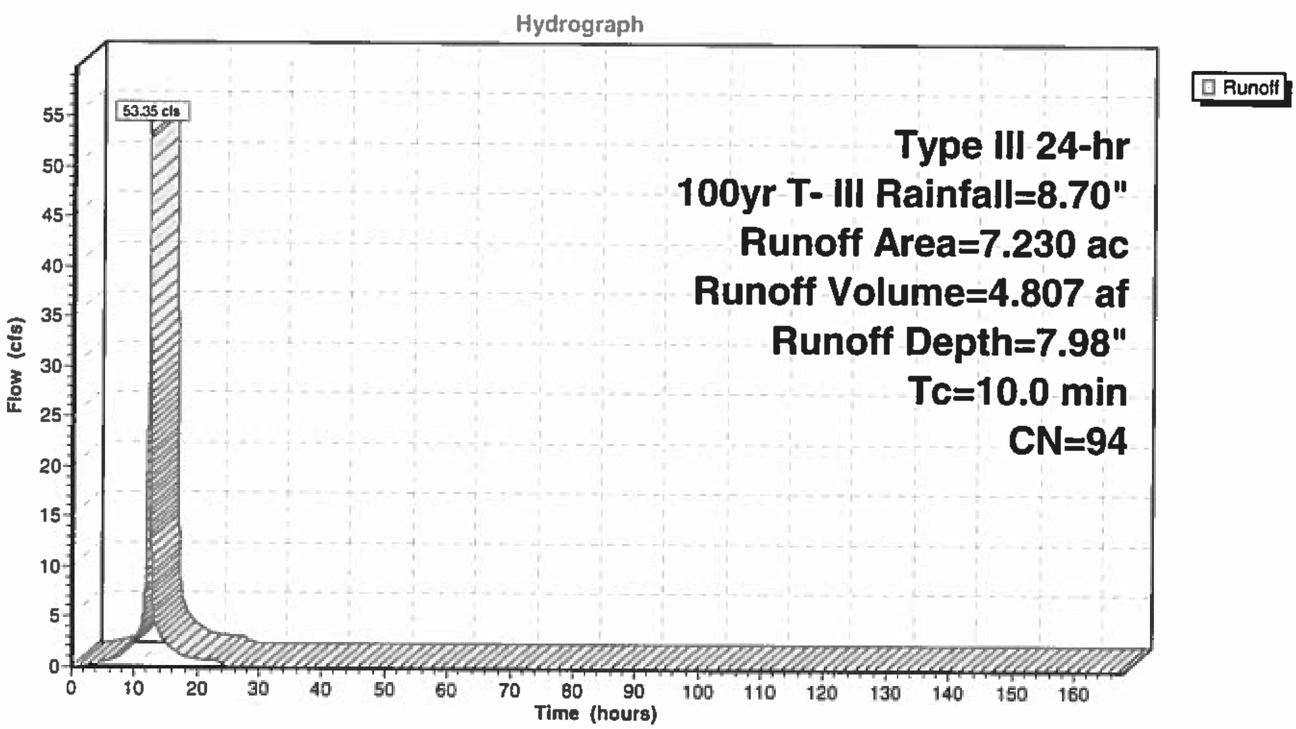
Routing by Dyn-Stor-Ind method, Time Span= 0.00-168.00 hrs, dt= 0.01 hrs
Max. Velocity= 10.52 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 3.06 fps, Avg. Travel Time= 0.6 min

Peak Storage= 1,203 cf @ 12.19 hrs
Average Depth at Peak Storage= 1.25'
Bank-Full Depth= 2.00' Flow Area= 22.0 sf, Capacity= 299.35 cfs

5.00' x 2.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 3.0 '/' Top Width= 17.00'
Length= 110.0' Slope= 0.1000 '/'
Inlet Invert= 569.00', Outlet Invert= 558.00'



Subcatchment 24S: Drg Area6



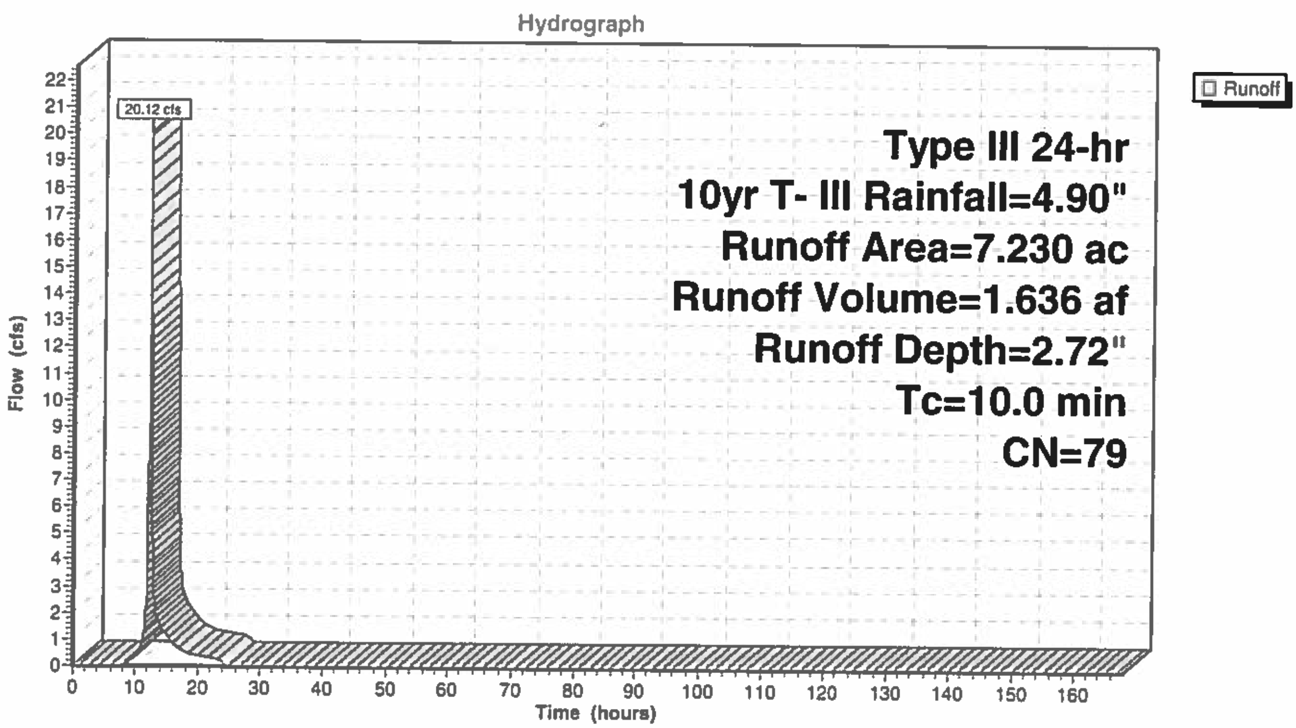
Temporary Sediment/Detention Basin B

HydroCAD Reports

10 yr. 24 Hr. Type III Storm

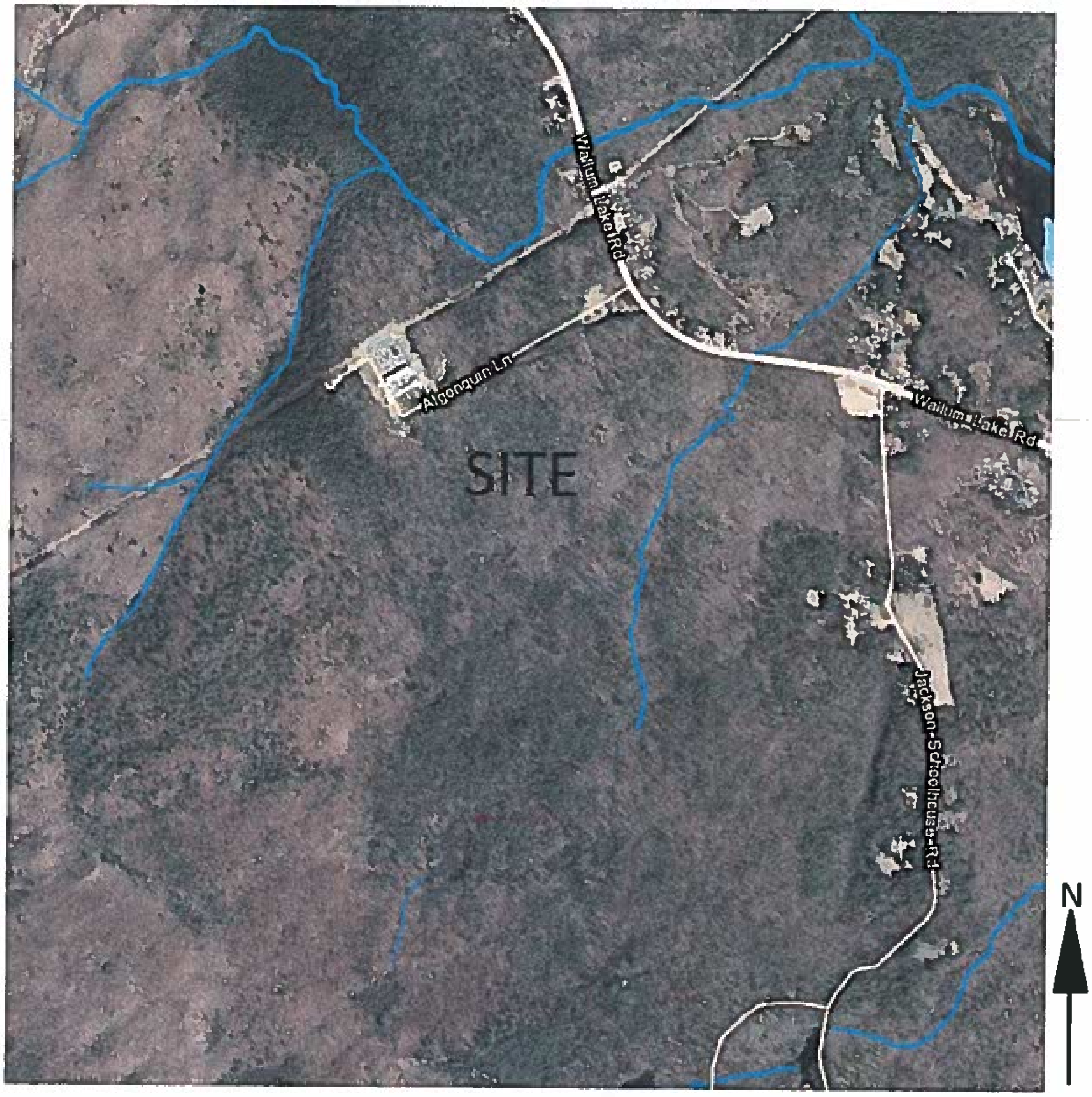
Before Mass Grading Begins

Subcatchment 25S: Drg Area6 Pre-Grade



Attachment A

General Location Map



SITE LOCATION MAP

(Not to Scale)

Clear River Energy Center

Wallum Lake Road (RI Route 100)

Burrillville, RI

Attachment B

SESC Site Plans

(Refer to Appendix B of Storm Water Management Plan)

Attachment C

Copy of RIPDES Construction General Permit and Authorization to Discharge

Attachment D

Copy of Other Regulatory Permits

Additional Regulatory Permits for this project site are pending and will be included once issued by respective Agencies

Attachment E

Copy of RIPDES NOI

Attachment F

Inspection Reports w/ Corrective Action Log

SWPPP Inspection Report

Project Information			
Name/Location	**Clear River Energy Center/Wallum Lake Road (RI Route 100), Burrillville, RI**		
Project Manager		**Resident Engineer**	
Contractor		**SWPPP Contact**	
E&S Sub-Contractor		**SWPPP Contact**	

Inspection Information			
Inspector			
Inspection Date		**Start/End Time**	
Inspection Type ❑ **Weekly** ❑ **Pre-storm event** ❑ **During storm event** ❑ **Post-storm event** ❑ **Violation**			

Weather Information		
Rain Gauge:		
Last Rain Event Date:	Duration (hrs):	Approximate Rainfall (in):
Current Weather at time of this inspection:		
Weather Forecast at time of this inspection: (when is next precipitation or wind event anticipated?)		

Certification Statements		
Inspector: (check one) ☐ I, as the designated Inspector, certify that this site has been inspected and is in compliance with the site-specific SWPPP. ☐ I, as the designated Inspector, certify that this site has been inspected and I have made the determination that the site requires corrective actions before it will be compliant with the site-specific SWPPP. The required corrective actions are noted within this inspection report.		
Print Name:	Signature:	Date:
Resident Engineer: I, the Resident Engineer, acknowledge the receipt of this SWPPP inspection report, and understand the requirements set forth in the Site Specifications and the Contract Documents regarding the implementation and maintenance of erosion and sedimentation controls.		
Print Name:	Signature:	Date:
Contractor: I, the designated Contractor representative, acknowledge the receipt of this SWPPP inspection report, and understand the requirements set forth in the Site Specifications and the Contract Documents regarding the implementation and maintenance of erosion and sedimentation controls.		
Print Name:	Signature:	Date:

Site-specific BMPs

Number the structural and non-structural BMPs identified in the SWPPP on the site map and list them below (add as necessary). Bring a copy of this inspection form and numbered site map with you during your inspections. This list will help ensure that you are inspecting all required BMPs at your site.

	Location/Station	BMP Description	Installed & Operating Properly?	Assoc. Photo/ Figure #	Corrective Action
1			❑Yes ❑No		
2			❑Yes ❑No		
3			❑Yes ❑No		
4			❑Yes ❑No		
5			❑Yes ❑No		
6			❑Yes ❑No		
7			❑Yes ❑No		
8			❑Yes ❑No		
9			❑Yes ❑No		
10			❑Yes ❑No		
11			❑Yes ❑No		
12			❑Yes ❑No		
13			❑Yes ❑No		
14			❑Yes ❑No		
15			❑Yes ❑No		

(add more as necessary)

Overall Site Issues

Below are some general site issues that should be assessed during inspections. Please customize this list as needed for conditions at the site. If item is not applicable, please note why.

EROSION AND SEDIMENTATION BMP INSPECTION	**Installed & Operating correctly?**	**Assoc. Photo/ Figure #**	**CORRECTIVE ACTION**
Are **Limits of Disturbance** clearly marked?	❑Yes ❑No ❑ N/A		
Are **natural resource areas** (e.g., streams, wetlands, trees, etc.) protected with barriers or similar BMPs?	❑Yes ❑No ❑ N/A		
Is **construction sequencing** being followed?	❑Yes ❑No ❑ N/A		
Are **structural BMPs** properly installed to control stormwater flow on the construction site?	❑Yes ❑No ❑ N/A		
Is **clearing/grubbing** only occurring in areas that will have active work within 21-days?	❑Yes ❑No ❑ N/A		
Do **unstabilized areas** have appropriate controls in place?	❑Yes ❑No ❑ N/A		
Are all **slopes** protected from concentrated stormwater flow?	❑Yes ❑No ❑ N/A		
Are storm drain **inlets** properly protected?	❑Yes ❑No ❑ N/A		
Are storm drain **outfalls** properly protected?	❑Yes ❑No ❑ N/A		
Are **perimeter controls** and sediment barriers adequately installed and maintained?	❑Yes ❑No ❑ N/A		
Are discharge points and **receiving waters** free of sediment deposits?	❑Yes ❑No ❑ N/A		
Is **weather** forecast being checked regularly?	❑Yes ❑No ❑ N/A		
Notes on Erosion and Sediment Controls:			

GOOD HOUSEKEEPING BMP INSPECTION	**Installed & Operating correctly?**	**Assoc. Photo/ Figure #**	**CORRECTIVE ACTION**
Are BMPs effectively limiting **sediment** from being tracked into the street?	❑Yes ❑No ❑ N/A		
Is **trash/litter** from work areas collected and placed in covered containers regularly?	❑Yes ❑No ❑ N/A		
Are on-site **equipment**, vehicles, containers, and storage areas free from leaks?	❑Yes ❑No ❑ N/A		
Are **materials** that are potential stormwater contaminants stored inside or under cover?	❑Yes ❑No ❑ N/A		
Are **non-storm water discharges** free from contamination?	❑Yes ❑No ❑ N/A		
Are **stockpiles** covered (either with temporary vegetation or tarps), ringed with barrier BMPs, and located at least 50 feet away from natural resources and storm drains?	❑Yes ❑No ❑ N/A		
Are **washout facilities** (e.g. paint, concrete) available, clearly marked, and maintained and located at least 50-feet away from natural resources and storm drains?	❑Yes ❑No ❑ N/A		
Are **vehicle and equipment** fueling, cleaning, and maintenance areas free from leaks and located at least 50-feet away from natural resources and storm drains?	❑Yes ❑No ❑ N/A		
Is **dust** being controlled on-site?	❑Yes ❑No ❑ N/A		
Is **sweeping** being used to keep sediment off roads and parking lots?	❑Yes ❑No ❑ N/A		

PROCEURAL BMP INSPECTION	**Installed & Operating correctly?**	**Assoc. Photo/ Figure #**	**Corrective Action**
Are **permanent BMPs** being protected during the active construction phase?	❑Yes ❑No ❑ N/A		
Are all **structural BMPs** being maintained in accordance with RI SESC Handbook?	❑Yes ❑No		
Are **inspections** taking place every 7-days & after storm events?	❑Yes ❑No		
Have previous **Corrective Actions** been initiated & completed by the Contractor?	❑Yes ❑No ❑ N/A		
Are SWPPP **Amendments** being logged?	❑Yes ❑No ❑ N/A		
Are the SWPPP and ALL inspection **reports** being kept at the site construction office?	❑Yes ❑No		

Photo Log:

(Associated photos – each photo should be dated and have a unique identification # and written description indicating where it is located within the project area. If a close up photo is required, it should be preceded with a photo including both the detail area and some type of visible fixed reference point. Photos should be annotated with Station numbers and other identifying information where needed.)

Photo #:	**Station:**
(insert Photo here)	**Description:**

Photo #:	**Station:**
(insert Photo here)	**Description:**

Photo #:	**Station:**
(insert Photo here)	**Description:**

Photo #:	**Station:**
(insert Photo here)	**Description:**

Photo #:	**Station:**
(insert Photo here)	**Description:**

Photo #:	**Station:**
(insert Photo here)	**Description:**

(add more as necessary)

General Field Comments:

<table>
<tr><th colspan="2">NOTICE TO CONTRACTOR</th></tr>
<tr><td colspan="2">This SWPPP Inspection Report, completed by a certified inspector, indicates that this construction site is:</td></tr>
<tr><td>☐
COMPLIANT</td><td>• No immediate actions are required, other than keeping up the good work!
• Work is required to maintain Site compliance</td></tr>
<tr><td rowspan="3">☐
NON-COMPLIANT</td><td>This document serves as your directive to proceed with corrective actions that have been outlined above.

The SWPPP, Construction Contract documents, and the RI DEM requirements state that non-compliance issues shall be addressed no later than (7) seven calendar days from date of inspection. In accordance with the SWPPP, the contractor shall commence with the requisite cleaning and maintenance measures no later than the next calendar day after receiving such a directive from the engineer.</td></tr>
<tr><td>Date work to begin:</td></tr>
<tr><td>Date work to be completed:</td></tr>
<tr><td>R.E. initials: ____________

Date: ____________</td><td>R.E. Comments:</td></tr>
</table>

Attachment G

SESC Plan Amendment Log

SESC Plan Amendment Log

Rev. No.	Date	Revision Notes
Original Submittal	Sept. 12, 2016	

Appendix F – Maps

11 Stanwix Street | Suite 800 | Pittsburgh, PA 15222
T 412.497.6000

Floodplain

March 26, 2017

Coastal A Zone

Riverine Reference

1:18,056

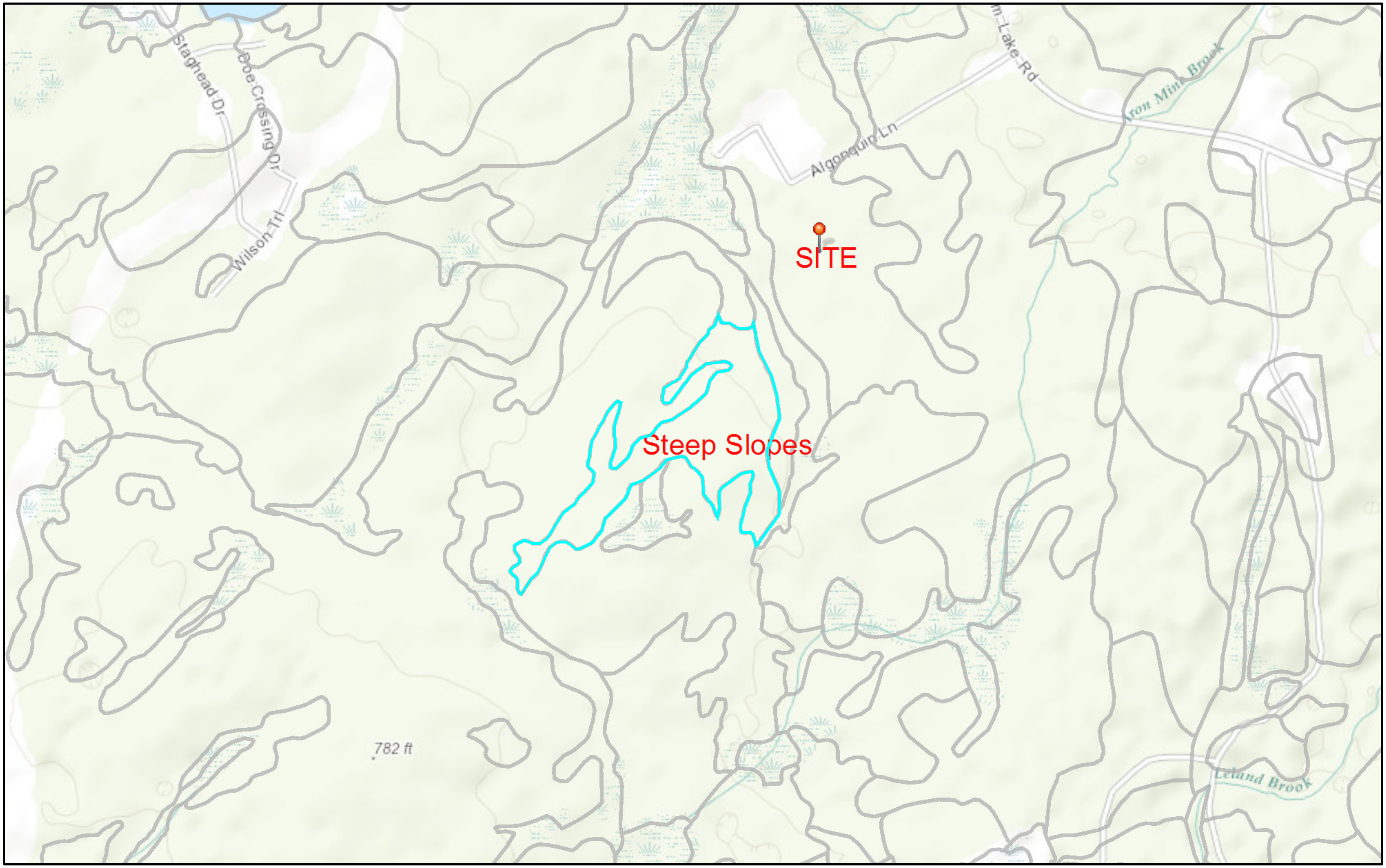
0 0.15 0.3 0.6 mi

0 0.175 0.35 0.7 km

Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey,

e Island Department of Environmental Management (RIDEM) | USDA NRCS | USDA NRCS Rhode Island State Office, RIGIS, University of Rhode Island Environmental Data Center (URIEDC) | RIGIS, University of Rhode Island Environmental Data Center | RIEMA | Esri, HERE, iPC |

Steep Slopes



March 26, 2017

Soil Map Units

1:18,056

0 0.15 0.3 0.6 mi

0 0.175 0.35 0.7 km

Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey,

e Island Department of Environmental Management (RIDEM) | USDA NRCS | USDA NRCS Rhode Island State Office, RIGIS, University of Rhode Island Environmental Data Center (URIEDC) | RIGIS, University of Rhode Island Environmental Data Center | RIEMA | Esri, HERE, iPC |

Drainage Areas

March 26, 2017

RIPDES Phase II Stormwater Area

World Transportation

Rivers

0

1

2

3

4

5

Lakes

Estuarine and Marine Waters

1:36,112

0 0.3 0.6 1.2 mi

0 0.35 0.7 1.4 km

Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey,

Rhode Island Department of Environmental Management (RIDEM) | USDA NRCS | USDA NRCS Rhode Island State Office, RIGIS, University of Rhode Island Environmental Data Center (URIEDC) | RIGIS, University of Rhode Island Environmental Data Center | RIEMA | Esri, HERE |

Wetlands, Hydric Soils & Surface Waters

March 26, 2017

Soil Map Units

Predominately hydric

World Transportation

Hydric Soil

Hydric

Rivers

0
1
2
3
4
5

Lakes

Estuarine and Marine Waters

1:18,056

0 0.15 0.3 0.6 mi

0 0.175 0.35 0.7 km

Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey,

e Island Department of Environmental Management (RIDEM) | USDA NRCS | USDA NRCS Rhode Island State Office, RIGIS, University of Rhode Island Environmental Data Center (URIEDC) | RIGIS, University of Rhode Island Environmental Data Center | RIEMA | Esri, HERE, iPC |

Appendix K

Stormwater Management Plan for Burrillville Interconnection Project

PERMIT HISTORY AND APPLICABILITY - **Double-click** to check all boxes that apply to the proposed project.

Permit History	**Provide all other application or file numbers associated with this site.**			RIDEM USE ONLY
	RI CRMC Assent:	US Army Corps of Engineers:	RIDEM Program Name & File Number:	

Stormwater Construction Activity

Select all that apply. [Stormwater submissions must comply with all requirements of the RI Stormwater Design and Installation Standards Manual (RISDISM). Click links below to refer to other applicable Rules.]

There are Freshwater Wetlands on the subject or adjacent property, AND the project proposes:

- ☐ New or increased impervious cover for property other than a single family home; or
- ☐ Disturbance of more than 10,000 sq. ft. of existing impervious cover; or
- ☐ To fill in any amount of floodplain or alter storm flowage to a river, stream or wetland on any lot.

Refer to Freshwater Wetland: *Rules*

The project requires an application to RI CRMC, AND proposes:

- ☐ A residential development of 6 units or more; or
- ☐ A project that results in the creation of 10,000 sq. ft. or more of impervious area.

Refer to Water Quality: *Rules*

The project proposes an infiltration system listed in Section 5.3 of the RISDISM (i.e. infiltration trench, infiltration basin, UIC chamber or drywell) that receives stormwater from:

- ☐ A residential impervious area that is more than 10,000 sq.ft.; or
- ☐ A non-residential roof area greater than 10,000 sq.ft.; or
- ☐ A non-residential (commercial, industrial, institutional...) road or parking area of any size.

Indicate if the treatment system discharges:

- ☐ Below the ground (UIC); or
- ☐ Above the ground and infiltrates (not UIC), but must be reviewed for compliance with the RISDISM to be protective of groundwater.

Refer to Groundwater Discharge: *Rules*

The project proposes **discharge of stormwater** to waters of the State [including a Separate Storm Sewer System (MS4)], AND :

- ☐ Disturbs less than 1 acre, but the activity is part of a larger common plan resulting in more than 1 acre of disturbance.
- ☑ Disturbs more than 1 acre of property.

Site is within or directly discharges to a Natural Heritage Area? No

Refer to RI Pollutant Discharge Elimination System: *General Permit*

RIDEM USE ONLY: RIPDES Application # Required:

Water Quality Certification (WQC)

Select all project type(s):

- ☑ Discharge that requires a Federal Permit — Click to Select One:
  - ☐ Federal Energy Regulatory Commission (FERC)
  - ☐ Marinas - New Construction or Expansion
  - ☑ Individual Permit
  - ☐ Fill Waters of the State
- ☐ Harbor Management Plan
- ☐ Flow Alteration
- ☐ Stormwater Master Plan

Refer to Water Quality: *Rules* *Guidance*

RIDEM USE ONLY: STW/WQC Application # Required:

Submission Requirements

Please submit separately bound documents, as required. Additional copies are required when submitting concurrently with a Freshwater Wetlands Application.

1	Site Plan(s)
1	RISDISM Appendix A Checklist and LID Planning Assessment
1	Stormwater Analysis and Drainage Report
1	Soil Erosion and Sediment Control (SESC) Plan
1	Post-Construction Operation and Maintenance (O&M) Plan
	Appropriate Fee: New Permit = $400; Permit Modification = $200.

RIDEM USE ONLY: Amt Paid: Check No: Date Received:

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
Office of Water Resources
235 Promenade Street, Providence, RI 02908-5767
Telephone: 401-222-6820; Rhode Island Relay: 711; FAX: 401-222-6177

Received by RIDEM
(DATE STAMP HERE)

Application for Stormwater Construction Permit and Water Quality Certification

Use this form to request a Stormwater Construction Permit or Water Quality Certification (WQC). [This form replaces the formerly used WQC Program Application; Applications for a Stormwater Discharge System Registration and to Modify a Groundwater or Stormwater Discharge System (GWD/UIC Program); and the RIPDES Notice of Intent (NOI) Stormwater General Permit for Construction Activity (CGP).] **If a Freshwater Wetlands (FWW) Application is required, this form must be submitted in addition to the FWW Application form.**

Please complete this form online before printing. Submit the completed form with all required documentation and fee to:
(Check or money order must be made payable to the Rhode Island General Treasurer.)
Stormwater Construction Permit Fee will be waived for applications submitted concurrently with a Freshwater Wetlands Application.

Permit Application Center (PAC)
RIDEM
235 Promenade Street, Room 260
Providence, RI 02908-5767

Provide all applicable information by completing the **shaded** areas.

Double-click to select:	☑ **New Permit** Fee = $400.	☐ **Permit Modification**	

Site & Project

City/Town:	Street Address:	Water Body Class:
Burrillville	Utility ROW-Wallum Lake Road to Sherman Farm Road	B1

Plat(s):	Lot(s):	Project Name:
		Burrillville Interconnection Project

Location:	Water Body Name(s):
6.0 miles of existing TNEC ROW & 0.8 mile of new Clear River Energy Center ROW	Dry Arm Brook, Clear River, Mowry Brook, Round Top Brook, Chockalog River

Latitude:	Longitude:	Utility Pole #:	Total Site Area:	Site Area to be Disturbed:
			~347 acres	~17.9 acres

RI Federal Aid Project #:	RI Contract #:	Was there a Pre-Application Meeting?	Provide Meeting Date:
		☑ Yes ☐ No	12/08/16

Owner / Applicant

Organization/Company Name:	Contact Name of Owner's Representative for Questions:
The Narragansett Electric Compnay	James Durand

First Name:	Last Name:	Email:	Phone:
Michael	Ryan	jamie.durand@powereng.com	774-643-1829

Address:	City/Town:	State:	Zip:
280 Melrose Street, Providence, RI 02907	North Attleboro	MA	02763

I certify under penalty of law that I've requested and authorized the investigation, compilation, and submission of all the information, in whatever form, contained in this Application; I have personally examined and am familiar with the information submitted herein; and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe the information is true, accurate and complete. I'm aware that it's the owner's responsibility to implement or hire a qualified contractor responsible to implement any required Soil Erosion and Sediment Control Plan, so as to effectively control stormwater discharges leaving the site during the construction period. I authorize RIDEM personnel access to the property for purposes of observing conditions pertinent to this application and assessing compliance with any permit or determination resulting from this application.

Applicant's Signature:	Title:	Date:
Michael F. Ryan	Vice President	03/30/17

Professional

Professional's Name:	Professional's License Type(s) and Number(s):
Pamela S. Kelley	Professional Engineer No. 8879

Company Name:	Email:	Phone:
POWER Engineers, Inc.	pam.kelley@powereng.com	207-869-1206

I certify under penalty of law that the project described in this application and associated materials is in compliance with the RI Stormwater Design and Installation Standards Manual (as amended) and the Rhode Island Soil Erosion and Sediment Control Handbook (as amended) [if required] and I believe all information presented in this application and the accompanying materials are true, accurate and complete. All engineering designs, plans and specifications [if required] included in this application were done by me or by someone working directly for me. The Natural Heritage Area Information [if required] and the site specific Soil Erosion and Sediment Control Plan [if required] were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering or developing the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete at the time this application is made. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Professional's Signature:	Title:	Date:
Pamela S Kelley	Senior Professional Engineer	03/30/17

APPENDIX A: STORMWATER MANAGEMENT CHECKLIST AND LID PLANNING REPORT

PROJECT NAME: Burrillville Interconnection Project	(RIDEM USE ONLY)
CONTACT FOR STORMWATER DESIGN QUESTIONS: Pam Kelley	
PHONE NUMBER: 207-869-1206	
EMAIL ADDRESS: pam.kelley@powereng.com	
BRIEF PROJECT DESCRIPTION: The Narragansett Electric Company d/b/a National Grid (TNEC), and Clear River Energy LLC, a project company of Invenergy Thermal Development LLC (Invenergy) (collectively the Applicant) is proposing to construct a new approximately 6.8 mile 345 kilovolt (kV) transmission line (the 3052 Line) in the Town of Burrillville, Rhode Island, to interconnect the proposed Clear River Energy Center (CREC) to the existing electric transmission system (the Burrillville Interconnection Project or the Project). The 3052 Line will begin at the proposed CREC to be located off of Wallum Lake Road in Burrillville. From the CREC facility, it will extend approximately 0.8 miles along a new right-of-way (ROW) on an easement owned by CREC (CREC ROW) to its intersection with an existing TNEC transmission line ROW (TNEC ROW). The 3052 Line will then continue east approximately six miles along the TNEC ROW to the existing Sherman Road Switching Station in Burrillville (Refer to RIDEM Permit Drawings). Improvements to the Sherman Road Switching Station will occur within the existing Station yard. The 3052 Line will share the TNEC ROW with the two existing 345 kV lines, the 347 Line and the 341 Line. The 341 Line was recently installed as part of the Interstate Reliability Project (IRP).	DATE RECEIVED

STORMWATER MANAGEMENT PLAN ELEMENTS

APPENDIX A: STORMWATER MANAGEMENT CHECKLIST	STORMWATER ANALYSIS AND DRAINAGE REPORT	SOIL EROSION AND SEDIMENT CONTROL PLAN	OPERATIONS AND MAINTENANCE PLAN
PART 1: PROJECT AND SITE INFORMATION **MINIMUM STANDARDS:** 6. REDEVELOPMENT 8. LUHHPL IDENTIFICATION **PART 2.** **MINIMUM STANDARD:** 1. LID SITE PLANNING **PART 3.** SUMMARY OF REMAINING STANDARDS **PART 4.** SUBWATERSHED MAPPING SITE PLAN DETAILS	ADDRESSES MINIMUM STANDARDS: 2. GROUNDWATER RECHARGE 3. WATER QUALITY VOLUME 4. CONVEYANCE & NATURAL CHANNEL PROTECTION 5. OVERBANK AND FLOOD PROTECTION 9. ILLICIT DISCHARGE DETECTION AND ELIM.	ADDRESSES MINIMUM STANDARDS: 7. POLLUTION PREVENTION DURING CONSTRUCTION 10. CONSTRUCTION EROSION AND SEDIMENTATION CONTROL	ADDRESSES MINIMUM STANDARDS: 7. POLLUTION PREVENTION AFTER CONSTRUCTION 11. OPERATIONS AND MAINTENANCE

Note: **All** stormwater construction projects **must submit** a Stormwater Management Plan (SMP). However, not every element listed below (see the Stormwater Management Plan Table) is required per the RISDISM and the RIPDES Construction General Permit (CGP). This checklist will help you identify the elements of the stormwater plan you are required to submit with your permit application.

PART 1. PROJECT AND SITE INFORMATION

PROJECT TYPE (Check all that apply)

☐ RESIDENTIAL	☐ COMMERCIAL	☐ FEDERAL	☐ RETROFIT	☐ RESTORATION
☐ ROAD	X UTILITY	☐ FILL	☐ DREDGE	☐ MINE
☐ OTHER: (please explain)				

SITE INFORMATION

X VICINITY MAP Refer to Burrillville Interconnection Project RIDEM Permit Drawings

☐ EXISTING ZONING

DISCHARGE LOCATION: The WQv discharges to: (you may choose more than one answer if there are several discharge points on the project) (Guidance to identify receiving waters)

X GROUNDWATER	GROUNDWATER ☐ GAA X GA ☐ GB
☐ SURFACE WATER	X ISOLATED WETLAND X NAMED WATERBODY X UNNAMED WATERBODY CONNECTED TO NAMED WATERBDY Dry Arm Brook, Clear River, Mowry Brook, Round Top Brook, Chockalog River, and all wetlands and unnamed streams identified along and adjacent to the Project identified on the Plans.
☐ MS4	☐ RIDOT ☐ RIDOT ALTERATION PERMIT IS APPROVED ☐ TOWN ☐ OTHER:____

RECEIVING WATER INFORMATION: (check all that apply and *repeat* this row for each waterbody)

THE WATER QUALITY VOLUME DISCHARGES TO: ☐ N/A (discharges to: CSO, Disconnected wetland or Groundwater) WATERBODY NAME: _Dry Arm Brook______________________ WATERBODY ID: __RI0001002R-06________________________ IMPAIRMENTS: None____________________________ ☐ TMDL FOR: _____________________________ ☐ CONTRIBUTES TO A PRIORITY OUTFALL	☐ IMPAIRED (303(d) LIST) ☐ SRPW ☐ COLDWATER X WARMWATER ☐ UNASSESSED ☐ 4TH ORDER STREAM ☐ POND OF 50 ACRES OR MORE ☐ KNOWN HISTORY OF REPETITIVE FLOODING (i.e. Pocassett River) ☐ CONTRIBUTES STORMWATER TO A PUBLIC BEACH ☐ CONTRIBUTES TO SHELLFISHING GROUNDS

LISTED IN THE TMDL	
THE WATER QUALITY VOLUME DISCHARGES TO: ☐ N/A (discharges to: CSO, Disconnected wetland or Groundwater) WATERBODY NAME: Clear River________________________ WATERBODY ID: __RI0001002R-05B_________________________ IMPAIRMENTS: None_____________________________ ☐ TMDL FOR: _____________________________ ☐ CONTRIBUTES TO A PRIORITY OUTFALL LISTED IN THE TMDL	☐ IMPAIRED (303(d) LIST) ☐ SRPW X COLDWATER ☐ WARMWATER ☐ UNASSESSED ☐ 4^{TH} ORDER STREAM ☐ POND OF 50 ACRES OR MORE ☐ KNOWN HISTORY OF REPETITIVE FLOODING (i.e. Pocassett River) ☐ CONTRIBUTES STORMWATER TO A PUBLIC BEACH ☐ CONTRIBUTES TO SHELLFISHING GROUNDS
THE WATER QUALITY VOLUME DISCHARGES TO: ☐ N/A (discharges to: CSO, Disconnected wetland or Groundwater) WATERBODY NAME: Mowry Brook________________________ WATERBODY ID: RI0001002R-18__ _________________________ IMPAIRMENTS: None_____________________________ ☐ TMDL FOR: _____________________________ ☐ CONTRIBUTES TO A PRIORITY OUTFALL LISTED IN THE TMDL	☐ IMPAIRED (303(d) LIST) ☐ SRPW X COLDWATER ☐ WARMWATER ☐ UNASSESSED ☐ 4^{TH} ORDER STREAM ☐ POND OF 50 ACRES OR MORE ☐ KNOWN HISTORY OF REPETITIVE FLOODING (i.e. Pocassett River) ☐ CONTRIBUTES STORMWATER TO A PUBLIC BEACH ☐ CONTRIBUTES TO SHELLFISHING GROUNDS
THE WATER QUALITY VOLUME DISCHARGES TO: ☐ N/A (discharges to: CSO, Disconnected wetland or Groundwater) WATERBODY NAME: Round Top Brook________________________ WATERBODY ID: RI0001002R-11__ _________________________ IMPAIRMENTS: None_____________________________ ☐ TMDL FOR: _____________________________ ☐ CONTRIBUTES TO A PRIORITY OUTFALL LISTED IN THE TMDL	☐ IMPAIRED (303(d) LIST) ☐ SRPW ☐ COLDWATER X WARMWATER ☐ UNASSESSED ☐ 4^{TH} ORDER STREAM ☐ POND OF 50 ACRES OR MORE ☐ KNOWN HISTORY OF REPETITIVE FLOODING (i.e. Pocassett River) ☐ CONTRIBUTES STORMWATER TO A PUBLIC BEACH ☐ CONTRIBUTES TO SHELLFISHING GROUNDS
THE WATER QUALITY VOLUME DISCHARGES TO: ☐ N/A (discharges to: CSO, Disconnected wetland	☐ IMPAIRED (303(d) LIST) ☐ SRPW

or Groundwater) WATERBODY NAME: Chockalog River________________________ WATERBODY ID: RI0001002R-04__ _________________________ IMPAIRMENTS: None____________________________ ☐ TMDL FOR: _____________________________ ☐ CONTRIBUTES TO A PRIORITY OUTFALL LISTED IN THE TMDL	X COLDWATER ☐ WARMWATER ☐ UNASSESSED ☐ 4^{TH} ORDER STREAM ☐ POND OF 50 ACRES OR MORE ☐ KNOWN HISTORY OF REPETITIVE FLOODING (i.e. Pocassett River) ☐ CONTRIBUTES STORMWATER TO A PUBLIC BEACH ☐ CONTRIBUTES TO SHELLFISHING GROUNDS
PROJECT HISTORY:	
☐ PRE-APPPLICATION MEETING DATE: __12/08/2016_______	☐ MINUTES ARE ATTACHED
☐ RIDEM GRANT FUNDING INVOLVED	GRANT SOURCE:_____________
☐ TOWN MASTER PLAN APPROVAL DATE: __________	☐ MINUTES ARE ATTACHED
☐ SUBDIVISION SUITABILITY REQUIRED	APPROVAL #: ___________________
☐ PREVIOUS ENFORCEMENT ACTION HAS BEEN TAKEN ON THIS PROPERTY	ENFORCEMENT # _______________
FRESHWATER WETLANDS JURISDICTION: X **FEMA FLOODPLAIN FIRMETTE HAS BEEN REVIEWED** ☐ CALCULATIONS ARE PROVIDED FOR CUT/FILL PROPOSED ANYWHERE WITHIN THE 100-YR FLOODPLAIN ☐ RESTRICTIONS OR MODIFICATINS ARE PROPOSED TO THE FLOWPATH OR VELOCITIES IN A FLOODWAY. ☐ FLOODPLAIN STORAGE CAPACITY IS IMPACTED	AMOUNT OF FILL: _see below____(CY) AMOUNT OF CUT: _see below____(CY) One new structure (H-frame Structure 3052-45) will be located within the FEMA-designated floodplain associated with Round Top Brook for the construction of the 3052 Line. In this instance where the installation of the one new transmission line structure is proposed within a floodplain where no detailed FEMA study has been performed to establish a base flood elevation, it is anticipated to have *de minimus* impact on flood storage capacity and not result in an increase in flood storage in a meaningful way. The permanent impact to floodplain is estimated to be 48 square feet and 96 cubic feet of flood storage. Further, the wetland restoration completed at the Round Top Brook wetland associated with the Interstate Reliability Project involved removal of previous fill and compensation of floodplain. Any temporary fill placed within documented

	floodplains for temporary access roads or work pads will be removed following the completion of construction. The Contractor will be directed to over-excavate within the limits of floodplain for any new access road and/or work pad that permanently displaces floodplain. Over-excavation within the limits of floodplain will compensate for loss of flood storage volume by reestablishing the pre-existing conditions.
CRMC JURISDICTION- The Project is not within CRMC Jurisdiction ☐ THIS PROJECT REQUIRES A CRMC PERMIT ☐ THE PROPERTY IS SUBJECT TO A SPECIAL AREA MANAGEMENT PLAN ☐ SEA LEVEL RISE MITIGATION WAS DESIGNED INTO THIS PROJECT	
MINUMUM STANDARD 8: LUHHPL IDENTIFICATION	
OFFICE OF WASTE MANAGEMENT (OWM) – N/A ☐ THERE ARE KNOWN OR SUSPECTED RELEASES OF HAZARDOUS MATERIAL AT THE SITE ☐ THIS SITE IS ON THE LIST OF CERCLA and STATE SITES in RI	OWM CONTACT: ____________ ☐ SITE ID#:_______________
STORMWATER INDUSTRIAL PERMITTING – N/A ☐ THERE ARE EXISTING OR PROPOSED ACTIVITIES THAT ARE CONSIDERED LAND USES WITH HIGHER POTENTIAL POLLUTANT LOADS (LUHPPLS) (see Table 3-2) ☐ 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. ☐ ADDITIONAL STORMWATER TREATMENT IS REQUIRED BY THE MSGP	ACTIVITIES: ______________________ SECTOR: __________________________ MSGP PERMIT #: ____________________ EXPLAIN ADDITIONAL TREATMENT: ____ __________________________________

MINIMUM STANDARD 6. REDEVELOPMENT (*Required calculation for all construction projects) No change in impervious area proposed. Please refer to the attached Stormwater Analysis and Drainage Report.		
☐ PRE-CONSTRUCTION IMPERVIOUS AREA		TOTAL IMPERVIOUS AREA **(TIA)** = _________
☐ CALCULATE THE SITE SIZE SITE SIZE **(SS)** = **(TSA)** – **(JW)** – **(CL)** = _____________		TOTAL SITE AREA **(TSA)** = ________________ JURISDICTIONAL WETLANDS **(JW)**: ________ CONSERVATION LAND **(CL)** = ______________
(TIA)/(SS) = _____________	**(TIA)/(SS)** IS > 0.4) ☐ YES (REDEVELOPMENT) (address minimum standards 3 and 7-11)	**(TIA)/(SS)** IS < 0.4) ☐ NO (NEW DEVELOPMENT) (all standards must be addressed)

PART 2: MINIMUM STANDARD 1	
LOW IMPACT DEVELOPMENT ASSESSMENT – N/A (**NOT REQUIRED FOR REDEVELOPMENT OR RETROFITS**) – You may delete this section if it is not required	
•	

PART 3: SUMMARY OF REMAINING STANDARDS

Minimum Standard 2: Groundwater Recharge

☐ YES ☐ NO The project has been designed to meet the groundwater recharge standard.

If No, please explain the justification for groundwater recharge criterion waiver (i.e. threat of groundwater contamination, or physical limitation), if applicable (see Section 3.3.2);

Please describe your waiver request _

Not Applicable. No change in impervious surface is proposed. Please refer to Stormwater Analysis and Drainage Report for further information.

☐ YES ☒ NO Is this site listed as a CERCLA or contaminated site?, if yes?

☐ YES ☐ NO Has any part of the site been approved for infiltration by the Office of Waste Management? (see Subsurface Contamination Guidance)

☐ YES ☒ NO Is there an ELUR on the property?

TABLE 2-1: Summary of Recharge (see Manual section 3.3.2) – Not Applicable. No change in impervious surface is proposed.

Subwatershed	Total Re_v Required (Acre-ft)	LID Stormwater Credits (Manual see Section 4.6.1)		Recharge Required by Remaining BMPs (acre-ft)	Recharge Provided by BMPs (acre-ft)
		Impervious volume directed to a QPA (acre-ft)	Recharge Credit Applied (acre-ft)		
DP-1:					
DP-2:					
DP-3:					
DP-4:					
Totals:					

**Note: Only BMPs listed in Manual Table 3-5, List of BMPs Acceptable for Recharge may be used to meet the recharge requirement.*

☐ Indicate below where the pertinent calculations and/or information for the above items are provided (i.e. name of report/document, page numbers);

Minimum Standard 3: Water Quality – Not Applicable. No water quality devices are proposed for this Project. No change in impervious surface is proposed.

☐ YES ☐ NO Does this project meet or exceed the required water quality volume WQv (see section 3.3.3)?

☐ YES ☒ NO Is the proposed final impervious cover is greater than 20% of the disturbed area (see section 3.3.3)?

☐ If yes, the Spit Pervious/Impervious method in Hydro-Cad was used to calculate WQv, or

☐ If yes, 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.

☐ YES ☐ NO Does this project meet or exceed the ability to treat required water quality flow WQf(see section 3.3.3.2)? **Not Applicable. No increase in impervious surface is proposed.**

☐ YES ☒ NO Is there 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.

☐ RISDISM section H.3 Pollutant Loading Analysis

☐ The Water Quality Guidance Document (Water Quality Goals and Pollutant Loading Analysis Guidance for Discharges to Impaired Waters)

☐ YES ☐ NO BMPs are proposed that are on the approved technology list if yes, please provide all of the required worksheets from the manufacturer. **(No permanent Stormwater Quality Technologies are proposed. Refer to Burrillville Interconnection Project RIDEM Permit Drawings for proposed temporary BMPs.)**

☐ YES ☒ NO 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 Manual section 3.3.3) Not Applicable. No change in impervious surface is proposed. No permanent water quality devices are proposed for this Project.

Subwatershed	Total WQ_v Required (Acre-ft)	LID Stormwater Credits (Manual see Section 4.6.1)		Water Quality Treatment Remaining (acre-ft)	Water Quality Provided by BMPs (acre-ft)
		Impervious volume directed to a QPA (acre-ft)	Water Quality Credit Applied (acre-ft)		
DP-1:					
DP-2:					
DP-3:					
DP-4:					
Totals:					

**Note: Only BMPs listed in Chapter 5 of the Manual or the Approved Technologies List of BMPs is Acceptable for Water Quality treatment.*

☐ YES ☐ NO This project has met the setback requirements for each BMP. If no, please explain – **N/A**

☐ Indicate below where the pertinent calculations and/or information for the above items are provided (i.e. name of report/document, page numbers); **N/A**

Minimum Standard 4: Conveyance and Natural Channel Protection (3.3.4)

☐ YES ☒ NO Is this standard waived? If yes, please check 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 order), 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)*

☒ YES ☐ NO Conveyance and natural channel protection for the site have been met.

If no, explain why ____________________

TABLE 4-1: Summary of Channel Protection Volumes (see Manual section 3.3.4)

Drainage Point	Receiving Water Body Name	Coldwater Fishery? Y/N	Total CPv Required (acre-ft)	Total CPv Provided (acre-ft)	Release Rate Modeled in the 2-yr storm (cfs)
DP-1:	PFO4/1E/R2/R4	N	N/A	N/A	0.8
DP-2:	--	N	N/A	N/A	5.6
DP-3:	Dry Arm Brook	N	N/A	N/A	0.9
DP-4:	Dry Arm Brook	N	N/A	N/A	3.0
DP-5:	PFO1E	N	N/A	N/A	1.0
Totals:					

N/A. No change in impervious surface is proposed. No permanent water quantity detention devices are proposed for this Project.

Minimum Standard 4: Conveyance and Natural Channel Protection

Minimum Standard 4 requires that designers provide adequate stormwater conveyance systems for at least the 10-year, 24-hour Type III design event. Channel protection must be supplied by providing 24-hour extended detention of the one-year, 24- hour Type III design storm event runoff volume.

The Project will not result in a permanent change or increase in impervious surfaces; therefore pre- and post-development flows are unchanged. Water quantity is unchanged. No permanent water quantity detention measures are proposed. Permanent measures are proposed to control water velocity and promote channelization.

The US Topo from the USGS Survey was used for watershed determination and drainage areas to proposed work pads and roadway areas which would receive flow from offsite areas. These were used to estimate the flow rate to determine ditch sizing and velocity, culvert locations, culvert sizes, culvert outlet sizes, level spreader sizes, and required spacing of rock check dams within the ditch channels. The 100-year rainfall intensity for one hour was conservatively taken as 3.0 inches per hour for design. This was based on multiple sources (NOAA, U.S. Department of Commerce, NRCC, and NRCS) concluding that for this project area, the intensity would be between 2.6 and 3.0 inches per hour.

Drainage volume calculations were performed using the rational method in accordance with RISDISM paragraph 3.3.4 – Channel Protection (CPv) for sizing of conveyance systems.

Ditch liners were evaluated for erosive capacity. Rock ford stone topping was checked for stability for proposed flows.

☐ YES ☐ NO The CPv is released at roughly a uniform rate over a 24-hour duration (see example sizing calculations in Appendix D of the RISDISM). **N/A**

☐ YES X NO Do additional design restrictions apply resulting from any discharge to cold water fisheries;

If yes, please indicate restrictions and solutions

____

____

☐ Indicate below where the pertinent calculations and/or information for the above items are provided (i.e. name of report/document, page numbers);

_ **Attached Stormwater Analysis and Drainage Report; Appendix A**

Minimum Standard 5: Overbank Flood Protection (3.3.5) (and other potential high flows)

☐ YES ☐ NO Is this standard waived? If yes, please check 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 order), bodies of water >50.0 acres in surface area (i.e., lakes, ponds, reservoirs), or tidal waters.

☐ A Downstream Analysis (see section 3.3.6), indicates that peak discharge control would not be beneficial or would exacerbate peak flows in a downstream tributary of a particular site (i.e. through coincident peaks)

N/A

Minimum Standard 5: Overbank Flood Protection

Minimum Standard 5 requires that designers provide attenuation for the 10-year and 100-year, 24-hour Type III design storm events to predevelopment rates.

The Project will not result in a change or increase in impervious surfaces, therefore, a change in pre- and post-construction attenuation is not proposed. During Project restoration, work areas will be re-graded, loamed and vegetated. Temporary sediment controls will be removed after vegetative stabilization has been achieved (~75% cover).

☐ YES ☒ NO Does the project flow to an MS4 system? If yes, indicate below:

☐ RIDOT ☐ Other ________________

(**NOTE**: *your 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 your strategy to comply with RIDEM and the MS4.

____
____
____

☐ YES ☒ NO Did you use a model for your analysis, if yes, indicate below

☐ TR-55 ☐ TR-20 ☐ Hydrocad ☐ Other ____________

☐ YES ☐ NO Does the hydrologic model demonstrate that flows from the 100-year event will be safely conveyed to a control practice designed to manage the 100-year event? If no, please explain

____
____

☐ YES ☐ NO Do off-site areas contribute to the subwatersheds and design points? If yes,

☐ YES ☐ NO Are the areas modeled as "present condition" for both pre- and post-development analysis

☐ YES ☐ NO Are the off-site areas are shown on the subwatershed maps

☐ YES ☐ NO Does the hydrologic model confirm safe passage of the 100-year flow through the site for off-site runoff;

☐ YES ☐ NO Is a Downstream Analysis required? (see Manual Section 3.3.6):

<u>Please calculate the following:</u>

Area of disturbance within the sub-watershed (areas) _______

Impervious cover (%) ________

☐ YES ☒ NO Is a dam breach analysis required (earthen embankements over six (6) feet in height, or a capacity of 15 acre-feet or more, and contributes to a significant or high hazard dam?

☐ YES ☐ NO Does this project meet the overbank flood protection standard? **N/A**

Table 5-1 Hydraulic Analysis Summary

Subwatershed (design point)	**1.2" Peak Flow Pre (cfs)**	**1.2" Peak Flow Post (cfs)**	**1-yr Peak Flow Pre (cfs)**	**1-yr Peak Flow Post (cfs)**	**10-yr Peak Flow Pre (cfs)**	**10-yr Peak Flow Post (cfs)**	**100-yr Peak Flow Pre (cfs)**	**100-yr Peak Flow Post (cfs)**
DP-1:								
DP-2:								
DP-3:								
DP-4:								
Totals:								

☐ Indicate below where the pertinent calculations and/or information for the above items are provided (i.e. name of report/document, page numbers); **N/A**

☐ Existing condition analysis for each subwatershed, including (curve numbers, times of concentration, runoff rates, volumes, and water surface elevations showing methodologies used and supporting calculations);

____

☐ Proposed condition 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);

____

☐ Final sizing calculations for structural stormwater BMPs including, contributing drainage area, storage, and outlet configuration;

____

☐ Stage-storage, inflow and outflow hydrographs for storage facilities (e.g., detention, retention, or infiltration facilities);

____

Table 5-2 Summary of Best Management Practices **Not Applicable**.

DP No.	BMP ID.	BMP Type (i.e. bioretention or tree filter)	BMP Functions (acre-ft)				Overbank Flood Reduction	Internal Bypass	Horizontal Setback Criteria Met	
			Pre-treatment (volume)	Re_v	WQ_v	CP_v	Y/N	Y/N	Distance (ft)	From constraint (i.e. private well or foundation)
		TOTAL:								

Table 5-3 Summary of Soils to evaluate each BMP Not Applicable.

DP No.	BMP ID.	BMP Type (i.e. bioretention or tree filter)	Soils Analysis for Each BMP						
			Primary Test Pit ID #	Secondary	Top of Filter Elevation (ft)	SHWT Elevation (ft)	Separation Distance (ft)	Hydrologic Soil Group A,B,C or D	Exfiltration Rate Applied (in/hr)
		TOTAL:							

Minimum Standard 7: (questions are now asked in Minimum Standard 10 and 11)

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

☐ YES ☒ NO Are there any existing activities or land uses proposed that would be considered LUHPPLs (see Manual Table 3-2)? If yes, please describe. If no, you may continue on to Minimum Standard 9:

☐ YES ☐ NO Are these activities already covered under an MSGP? If, no please explain if you have applied for an MSGP, or intend to do so?

☐ YES ☐ NO ☐ List the specific BMPs that are proposed for this project that receive stormwater from LUHPPL drainage areas. These BMP types must be listed in Manual 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);

Minimum Standard 9: Illicit Discharges N/A no MS4 tie-ins or discharges to MS4 are proposed.

☒ YES ☐ NO Have you checked for illicit discharges?

☐ YES ☒ NO Have any been found and/or corrected? If yes, please identify

☒ YES ☐ NO Does your report explain preventative measures that keep non-stormwater discharges out of the Waters of the State (during and after construction)? See attached Soil Erosion and Sediment Control Plan

Minimum Standard 10 Soil Erosion and Sediment Control

☒ YES ☐ NO Have you included a Soil Erosion and Sediment Control Plan Set and/or Complete Construction Plan Set?
☒ YES ☐ NO Did you provide 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 a 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.

Minimum Standard 7&11: Stormwater Management System Operation, Maintenance and Pollution Prevention Plan (See section 3.2.11 and Appendices G and E for guidance)

☒ YES ☐ NO Have you minimized all sources of pollutant contact with stormwater runoff, to the maximum extent practicable?

☐ YES ☒ NO Have you provided a separately bound **Operations, Maintenance and Pollution Prevention Manual** for the site and for all of the BMPs? **Inspection, Operations and Maintenance is described in the attached narrative of the Stormwater Analysis and Drainage Report, and the attached Soil Erosion and Sediment Control Plan.**

The (O&M and PP Plan Contains):

☐ YES ☐ NO Contact name, address, and phone number of the responsible party for maintenance;

☐ YES ☐ NO 8.5" x 11" map indicating the location of all of the proposed stormwater BMPs that will require maintenance;

☐ YES ☐ NO Description of routine and non-routine maintenance tasks and their frequency for required elements for each BMP;

☐ YES ☐ NO A description and delineation of public safety features;

☐ YES ☐ NO An estimated operations and maintenance budget;

☐ YES ☐ NO Minimum vegetative cover requirements;

☐ YES ☐ NO Access and safety for maintenance?

☐ YES ☐ NO Lawn, Garden and Landscape Management meet the requirements of section G.7? If not, why not? ___ **N/A**

☐ YES ☒ NO Is the property owner or homeowners association is responsible for the stormwater maintenance of all BMP's?

If no, you must provide a legally binding and enforceable maintenance agreement (see Appendix E-page 26) that identifies the entity that will be responsible for maintenance of the stormwater. Please indicate where this agreement can be found in your report:____

☐ YES ☒ NO Do you anticipate that you will need legal agreements related to the stormwater structures? (e.g. off-site easements, deed restrictions, and covenants).
If yes, have you obtained them? Or please explain your plan to obtain them:

☐ YES ☒ NO Is stormwater being directed from public areas to private property? If yes, (**NOTE**: *this is not allowed unless there is a funding mechanism in place to provide the finances for the long-term maintenance of the BMP and drainage unless there is a funding mechanism is demonstrated that can guarantee the long-term maintenance of a stormwater BMP by an individual homeowner*)

Pollution Prevention Section Contains:

X YES ☐ NO Designated snow stockpile locations? **Refer to National Grid's Environmental Guidance (EG-303NE) Section 6.1 - Snow Management**

☐ YES X NO Trash racks to prevent floatables, **N/A**

☐ YES X NO Asphalt only based sealants? **N/A No sealants proposed.**

☐ YES X NO Pet waste stations? (**NOTE:** *if a receiving water has a bacterial impairment and the project involves housing units, this could be an important part your pollution prevention plan*) **N/A**

X YES ☐ NO Regular sweeping? Please describe _**No post-construction sweeping will be required**

X YES ☐ NO Deicing specifications in accordance with Appendix G of the Manual. (**NOTE**: *if the groundwater is GAA or this area contributes to a drinking water supply, this could be an important part of your pollution prevention plan (see Appendix G):* **If necessary during construction, de-icing will be conducted in accordance with National Grid's Environmental Guidance (EG-303NE) Section 6.2 – De-Icing Procedures**

X YES ☐ NO A prohibition of phosphate based fertilizers? (**NOTE**: *if the site discharges to a phosphorus impaired waterbody, this could be an important part of your pollution prevention plan*)? **The use of phosphate based fertilizers is not proposed at this time. Project stormwater does not drain to waterbodies impaired by phosphate.**

PART 3: SUBWATERSHED MAPPING AND SITE PLAN DETAILS

Existing and Proposed Subwatershed Mapping (REQUIRED)

☒ Existing and proposed drainage area delineations.

- ✓ Locations, cross sections, and profiles of all streams and drainage swales and their method of stabilization;
- ✓ Drainage flow paths, mapped according to the DEM *Guidance for Preparation of Drainage Area Maps* (included in 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. **N/A**

☐ Mapped seasonal high water table, **N/A**

☐ Mapped locations of the site-specific borings and/or test pits and soils information from the test pits at the locations of the BMPs. **N/A**

☒ Mapped locations of the BMPs with the BMPs consistently identified on the Site Construction Plans

☐ Mapping bedrock within 3' of any BMP **N/A**

☐ YES ☒ NO Soils were logged by a:

☐ DEM-licensed Class IV soil evaluator Name: ____________________

☐ RI-registered PE. Name; ____________________________________

Subwatershed Summary *(add or subtract rows as necessary)*						
Subwatershed (acres to each design point)	**First Receiving Water ID or MS4**	**Area Disturbed (acres)**	**Existing Impervious (acres)**	**Proposed Impervious (acres)**	**Pole Number**	**Permit Drawing Number**
DP-1: 0.93	W03pr147	N/A	0	0	3052-024	SH. 56
DP-2: 26.6	W03pr149	N/A	0	0	347-034	SH. 54
DP-3: 77.4	W03pr155	N/A	0	0	347-031	SH. 53
DP-4: 105.1	W03pr164	N/A	0	0	347-022	SH. 12
DP-5 112.3	W03pr164	N/A	0	0	347-021	SH. 12
DP-6 13.8	PF01E	N/A	0	0	3052-007	SH. 36
DP-7 232.7	PF04/1E/R2/R4	N/A	0	0	3052-004	SH. 42
DP-8 N/A	PF04/1E/R2/R4	N/A	0	0	3052-004	SH. 42
DP-9 2.2	PF04/1E/R2/R4	N/A	0	0		SH. 44
DP-10 1.9	PF04/1E/R2/R4	N/A	0	0		SH. 50
Totals:		N/A	0	0		

Site Construction Plans (the following applicable specifications are provided) The applicable specifications below are included in the Burrillville Interconnection RIDEM Plan Set (Permit Drawings).

- ✓ 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, lakes, 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, 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 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., invert of pipes, manholes, etc.);
  - Location of floodplain and, if applicable, floodway limits and relationship of site to upstream and downstream properties or drainage that could be affected by work in the floodplain;
  - Planting plans for structural stormwater BMPs, including species, size, planting methods, and maintenance requirements of proposed planting;
  - Logs of borings and/or test pit investigations along with supporting soils/geotechnical report and corresponding water tables.

  Mapping of any OWM approved activities related to current/former site use areas for any known contamination and/or remedial clean-up efforts. **N/A**

- ✓ 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, as well as location(s) of final discharge point (wetland, waterbody);
  - 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

Attachment A- Engineering Calculations

Stormwater Analysis and Drainage Report

For:

Burrillville Interconnection Project

3052 345 kV Line

Burrillville, Rhode Island

Owner:	The Narragansett Electric Company (d/b/a National Grid) 280 Melrose Street Providence, Rhode Island 02907 (401) 784-7515 Michael Ryan: Michael.Ryan@nationalgrid.com and Clear River Invenergy LLC One South Wacker Drive Suite 1800 Chicago, Illinois 60606 (781) 424-3223 (John Niland): JNiland@invenergyllc.com

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Operator: *TO BE DETERMINED UPON CONTRACT AWARD*	Company Name Name Address City, State, Zip Code Telephone Number Email Address
Estimated Project Dates:	Start Date: Spring 2018 Completion Date: Winter 2018/2019
SADR Plan Prepared By:	POWER Engineers Pamela Kelley, P.E. 303 US Route 1 Freeport, Maine 04032 Pam.kelley@powereng.com PE # 8879
SADR Plan Preparation Date:	March 29, 2017
SADR Plan Revision Date:	

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INTRODUCTION

This Stormwater Analysis and Drainage Report (SADR) has been prepared for The Narragansett Electric Company d/b/a National Grid (TNEC) and Clear River Energy LLC, a project company of Invenergy Thermal Development LLC (Invenergy) for the Burrillville Interconnection Project. This document does not negate or eliminate the need to understand and adhere to all applicable RIPDES regulations.

The purpose of stormwater drainage measures is to manage water flowing onto and from constructed features and direct and handle the stormwater discharges to prevent pollutants from leaving the construction site and entering waterways or environmentally sensitive areas after construction, allow for groundwater recharge and prevent erosive characteristics of discharge. The control measures depicted on the site plans and described in this narrative should be considered the minimum measures required to control stormwater for the project.

Since construction is a dynamic process with changing site conditions, it is the operator's responsibility to manage the site during each construction phase so as to prevent pollutants from leaving the site. Please It is the responsibility of the site owner and the site operator to install and maintain the SADR measures at the site, including all attachments. Note: **Even if practices are correctly installed on a site according to the approved plan, the site is only in compliance when erosion, runoff, and sedimentation are effectively controlled throughout the entire site.**

ADDITIONAL RESOURCES

Rhode Island Department of Environmental Management
Office of Water Resources
235 Promenade Street
Providence, RI 02908-5767
phone: 401-222-4700
email: water@dem.ri.gov

RIDEM *RI Stormwater Design and Installation Standards Manual* (RISDISM) (as amended)

http://www.dem.ri.gov/pubs/regs/regs/water/swmanual15.pdf

RI Soil Erosion and Sediment Control Handbook http://www.dem.ri.gov/soilerosion2014final.pdfRIDEM
2013 RIPDES Construction General Permit http://www.dem.ri.gov/pubs/regs/regs/water/ripdesca.pdf

Rhode Island Department of Transportation *Standard Specifications for Road and Bridge Design and Other Specifications* and *Standard Details* http://www.dot.ri.gov/business/bluebook.php

SECTION 1: SITE DESCRIPTION

Project/Site Name:

The Narragansett Electric Company d/b/a National Grid (TNEC)[11], and Clear River Energy LLC, a project company of Invenergy Thermal Development LLC (Invenergy) (collectively the Applicant) is proposing to construct a new approximately 6.8 mile 345 kilovolt (kV) transmission line (the 3052 Line) in the Town of Burrillville, Rhode Island, to interconnect the proposed Clear River Energy Center (CREC) to the existing electric transmission system (the Burrillville Interconnection Project or the Project). The 3052 Line will begin at the proposed CREC to be located off of Wallum Lake Road in Burrillville. From the CREC facility, it will extend approximately 0.8 miles along a new right-of-way (ROW) on an easement owned by CREC (CREC ROW) to its intersection with an existing TNEC transmission line ROW (TNEC ROW). The 3052 Line will then continue east approximately six miles along the TNEC ROW to the existing Sherman Road Switching Station in Burrillville (Refer to RIDEM Permit Drawings). Improvements to the Sherman Road Switching Station will occur within the existing Station yard. The 3052 Line will share the TNEC ROW with the two existing 345 kV lines, the 347 Line and the 341 Line. The 341 Line was recently installed as part of the Interstate Reliability Project (IRP).

Construction Project Overview:

Construction consists of the installation of concrete foundations and 345kV transmission poles along the ROW. Most of the construction is supported by existing gravel roads and work pads on the TNEC ROW constructed for the IRP.

Permanent construction for this project consists of the 0.8 mile gravel road and associated ditching, installation of three culverts, three rock fords at wetland crossings, relocation of one existing drainage swale, and construction or reconfiguration of temporary construction work pads for transmission pole installation.

SECTION 2: STORMWATER ANALYSIS AND DRAINAGE

During preliminary Project pre-application meetings for the Interstate Reliability Project and email correspondences with the RIDEM, the RIDEM and TNEC concurred that given the specific uses and infrequency of use of the gravel roads associated with the Project, that the RIDEM did not plan to treat these roadways as impervious. TNEC understands that to the degree possible, access roads should comply with the stormwater policy and stormwater standards. Specifically, Standard 4- Conveyance, Standard 10- Erosion and Sediment control, and Standard 11 – Operation and Maintenance are all applicable to pervious roadways. Gravel roads will be crowned to shed water laterally to ensure

[1] The Narragansett Electric Company d/b/a National Grid, a subsidiary of National Grid USA, is an electric distribution and transmission company serving approximately 465,000 customers in 38 Rhode Island communities. National Grid USA is a public utility holding company. Other subsidiaries of National Grid USA include operating companies such as New England Power Company, Massachusetts Electric Company, Nantucket Electric Company (in Massachusetts), and Niagara Mohawk Power Corporation (in New York), as well as National Grid USA Service Company, Inc., which provides services such as engineering, facilities construction and accounting.

roadways do not act as conduit for flow. Existing access roads will be improved to facilitate construction within the ROW, including access road and cross culvert improvements, including temporary and permanent storm water management features, as detailed in the Soil Erosion and Sediment Control Plan.

The gravel access roads will be used in phases during construction, based on the progression of activities that occur along the ROW (i.e., tree clearing and mowing, installation of BMPs, construction of access roads and work pads, installation of structure foundation, erection of structures, and wire stringing). The access roads will undergo fairly heavy usage during the estimated one year of construction. During active construction, temporary storm water BMPs such as wattles and staked bales will be utilized to prevent storm water from concentrating and causing on-site erosion. Throughout construction the access roads will be monitored and if erosion is observed will be regraded to address any issues as required. After construction, the ROW will be restored and the access roads will be left in place along with the permanent storm water BMPs. Use of the access roads after energization of the transmission lines will be intermittent for inspection purposes, and operation and maintenance of the transmission line facilities. A majority of the access road shoulders and gravel access roads will re-establish vegetative cover and will not be as compact or impervious as a typical roadway or maintained access drive.

Pursuant to the requirements of the Rhode Island Pollutant Discharge Elimination System (RIPDES) *Stormwater Discharge Associated with Construction Activity General Permit* (CGP), the Applicant submits this application package in fulfillment of the Stormwater Management Plan in Section II. *Permit Limits and Conditions*. The Stormwater Management Plan consists of three elements: (1) Stormwater Site Planning, Analysis and Design, (2) Soil Erosion, Runoff, and Sediment Control, and (3) Post Construction Operation and Maintenance. Each of these three requirements is further discussed below.

Stormwater Site Planning, Analysis and Design

This element of the Stormwater Management Plan addresses the following Minimum Standards and, where appropriate, includes supporting documentation and calculations.

Minimum Standard 1: LID Site Planning and Design Strategies

As stated in the Rhode Island *Stormwater Design and Installation Standards Manual* (2015), the goals of LID Site Planning and Design Strategies are to:

- Reduce impervious cover and thus the generation of stormwater runoff volume;
- Prevent impacts to natural drainage ways, surface waters, and wetlands;
- Manage water (quantity and quality) as close to the source as possible and minimize the use of large stormwater collection and conveyance systems;
- Preserve natural areas, native vegetation, and reduce the impact on watershed hydrology;
- Protect natural drainage pathways as a framework for site design;
- Utilize less complex, non-structural methods for stormwater management that are lower cost and lower maintenance than conventional structural controls; and

- Create a multifunctional landscape.

The requirements on Minimum Standard 1 are not applicable to the scope of the Project. No paved surfaces, building or other impervious surfaces are proposed. The Project has been designed to create no net increase in impervious cover, and therefore is not anticipated to alter stormwater runoff volume, quality or quantity. Where the ROWs cross streams and brooks, stream fords will be installed, vegetation along the stream bank will be selectively cut to minimize the disturbance of bank soils and the potential for project related soil erosion. A minimum of a 25-foot wide riparian zone will be maintained along watercourses, to the extent feasible. After completion of the Project, all disturbed areas around structures and other graded locations will be seeded with an appropriate conservation seed mixture and/or mulched to stabilize the soils in accordance with applicable regulations.

Minimum Standard 2: Groundwater Recharge

Minimum Standard 2 requires that Stormwater must be recharged within the same sub-watershed to maintain base-flow at pre-development recharge levels to the maximum extent practicable.

The Project will not result in a change or increase in impervious surfaces; therefore pre- and post-development flows are unchanged. A change in groundwater recharge capacity is not proposed.

Minimum Standard 3: Water Quality

Section 3.2.3 of the Rhode Island *Stormwater Design and Installation Standards Manual* (2015) states that stormwater run-off must be treated before discharge.

The Project will not result in a permanent change or increase in impervious surfaces; therefore pre- and post- development flows are unchanged. Water quality is unchanged. No permanent water quality treatment measures are proposed.

Potential temporary impacts on water quality will be mitigated during the construction phase of the Project. The Project sitework and grading will progress in a linear fashion, and each work area will be stabilized with stone or seeded and mulched prior to moving to the next work area.

Temporary and permanent vegetative control measures will be utilized to stabilize all disturbed areas on the Project. Structural control measures will be used to limit stormwater flow from coming onto the project area, and to divert and slow on-site stormwater flow that is expected to impact exposed soils for the purpose of minimizing erosion, runoff, and the discharge of pollutants from the site.

Sediment barriers will be installed along the perimeter areas of the site that will receive stormwater from disturbed areas. This also may include the use of sediment barriers along the contour of disturbed slopes to maintain sheet flow and minimize rill and gully erosion during construction. Installation and maintenance of sediment barriers will be completed in accordance with the maintenance requirements specified by the product manufacturer or the RI SESC Handbook.

Where excavations require the need for dewatering of groundwater or accumulated stormwater, the water shall be treated before discharge. Appropriate controls include dewatering basins, filter bags, filter socks, or weir tanks. Water trucks or fractionation tanks may be utilized if watertight containers are desired for controlled on-site discharge or for off-site discharge into an approved dewatering area when site restrictions make it difficult to utilize other dewatering methods onsite.

Existing and proposed culverts and stream fords installed on the ROWs will be protected during the construction phase of the Project. The culvert and overburden are designed to withstand the weight of the construction equipment that will be utilizing the access roads. Stream fords will be protected during construction activity by placing swamp mats across the wetland and watercourses and installed after the construction activity has been completed. All water bars and other long-term stormwater control devices will be refreshed or repaired, if necessary, during the restoration of the Project ROW.

During Project restoration, work areas will be re-graded, loamed and vegetated. Temporary sediment controls will be removed after vegetative stabilization has been achieved (~75% cover).

For further details of temporary/construction measures, please refer to the Soil Erosion and Sediment Control Plan.

Minimum Standard 4: Conveyance and Natural Channel Protection

Minimum Standard 4 requires that designers provide adequate stormwater conveyance systems for at least the 10-year, 24-hour Type III design event. Channel protection must be supplied by providing 24-hour extended detention of the one-year, 24- hour Type III design storm event runoff volume.

The Project will not result in a permanent change or increase in impervious surfaces; therefore pre- and post- development flows are unchanged. Water quantity is unchanged. No permanent water quantity detention measures are proposed. Permanent measures are proposed to control water velocity and promote channelization.

The US Topo from the USGS Survey was used for watershed determination and drainage areas to proposed work pads and roadway areas which would receive flow from offsite areas. These were used to estimate the flow rate to determine ditch sizing and velocity, culvert locations, culvert sizes, culvert outlet sizes, level spreader sizes, and required spacing of rock check dams within the ditch channels. The 100-year rainfall intensity for one hour was conservatively taken as 3.0 inches per hour for design. This was based on multiple sources (NOAA, U.S. Department of Commerce, NRCC, and NRCS) concluding that for this project area, the intensity would be between 2.6 and 3.0 inches per hour.

Drainage volume calculations were performed using the rational method in accordance with RISDISM paragraph 3.3.4 – Channel Protection (CPv) for sizing of conveyance systems.

Ditch liners were evaluated for erosive capacity. Rock ford stone topping was checked for stability for proposed flows.

The RIDEM Permitting Calculations included with this application package describes in more detail the means and methods used to determine conveyance and natural channel protection required for the Project.

Minimum Standard 5: Overbank Flood Protection

Minimum Standard 5 requires that designers provide attenuation for the 10-year and 100-year, 24-hour Type III design storm events to predevelopment rates.

The Project will not result in a change or increase in impervious surfaces, therefore, a change in pre- and post-construction attenuation is not proposed. During Project restoration, work areas will be re-graded, loamed and vegetated. Temporary sediment controls will be removed after vegetative stabilization has been achieved (~75% cover).

Minimum Standard 6: Redevelopment and Infill Projects

Section 3.2.6 of the Rhode Island *Stormwater Design and Installation Standards Manual* (2015) defines the following:

Redevelopment Project: "Redevelopment is defined as any construction, alteration, or improvement that disturbs a total of 10,000 square feet or more of existing impervious area where the existing land use is commercial, industrial, institutional, governmental, recreational, or multifamily residential….. Any creation of new impervious area over portions of the site that are currently pervious is required to comply fully with the requirements of this manual."

Infill Project: "An infill project is a development site that meets all of the following: the site is currently predominately pervious (less than 10,000 sf of existing impervious cover); it is surrounded (on at least three sides) by existing development (not including roadways); the site is served by a network of existing infrastructure and does not require the extension of utility lines or new public road construction to serve the property; and the site is one (1) acre or less where the existing land use is commercial, industrial, institutional, governmental, recreational, or multifamily residential ."

This Project does not propose an increase in impervious surface nor meet the definition of a Redevelopment or Infill Project.

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

As defined in Table 3-2 of the Rhode Island *Stormwater Design and Installation Standards Manual* (2015), the following land uses and activities are considered stormwater LUHPPLs:

1. Areas within an industrial site (as defined in RIPDES Rule 31(b)(15)) that are the location of activities subject to the RIPDES Multi-Sector General Permit (except where a No Exposure Certification for Exclusion from RIPDES Stormwater Permitting has been executed);

2. Auto fueling facilities (i.e., gas stations);

3. Exterior vehicle service, maintenance and equipment cleaning areas;

4. Road salt storage and loading areas (if exposed to rainfall); and

5. Outdoor storage and loading/unloading of hazardous substances.

This Project does not meet the definition of a LUHPPL.

Minimum Standard 9: Illicit Discharges

As stated in Section 3.2.9 of the Rhode Island *Stormwater Design and Installation Standards Manual* (2015), all illicit discharges to stormwater management systems are prohibited, including discharges from OWTS, and sub-drains and French drains near OWTSs that do not meet the State's OWTS Rules.

There are no on-site waste water treatment systems proposed for this Project.

Post Construction Inspection, Operation and Maintenance

The temporary soil erosion controls will be maintained, as necessary, throughout the period of active construction until restoration has been deemed successful, as determined by standard criteria for stormwater pollution control/prevention and soil erosion control. In addition to silt fence or straw bales, temporary soil erosion controls may include the use of mulch, jute netting (or equivalent), soil erosion control blankets, reseeding to establish a temporary vegetative cover, and/or other equivalent structural or vegetative measures. After the completion of construction activities in any area, permanent stabilization measures (e.g., seeding and/or mulching) will be performed.

During the course of periodic post-construction inspections, the Applicant will determine the appropriate time frame for removing these temporary soil erosion controls. This determination will be made based on the effectiveness of restoration measures, such as percent re-vegetative cover achieved, in accordance with applicable permit and certificate requirements. There are no proposals to use wetland as detention or detention facilities. As such, no post-construction operation and maintenance of these facilities will be required.

CALCULATION COVER SHEET

Project Name:	Burrillville Interconnection Project	**Calculation No.:**	RIDEM and USACE Permitting Calculations
Client Name:	Invenergy	**Number of Sheets:**	45
Project Number:	142704	**Task Number:**	08.02

Title: Drainage Calculations

	Name	**Initials**
Designed/Calculated By:	Evan Lonstein	ETL
Checked By:	Pamela Kelley	PSK
Approved and Released By:		
Code Related:		
Reviewed By:		
P. E.'s Seal No. (If Required):	8879	**State of:** RI

Drawing		Responsible Design Engineer (RDE)		Checker		Lead Design Engineer (LDE)		PM/PE
Rev.	**Description**	**By**	**Date**	**Checker**	**Date**	**Approve**	**Date**	**QA/QC**
A	Issued for Review	ETL	2/17/17	PSK				
B	Issued for Permit	ETL	3/29/17	PSK	3/29/17			

☒ Preliminary Calculation
☐ Final Calculation
☐ Superseded by Calculation Number _____

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INCLUDED CALCULATIONS

USGS TOPO WATERSHED AND DRAINAGE AREAS (6 SHEETS)
DRAINAGE DESIGN SUMMARY TABLE (1 SHEET)
MATHCAD SPREADSHEETS FOR OPEN CHANNEL CHECK (5 SHEETS)
MATHCAD SPREADSHEETS FOR STREAM FORD CHECK (3 SHEETS)
MATHCAD SPREADSHEET FOR OPEN CHANNEL FLOW – POLE #3052-024 (2 SHEETS)
MATHCAD SPREADSHEET FOR CHANNEL DESIGN – POLE #3052-024 (2 SHEETS)
MATHCAD SPREADSHEET FOR SWALE RELOCATION – POLE #347-034 (1 SHEET)
CULVERT SIZING CALCULATION (1 SHEET)
CULVERT OUTLET CALCULATION (1 SHEET)
LEVEL SPREADER AND CHECK DAMS CALCULATION (1 SHEET)
CALCULATION REFERENCES (18 SHEETS)

EXECUTIVE SUMMARY

This calculation covers the design of the drainage at the work pads and along the proposed access road for the Clear River Project, located in Burrillville, Rhode Island.

Purpose

The purpose of this calculation is to design adequate drainage measures for the proposed access road and work pads considering site conditions.

References

The following design guidelines were followed in conducting this work:

- Rhode Island Stormwater Design and Installation Standards Manual, Amended March 2015
- Rhode Island Soil Erosion and Sediment Control Handbook, Issued 1989 (Revised 2014)
- Advanced Drainage Systems (ADS) Inc. Drainage Handbook, Section 3 Hydraulics, dated July 2014.
- Open-Channel Hydraulics by Ven Te Chow, Copyright 1959 by McGraw-Hill Book Company, Inc.
- Design of Roadside Channels with Flexible Linings. FHWA Hydraulic Engineering Circular No. 15, Third Edition by the National Highway Institute, dated September 2005.

The following documents were used in the development of this work:

- The United States Department of the Interior U.S. Geological Survey US Topo for the Oxford, Uxbridge, Thomson, and Chepachet Quadrangles, dated 2015.

Approach

The US Topo from the USGS Survey was used for watershed determination and drainage areas to work pads for culvert and swale sizing. These were used to estimate the flow rate to determine culvert locations, culvert sizes, culvert outlet sizes, level spreader sizes, and required spacing of rock check dams within the channel ditches. The 100-year rainfall intensity for one hour was conservatively taken as 3.0 inches per hour. This was based on multiple sources (NOAA, U.S. Department of Commerce, NRCC, and NRCS) concluding that for this project area, the intensity would be between 2.6 and 3.0 inches per hour.

The proposed access road is approximately 4360 feet long and 16 feet wide. The roadway plan, profile and typical cross sections are shown on Permit Drawing Sheets 34 to 52 of 63. It is constructed of a 12 inch gravel lift placed on excavated subgrade. The road typically follows the slope of the existing land. There are some minor cuts for installation. There are very minor fills in order to provide a smooth road profile. Portions of the roadway require ditching to direct stormwater from upstream offsite sources along the roadway to prevent washouts. Ditches on the downstream sides of the road are constructed in cut sections to promote flow across the roadway.

During preliminary Project pre-application meetings for the Interstate Reliability Project and email correspondences with the RIDEM, the RIDEM and TNEC concurred that given the specific uses and infrequency of use of the gravel roads associated with the Project, that the RIDEM did not plan to treat these roadways as impervious. TNEC understands that to the degree possible, access roads should comply with the stormwater policy and stormwater standards. Specifically, Standard 4- Conveyance, Standard 10- Erosion and Sediment control, and Standard 11 – Operation and Maintenance are all applicable to pervious roadways. Gravel roads will be crowned or monosloped to shed water laterally to ensure roadways do not act as conduit for flow.

Permanent wetland crossings are proposed to be stream fords. Water velocity across the fords was checked for shear stability to prevent washout.

Results

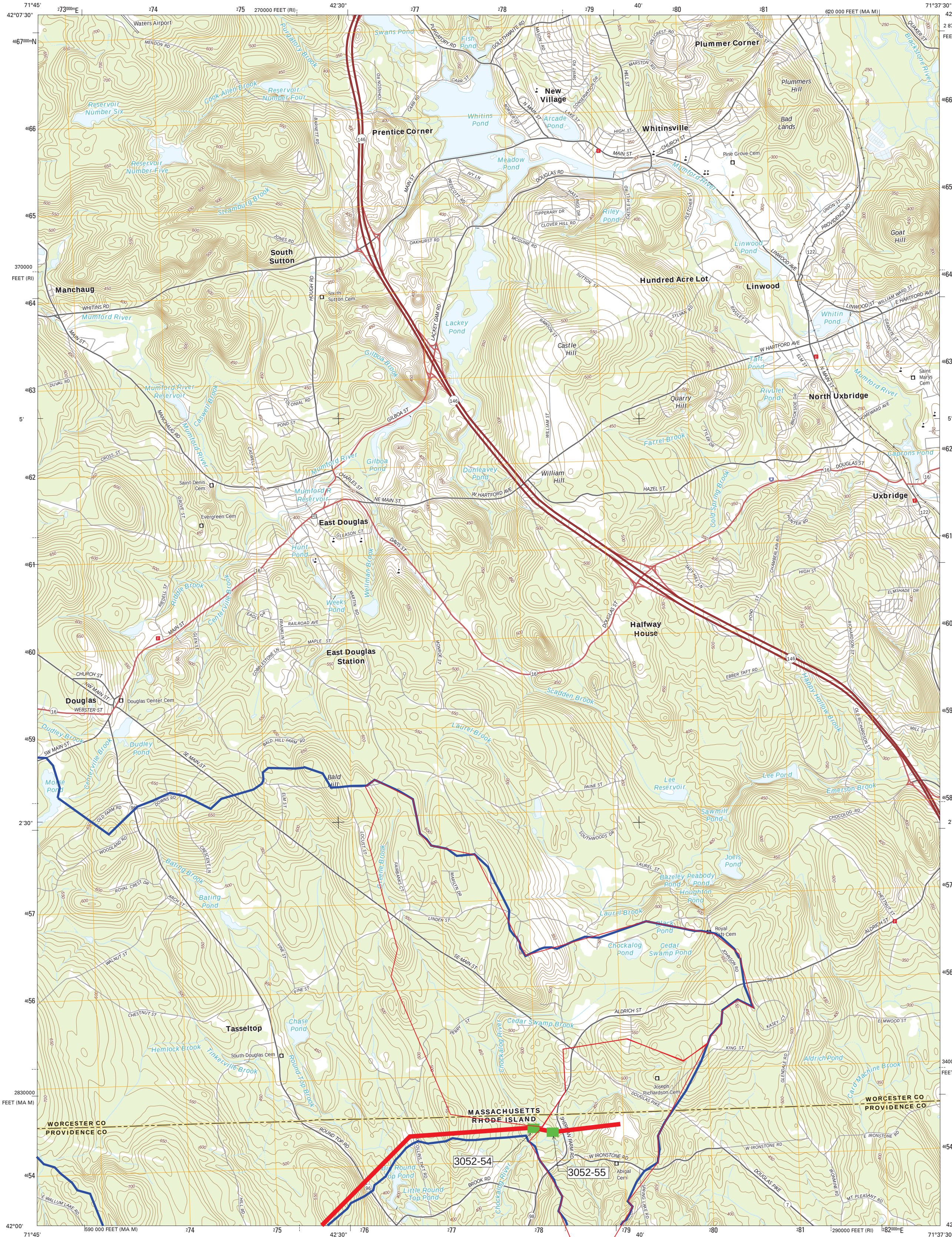
Drainage and erosion control measures were designed for the new access road, existing access road, and work pads.

USGS science for a changing world

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map US Topo

UXBRIDGE QUADRANGLE
MASSACHUSETTS-RHODE ISLAND
7.5-MINUTE SERIES



Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 000-meter grid: Universal Transverse Mercator, Zone 19T
10 000-foot ticks: Massachusetts Coordinate System of 1983
(mainland zone), Rhode Island Coordinate System of 1983

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery....NAIP, July 2014
Roads.... HERE, ©2013 - 2014
Names....GNIS, 2015
Hydrography....National Hydrography Dataset, 2014
Contours....National Elevation Dataset, 2012
Boundaries....Multiple sources; see metadata file 1972 - 2015

MN GN
14° 28´ 257 MILS
1° 48´ 32 MILS
UTM GRID AND 2015 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

U.S. National Grid
100,000-m Square ID
BG
Grid Zone Designation
19T

SCALE 1:24 000

KILOMETERS 1 0.5 0 1 2
METERS 1000 500 0 1000 2000
MILES 1 0.5 0 1
FEET 1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is draft version 0.6.18

MASSACHUSETTS
QUADRANGLE LOCATION

ROAD CLASSIFICATION

Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route

1	2	3
4		5
6	7	8

1 Worcester South
2 Grafton
3 Milford
4 Oxford
5 Blackstone
6 Thompson
7 Chepachet
8 Georgiaville

ADJOINING QUADRANGLES

UXBRIDGE, MA-RI
2015

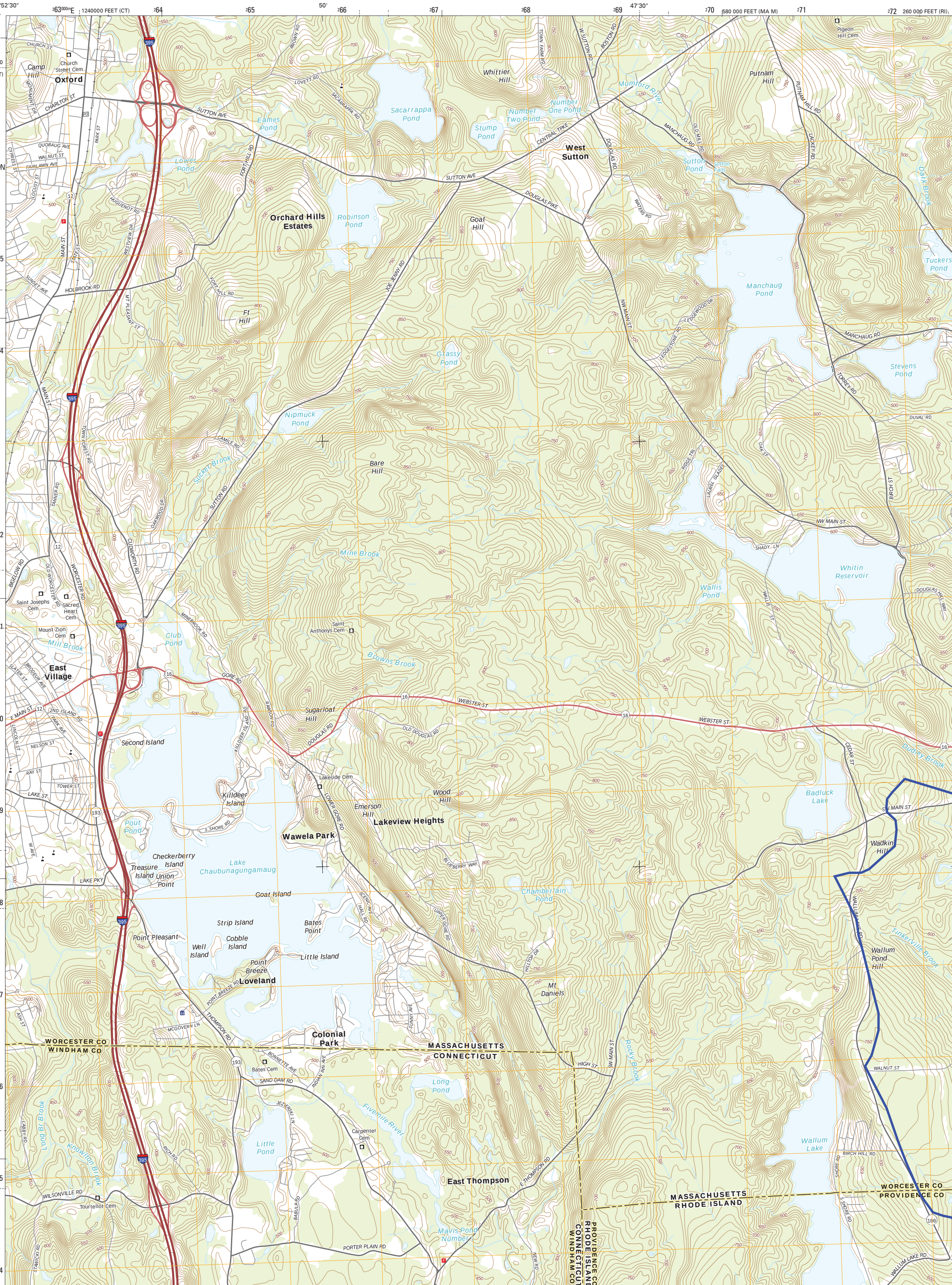
NSN. 7643016369663
NGA REF NO. USGSX24K46491

USGS
science for a changing world

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map
US Topo

OXFORD QUADRANGLE
MASSACHUSETTS-CONNECTICUT-RHODE ISLAND
7.5-MINUTE SERIES



Produced by the United States Geological Survey

North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and 1 000-meter grid: Universal Transverse Mercator, Zone 19T
10 000-foot ticks: Massachusetts Coordinate System of 1983 (mainland zone), Connecticut Coordinate System of 1983, Rhode Island Coordinate System of 1983

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Imagery.....NAIP, July 2014
Roads.....HERE, ©2013 - 2014
Names.....GNIS, 2015
Hydrography.....National Hydrography Dataset, 2014
Contours.....National Elevation Dataset, 1998
Boundaries.....Multiple sources; see metadata file 1972 - 2015

14° 25' 256 MILS
1° 53' 33 MILS
UTM GRID AND 2015 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

U.S. National Grid
100,000-m Square ID
BG
Grid Zone Designation
19T

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is draft version 0.6.18

QUADRANGLE LOCATION

ROAD CLASSIFICATION
Expressway — Local Connector
Secondary Hwy — Local Road
Ramp — 4WD
Interstate Route — US Route — State Route

1 Leicester
2 Worcester South
3 Grafton
4 Webster
5 Uxbridge
6 Putnam
7 Thompson
8 Chepachet

ADJOINING QUADRANGLES

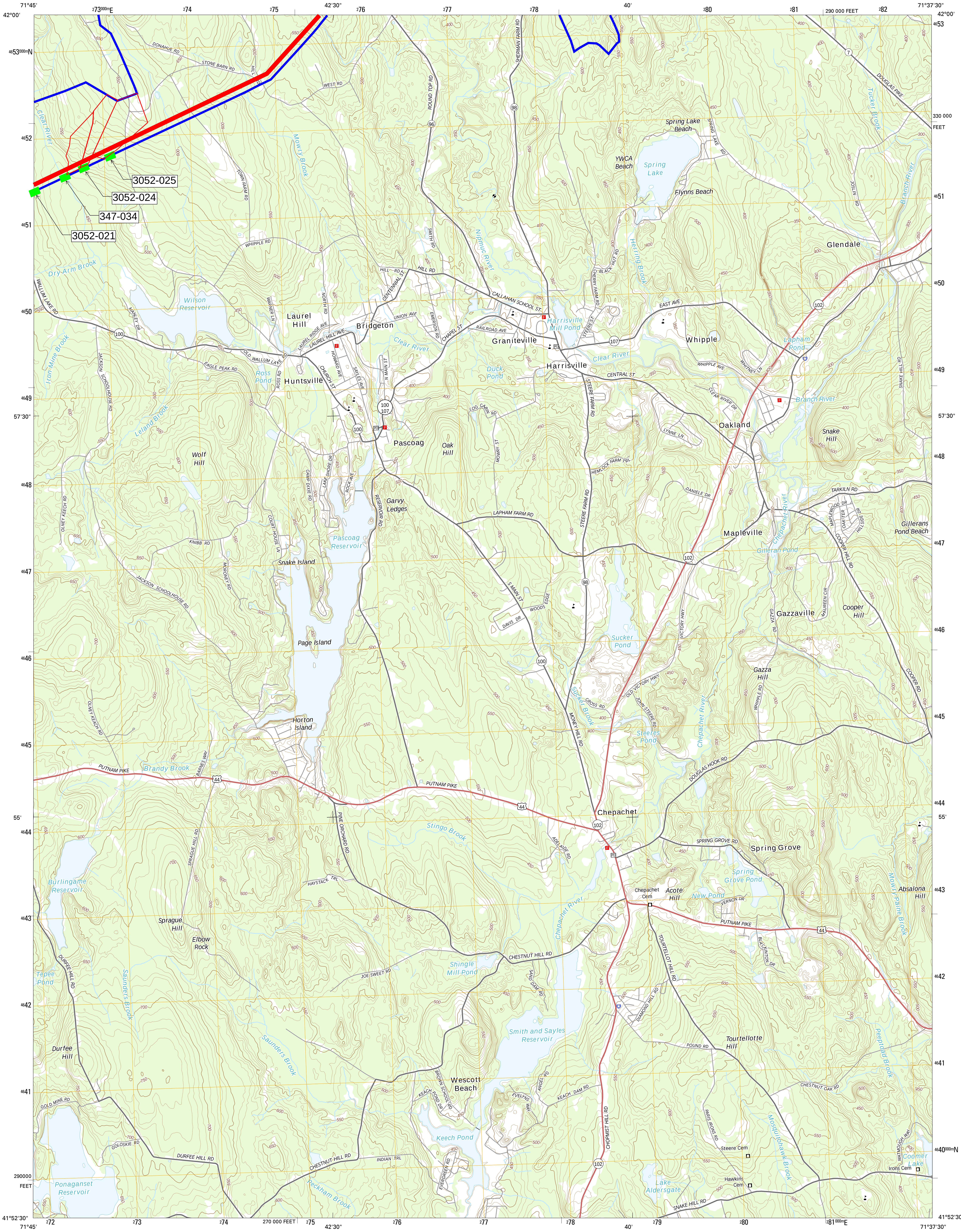
OXFORD, MA-CT-RI
2015

NSN. 7643016369610
NGA REF NO. USGSX24K33781

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map
US Topo

CHEPACHET QUADRANGLE
RHODE ISLAND-PROVIDENCE CO.
7.5-MINUTE SERIES



Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 000-meter grid: Universal Transverse Mercator, Zone 19T
10 000-foot ticks: Rhode Island Coordinate System of 1983

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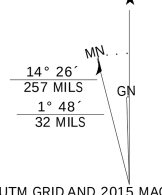
Imagery.....NAIP, July 2014
Roads.....HERE, ©2013 - 2014
Names.....GNIS, 2015
Hydrography.....National Hydrography Dataset, 2014
Contours.....National Elevation Dataset, 2012
Boundaries.....Multiple sources; see metadata file 1972 - 2015



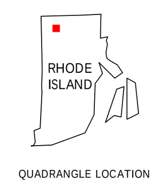
UTM GRID AND 2015 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

U.S. National Grid
100,000-m Square ID
BG
Grid Zone Designation
19T

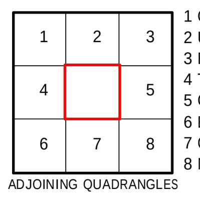
SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is draft version 0.6.18



QUADRANGLE LOCATION



1 Oxford
2 Uxbridge
3 Blackstone
4 Thompson
5 Georgiaville
6 East Killingly
7 Clayville
8 North Scituate

ADJOINING QUADRANGLES

ROAD CLASSIFICATION

Expressway — Local Connector
Secondary Hwy — Local Road
Ramp — 4WD
Interstate Route — US Route — State Route

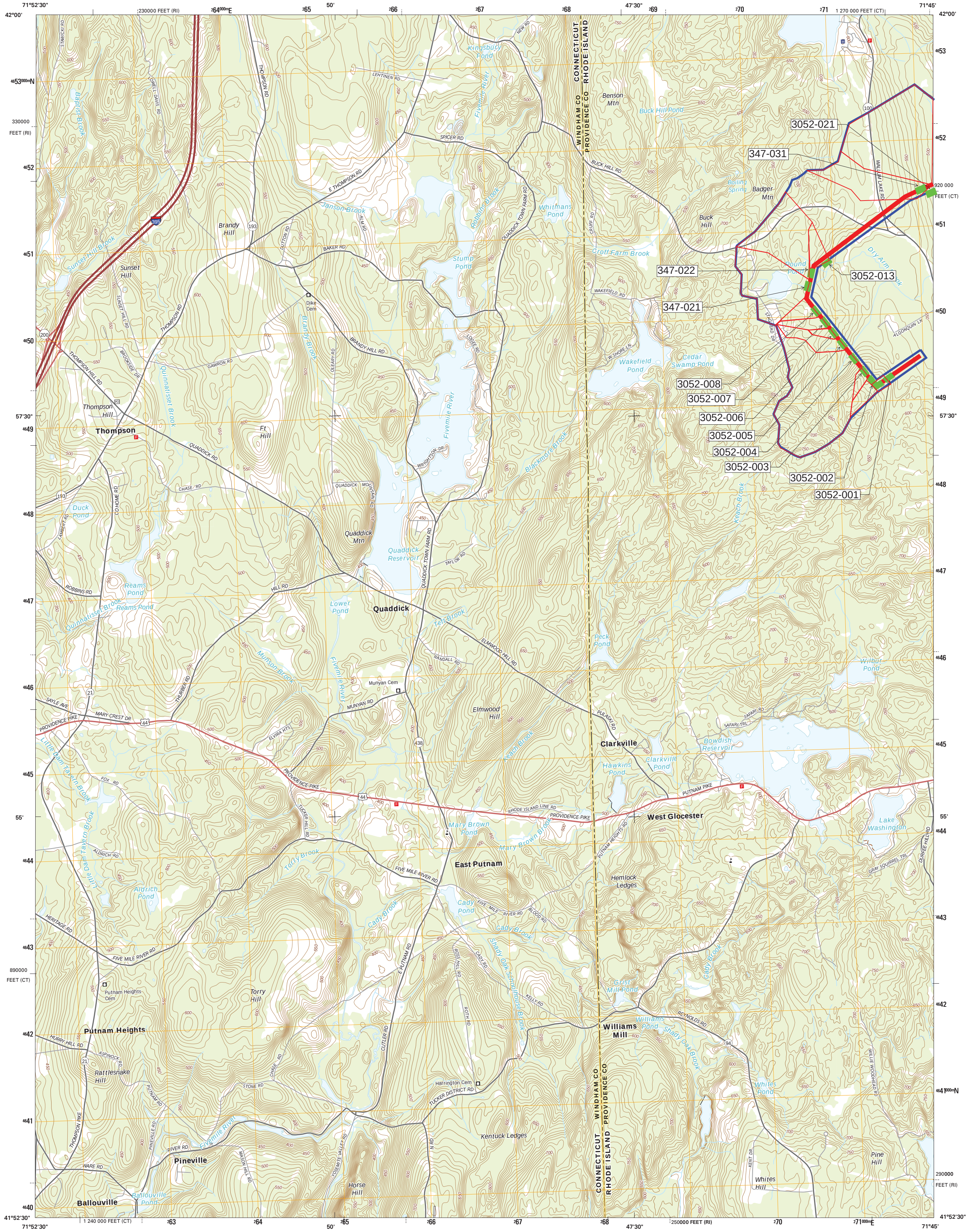
CHEPACHET, RI
2015

NSN. 7643016398067
NGA REF NO. USGSX24K69625

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map
US Topo

THOMPSON QUADRANGLE
CONNECTICUT-RHODE ISLAND
7.5-MINUTE SERIES



Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 000-meter grid: Universal Transverse Mercator, Zone 19T
10 000-foot ticks: Connecticut Coordinate System of 1983,
Rhode Island Coordinate System of 1983

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Imagery....NAIP, July 2014
Roads....HERE, ©2013 - 2014
Names....GNIS, 2015
Hydrography....National Hydrography Dataset, 2014
Contours....National Elevation Dataset, 2012
Boundaries....Multiple sources; see metadata file 1972 - 2015

MN
GN
14° 23'
256 MILS
1° 53'
33 MILS
UTM GRID AND 2015 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

U.S. National Grid
100,000-m Square ID
BG
Grid Zone Designation
19T

SCALE 1:24 000

KILOMETERS 1 0.5 0 1 2
METERS 1000 500 0 1000 2000
MILES 1 0.5 0 1
FEET 1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is draft version 0.6.18

CONNECTICUT
QUADRANGLE LOCATION

1	2	3
4		5
6	7	8

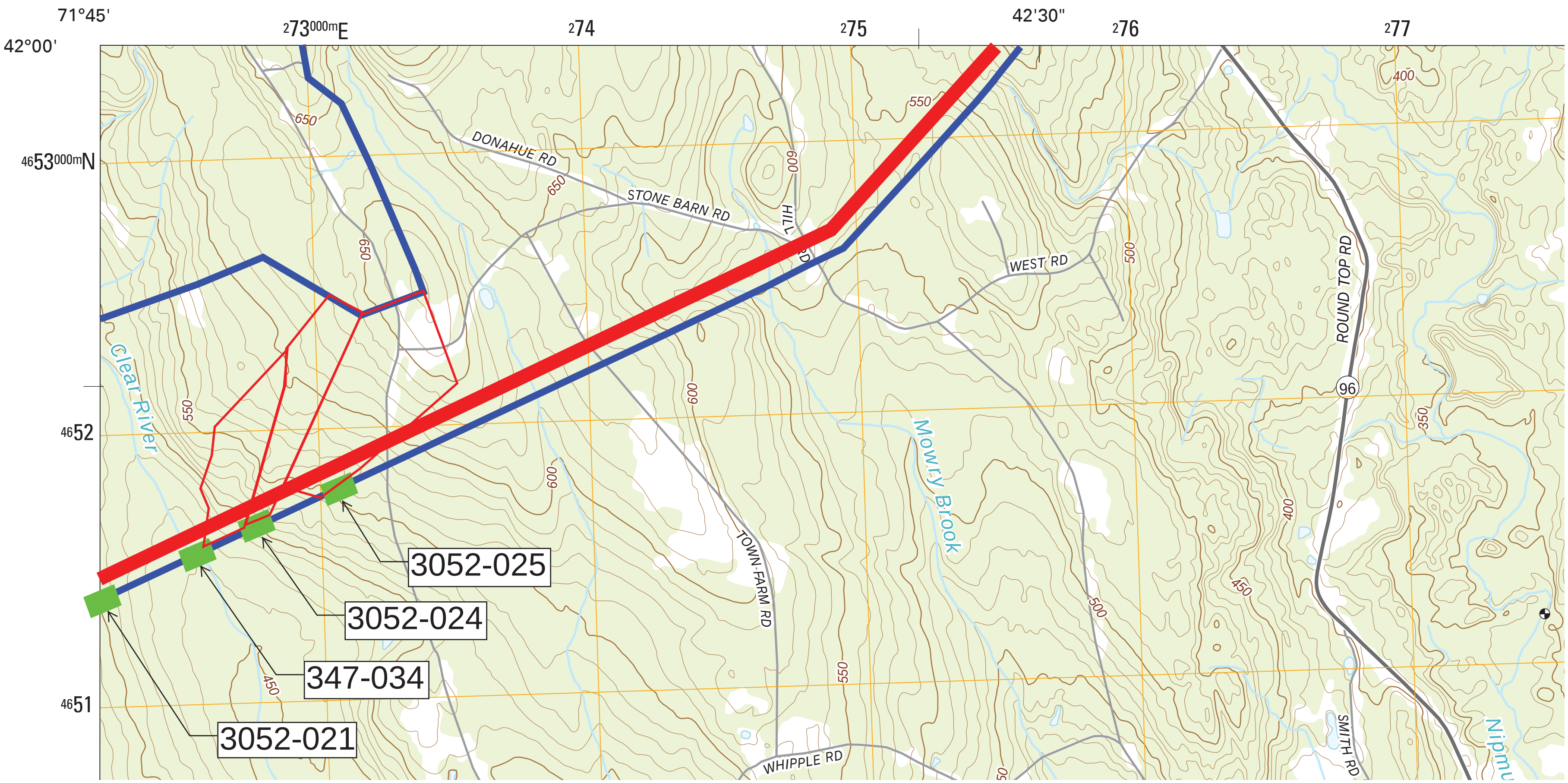
1 Webster
2 Oxford
3 Uxbridge
4 Putnam
5 Chepachet
6 Danielson
7 East Killingly
8 Clayville

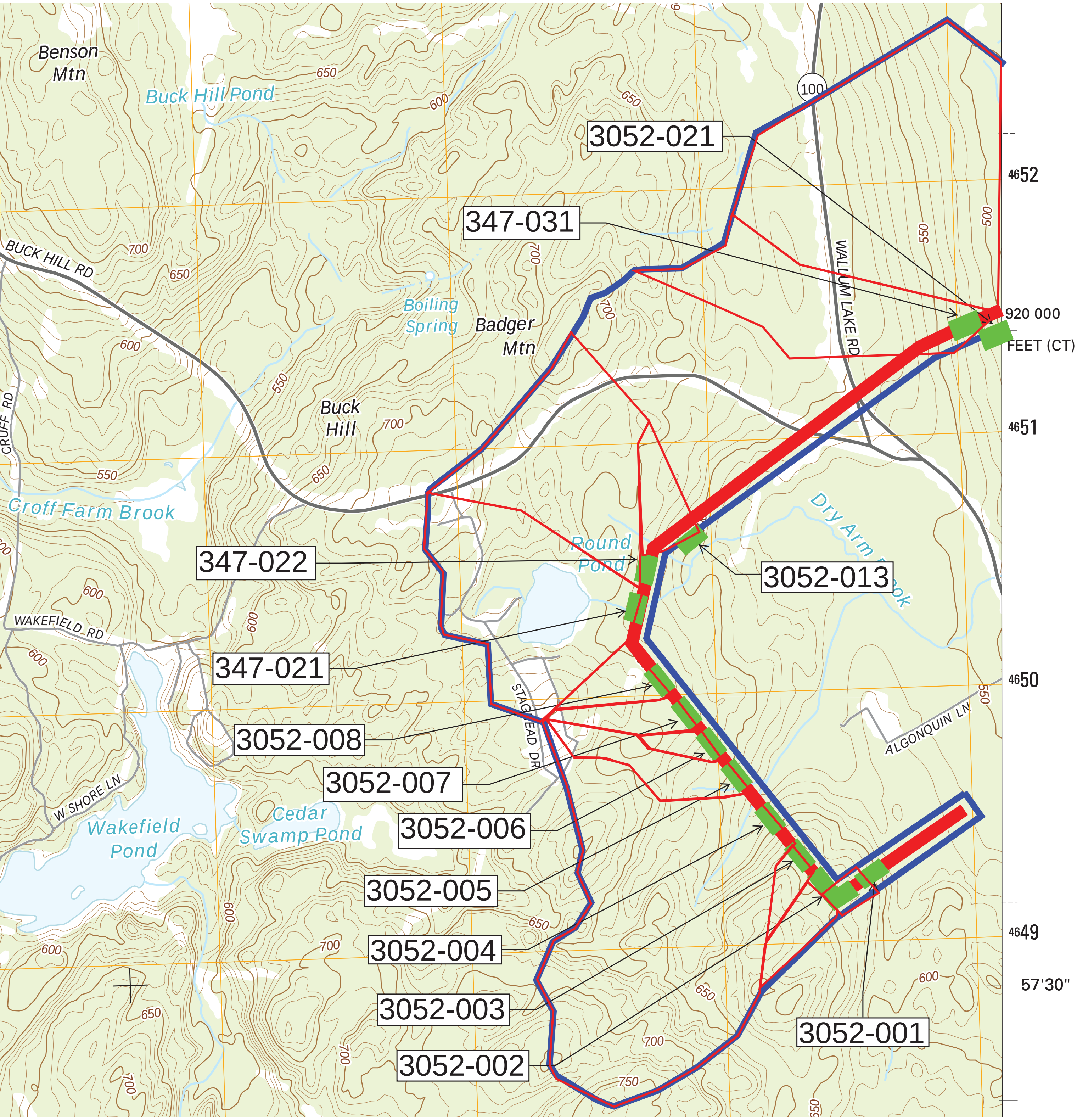
ADJOINING QUADRANGLES

ROAD CLASSIFICATION
Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route

THOMPSON, CT-RI
2015

NSN. 7643016360170
NGA REF NO. USGSX24K44889


71°45'
42°00'
273000mE
274
275
42'30"
276
277
4653000mN
4652
4651
DONAHUE RD
STONE BARN RD
WEST RD
ROUND TOP RD
96
TOWN FARM RD
WHIPPLE RD
SMITH RD
Clear River
Mowry Brook
3052-025
3052-024
347-034
3052-021


3052-021
347-031
347-022
3052-013
347-021
3052-008
3052-007
3052-006
3052-005
3052-004
3052-003
3052-002
3052-001
Benson Mtn
Buck Hill Pond
Boiling Spring
Badger Mtn
Buck Hill
BUCK HILL RD
CRUFF RD
Croff Farm Brook
Round Pond
Dry Arm Brook
WAKEFIELD RD
STAG HEAD DR
WALLUM LAKE RD
ALGONQUIN LN
W SHORE LN
Wakefield Pond
Cedar Swamp Pond
100
4652
4651
4650
4649
920 000
FEET (CT)
57'30"

Invenergy Clear River 345kV Drainage Design Summary Table

Checklist Summary Design Point	Drawing Number	Work Pads	Drainage Area (ac)	Drainage Area (sf)	Q (CFS)	Drainage Slope	Slope of Channel	Check Dam Spacing (ft)	Culvert Size (ft)	Outlet Velocity (fps)	Length of Outlet (ft)	Width of Outlet (ft)	Length of Stream Ford (ft)	Width of Stream Ford (ft)	Check Dam Height: 2 feet
DP-1	SH. 56 of 63	3052-024	28.6	1247122.8	11.2										
DP-2	SH. 54 of 63	347-034	26.6	1158696.0	10.4	4.2%	RIPRAP LINED TO PROTECT POLES, not needed for velocity								Swale Relocation for Pole Installation, Existing Level Spreader
DP-3	SH. 53 of 63	347-031	77.4	3370672.8	30.2	3.5%			2	10	35.0	20.0	25	16	Culvert 3/Stream Ford 3
DP-4	SH. 12 of 63	347-022	105.1	4579898.4	41.0	2.8%			2.5	8	40.0	25.0			Culvert 2 (Invert In 623.75')
DP-5	SH. 12 of 63	347-021	112.3	4890916.8	43.8	2.8%			2.5	9	40.0	25.0			Culvert 1 (Invert In 624.75')

Checklist Summary Design Point	Drawing Number	New Road Work Pads	Drainage Area (ac)	Drainage Area (sf)	Q (CFS)	Drainage Slope	Slope of Channel	Check Dam Spacing (ft)	Culvert Size (ft)	Outlet Velocity (fps)	Length of Outlet (ft)	Width of Outlet (ft)	Length of Stream Ford (ft)	Width of Stream Ford (ft)	
DP-6	SH. 36 of 63	3052-007	13.8	602434.8	5.4	2.8%	3.0%						85	16	Stream Ford 1 (Sta. 7+65 to Sta. 8+50)
DP-7	SH. 42 of 63	3052-004	232.7	10135105.2	90.7	5.6%	10.0%						200	16	Stream Ford 2 (Sta. 23+10 to 25+10)
DP-8	SH. 42 of 63	3052-004	N/A Constructed for wetland crossing										30	16	Stream Ford 2a (Sta. 22+50 to Sta. 22+80)

Checklist Summary Design Point	Drawing Number	New Road Ditch Locations	Drainage Area (ac)	Drainage Area (sf)	Q (CFS)	Drainage Slope	Slope of Channel	Check Dam Spacing (ft)	Culvert Size (ft)	Outlet Velocity (fps)	Length of Outlet (ft)	Width of Outlet (ft)	Length of Stream Ford (ft)	Width of Stream Ford (ft)		
		Sta. 0+00 to Sta. 7+50	2.7	117159.0	1.0	2.4%	3.0%	67								Needs Check Dams Every 65'
		Sta. 8+00 to Sta. 22+50	7.6	332101.8	3.0	5.7%	8.0%	25								Needs Check Dams Every 25'
DP-9	SH. 44 of 63	Sta. 25+10 to Sta. 30+75	2.2	97976.9	0.9	8.2%	8.5%	24							6' Level Spreaders 1 and 2	Needs Check Dams Every 20'
		Sta. 30+75 to Sta. 36+00	14.4	625491.7	5.6	5.7%	4.5%	44								Needs Check Dams Every 40'
DP-10	SH. 50 of 63	Sta. 36+00 to Sta. 40+00	1.9	84118.5	0.8	6.2%	6.0%	33							6' Level Spreader 3	Needs Check Dams Every 30'

New Road Sta. 0+00 to 7+50

Channel Design

Open channel flow analysis uses the following two equations, the continuity equation and Manning's equation.

Continuity Equation: Q=V1*A1=V2*A2 where Q=discharge, cfs; A=area of flow, sf; V=velocity, fps.

Manning's Equation: V=1/n*R^$^{.6667}$*S_o^$^{.5}$ where n=Manning's roughness coefficient; R=hydraulic radius, A/P, ft; S_o= slope, ft/ft.

Calculating the depth of flow is an iterative solution based on the combination of these equations.

$Q := 1.0$ cfs

$B := 2$ Width of channel bottom, ft

$Slope := .03$

$Z := 3$ Channel sideslope, 1/Z

$n := 0.05$ Mannings Roughness — Channels not maintained; for clean bottom, brush on sides

Assume the depth of flow for the first trial.

$d1 := 0.23$ ft

$$Area := B \cdot d1 + \left(Z \cdot d1^2\right) \qquad Area = 0.619 \text{ sf}$$

$$Perim := B + 2 \cdot d1 \cdot \left(Z^2 + 1\right)^{.5} \qquad Perim = 3.455 \text{ ft}$$

$$R := \frac{Area}{Perim} \qquad R = 0.179 \text{ ft}$$

$$Q1 := \frac{1.49 \cdot Area \cdot R^{.666} \cdot Slope^{.5}}{n} \qquad Q1 = 1.016 \text{ cfs}$$

Reiterate to achieve 5% closure for flow rate.

$$\frac{Q1}{Q} = 1.016$$ CHECK _ Between .95 and 1.05.

$$Velocity := \frac{\left(1.49 \cdot R^{.6667} \cdot Slope^{.5}\right)}{n}$$

$Velocity = 1.64$ fps — OK; Velocity < 3.5 fps

RI Stormwater Design and Installation Standards Open Channel System "non erosive peak velocity <3.5 fps"

New Road Sta. 8+00 to 22+50

Channel Design

Open channel flow analysis uses the following two equations, the continuity equation and Manning's equation.
Continuity Equation: Q=V1*A1=V2*A2 where Q=discharge, cfs; A=area of flow, sf; V=velocity, fps.
Manning's Equation: V=1/n*R^$^{.6667}$*S_o^$^{.5}$ where n=Manning's roughness coefficient; R=hydraulic radius, A/P, ft; S_o= slope, ft/ft.
Calculating the depth of flow is an iterative solution based on the combination of these equations.

$Q := 3.0$ cfs

$B := 2$ Width of channel bottom, ft

$Slope := 0.08$

$Z := 3$ Channel sideslope, 1/Z

$n := 0.05$ Mannings Roughness — Channels not maintained; for clean bottom, brush on sides

Assume the depth of flow for the first trial.

$d1 := 0.31$ ft

$Area := B \cdot d1 + \left(Z \cdot d1^2\right)$ $Area = 0.908$ sf

$Perim := B + 2 \cdot d1 \cdot \left(Z^2 + 1\right)^{.5}$ $Perim = 3.961$ ft

$R := \dfrac{Area}{Perim}$ $R = 0.229$ ft

$Q1 := \dfrac{1.49 \cdot Area \cdot R^{.666} \cdot Slope^{.5}}{n}$ $Q1 = 2.871$ cfs

Reiterate to achieve 5%
closure for flow rate.

$\dfrac{Q1}{Q} = 0.957$ CHECK _ Between .95 and 1.05.

$$Velocity := \frac{\left(1.49 \cdot R^{.6667} \cdot Slope^{.5}\right)}{n}$$

$Velocity = 3.158$ fps OK; Velocity < 3.5 fps

RI Stormwater Design and Installation Standards Open Channel System "non erosive peak velocity <3.5 fps"

DP-9

New Road Sta. 25+10 to 30+75

Channel Design

Open channel flow analysis uses the following two equations, the continuity equation and Manning's equation.
Continuity Equation: Q=V1*A1=V2*A2 where Q=discharge, cfs; A=area of flow, sf; V=velocity, fps.
Manning's Equation: V=1/n*R^$^{.6667}$*S_o^$^{.5}$ where n=Manning's roughness coefficient; R=hydraulic radius, A/P, ft; S_o= slope, ft/ft.
Calculating the depth of flow is an iterative solution based on the combination of these equations.

$Q := 0.9$ cfs

$B := 2$ Width of channel bottom, ft

$Slope := 0.085$

$Z := 3$ Channel sideslope, 1/Z

$n := 0.05$ Mannings Roughness — Channels not maintained; for clean bottom, brush on sides

Assume the depth of flow for the first trial.

$d1 := 0.16$ ft

$Area := B \cdot d1 + \left(Z \cdot d1^2\right)$ $\quad Area = 0.397$ sf

$Perim := B + 2 \cdot d1 \cdot \left(Z^2 + 1\right)^{.5}$ $\quad Perim = 3.012$ ft

$R := \frac{Area}{Perim}$ $\quad R = 0.132$ ft

$Q1 := \frac{1.49 \cdot Area \cdot R^{.666} \cdot Slope^{.5}}{n}$ $\quad Q1 = 0.894$ cfs

Reiterate to achieve 5% closure for flow rate.

$\frac{Q1}{Q} = 0.993$ CHECK _ Between .95 and 1.05.

$Velocity := \frac{\left(1.49 \cdot R^{.6667} \cdot Slope^{.5}\right)}{n}$

$Velocity = 2.249$ fps OK; Velocity < 3.5 fps

RI Stormwater Design and Installation Standards Open Channel System "non erosive peak velocity <3.5 fps"

New Road Sta. 30+75 to 36+00

Channel Design

Open channel flow analysis uses the following two equations, the continuity equation and Manning's equation.
Continuity Equation: Q=V1*A1=V2*A2 where Q=discharge, cfs; A=area of flow, sf; V=velocity, fps.
Manning's Equation: V=1/n*R^$^{.6667}$*S_o^$^{.5}$ where n=Manning's roughness coefficient; R=hydraulic radius, A/P, ft; S_o= slope, ft/ft.
Calculating the depth of flow is an iterative solution based on the combination of these equations.

$Q := 5.6$ cfs

$B := 2$ Width of channel bottom, ft

$Slope := 0.045$

$Z := 3$ Channel sideslope, 1/Z

$n := 0.05$ Mannings Roughness — Channels not maintained; for clean bottom, brush on sides

Assume the depth of flow for the first trial.

$d1 := 0.5$ ft

$Area := B \cdot d1 + \left(Z \cdot d1^2\right)$ $\quad Area = 1.75$ sf

$Perim := B + 2 \cdot d1 \cdot \left(Z^2 + 1\right)^{.5}$ $\quad Perim = 5.162$ ft

$R := \frac{Area}{Perim}$ $\quad R = 0.339$ ft

$Q1 := \frac{1.49 \cdot Area \cdot R^{.666} \cdot Slope^{.5}}{n}$ $\quad Q1 = 5.382$ cfs

Reiterate to achieve 5% closure for flow rate.

$\frac{Q1}{Q} = 0.961$ CHECK _ Between .95 and 1.05.

$Velocity := \frac{\left(1.49 \cdot R^{.6667} \cdot Slope^{.5}\right)}{n}$

$Velocity = 3.073$ fps OK; Velocity < 3.5 fps

RI Stormwater Design and Installation Standards Open Channel System "non erosive peak velocity <3.5 fps"

DP-10

New Road Sta. 36+00 to 40+00
Channel Design

Open channel flow analysis uses the following two equations, the continuity equation and Manning's equation.
Continuity Equation: Q=V1*A1=V2*A2 where Q=discharge, cfs; A=area of flow, sf; V=velocity, fps.
Manning's Equation: V=1/n*R^$^{.6667}$*S_o^$^{.5}$ where n=Manning's roughness coefficient; R=hydraulic radius, A/P, ft; S_o= slope, ft/ft.
Calculating the depth of flow is an iterative solution based on the combination of these equations.

$Q := 0.8$ cfs

$B := 2$ Width of channel bottom, ft

$Slope := 0.06$

$Z := 3$ Channel sideslope, 1/Z

$n := 0.05$ Mannings Roughness — Channels not maintained; for clean bottom, brush on sides

Assume the depth of flow for the first trial.

$d1 := 0.165$ ft

$Area := B \cdot d1 + \left(Z \cdot d1^2\right)$ — $Area = 0.412$ sf

$Perim := B + 2 \cdot d1 \cdot \left(Z^2 + 1\right)^{.5}$ — $Perim = 3.044$ ft

$R := \frac{Area}{Perim}$ — $R = 0.135$ ft

$Q1 := \frac{1.49 \cdot Area \cdot R^{.666} \cdot Slope^{.5}}{n}$ — $Q1 = 0.793$ cfs

Reiterate to achieve 5% closure for flow rate.

$\frac{Q1}{Q} = 0.991$ CHECK _ Between .95 and 1.05.

$Velocity := \frac{\left(1.49 \cdot R^{.6667} \cdot Slope^{.5}\right)}{n}$

$Velocity = 1.923$ fps OK; Velocity < 3.5 fps

RI Stormwater Design and Installation Standards Open Channel System "non erosive peak velocity <3.5 fps"

DP-6

Stream Ford 1

Sta. 7+65 to 8+50

Open channel flow is analyzed by the following two equations, the continuity equation and Manning's equation.
Continuity Equation: Q=V1*A1=V2*A2 where Q=discharge, cfs; A=area of flow, sf; V=velocity, fps.
Manning's Equation: V=1/n*R^$^{.6667}$*S_o^$^{.5}$ where n=Manning's roughness coefficient; R=hydraulic radius, A/P, ft; S_o= slope, ft/ft.
Calculating the depth of flow is an iterative solution based on the combination of these equations.

$Q := 5.4$ cfs

$B := 70$ Width of channel bottom, ft

$Slope := 0.03$

$Z := 3$ Channel sideslope, 1/Z

$n := 0.08$ Mannings Roughness — Select from HEC-15 Table 2.2 in Appendix

Assume the depth of flow for the first trial.

$d1 := 0.105$ ft

$Area := B \cdot d1 + \left(Z \cdot d1^2\right)$ $\quad Area = 7.383$ sf

$Perim := B + 2 \cdot d1 \cdot \left(Z^2 + 1\right)^{.5}$ $\quad Perim = 70.664$ ft

$R := \frac{Area}{Perim}$ $\quad R = 0.104$ ft

$Q1 := \frac{1.49 \cdot Area \cdot R^{.666} \cdot Slope^{.5}}{n}$ $\quad Q1 = 5.291$ cfs

Reiterate to achieve 5% closure for flow rate. $\frac{Q1}{Q} = 0.98$ CHECK _ Between .95 and 1.05.

<u>Determine Shear Stress on Channel Liner</u>

$\gamma w := 62.4$

$\tau d := \gamma w \cdot d1 \cdot Slope$

$\tau d = 0.197$ psf — Shear Stress in Channel at Maximum Depth

Select Permissible Shear Stress from HEC-15 Table 2.3 in Appendix. Must be greater than value above for stability.

Select Rock Riprap D50 = 2" dia; Shear Stress = 0.8 psf

DP-7
DP-8

Stream Ford 2 (and 2a)

Sta. 22+50 to 25+10

Open channel flow is analyzed by the following two equations, the continuity equation and Manning's equation.
Continuity Equation: Q=V1*A1=V2*A2 where Q=discharge, cfs; A=area of flow, sf; V=velocity, fps.
Manning's Equation: V=1/n*R^.6667*S_o^.5 where n=Manning's roughness coefficient; R=hydraulic radius, A/P, ft; S_o= slope, ft/ft.
Calculating the depth of flow is an iterative solution based on the combination of these equations.

$Q := 90.7$ cfs

$B := 165$ Width of channel bottom, ft

$Slope := 0.10$

$Z := 3$ Channel sideslope, 1/Z

$n := 0.08$ Mannings Roughness — Select from HEC-15 Table 2.2 in Appendix

Assume the depth of flow for the first trial.

$d1 := 0.24$ ft

$Area := B \cdot d1 + \left(Z \cdot d1^2\right)$ — $Area = 39.773$ sf

$Perim := B + 2 \cdot d1 \cdot \left(Z^2 + 1\right)^{.5}$ — $Perim = 166.518$ ft

$R := \dfrac{Area}{Perim}$ — $R = 0.239$ ft

$Q1 := \dfrac{1.49 \cdot Area \cdot R^{.666} \cdot Slope^{.5}}{n}$ — $Q1 = 90.264$ cfs

Reiterate to achieve 5% closure for flow rate. $\dfrac{Q1}{Q} = 0.995$ CHECK _ Between .95 and 1.05.

<u>Determine Shear Stress on Channel Liner</u>

$\gamma w := 62.4$

$\tau d := \gamma w \cdot d1 \cdot Slope$

$\tau d = 1.498$ psf — shear stress in channel at maximum depth

Select Permissible Shear Stress from HEC-15 Table 2.3 in Appendix. Must be greater than value above for stability.

Select Rock Riprap D50 = 6" dia; Shear Stress = 2.4 psf

DP-3

Stream Ford 3

Work Pad 347-31

Open channel flow is analyzed by the following two equations, the continuity equation and Manning's equation.
Continuity Equation: Q=V1*A1=V2*A2 where Q=discharge, cfs; A=area of flow, sf; V=velocity, fps.
Manning's Equation: V=1/n*R^$^{.6667}$*S_o^$^{.5}$ where n=Manning's roughness coefficient; R=hydraulic radius, A/P, ft; S_o= slope, ft/ft.
Calculating the depth of flow is an iterative solution based on the combination of these equations.

$Q := 30.2$ cfs

$B := 50$ Width of channel bottom, ft

$Slope := 0.035$

$Z := 3$ Channel sideslope, 1/Z

$n := 0.08$ Mannings Roughness — Select from HEC-15 Table 2.2 in Appendix

Assume the depth of flow for the first trial.

$d1 := 0.35$ ft

$Area := B \cdot d1 + (Z \cdot d1^2)$ — $Area = 17.867$ sf

$Perim := B + 2 \cdot d1 \cdot (Z^2 + 1)^{.5}$ — $Perim = 52.214$ ft

$R := \dfrac{Area}{Perim}$ — $R = 0.342$ ft

$Q1 := \dfrac{1.49 \cdot Area \cdot R^{.666} \cdot Slope^{.5}}{n}$ — $Q1 = 30.481$ cfs

Reiterate to achieve 5% closure for flow rate. $\dfrac{Q1}{Q} = 1.009$ — CHECK _ Between .95 and 1.05.

Determine Shear Stress on Channel Liner

$\gamma w := 62.4$

$\tau d := \gamma w \cdot d1 \cdot Slope$

$\tau d = 0.764$ psf — shear stress in channel at maximum depth

Select Permissible Shear Stress from HEC-15 Table 2.3 in Appendix. Must be greater than value above for stability.

Select Rock Riprap D50 = 2" dia; Shear Stress = 0.8 psf

DP-1

OPEN CHANNEL FLOW
Design of Runoff Volumes
Work Pad Stormwater Upstream Ditch - Pole #3052-024 Dwg. Sh. 56 of 63

The Rational Method is used for determining peak discharges from small drainage areas. The method is traditionally used to size storm sewers, channels and other stormwater strucutures which handle runoff from discharge areas less than 20 acres. The runoff volume is calculated by determining the area to be drained, A (acres); the rainfall intensity, I (inches per hour); and the runoff coefficient, C (unitless). These values are multiplied; Q=CIA (cfs)

$A := .93$ acres

$I := 3$ inches per hour, CT DOT IDF Curve from Table Below

The runoff coefficient may be calculated as an average of the surfaces in the drainage area. Reference Tables attached below.

$Ca := .5$ $area1 := 40544$ sf Area will be meadow/riprap slope at project completion.

$Cb := .0$ $area2 := 0$ sf

$Cc := .0$ $area3 := 0$ sf

$Cd := .0$ $area4 := 0$ sf

$$C := \frac{(Ca \cdot area1 + Cb \cdot area2 + Cc \cdot area3 + Cd \cdot area4)}{A \cdot 43560}$$

$C = 0.5$

$Q := C \cdot I \cdot A$

$Q = 1.396$ cfs

Runoff Coefficients for Various Site Conditions

Typical Composite Runoff Coefficients by Land Use.	
Description of Area	C
Business:	
Downtown areas	0.70-0.95
Neighborhood areas	0.50-0.70
Residential:	
Single-family areas	0.30-0.50
Multi units, detached	0.40-0.60
Multi units, attached	0.60-0.75
Suburban	0.25-0.40
Apartment	0.50-0.70
Industrial:	
Light areas	0.50-0.80
Heavy areas	0.60-0.90
Parks, cemeteries	0.10-0.25
Playgrounds	0.20-0.35
Railroad yard areas	0.20-0.35
Unimproved areas	0.10-0.30

Normal Range of Runoff Coefficients.	
Character of Surface	C
Lawns:	
Sandy soil, flat (2%)	0.05-0.10
Sandy soil, ave. (2-7%)	0.10-0.15
Sandy soil, steep (7%)	0.15-0.20
Heavy soil, flat (2%)	0.13-0.17
Heavy soil, ave. (2-7%)	0.18-0.22
Heavy soil, steep (7%)	0.25-0.35
Agricultural land:	
Bare packed soil	
Smooth	0.30-0.60
Rough	0.20-0.50
Cultivated rows	
Heavy soils, no crop	0.30-0.60
Heavy soils with crop	0.20-0.50
Sandy soil no crop	0.20-0.40
Sandy soil with crop	0.10-0.25
Pasture	
Heavy soil	0.15-0.45
Sandy soil	0.05-0.25
Woodlands	0.05-0.25
Pavement	
Asphalt and Concrete	0.70-0.95
Brick	0.70-0.85
Roofs	0.75-0.95

NOTE: The designer must use judgment to select the appropriate "C" value within the range for the appropriate land use. Generally, larger areas with permeable soils, flat slopes, and dense vegetation should have lowest "C" values. Smaller areas with slowly permeable soils, steep slopes, and sparse vegetation should be assigned highest "C" values. The range of "C" values presented are typical for return periods of 2-10 years. Higher values are appropriate for larger design storms. (ASCE 1992 and others)

Runoff Coefficients for the Rational Formula by Hydrologic Soil Group and Slope Range *

	A			B			C			D		
Land use	0–2%	2–6%	6%+	0–2%	2–6%	6%+	0–2%	2–6%	6%+	0–2%	2–6%	6%+
Cultivated land	0.08	0.13	0.16	0.11	0.15	0.21	0.14	0.19	0.26	0.18	0.23	0.31
	0.14	0.18	0.22	0.16	0.21	0.28	0.20	0.25	0.34	0.24	0.29	0.41
Pasture	0.12	0.20	0.30	0.18	0.28	0.37	0.24	0.34	0.44	0.30	0.40	0.50
	0.15	0.25	0.37	0.23	0.34	0.45	0.30	0.42	0.52	0.37	0.50	0.62
Meadow	0.10	0.16	0.25	0.14	0.22	0.30	0.20	0.28	0.36	0.24	0.30	0.40
	0.14	0.22	0.30	0.20	0.28	0.37	0.26	0.35	0.44	0.30	0.40	0.50
Forest	0.05	0.08	0.11	0.08	0.11	0.14	0.10	0.13	0.16	0.12	0.16	0.20
	0.08	0.11	0.14	0.10	0.14	0.18	0.12	0.16	0.20	0.15	0.20	0.25
Residential												
Lot size $\frac{1}{8}$ acre	0.25	0.28	0.31	0.27	0.30	0.35	0.30	0.33	0.38	0.33	0.36	0.42
(0.05 ha)	0.33	0.37	0.40	0.35	0.39	0.44	0.38	0.42	0.49	0.41	0.45	0.54
Lot size $\frac{1}{4}$ acre	0.22	0.26	0.29	0.24	0.29	0.33	0.27	0.31	0.36	0.30	0.34	0.40
(0.10 ha)	0.30	0.34	0.37	0.33	0.37	0.42	0.36	0.40	0.47	0.38	0.42	0.52
Lot size $\frac{1}{3}$ acre	0.19	0.23	0.26	0.22	0.26	0.30	0.25	0.29	0.34	0.28	0.32	0.39
(0.13 ha)	0.28	0.32	0.35	0.30	0.35	0.39	0.33	0.38	0.45	0.36	0.40	0.50
Lot size $\frac{1}{2}$ acre	0.16	0.20	0.24	0.19	0.23	0.28	0.22	0.27	0.32	0.26	0.30	0.37
(0.2 ha)	0.25	0.29	0.32	0.28	0.32	0.36	0.31	0.35	0.42	0.34	0.38	0.48
Lot size 1 acre	0.14	0.19	0.22	0.17	0.21	0.26	0.20	0.25	0.31	0.24	0.29	0.35
(0.4 ha)	0.22	0.26	0.29	0.24	0.28	0.34	0.28	0.32	0.40	0.31	0.35	0.46
Industrial	0.67	0.68	0.68	0.68	0.68	0.69	0.68	0.69	0.69	0.69	0.69	0.70
	0.85	0.85	0.86	0.85	0.86	0.86	0.86	0.86	0.87	0.86	0.86	0.88
Commercial	0.71	0.71	0.72	0.71	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72
	0.88	0.88	0.89	0.89	0.89	0.89	0.89	0.89	0.90	0.89	0.89	0.90
Streets	0.70	0.71	0.72	0.71	0.72	0.74	0.72	0.73	0.76	0.73	0.75	0.78
	0.76	0.77	0.79	0.80	0.82	0.84	0.84	0.85	0.89	0.89	0.91	0.95
Open space	0.05	0.10	0.14	0.08	0.13	0.19	0.12	0.17	0.24	0.16	0.21	0.28
	0.11	0.16	0.20	0.14	0.19	0.26	0.18	0.23	0.32	0.22	0.27	0.39
Parking	0.85	0.86	0.87	0.85	0.86	0.87	0.85	0.86	0.87	0.85	0.86	0.87
	0.95	0.96	0.97	0.95	0.96	0.97	0.95	0.96	0.97	0.95	0.96	0.97

*First row of each entry gives runoff coefficients for storm recurrence intervals less than 25 years; second row gives runoff coefficients for storm recurrence intervals of 25 years or more.

(Source: Rawls et.al., 1981)

DP-1

Work Pad for Pole 3052-024

Channel Design

Open channel flow analysis uses the following two equations, the continuity equation and Manning's equation.
Continuity Equation: Q=V1*A1=V2*A2 where Q=discharge, cfs; A=area of flow, sf; V=velocity, fps.
Manning's Equation: V=1/n*R^$^{.6667}$*S_o^$^{.5}$ where n=Manning's roughness coefficient; R=hydraulic radius, A/P, ft; S_o= slope, ft/ft.
Calculating the depth of flow is an iterative solution based on the combination of these equations.

$Q := 1.4$ cfs

$B := 2$ Width of channel bottom, ft

$Slope := .017$

$Z := 3$ Channel sideslope, 1/Z

$n := 0.05$ Mannings Roughness — Channels not maintained; for clean bottom, brush on sides

Assume the depth of flow for the first trial.

$d1 := 0.27$ ft

$Area := B \cdot d1 + \left(Z \cdot d1^2\right)$ — $Area = 0.759$ sf

$Perim := B + 2 \cdot d1 \cdot \left(Z^2 + 1\right)^{.5}$ — $Perim = 3.708$ ft

$R := \frac{Area}{Perim}$ — $R = 0.205$ ft

$Q1 := \frac{1.49 \cdot Area \cdot R^{.666} \cdot Slope^{.5}}{n}$ — $Q1 = 1.025$ cfs

Reiterate to achieve 5% closure for flow rate.

$\frac{Q1}{Q} = 0.732$ CHECK _ Between .95 and 1.05.

$Velocity := \frac{\left(1.49 \cdot R^{.6667} \cdot Slope^{.5}\right)}{n}$

$Velocity = 1.349$ fps OK; Velocity < 3.5 fps

RI Stormwater Design and Installation Standards Open Channel System "non erosive peak velocity <3.5 fps"

Table 7-1 Values of Roughness Coefficient n (Uniform Flow)

Type Of Channel And Description	Minimum	Normal	Maximum
EXCAVATED OR DREDGED			
a. Earth, straight and uniform			
1. Clean, recently completed	0.016	0.018	0.020
2. Clean, after weathering	0.018	0.022	0.025
3. Gravel, uniform section, clean	0.022	0.025	0.030
4. With short grass, few weeds	0.022	0.027	0.033
b. Earth, winding and sluggish			
1. No vegetation	0.023	0.025	0.030
2. Grass, some weeds	0.025	0.030	0.033
3. Dense weeds or aquatic plants in deep channels	0.030	0.035	0.040
4. Earth bottom and rubble sides	0.025	0.030	0.035
5. Stony bottom and weedy sides	0.025	0.035	0.045
6. Cobble bottom and clcan sides	0.030	0.040	0.050
c. Dragline-excavated or dredgcd			
1. No vegetation	0.025	0.028	0.033
2. Light brush on banks	0.035	0.050	0.060
d. Rock cuts			
1. Smooth and uniform	0.025	0.035	0.040
2. Jagged and irregular	0.035	0.040	0.050
e. Channels not maintained, weeds and brush uncut			
1. Dense weeds, high as flow depth	0.050	0.080	0.120
2. Clean bottom, brush on sides	0.040	0.050	0.080
3. Same, highest stagc of flow	0.045	0.070	0.110
4. Dense brush, high stage	0.080	0.100	0.140
NATURAL STREAMS			
1. Minor streams (top width at flood stage < 30 m)			
a. Streams on Plain			
1. Clean, straight, full stage, no rifts or deep pools	0.025	0.030	0.033
2. Same as above, but more stones/weeds	0.030	0.035	0.040
3. Clean, winding, some pools/shoals	0.033	0.040	0.045
4. Same as above, but some weeds/stones	0.035	0.045	0.050
5. Same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
6. Same as 4, but more stones	0.045	0.050	0.060
7. Sluggish reaches, weedy, deep pools	0.050	0.070	0.080
8. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush	0.075	0.100	0.150

DP-2

Swale Relocation at Pole 347-34

Channel Design

Open channel flow analysis uses the following two equations, the continuity equation and Manning's equation.

Continuity Equation: Q=V1*A1=V2*A2 where Q=discharge, cfs; A=area of flow, sf; V=velocity, fps.

Manning's Equation: V=1/n*R^$^{.6667}$*S_o^$^{.5}$ where n=Manning's roughness coefficient; R=hydraulic radius, A/P, ft; S_o= slope, ft/ft.

Calculating the depth of flow is an iterative solution based on the combination of these equations.

$Q := 10.6$ cfs

$B := 2$ Width of channel bottom, ft

$Slope := 0.05$

$Z := 3$ Channel sideslope, 1/Z

$n := 0.04$ Mannings Roughness Call a Jagged Rock Cut

Assume the depth of flow for the first trial.

$d1 := 0.175$ ft

$Area := B \cdot d1 + \left(Z \cdot d1^2\right)$ $Area = 0.442$ sf

$Perim := B + 2 \cdot d1 \cdot \left(Z^2 + 1\right)^{.5}$ $Perim = 3.107$ ft

$R := \dfrac{Area}{Perim}$ $R = 0.142$ ft

$Q1 := \dfrac{1.49 \cdot Area \cdot R^{.666} \cdot Slope^{.5}}{n}$ $Q1 = 1.004$ cfs

Reiterate to achieve 5% closure for flow rate.

$\dfrac{Q1}{Q} = 0.095$ CHECK _ Between .95 and 1.05.

$Velocity := \dfrac{\left(1.49 \cdot R^{.6667} \cdot Slope^{.5}\right)}{n}$

$Velocity = 2.269$ fps OK; Velocity < 3.5 fps

RI Stormwater Design and Installation Standards Open Channel System "non erosive peak velocity <3.5 fps", but riprap installed to protect transmission poles.

POWER ENGINEERS

SHEET NUMBER: ____ OF ____

PROJECT: Invenergy Clear River | PROJECT NUMBER: 142704

SUBJECT: Culvert Design | BY: ETL | DATE:

CHECKED BY: | DATE:

Work pads

Culvert 1: Structure 347-21

Drainage Area: $A = 112.3$ Acres

Drainage slope $= S = 2.8\%$

$C = 0.13$ Based on "Forest" between Soil B+C and 2-6% Slope

Conservative $i = 3$ in/hr

$$Q = CiA = (0.13)(3)(112.3) = 43.8 \text{ cfs}$$

$$K = \frac{Q}{\sqrt{S}} = \frac{43.8}{\sqrt{0.028}} = 262 \Rightarrow \underline{30'' \text{ RCP culvert}}$$

Culvert 2: Structure 347-22

$A = 105.14$ ac
$S = 2.8\%$
$c = 0.13$
$i = 3$ in/hr

$Q = CiA = 41.0$ cfs

$K = 245$ $\Rightarrow$ 30" RCP culvert

Culvert 3: Structure 347-31

$A = 77.38$ ac
$S = 3.5\%$
$C = 0.13$
$i = 3$ in/hr

$Q = 30.2$ cfs

$K = 161.4$ $\Rightarrow$ 24" RCP culvert

POWER ENGINEERS

SHEET NUMBER: ______ OF ______

PROJECT: Invenergy Clear River

PROJECT NUMBER: 142704

SUBJECT: Culvert outlets

BY: ETL

DATE:

CHECKED BY:

DATE:

* Based on RI Soil Erosion 2014

Culvert 1; structure 347.21

Diameter = D_o = 30" = 2.5'

Q = 43.8 cfs

Tailwater = T_w = 0.5 (D_o) = 1.25'

Length: $L_a = \frac{1.7\,Q}{D_o^{3/2}} + 8D_o$

$= \frac{1.7(43.8)}{(2.5)^{3/2}} + 8(2.5')$

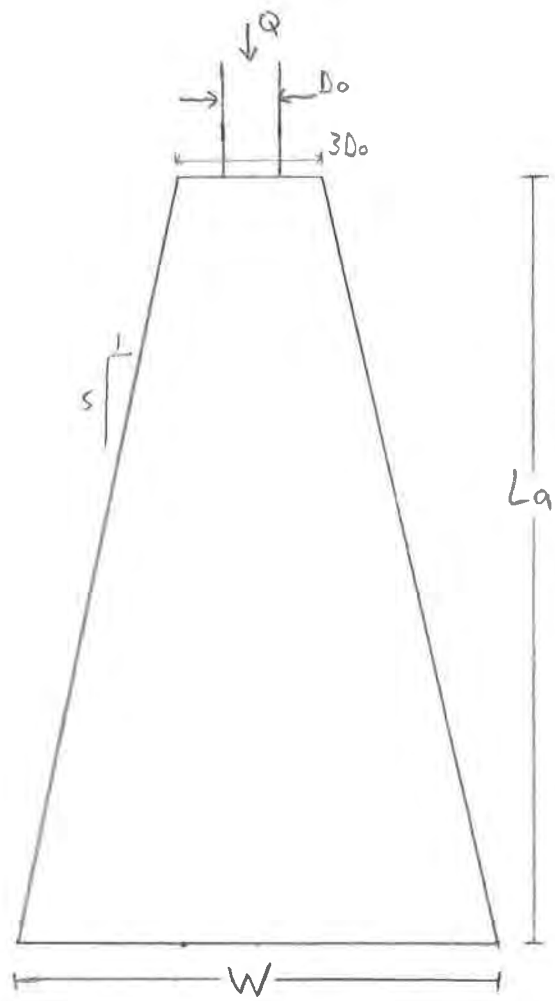
$= 38.8' \Rightarrow 40'$

width: $W = 3D_o + (0.4)L_a$

$= 3(2.5') + (0.4)(40')$

$= 23.5' \Rightarrow 25'$

Using D_{50} = 6" RipRap



* See spreadsheet for other culvert calculations

POWER ENGINEERS

SHEET NUMBER: ______ OF ______

PROJECT: Invenergy Clear River

PROJECT NUMBER: 142704

SUBJECT: Level Spreader / Check dams

BY: ETL

DATE:

CHECKED BY:

DATE:

RIDEM Manual

Level Spreaders (Pg H-10)

Stormwater flowing over lip limited to 1FPS and a depth of 6".

$$L = \frac{Q}{V \times d} \qquad V = 1 \text{fps}, \quad d = 0.5'$$

Minimum $L = 6'$ ∴ when $Q \geq 3$ cfs

→ Three locations along new access road.

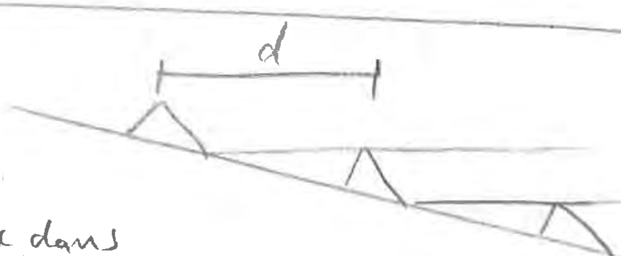
↳ Sta. 25+75 : $Q \approx 1$ CFS $L = 6'$

↳ Sta 28+75 ; $Q \approx 1$ CFS $L = 6'$

↳ Sta. 40+00 : $Q \approx 1$ CFS $L = 6'$

RI Soil Erosion 2014

Check Dams (Section 5)



Maximum height 3' typically 12-18"

d = distance between check dams (based on height and slope)

First section of new Road:

Dam Height : 2.0'

Channel slope = 3.0% : $\tan^{-1}\left(\frac{3.0}{100}\right) = 1.72°$

$$\tan(1.72°) = 0.030 = \frac{2.0'}{d} \qquad d = \frac{\text{height}}{\text{slope}} = \frac{2.0'}{0.030} = 66.7'$$

*See spreadsheet for calc in each section

Rational Method from ASCE, 1992
and Rossmiller 1980

RUNOFF COEFFICIENTS FOR THE RATIONAL FORMULA BY HYDROLOGIC SOIL GROUP AND SLOPE

Land Use	A			B			C			D		
	0-2%	2-6%	6+%	0-2%	2-6%	6+%	0-2%	2-6%	6+%	0-2%	2-6%	6+%
First row of each entry provides runoff coefficients for storm recurrence intervals of 25 years or less. Second row provides runoff coefficients for storm recurrence intervals of 25 years or more.												
Cultivated Land	0.08	0.13	0.16	0.11	0.15	0.21	0.14	0.19	0.26	0.18	0.23	0.31
	0.14	0.18	0.22	0.16	0.21	0.28	0.20	0.25	0.34	0.24	0.29	0.41
Pasture	0.12	0.20	0.30	0.18	0.28	0.37	0.24	0.34	0.44	0.30	0.40	0.50
	0.15	0.25	0.37	0.23	0.34	0.45	0.30	0.42	0.52	0.37	0.50	0.62
Meadow	0.10	0.16	0.25	0.14	0.22	0.30	0.20	0.28	0.36	0.24	0.30	0.40
	0.14	0.22	0.30	0.20	0.28	0.37	0.26	0.35	0.44	0.30	0.40	0.50
Forest	0.05	0.08	0.11	0.08	0.11	0.14	0.10	0.13	0.16	0.12	0.16	0.20
	0.08	0.11	0.14	0.10	0.14	0.18	0.12	0.16	0.20	0.15	0.20	0.25
Residential												
Lot Size (1/8 acre)	0.25	0.28	0.31	0.27	0.30	0.35	0.30	0.33	0.38	0.33	0.36	0.42
	0.33	0.37	0.40	0.35	0.39	0.44	0.38	0.42	0.49	0.41	0.45	0.54
Lot Size (1/4 acre)	0.22	0.26	0.29	0.24	0.29	0.33	0.27	0.31	0.36	0.30	0.34	0.40
	0.30	0.34	0.37	0.33	0.37	0.42	0.36	0.40	0.47	0.38	0.42	0.52
Lot Size (1/3 acre)	0.19	0.23	0.26	0.22	0.26	0.30	0.25	0.29	0.34	0.28	0.32	0.39
	0.28	0.32	0.35	0.30	0.35	0.39	0.33	0.38	0.45	0.36	0.40	0.50
Lot Size (1/2 acre)	0.16	0.20	0.24	0.19	0.23	0.28	0.22	0.27	0.32	0.26	0.30	0.37
	0.25	0.29	0.32	0.28	0.32	0.36	0.31	0.35	0.42	0.34	0.38	0.48
Lot Size (1 acre)	0.14	0.19	0.22	0.17	0.21	0.26	0.20	0.25	0.31	0.24	0.29	0.35
	0.22	0.26	0.29	0.24	0.28	0.34	0.28	0.32	0.40	0.31	0.35	0.46
Industrial	0.67	0.68	0.68	0.68	0.68	0.69	0.68	0.69	0.69	0.69	0.69	0.70
	0.85	0.85	0.85	0.85	0.86	0.86	0.86	0.86	0.87	0.86	0.86	0.88
Commercial	0.71	0.71	0.71	0.71	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72
	0.88	0.88	0.89	0.89	0.89	0.89	0.89	0.89	0.90	0.89	0.89	0.90
Streets	0.70	0.71	0.71	0.71	0.72	0.74	0.72	0.73	0.76	0.73	0.75	0.78
	0.76	0.77	0.80	0.80	0.82	0.84	0.84	0.85	0.80	0.89	0.91	0.95
Open Space	0.05	0.10	0.08	0.08	0.13	0.19	0.12	0.17	0.24	0.16	0.21	0.28
	0.11	0.16	0.14	0.14	0.19	0.26	0.18	0.23	0.32	0.22	0.27	0.39
Parking	0.85	0.86	0.85	0.85	0.86	0.87	0.85	0.86	0.87	0.85	0.86	0.87
	0.95	0.96	0.95	0.95	0.96	0.97	0.95	0.95	0.97	0.95	0.96	0.97

Chow

TABLE 5-6. VALUES OF THE ROUGHNESS COEFFICIENT *n* (*continued*)

Type of channel and description	Minimum	Normal	Maximum
C. EXCAVATED OR DREDGED			
a. Earth, straight and uniform			
1. Clean, recently completed	0.016	0.018	0.020
2. Clean, after weathering	0.018	**0.022**	0.025
3. Gravel, uniform section, clean	0.022	0.025	0.030
4. With short grass, few weeds	0.022	0.027	0.033
b. Earth, winding and sluggish			
1. No vegetation	0.023	0.025	0.030
2. Grass, some weeds	0.025	0.030	0.033
3. Dense weeds or aquatic plants in deep channels	0.030	0.035	0.040
4. Earth bottom and rubble sides	0.028	0.030	0.035
5. Stony bottom and weedy banks	0.025	0.035	0.040
6. Cobble bottom and clean sides	0.030	0.040	0.050
c. Dragline-excavated or dredged			
1. No vegetation	0.025	0.028	0.033
2. Light brush on banks	0.035	0.050	0.060
d. Rock cuts			
1. Smooth and uniform	0.025	0.035	0.040
2. Jagged and irregular	0.035	0.040	0.050
e. Channels not maintained, weeds and brush uncut			
1. Dense weeds, high as flow depth	0.050	0.080	0.120
2. Clean bottom, brush on sides	0.040	0.050	0.080
3. Same, highest stage of flow	0.045	0.070	0.110
4. Dense brush, high stage	0.080	0.100	0.140
D. NATURAL STREAMS			
D-1. Minor streams (top width at flood stage < 100 ft)			
a. Streams on plain			
1. Clean, straight, full stage, no rifts or deep pools	0.025	**0.030**	0.033
2. Same as above, but more stones and weeds	0.030	0.035	0.040
3. Clean, winding, some pools and shoals	0.033	0.040	0.045
4. Same as above, but some weeds and stones	0.035	0.045	0.050
5. Same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
6. Same as 4, but more stones	0.045	0.050	0.060
7. Sluggish reaches, weedy, deep pools	0.050	0.070	0.080
8. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush	0.075	0.100	0.150

Table 2.1. Typical Roughness Coefficients for Selected Linings

Lining Category	Lining Type	Manning's n[1] Maximum	Typical	Minimum
Rigid	Concrete	0.015	0.013	0.011
	Grouted Riprap	0.040	0.030	0.028
	Stone Masonry	0.042	0.032	0.030
	Soil Cement	0.025	0.022	0.020
	Asphalt	0.018	0.016	0.016
Unlined	Bare Soil[2]	0.025	0.020	0.016
	Rock Cut (smooth, uniform)	0.045	0.035	0.025
RECP	Open-weave textile	0.028	0.025	0.022
	Erosion control blankets	0.045	0.035	0.028
	Turf reinforcement mat	0.036	0.030	0.024

[1]Based on data from Kouwen, et al. (1980), Cox, et al. (1970), McWhorter, et al. (1968) and Thibodeaux (1968).
[2]Minimum value accounts for grain roughness. Typical and maximum values incorporate varying degrees of form roughness.

Table 2.2. Typical Roughness Coefficients for Riprap, Cobble, and Gravel Linings

Lining Category	Lining Type	Manning's n for Selected Flow Depths[1] 0.15 m (0.5 ft)	0.50 m (1.6 ft)	1.0 m (3.3 ft)
Gravel Mulch	D_{50} = 25 mm (1 in.)	0.040	0.033	0.031
	D_{50} = 50 mm (2 in.)	0.056	0.042	0.038
Cobbles	D_{50} = 0.10 m (0.33 ft)	--[2]	0.055	0.047
Rock Riprap	D_{50} = 0.15 m (0.5 ft)	--[2]	0.069	0.056
	D_{50} = 0.30 m (1.0 ft)	--[2]	--[2]	0.080

[1]Based on Equation 6.1 (Blodgett and McConaughy, 1985). Manning's n estimated assuming a trapezoidal channel with 1:3 side slopes and 0.6 m (2 ft) bottom width.
[2]Shallow relative depth (average depth to D_{50} ratio less than 1.5) requires use of Equation 6.2 (Bathurst, et al., 1981) and is slope-dependent. See Section 6.1.

2.2 SHEAR STRESS

2.2.1 Equilibrium Concepts

Most highway drainage channels cannot tolerate bank instability and possible lateral migration. Stable channel design concepts focus on evaluating and defining a channel configuration that will perform within acceptable limits of stability. Methods for evaluation and definition of a stable configuration depend on whether the channel boundaries can be viewed as:

- essentially rigid (static)
- movable (dynamic).

In the first case, stability is achieved when the material forming the channel boundary effectively resists the erosive forces of the flow. Under such conditions the channel bed and banks are in protected. Therefore permissible shear stress is not significantly affected by the erodibility of the underlying soil. However, if the lining moves, the underlying soil will be exposed to the erosive force of the flow.

Table 2.3 provides typical examples of permissible shear stress for selected lining types. Representative values for different soil types are based on the methods found in Chapter 4 while those for gravel mulch and riprap are based on methods found in Chapter 7. Vegetative and RECP lining performance relates to how well they protect the underlying soil from shear stresses so these linings do not have permissible shear stresses independent of soil types. Chapters 4 (vegetation) and 5 (RECPs) describe the methods for analyzing these linings. Permissible shear stress for gabion mattresses depends on rock size and mattress thickness as is described in Section 7.2.

Table 2.3. Typical Permissible Shear Stresses for Bare Soil and Stone Linings

		Permissible Shear Stress	
Lining Category	Lining Type	N/m^2	lb/ft^2
Bare Soil[1] Cohesive (PI = 10)	Clayey sands	1.8-4.5	0.037-0.095
	Inorganic silts	1.1-4.0	0.027-0.11
	Silty sands	1.1-3.4	0.024-0.072
Bare Soil[1] Cohesive (PI $\geq$ 20)	Clayey sands	4.5	0.094
	Inorganic silts	4.0	0.083
	Silty sands	3.5	0.072
	Inorganic clays	6.6	0.14
Bare Soil[2] Non-cohesive (PI < 10)	Finer than coarse sand D_{75}<1.3 mm (0.05 in)	1.0	0.02
	Fine gravel D_{75}=7.5 mm (0.3 in)	5.6	0.12
	Gravel D_{75}=15 mm (0.6 in)	11	0.24
Gravel Mulch[3]	Coarse gravel D_{50} = 25 mm (1 in)	19	0.4
	Very coarse gravel D_{50} = 50 mm (2 in)	38	0.8
Rock Riprap[3]	D_{50} = 0.15 m (0.5 ft)	113	2.4
	D_{50} = 0.30 m (1.0 ft)	227	4.8

[1]Based on Equation 4.6 assuming a soil void ratio of 0.5 (USDA, 1987).
[2]Based on Equation 4.5 derived from USDA (1987)
[3]Based on Equation 6.7 with Shield's parameter equal to 0.047.

2.3 DESIGN PARAMETERS

2.3.1 Design Discharge Frequency

Design flow rates for permanent roadside and median drainage channel linings usually have a 5 or 10-year return period. A lower return period flow is allowable if a transitional lining is to be used, typically the mean annual storm (approximately a 2-year return period, i.e., 50 percent probability of occurrence in a year). Transitional channel linings are often used during the establishment of vegetation. The probability of damage during this relatively short time is low,

5.7 Open Channel Systems

Source: HW Group File Photo

Description: Open channel systems are vegetated open channels that are explicitly designed to capture and treat the full WQ_v within dry or wet cells formed by check dams or other means. Design variants include Dry Swales and Wet Swales.

KEY CONSIDERATIONS

FEASIBILITY

- Maximum longitudinal slope of 4%, without checkdams.

CONVEYANCE

- Non-erosive (3.5 to 5.0 fps) peak velocity for the 1-year storm.
- Safe conveyance of the 10-year storm.
- Side slopes gentler than 2:1 (3:1 preferred).
- The maximum allowable temporary ponding time of 48 hours.

PRETREATMENT

- 10% of the WQ_v in pretreatment, usually provided using check dams at culverts or driveway crossings.

TREATMENT

- Storage of WQ_v in facility (wet swale) or through properly sized filter media/bioretention soil (dry swale).
- Bottom width no greater than 8 feet, but no less than 2 feet.
- Dry Swale utilizes bioretention soil media as detailed in Appendix F.

STORMWATER MANAGEMENT SUITABILITY

- ☑ Water Quality
- ☑ Recharge
- ☑ Channel Protection*
- ☐ Overbank Flood Control

* Generally applies only to wet swale

Accepts LUHPPL Runoff: *Yes (requires impermeable liner for water quality treatment)*

IMPLEMENTATION CONSIDERATIONS

L Capital Cost

L Maintenance Burden

Residential/Subdivision Use: *Yes*

High Density/Ultra-Urban: *No*

Drainage Area: *5 acres max. to one inlet*

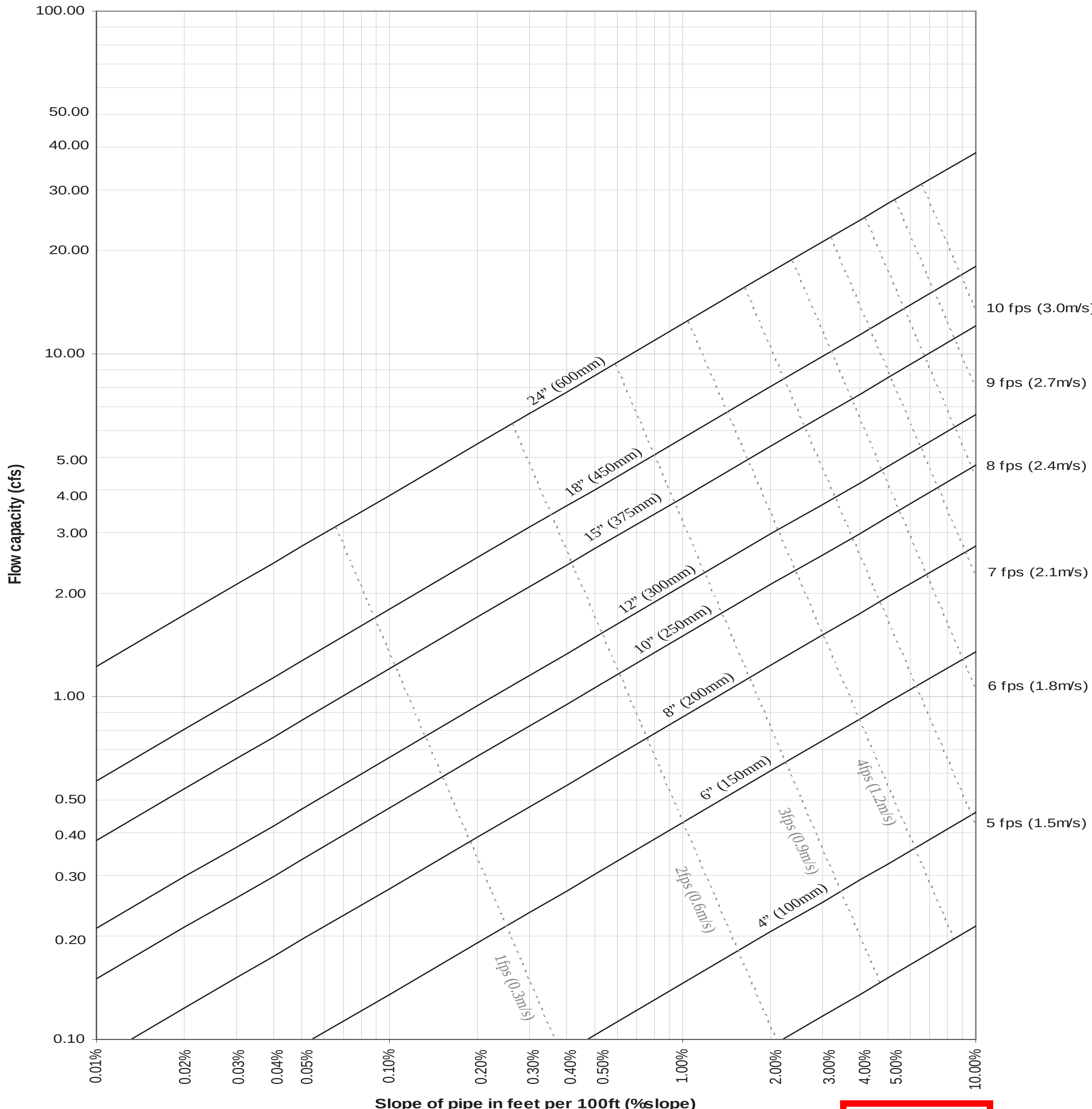
Soils: *No restrictions*

Other Considerations:

- Bioretention soil layer (Dry Swale)
- Emergent plants (Wet Swale)

Key: L=Low M=Moderate H=High

Figure 3-2
Discharge Rates for ADS Single Wall Heavy Duty and Highway Pipe



1cfs = 0.02832 m^3/s
1ft/s = 0.30480 m/s
1% = 0.01 ft/ft

Note: Based on a design Manning's "n" described in Table 3-1 for respective diameter.
Pipe may not be available in all diameters shown.
Solid lines indicate pipe diameters. Dashed lines indicate approximate average velocity.

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Table 3-1
Conveyance Factors (Standard Units)

Design Manning's Values for ADS Thermoplastic Pipe *		
Product	**Diameter**	**Design Manning's "n"**
N-12, MEGA GREEN, N-12 STIB, N-12 WTIB, HP STORM, SaniTite, SaniTite HP, N-12 Low Head	4" - 60"	"n" = 0.012
Single Wall Highway and Heavy Duty *	18" - 24" 12" - 15" 10" 8" 3" - 6"	"n" = 0.020 "n" = 0.018 "n" = 0.017 "n" = 0.016 "n" = 0.015
TripleWall and Smoothwall Sewer & Drain	3" - 6"	"n" = 0.009 **
Conveyance Equations: k = Q/(s^0.5) Q = k s^0.5		

n-value of Concrete Storm Sewers

Conveyance Factors for Circular Pipe Flowing Full																		
		Manning's "n" Values																
Dia. (in.)	**Area (sq. ft.)**	**0.009**	**0.010**	**0.011**	**0.012**	**0.013**	**0.014**	**0.015**	**0.016**	**0.017**	**0.018**	**0.019**	**0.020**	**0.021**	**0.022**	**0.023**	**0.024**	**0.025**
3	0.05	1.3	1.1	1.0	1.0	0.9	0.8	0.8	0.7	0.7	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.5
4	0.09	2.7	2.5	2.2	2.1	1.9	1.8	1.6	1.5	1.5	1.4	1.3	1.2	1.2	1.1	1.1	1.0	1.0
6	0.20	8.1	7.3	6.6	6.1	5.6	5.2	4.9	4.6	4.3	4.1	3.8	3.6	3.5	3.3	3.2	3.0	2.9
8	0.35	17.5	15.7	14.3	13.1	12.1	11.2	10.5	9.8	9.2	8.7	8.3	7.9	7.5	7.1	6.8	6.5	6.3
10	0.55	31.6	28.5	25.9	23.7	21.9	20.3	19.0	17.8	16.8	15.8	15.0	14.2	13.6	12.9	12.4	11.9	11.4
12	0.79	51.5	46.3	42.1	38.6	35.6	33.1	30.9	28.9	27.2	25.7	24.4	23.2	22.1	21.1	20.1	19.3	18.5
15	1.23	93.3	84.0	76.3	70.0	64.6	60.0	56.0	52.5	49.4	46.7	44.2	42.0	40.0	38.2	36.5	35.0	33.6
18	1.77	151.7	136.6	124.1	113.8	105.0	97.5	91.0	85.3	80.3	75.9	71.9	68.3	65.0	62.1	59.4	56.9	54.6
21	2.41	228.9	206.0	187.3	171.6	158.4	147.1	137.3	128.7	121.2	114.4	108.4	103.0	98.1	93.6	89.6	85.8	82.4
24	3.14	326.8	294.1	267.3	245.1	226.2	210.1	196.1	183.8	173.0	163.4	154.8	147.0	140.0	133.7	127.9	122.5	117.6
27	3.98	447.3	402.6	366.0	335.5	309.7	287.6	268.4	251.6	236.8	223.7	211.9	201.3	191.7	183.0	175.0	167.8	161.0
30	4.91	592.5	533.2	484.7	444.3	410.2	380.9	355.5	333.3	313.7	296.2	280.6	266.6	253.9	242.4	231.8	222.2	213.3
33	5.94	763.9	687.5	625.0	572.9	528.9	491.1	458.3	429.7	404.4	382.0	361.9	343.8	327.4	312.5	298.9	286.5	275.0
36	7.07	963.4	867.1	788.2	722.6	667.0	619.3	578.0	541.9	510.0	481.7	456.4	433.5	412.9	394.1	377.0	361.3	346.8
42	9.62	1453.2	1307.9	1189.0	1089.9	1006.1	934.2	871.9	817.5	769.4	726.6	688.4	654.0	622.8	594.5	568.7	545.0	523.2
45	11.04	1746.8	1572.1	1429.2	1310.1	1209.3	1122.9	1048.1	982.6	924.8	873.4	827.4	786.1	748.6	714.6	683.5	655.0	628.8
48	12.57	2074.8	1867.4	1697.6	1556.1	1436.4	1333.8	1244.9	1167.1	1098.4	1037.4	982.8	933.7	889.2	848.8	811.9	778.1	746.9
54	15.90	2840.5	2556.4	2324.0	2130.4	1966.5	1826.0	1704.3	1597.8	1503.8	1420.2	1345.5	1278.2	1217.4	1162.0	1111.5	1065.2	1022.6
60	19.63	3762.0	3385.8	3078.0	2821.5	2604.4	2418.4	2257.2	2116.1	1991.6	1881.0	1782.0	1692.9	1612.3	1539.0	1472.1	1410.7	1354.3
72	28.27	6117.3	5505.6	5005.1	4588.0	4235.1	3932.6	3670.4	3441.0	3238.6	3058.7	2897.7	2752.8	2621.7	2502.5	2393.7	2294.0	2202.2

* Corrugated Polyethylene Pipe Association (2000) "Hydraulic Considerations for Corrugated Polyethylene Pipe"
** "Lingedburg, Michael, "Civil Engineer Reference Manual"[4]

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Figure 1. Manning's "n" Coefficients

For riprap-lined channels, "n" can be determine from the following equation:

$$n = (0.0395)d_{50}^{\frac{1}{6}}$$

Where,

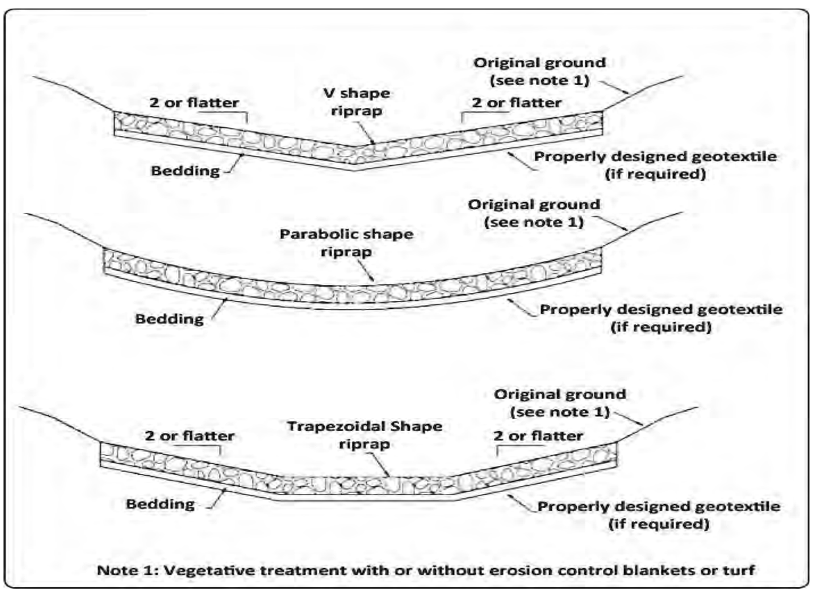
n = Manning's roughness coefficient
d_{50} = the median size stone in the gradation of riprap (feet)

The following table identifies Manning "n" coefficients for specific linings derived from the USDA-NRCS and the DOT Standard specifications M.12.02 (riprap).

Lining type	"n"
Concrete	0.012 - 0.014
Trowel Finish	0.013 - 0.014
Float Finish	0.013 - 0.017
Gunite	0.016 - 0.022
Flagstone	0.020 - 0.025
Riprap	
Modified (d_{50}=0.42)	0.034
Intermediate (d_{50}=0.67)	0.037
Standard (d_{50}=1.25	0.041

(Credit: *2002 Connecticut Guidelines for Soil Erosion and Sediment Control*)

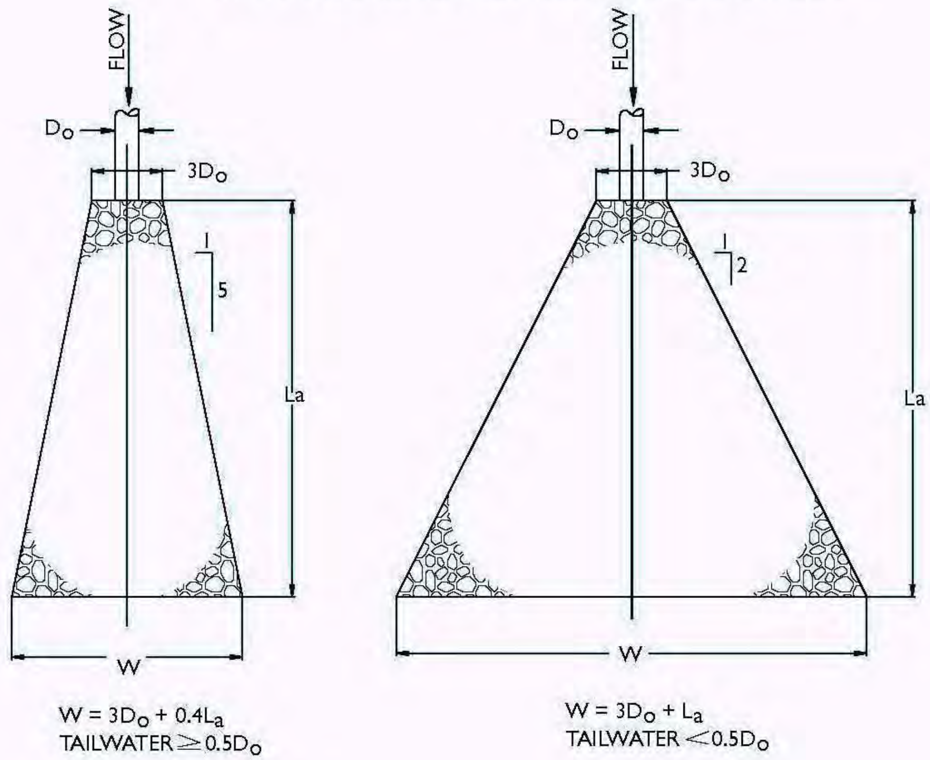
Figure 2. Typical Waterway Cross-Section



(Credit: *2002 Connecticut Guidelines for Soil Erosion and Sediment Control*)

Figure 1. Conduit Outlet Level Spreader

NOTE: FOR USE AS CONDUIT OUTLET PROTECTION WHERE THERE IS NO WELL DEFINED CHANNEL IMMEDIATELY DOWNSTREAM



Design Example

Given: $D_o = 1.5$ ft, $Q = 14.5$ cfs, $TW = 0.7$ ft.
Find: L_a, W, d_{50}

$$L_a = \frac{1.7Q}{D_o^{3/2}} + 8D_o = \frac{1.7(14.5\text{ cfs})}{1.5^{3/2}} + 8(1.5) = 25.4$$

$$L_a = 25.4\text{ ft.}$$

$$W = 3D_o + L_a = 3(1.5\text{ ft.}) + 25.4\text{ ft.} = 29.9\text{ ft. (Say 30 ft.)}$$

Median Stone Diameter:

$$d_{50} = \left(\frac{0.02}{TW}\right)\left(\frac{Q}{D_o}\right)^{4/3} = \left(\frac{0.02}{0.7}\right)\left(\frac{14.5}{1.5}\right)^{4/3} = 0.58 = 7\text{ inches}$$

(Credit: *2002 Connecticut Guidelines for Soil Erosion and Sediment Control*)

H.2.4 Level Spreaders

Level spreaders are devices designed to uniformly distribute flow over a large area to prevent erosive flows and promote infiltration. There are several level spreader designs that differ based on the peak rate of inflow, the duration of use, the type of pollutant, and the site conditions. All designs follow the same basic principles: water enters the spreader through overland flow, a pipe, ditch or swale; the flow is distributed throughout a long linear shallow trench or behind a low berm; and then water flows over the berm/ditch uniformly along the entire length. Level spreaders can be used during construction or as a part of post-construction stormwater control. They are particularly useful to diffuse flow through vegetated buffers adjacent to waterbodies, in areas requiring a vegetative filter strip to pretreat runoff, and as a segment of a stormwater treatment series of BMPs where concentrated flow presents design constraints, such as with some filtering practices. One example of a level spreader is illustrated below in Figure H-7.

Required Elements

- A level spreader shall be installed in an undisturbed or finished area.
- The level spreader lip shall be constructed with a maximum slope of 0.1% along its length.
- Runoff entering a level spreader must not contain significant amounts of sediment. An upstream sediment removal practice may be required in addition to the level spreader.

Design Guidance

- A level spreader should disperse onto a vegetated slope that has a gradient of less than 10:1 (H:V).
- The lip can be constructed of either stabilized grass for low flows, or timber/concrete for higher flows.
- The length of the level spreader lip is dependent on the volume of water that must be discharged, but the minimum length for the level spreader lip is 6 feet.
- Stormwater flowing over the lip should be limited to a depth of approximately 6 inches and a velocity of 1 fps for the design storm.
- The maximum drainage area for a level spreader should be 2.5 acres for maximum efficiency.

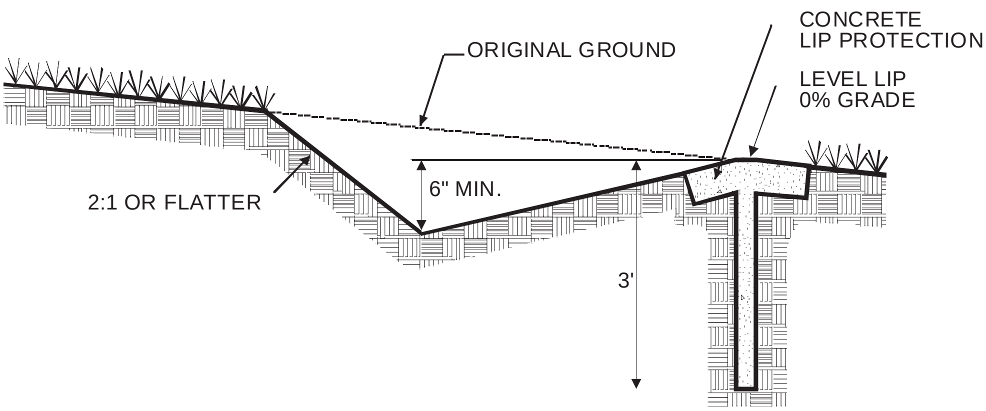
Sample Calculation:

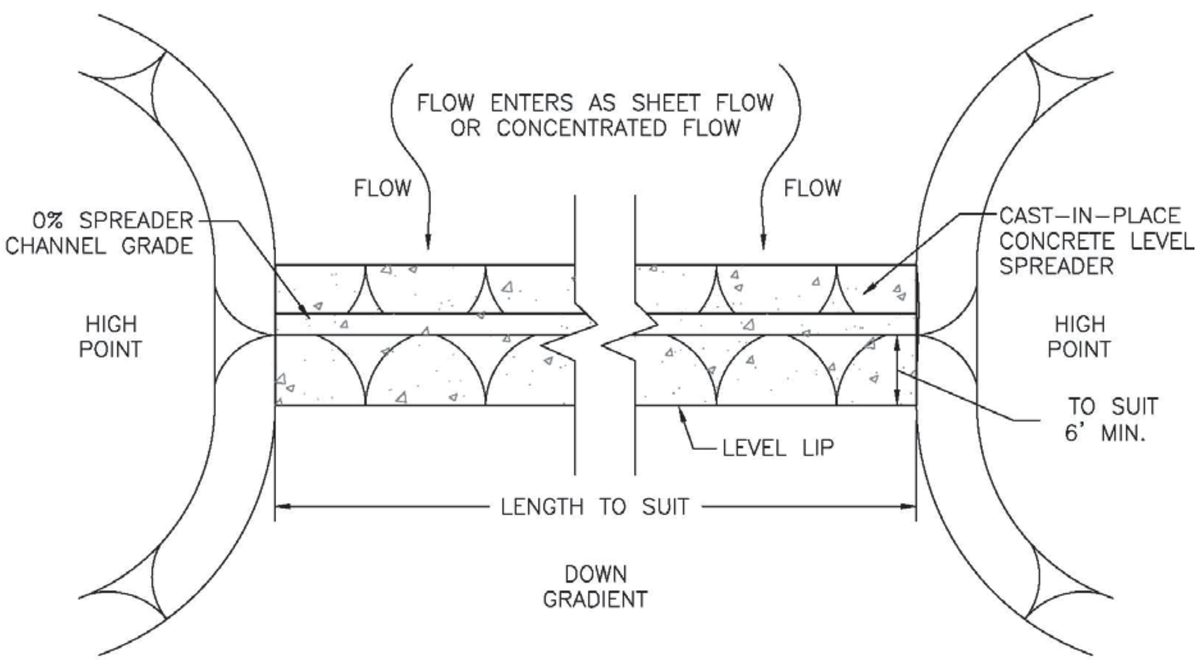
A level spreader is proposed to disperse the runoff from the 1-year storm event, with a peak discharge rate (q) of 5 cfs. Calculate the required length of the level spreader.

Length (L) = peak discharge rate (q) / [maximum velocity (v) * depth (d)]
L = 5 cfs / (1 fps * 0.5 ft) = 10 feet

A level spreader with a 10-foot lip is required for this example.

Figure H-7 Concrete Level Spreader - Profile and Plan Views





PLAN
NOT TO SCALE

Check Dams

(Photo Credit: MACC ESC Guide)

Definition

- Small, normally temporary dams constructed across a waterway or other watercourse.
- Check dams can be constructed of stone, logs or fiber roll.
- Check dams can be permanent or temporary. “Temporary" means that the structure will be in place only as long as needed but shall be removed after upgradient areas are stabilized.

Purpose

- To trap small amounts of sediment generated in the ditch itself.
- To temporarily pond storm water runoff to allow sediments to settle out.
- To reduce velocities of water in the channel.

Applicability

- Where concentrated flows are expected to cause erosion.
- Temporary drainage ways which, because of their short length of service, will not receive a non-erodible lining but still need protection to reduce erosion.
- Permanent ditches or swales which need protection prior to their stabilization.
- Permanent ditches or swales that will receive significant sediment loads during construction.

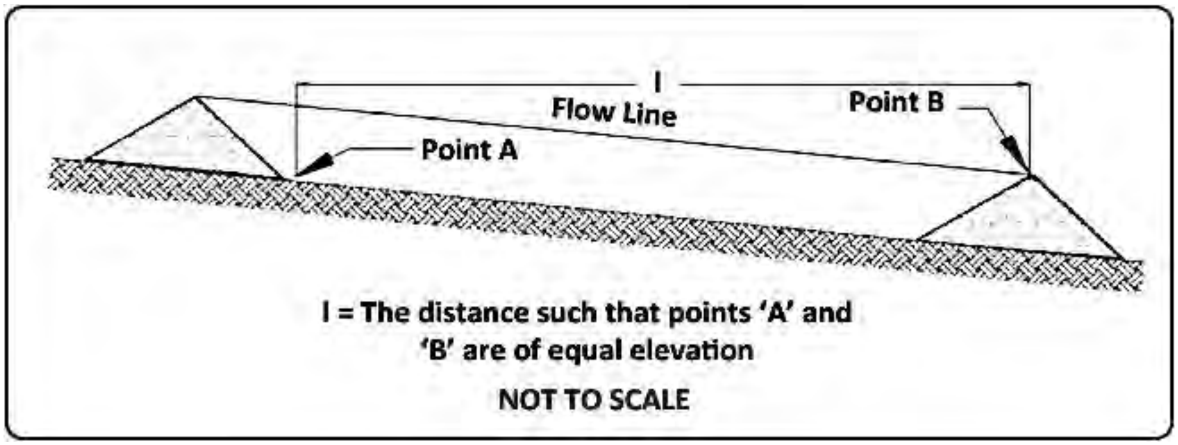
Note: Only stone check dams should be considered for permanent applications.
Note: This measure is limited to use in small open channels.
Note: This measure is not a sediment trapping measure and should not be used as substitute for a **Temporary Sediment Trap,** or a **Temporary Sediment Basin,** however, stone check dams may be used in conjunction with those measures.
Note: Not for installation in a natural watercourse.

Planning and Design Requirements

Critical Minimum Standards

Check dams must be placed close enough to one another such that the pool of water behind each check dam extends to the next upstream check dam (**Figure 1**). That is, the crest elevation of a downstream check dam must be at or above the base elevation of the next check dam. This will result in water draining directly from pool to pool in order to reduce velocities.

Figure 1. Calculating the Spacing between Check Dams



(Credit: *2002 Connecticut Guidelines for Soil Erosion and Sediment Control*)

- Check dams are considered to be temporary if it is used only during construction and for a period of less than 6 months. It is considered to be permanent if it is used after construction or for more than 6 months. Its length of use and the size of the watershed determine if an engineered design is required (see **Figure 2**). When planning the location of the stone check dam(s) consider the tailwater effects, duration of ponding, stone size, the contributing watershed. Also assess if the final use of the area will require the stone check dam(s) to be removed. Give consideration to mowing requirements and aesthetics.
- Check dams should never be placed in natural waterways.

Figure 2. Design Requirements

Design Requirements	Drainage Area	Length of Use
no engineered design	† 2 acres	<6 months
2-yr frequency storm	>2 acres	>6 months, < 1 year
25-yr frequency storm	any drainage size	> 1 year

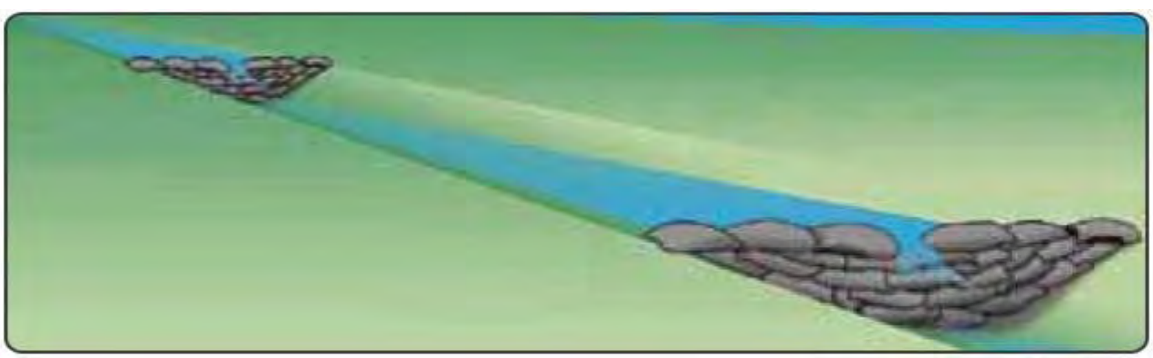
(Credit: *2002 Connecticut Guidelines for Soil Erosion and Sediment Control*)

Small or Temporary (< 6 Months) Check Dam Design Criteria

No formal design is required for a check dam if the contributing drainage area is 2 acres or less and its intended use is shorter than 6 months; however, the following criteria should be adhered to when specifying check dams.

- The drainage area of the ditch or swale being protected should not exceed 10 acres.
- The maximum height of the check dam should be 2 feet.
- The center of the check dam must be at least 6 inches lower than the outer edges (see **Figure 3**).
- The maximum spacing between the dams should be such that the toe at the upstream dam is at the same elevation as the top of the downstream dam.

Figure 3. Stone Check Dams with Center Lower than Edges



(Credit: MACC ESC Guide)

Larger or More Permanent (> 6 Months) Check Dam Design Criteria

- If the contributing drainage area is greater than 2 acres or its intended use is longer than 6 months, design the stone check dam according to generally accepted engineering standards For use of a stone check dam less than 1 year, design the stone check dam to safely pass the peak flow expected from a 2-year frequency storm without structural failure and adverse tailwater effects.

- For use of a stone check dam exceeding 1 year, design the stone check dam to safely pass the peak flow expected from the design flow of the drainage feature without structural failure of the check dam and adverse tailwater effects.
- Stone: Size shall at a minimum meet the requirements of DOT Standard Specifications Section M.01.09, Table 1, Gradation II as provided in **Figure 4**.

Figure 4. Stone Size Requirements

Sieve Size	Gradation - % Passing
2 1/4"	100
2"	90-100
1 1/2'	30-55
1 1/4"	0-25
1"	0-5

(Credit: *2002 Connecticut Guidelines for Soil Erosion and Sediment Control*)

- Stone shall be appropriately sized to manage the design storm flow without failure. The stone shall be sound, tough, durable, angular, not subject to disintegration on exposure to water or weathering, be chemically stable, and shall be suitable in all other respects for the purpose intended. Larger stone can be used on the outside of the check dam in order to stabilize it during larger flows.

Installation Requirements

Types of Check Dams

Stone Check Dams

Hand or mechanical placement will be necessary to achieve complete coverage of the ditch or swale and to ensure that the center of the dam is lower than the edges. A geotextile shall be placed below permanent check dams and keyed into the upstream and downstream channel bottom and sides at a depth of at least 6 inches.

Log Check Dams

Logs shall be in good condition and recently cut with no visible rot. Whole logs shall extend across the channel. Logs shall be anchored to the bottom of the channel and channel sides as appropriate to retain desired depth of ponding.

Fiber Roll Check Dams

Fiber rolls should be placed in a single row, lengthwise, oriented perpendicular to the flow lines of the channel, with ends of adjacent rolls tightly abutting one another. Rolls shall be secured in a manner that is consistent with manufacturer's recommendations for this application so that the rolls are not washed downstream.

Types of Applications

In General

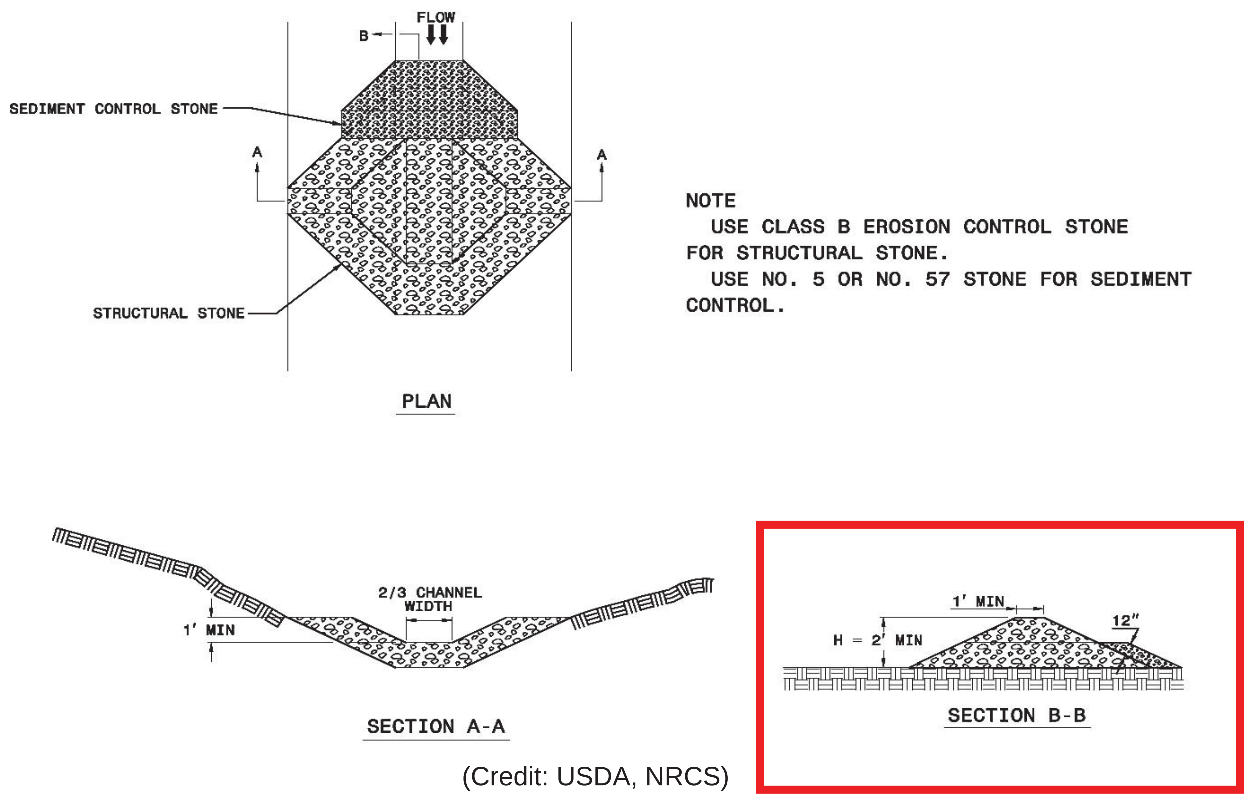
Place the stone by hand or machine, making side slopes no steeper than 1:1 (i.e., the angle of repose) with a maximum height of 3 feet at the center of the check dam. A geotextile shall be used in permanent installations under the stone to provide a stable foundation and to facilitate removal of the stone.

In Drainageways

Shall not exceed 3 feet in height at the center. Extend the stone check dam to the full width of the drainageway, plus 18 inches on each side leaving the height of the center of the stone check dam approximately 6 inches lower than the height of the outer edges (see **Figure 30-5**).

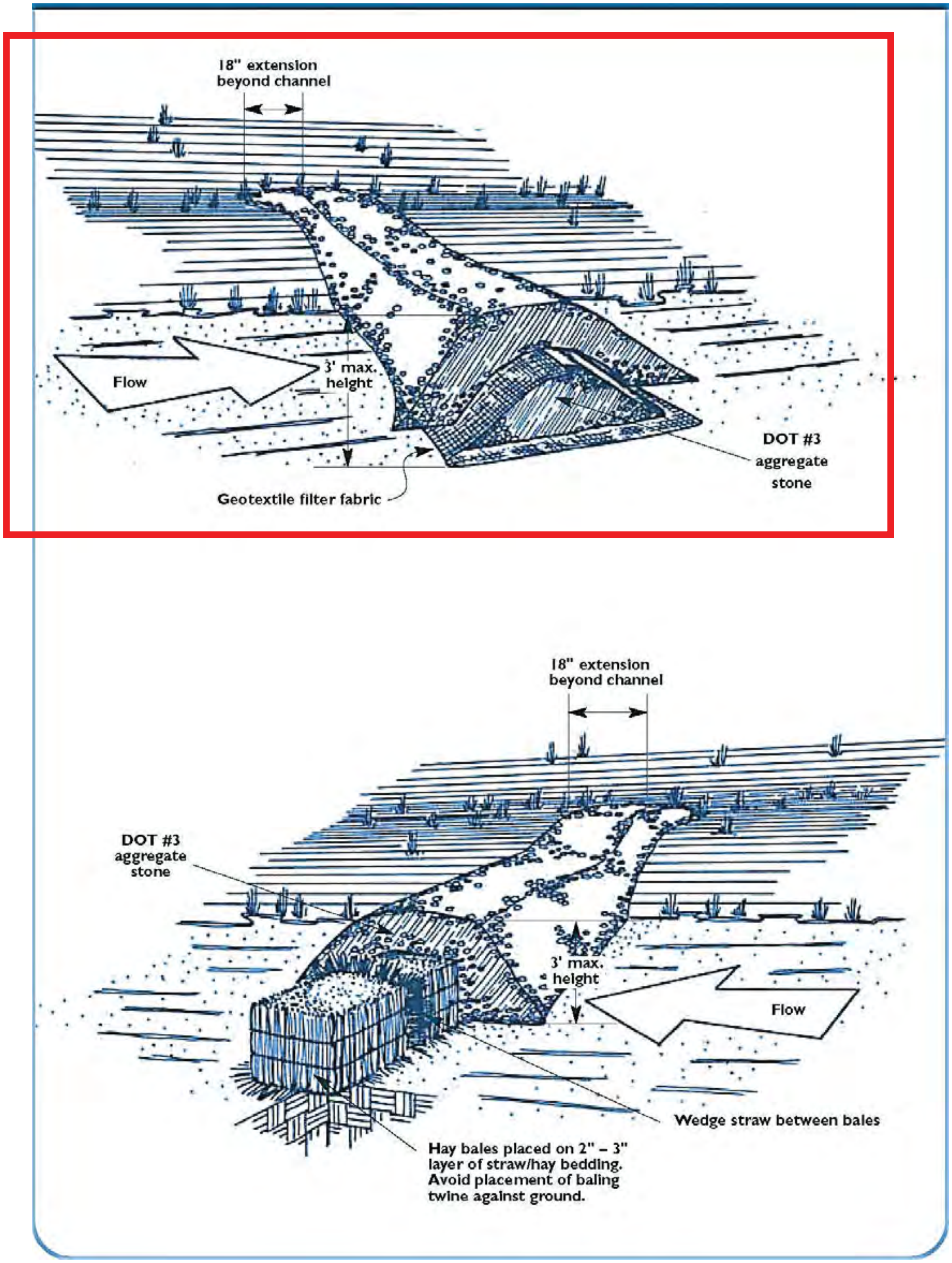
The maximum spacing between check dams shall be such that the toe of the upstream check dam is at the same elevation as the top of the center of the downstream check dam.

Figure 5. Stone Check Dam Installation in Drainageways



(Credit: USDA, NRCS)

Figure 6. Special Case Combination Stone Check Dam



(Credit: *2002 Connecticut Guidelines for Soil Erosion and Sediment Control*)

Soil Erosion and Sediment Control Plan

For:

Burrillville Interconnection Project

3052 345 kV Line

Burrillville, Rhode Island

Owner:	The Narragansett Electric Company (d/b/a National Grid) 280 Melrose Street Providence, Rhode Island 02907 (401) 784-7515 Michael Ryan: Michael.Ryan@nationalgrid.com and Clear River Invenergy LLC One South Wacker Drive Suite 1800 Chicago, Illinois 60606 (781) 424-3223 (John Niland): JNiland@invenergyllc.com
Operator: *TO BE DETERMINED UPON CONTRACT AWARD*	Company Name Name Address City, State, Zip Code Telephone Number Email Address
Estimated Project Dates:	Start Date: Spring 2018
	Completion Date: Winter 2018/2019

SESC Plan Prepared By:	POWER Engineers Alison Milliman 100 John L. Dietsch Square N. Attleboro, Massachusetts 02763 (401) 742-0487 Alison.milliman@powereng.com CPESC #6825
SESC Plan Preparation Date:	March 24, 2017
SESC Plan Revision Date:	

Revision Date: 10/24/2016

OPERATOR CERTIFICATION

Upon contract award, the OPERATOR must sign this certification statement before construction may begin.

I certify under penalty of law that this document and all attachments were prepared under the direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete.

I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. I am aware that it is the responsibility of the owner/operator to implement and amend the Soil Erosion and Sediment Control Plan as appropriate in accordance with the requirements of the RIPDES Construction General Permit.

Operator Signature: Date

Contractor Representative: Name

Contractor Title: Title

Contractor Company Name: Company Name (if applicable)

Address: Mailing Address

Phone Number: Phone Number

Email Address: Email

TABLE OF CONTENTS

INTRODUCTION

This Construction Site Soil Erosion and Sediment Control Plan (SESC Plan) has been prepared for The Narragansett Electric Company d/b/a National Grid (TNEC) and Clear River Energy LLC, a project company of Invenergy Thermal Development LLC (Invenergy) for the Burrillville Interconnection Project. In accordance with the RIDEM Rhode Island Pollutant Discharge Elimination System (RIPDES) General Permit for Stormwater Discharge Associated with Construction Activity (RIPDES Construction General Permit ("CGP")), projects that disturb one (1) or more acres require the preparation of a SESC Plan. This SESC Plan provides guidance for complying with the terms and conditions of the RIPDES Construction General Permit and Minimum Standard 10 of the RI Stormwater Design and Installation Standards Manual. In addition, this SESC Plan is also consistent with Part D of the *RI SESC Handbook* entitled "Soil Erosion and Sediment Control Plans". This document does not negate or eliminate the need to understand and adhere to all applicable RIPDES regulations.

The purpose of erosion, runoff, and sedimentation control measures is to prevent pollutants from leaving the construction site and entering waterways or environmentally sensitive areas during and after construction. This SESC Plan has been prepared prior to the initiation of construction activities to address anticipated worksite conditions. The control measures depicted on the site plan and described in this narrative should be considered the minimum measures required to control erosion, sedimentation, and stormwater runoff at the site. Since construction is a dynamic process with changing site conditions, it is the operator's responsibility to manage the site during each construction phase so as to prevent pollutants from leaving the site. This may require the operator to revise and amend the SESC Plan during construction to address varying site and/or weather conditions, such as by adding or realigning erosion or sediment controls to ensure the SESC Plan remains compliant with the RIPDES Construction General Permit. Records of these changes must be added to the amendment log attached to the SESC Plan, and to the site plans as "red-lined" drawings. Please Note: **Even if practices are correctly installed on a site according to the approved plan, the site is only in compliance when erosion, runoff, and sedimentation are effectively controlled throughout the entire site.**

It is the responsibility of the site owner and the site operator to maintain the SESC Plan at the site, including all attachments, amendments and inspection records, and to make all records available for inspection by RIDEM during and after construction. (RIPDES CGP - Part III.G)

The site owner, the site operator, and the designated site inspector are required to review the SESC Plan and sign the Party Certification pages (Section 8). The primary contractor (if different) and all subcontractors (if applicable) involved in earthwork or exterior construction activities are also required to review the SESC Plan and sign the certification pages before construction begins.

Any questions regarding the SESC Plan, control measures, inspection requirements, or any other facet of this document may be addressed to the RIDEM Office of Water Resources, at 401-222-4700 or via email: water@dem.ri.gov.

ADDITIONAL RESOURCES

Rhode Island Department of Environmental Management
Office of Water Resources
235 Promenade Street
Providence, RI 02908-5767
phone: 401-222-4700
email: water@dem.ri.gov

RIDEM *RI Stormwater Design and Installation Standards Manual* (RISDISM) (as amended)
http://www.dem.ri.gov/pubs/regs/regs/water/swmanual15.pdf

RI Soil Erosion and Sediment Control Handbook http://www.dem.ri.gov/soilerosion2014final.pdfRIDEM 2013 RIPDES Construction General Permit
http://www.dem.ri.gov/pubs/regs/regs/water/ripdesca.pdfRhode Island Department of Transportation *Standard Specifications for Road and Bridge Design and Other Specifications* and *Standard Details*
http://www.dot.ri.gov/business/bluebook.php

RIDEM Office of Water Resources Coordinated Stormwater Permitting website
http://www.dem.ri.gov/programs/water/permits/ripdes/stormwater/coordinated-stormwater-permitting.phpRIDEM RIPDES Stormwater website
http://www.dem.ri.gov/programs/water/permits/ripdes/stormwater/RIDEM Water Quality website (for 303(d) and TMDL listings)
http://www.dem.ri.gov/programs/water/quality/

RIDEM Rhode Island Natural Heritage Program mailto:plan@dem.ri.gov

RIDEM Geographic Data Viewer – Environmental Resource Map
http://www.dem.ri.gov/maps/

Natural Resources Conservation Service - Rhode Island Soil Survey Program
http://www.ri.nrcs.usda.gov/technical/soils.html

Note:

The *Soil Survey of Rhode Island*, issued in 1980 is no longer available or supported. More information on site-specific soil data and maps for Rhode Island is available from the Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture through the Web Soil Survey. This information is available online at: http://websoilsurvey.nrcs.usda.gov.

EPA NPDES – Stormwater Discharges from Construction Activities webpage:
http://water.epa.gov/polwaste/npdes/stormwater/Stormwater-Discharges-From-Construction-Activities.cfm

EPA Construction Site Stormwater Runoff Control BMP Menu
http://water.epa.gov/polwaste/npdes/swbmp/Construction-Site-Stormwater-Run-Off-Control.

SECTION 1: SITE DESCRIPTION

1.1 Project/Site Information

Project/Site Name:

The Narragansett Electric Company d/b/a National Grid (TNEC),[1] and Clear River Energy LLC, a project company of Invenergy Thermal Development LLC (Invenergy) (collectively the Applicant) is proposing to construct a new approximately 6.8 mile 345 kilovolt (kV) transmission line (the 3052 Line) in the Town of Burrillville, Rhode Island, to interconnect the proposed Clear River Energy Center (CREC) to the existing electric transmission system (the Burrillville Interconnection Project or the Project). The 3052 Line will begin at the proposed CREC to be located off of Wallum Lake Road in Burrillville. From the CREC facility, it will extend approximately 0.8 miles along a new right-of-way (ROW) on an easement owned by CREC (CREC ROW) to its intersection with an existing TNEC transmission line ROW (TNEC ROW). The 3052 Line will then continue east approximately six miles along the existing TNEC ROW to the existing Sherman Road Switching Station in Burrillville (Refer to RIDEM Permit Drawings). Improvements to the Sherman Road Switching Station will occur within the existing Station yard. The 3052 Line will share the TNEC ROW with the two existing 345 kV lines, the 347 Line and the 341 Line. The 341 Line was recently (December 2015) installed as part of the Interstate Reliability Project (IRP).

The following are estimates of the construction site area:

- Total Project Area (total area of TNEC & CREC ROW): ~347 acres
- Total Project Area to be Disturbed (total of temporary and permanent impacts for the Project): ~17.9 acres

1.2 Receiving Waters

RIPDES CGP - Parts IV.A.7 & IV.A.8

List/description of separate storm sewer systems or drainage systems that may be impacted during construction and the water bodies that receive discharges from each storm sewer or drainage system:

- There are no mapped stormwater outfalls in the vicinity of the Project (RI MS4 Stormwater Discharge Outfalls and General Permit Holders RIDEM Stormwater on the web. Retrieved February 9, 2017 from http://ridemgis.maps.arcgis.com/apps/webappviewer/index.html?id=dfd9ce07d7f94544497ab737eb693da6e)

List/description of receiving waters that may be impacted during construction:

- Dry Arm Brook, Clear River, Mowry Brook, Round Top Brook, Chockalog River, and all wetlands and unnamed streams identified along and adjacent to the Project right-of-way (ROW) identified on the Plans.

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[1] The Narragansett Electric Company d/b/a National Grid, a subsidiary of National Grid USA, is an electric distribution and transmission company serving approximately 465,000 customers in 38 Rhode Island communities. National Grid USA is a public utility holding company. Other subsidiaries of National Grid USA include operating companies such as New England Power Company, Massachusetts Electric Company, Nantucket Electric Company (in Massachusetts), and Niagara Mohawk Power Corporation (in New York), as well as National Grid USA Service Company, Inc., which provides services such as engineering, facilities construction and accounting.

Are any of the receiving waters in the vicinity of the proposed construction project listed as being impaired or subject to a TMDL?

☐ Yes ☒ No

If yes, List/provide description of 303(d)/TMDL waters and applicable TMDL requirements that must be addressed during construction:

- N/A

1.3 Natural Heritage Area Information

RIPDES CGP - Part III.H

Are there any Natural Heritage Areas being disturbed by the construction activity or will discharges be directed to the Natural Heritage Area as a result of the construction activity?

☒ Yes ☐ No

If yes, describe or refer to documentation which determines the likelihood of an impact on this area and the steps that will be taken to address any impacts.

- Impacts to sensitive habitats of state-listed rare, threatened or endangered species will be minimized and where possible avoided through close coordination with the RINHP, RIDEM and the USFWS in the development of avoidance and mitigation criteria for the Federally-listed Northern Long-Eared Bat (NLEB) as well as the state-listed plant species. To avoid possible adverse impacts to or forced relocation of NLEBs, the Applicant will implement appropriate time of year restrictions for clearing of the TNEC and CREC ROWs to avoid the maternity nesting season during June-July. The state-listed plant species will be protected by the placement of exclusion fencing around the habitat areas. No impacts to state-listed plant species is anticipated as a result of the Project.

1.4 Historic Preservation/Cultural Resources

Are there any historic properties, historic cemeteries or cultural resources on or near the construction site?

☒ Yes ☐ No

Describe how this determination was made and summarize state or tribal review comments:

- TNEC and Invenergy retained Gray & Pape, a Cultural Resources consultant to review previous surveys on the TNEC ROW and to complete cultural resource surveys of the CREC ROW. Gray & Pape are coordinating with the RIHPHC and The Tribes.

If yes, describe or refer to documentation which determines the likelihood of an impact on this historic property, historic cemetery or cultural resource and the steps taken to address that impact including any conditions or mitigation measures that were approved by other parties.

- The proposed project will not affect any known above-ground historic resources. Because the new transmission line will be added to an existing ROW, the feeling or character of nearby resources will not be altered in any significant manner. Construction of the CREC ROW will be in an undeveloped area not visible to any above-ground historic resources.
- Ground disturbing construction activities may impact known as well as previously unidentified archaeological resources. The installation of new electrical transmission structures or the creation of new access roads or improvements could disturb archaeological deposits, including both

Native American and Historic Period sites. However, any impacts to archaeological sites can be mitigated by completion of an archaeological site identification survey prior to project construction, and/or minor design deviations to avoid known sites. .

SECTION 2: EROSION, RUNOFF, AND SEDIMENT CONTROL

RIPDES Construction General Permit – Part III.J.1

The purpose of erosion controls is to prevent sediment from being detached and moved by wind or the action of raindrop, sheet, rill, gully, and channel erosion. Properly installed and maintained erosion controls are the primary defense against sediment pollution.

Runoff controls are used to slow the velocity of concentrated water flows. By intercepting and diverting stormwater runoff to a stabilized outlet or treatment practice or by converting concentrated flows to sheet flow erosion and sedimentation are reduced.

Sediment controls are the last line of defense against moving sediment. The purpose is to prevent sediment from leaving the construction site and entering environmentally sensitive areas.

This section describes the set of control measures that will be installed before and during the construction project to avoid, mitigate, and reduce impacts associated with construction activity. Specific control measures and their applicability are contained in Section Four: Erosion Control Measures, Section Five: Runoff Control Measures, and Section Six: Sediment Control Measures of the *RI SESC Handbook*. The *RI SESC Handbook* can be found at the following address:

http://www.dem.ri.gov/soilerosion2014final.pdf

2.1 Avoid and Protect Sensitive Areas and Natural Features

Areas of existing and remaining vegetation and areas that are to be protected as identified in the Section 1.6 of the SESC Plan must be clearly identified on the SESC Site Plans for each Phase of Construction. Prior to any land disturbance activities commencing on the site, the Contractor shall physically mark limits of disturbance (LOD) on the site and any areas to be protected within the site, so that workers can clearly identify the areas to be protected.

Note:

The *Soil Survey of Rhode Island*, issued in 1980 is no longer available or supported. More information on site-specific soil data and maps for Rhode Island is available from the Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture through the Web Soil Survey. This information is available online at: http://websoilsurvey.nrcs.usda.gov.

Feature Requiring Protection	Construction Phase #	Method of Protection	Sheet #
Wetlands and Watercourses	1, 2 and 3	Hang wetland and watercourse flags prior to the start of construction Install perimeter sediment controls as shown on the RIDEM Permit	07 to 33 of 63

		Drawings Where the ROW crosses streams and brooks, vegetation along the stream bank will be selectively cut to minimize the disturbance of bank soils and the potential for project related soil erosion. Retain 25-foot vegetated buffer where feasible.	
Protected Habitat Areas	1	Install orange safety fencing and signage around Protected Habitat Areas.	17, 18 and 28 of 63
Limits of Disturbance	1	Hang flagging at the limits of disturbance. Mark the limits of tree clearing in the field.	7 to 33 of 63

2.2 Minimize Area of Disturbance

Will >5 acres be disturbed in order to complete this project?

☒ Yes ☐ No

Will <5 acres be disturbed or will disturbance activities be completed within a six (6) month window?

☐ Yes ☒ No

Although greater than 5 acres will be disturbed in order to complete this Project, the linear nature of the Project will be phased as civil site crews work in a linear fashion to build and improve access roads and work areas. All individual work areas in uplands will be stabilized with crushed stone or seeded and mulched prior to constructing additional work areas. All access routes and work areas in wetlands will be constructed by placing temporary swamp mats down onto the soil surface.

Based on the answers to the above questions will phasing be required for this project?

☐ Yes ☒ No **Phasing will occur based on the linear nature of the Project and the progression of construction and stabilization of individual work areas.**

General construction is expected to begin in the Spring of 2018 and conclude in the Winter of 2019. The transmission line will be constructed in a progression of activities that will normally proceed as described below.

Phase 1. Survey and marking of all limits of tree clearing and areas that require protection before the start of the Project

Phase 2. Removal of Vegetation and ROW Mowing in Advance of Construction

- Implement appropriate time of year restrictions for clearing of the TNEC and CREC ROWs to avoid the maternity nesting season during June-July. The state-listed plant species will be protected by the placement of exclusion fencing around the habitat areas.
- Use temporary swamp matting in wetlands and to cross-watercourses
- Install Soil Erosion and Sediment Controls as necessary during and after the Vegetation and ROW Mowing activities.

Phase 3. Installation of Soil Erosion and Sediment Controls

- Installation of all erosion, runoff, and sediment controls and temporary pollution prevention measures are require to be in place and functional before any earthwork begins. The controls will be installed in accordance with the RI SESC Handbook/and or National Grid's Environmental Guidance EG-303NE

Phase 4. Construction of Access Road Improvements and Work Pads

- Includes adding stone and processed gravel to access roads and work pads
- Includes seeding and mulching all exposed soils
- All disturbed soils will be stabilized within 14 days after the construction activity in that area has temporarily or permanently ceased. Such temporary or permanent soil stabilization measures must be installed prior to initiating land disturbance in subsequent phases.
- Routine inspection and maintenance or modification of erosion, runoff, and sediment controls and temporary pollution prevention measures while earthwork is going on is required.

Phase 5. Removal and Disposal of Existing Transmission Line Components

Phase 6. Installation of Foundations and Structures

Phase 7. Installation of Conductor and Shield Wire

Phase 8. Restoration of the ROW

- Final site stabilization and/or revegetation of any disturbed areas after earthwork has been completed and removal of temporary erosion, runoff, and sediment controls and temporary pollution prevention measures.

PHASING PLAN

The following are estimates of each phase of the construction project:

Removal of Vegetation and ROW Mowing	Phase 2
Total Area of Phase	~20 acres of proposed tree clearing
Area to be Disturbed	N/A acres ***Site grubbing during tree clearing is not proposed**.
Construction of Access Road Improvements and Work Pads/ Installation of Foundations and Structures	Phases 4 and 6
Total Area of Phase	~18 acres (approximate total of temporary and permanent impacts).
Area to be Disturbed	~18 acres ***Work will be done in a linear fashion, and each work area will be stabilized with stone or seeded and mulched prior to moving to the next work area.**

2.3 Minimize the Disturbance of Steep Slopes

Are steep slopes (>15%) present within the proposed project area?

☒ Yes ☐ No

Mulch shall not be used as a temporary erosion control practice in drainageways. Mulch placement on steep slopes (>3:1) shall be limited to hydraulic mulch or rolled erosion control products (e.g., erosion control blankets, etc.).

Sheet 9 of 63 - If access road grading is required on steep terrain (exceeding 3:1 slope), water bars shall be installed during road bed preparation.

Sheet 18 of 63 - If access road grading is required on steep terrain (exceeding 3:1 slope), water bars shall be installed during road bed preparation. Work pad for Structure 3052-024 located on steep terrain has an engineered grading plan (Refer to Sheet 56 of 63).

Sheet 25 of 63 - If access road grading is required on steep terrain (exceeding 3:1 slope), water bars shall be installed during road bed preparation.

Sheet 27 of 63 - If access road grading is required on steep terrain (exceeding 3:1 slope), water bars shall be installed during road bed preparation.

Sheet 33 of 63 - If access road grading is required on steep terrain (exceeding 3:1 slope), water bars shall be installed during road bed preparation.

2.4 Preserve Topsoil

Site owners and operators must preserve existing topsoil on the construction site to the maximum extent feasible and as necessary to support healthy vegetation, promote soil stabilization, and increase stormwater infiltration rates in the post-construction phase of the project.

Will existing topsoil be preserved at the site?

☒ Yes ☐ No

When the work site requires excavation and grading, the topsoil will be stockpiled separately from the material excavated. This topsoil shall be spread as a top dressing over the disturbed area during restoration of the site. In some instances where work is occurring within wetlands, high organic content soil may be displaced. Such high organic content soil shall be segregated from other excavated materials and stockpiled for use in wetland restoration areas. Care shall be taken to minimize the handling of organic content soil. Preferably, the soil shall be stockpiled in one location until it is moved to the restoration area.

Soil compaction must be minimized by maintaining limits of disturbance throughout construction. In instances where site soils are compacted the site owner and operator must restore infiltration capacity of the compacted soils by tilling or scarifying compacted soils and amending soils as necessary to ensure a minimum depth of topsoil is available in these areas. In areas where infiltrating stormwater treatment practices are located, compacted soils must be amended such that they will comply with the design infiltration rates established in the *RI Stormwater Design and Installation Standards Manual*.

If rutting or soil compaction following swamp mat removal is observed, the area shall be returned to pre-existing conditions, and comparable to the surrounding area, by light hand raking or by back-blading with machinery. Restoration shall be overseen by the Project Environmental Consultant or National Grid Environmental Scientist. Deep ruts (>12”) shall be filled in using available, loose soil from the work area.

2.5 Stabilize Soils

Upon completion and acceptance of site preparation and initial installation of erosion, runoff, and sediment controls and temporary pollution prevention measures, the operator shall initiate appropriate temporary or permanent stabilization practices during all phases of construction on all disturbed areas as soon as possible, but not more than fourteen (14) days after the construction activity in that area has temporarily or permanently ceased.

Any disturbed areas that will not have active construction activity occurring within 14 days must be stabilized using the control measures depicted in the SESC Site Plans, in accordance with the *RI SESC Handbook*, and per manufacturer product specifications.

Only areas that can be reasonably expected to have active construction work being performed within 14 days of disturbance will be cleared/grubbed at any one time. It is NOT acceptable to clear and grub the entire construction site if portions will not be active within the 14-day time frame. Proper phasing of clearing and grubbing activities shall include temporary stabilization techniques for areas cleared and grubbed that will not be active within the 14-day time frame.

All disturbed soils exposed prior to October 15 of any calendar year shall be seeded by that date if vegetative measures are the intended soil stabilization method. Any such areas that do not have adequate vegetative stabilization, as determined by the site operator or designated inspector, by November 15, must be stabilized through the use of non-vegetative erosion control measures. If work continues within any of these areas during the period from October 15 through April 15, care must be taken to ensure that only the area required for that day’s work is exposed, and all erodible soil must be restabilized within 5 working days. In limited circumstances, stabilization may not be required if the intended function of a specific area of the site necessitates that it remain disturbed (i.e. construction of a motocross track).

<u>Temporary Vegetative Control Measures</u>

- An annual grass seed, such as winter rye, may be used to temporarily vegetate disturbed areas.

<u>Temporary Non-Vegetative Control Measures</u>

- Temporary non-vegetative control measures may include hydroseeding, mulching, or application of rolled erosion control products. In some circumstances, rock or rip rap may be used as a temporary non-vegetative control.

- Mulch shall not be used as a temporary erosion control practice in drainageways. Mulch placement on steep slopes (>3:1) shall be limited to hydraulic mulch or rolled erosion control products (e.g., erosion control blankets, etc.).

<u>Permanent Vegetative Control Measures</u>

- Permanent vegetative control measures shall provide established uniform vegetation (e.g., evenly distributed without large bare areas), with 70% or more of the density of coverage that was provided by vegetation prior to commencing earth-disturbing activities. The use of invasive species as cover will be avoided,
- For final stabilization, vegetative cover must be perennial; and
- Immediately after seeding or planting a disturbed are to be vegetatively stabilized, a non-vegetative erosion control must be implemented to the area while the area is becoming established. Examples include mulch and rolled erosion control products.

<u>Permanent Non-Vegetative Control Measures</u>

- Examples of locations where permanent non-vegetative control measures will be implemented includes access roads and work pads that will remain as stone on the ROW. Such non-vegetative stabilization techniques include, but are not limited to, rip-rap, and geotextiles.

2.6 Protect Storm Drain Outlets

Per RI Stormwater Design and Installation Standards Manual 3.3.7.7:

Temporary or permanent outlet protection must be used to prevent scour and erosion at discharge points through the protection of the soil surface, reduction in discharge velocities, and through the promotion of infiltration. Outlets often have high velocity, high volume flows, and require strong materials that will withstand the forces of stormwater. Storm drain outlet control measures also offer a last line of protection against sediment entering environmentally sensitive areas.

All stormwater outlets that may discharge sediment-laden stormwater flow from the construction site must be protected using the control practices depicted on the approved plan set and in accordance with the *RI SESC Handbook*.

Dewatering Activities

Where excavations require the need for dewatering of groundwater or accumulated stormwater, the water shall be treated before discharge. Appropriate controls include dewatering basins, flocculent blocks, filter bags, filter socks, or weir tanks. Water trucks or fractionation tanks may be utilized if watertight containers are desired for controlled on-site discharge or for off-site discharge into an approved dewatering area when site restrictions make it difficult to utilize other dewatering methods onsite.

Dewatering discharge water shall never be directed into wetlands, streams/rivers, other sensitive resource areas, catch basins, other stormwater devices, or substation Trenwa trenches. Dewatering flow shall be controlled so that it does not cause scouring or erosion through the use of a dewatering basin, filter sock, or equivalent. If it is determined that the chosen controls are not appropriately filtering the fine sediment from the dewatering pumpate then the controls shall be revised or supplemented. When establishing a dewatering basin, consideration should be given to the anticipated volume of water and rate of pumping in determining the size of the dewatering basin. Dewatering basins shall be constructed on level ground. Once pumping commences, the basin shall be monitored frequently to assure that the rate of water delivery to the structure is low enough to prevent water from flowing, unfiltered, over the top of the basin walls. The basin shall be monitored throughout the dewatering process because the rate of filtration shall decrease as sediment clogs the filter fabric. If the basin is not appropriately filtering the fine sediment from the dewatering pumpate then the basin may need to be supplemented with a flocculent block. (Note: A Treatment Chemical Action Plan must be developed prior to the use of flocculent on the Project.)

Field conditions shall dictate how often the basin should be inspected. Distance to sensitive areas, direction of flow (toward or away from protected or sensitive areas, such as wetlands, ponds, or streams), amount of vegetative ground cover between the basin and nearby sensitive areas, ground conditions (ledge, frozen, etc.), volume of water being pumped, and pump-rate, are some of the factors to be considered when determining an inspection frequency. Clogged filter fabric shall be replaced and accumulated sediment shall be removed as necessary from the basins to maintain efficacy. Basins shall be cleaned and removed as soon as dewatering is complete.

Rip Rap Outlets at Proposed Culvert Locations and Stream Fords

Appropriately sized rip rap outlets will be installed at the proposed culvert outfalls. Culverts and the rip rap outfalls were designed in accordance with the Rhode Island Design and Stormwater Installation Standards. Refer to the RIDEM Permit Drawings for the location and design of these culvert crossings.

Will temporary or permanent point source discharges be generated at the site as the result of construction of sediment traps or basins, diversions, and conveyance channels?

☒ Yes ☐ No

Sheet 9 of 63 – Installation of a stream ford in an intermittent stream. The stream ford was designed to allow unimpeded flow of water during times of a high groundwater table. The stream ford will be lined with rip rap to prevent scour and erosion at the discharge point.

Sheet 10 of 63 – Installation of a stream ford on the existing woods road in wetland 3. The stream ford was designed to allow unimpeded flow of water during times of a high groundwater table. The stream ford will be lined with rip rap to prevent scour and erosion at the discharge point.

Sheet 12 of 63 – Installation of a culvert in a wetland ditch (w03pr164). Appropriately sized rip rap outlet is designed to prevent scour and erosion at the discharge point.

Sheet 12 of 63 – Installation of a culvert in ASSF connecting wetlands w03pr164 and w03pr163. Appropriately sized rip rap outlet is designed to prevent scour and erosion at the discharge point.

Sheet 16 of 63 – Installation of a culvert in ASSF connecting wetlands w0spr152 and w03pr156. Appropriately sized rip rap outlet is designed to prevent scour and erosion at the discharge point.

Sheet 16 of 63 - Installation of a stream ford for access through wetland W03pr155. The stream ford was designed to allow unimpeded flow of water during times of a high groundwater table. The stream ford will be lined with rip rap to prevent scour and erosion at the discharge point

2.7 Establish Temporary Controls for the Protection of Post-Construction Stormwater Treatment Practices

Temporary measures shall be installed to protect permanent or long-term stormwater control and treatment measures as they are installed and throughout the construction phase of the project so that they will function properly when they are brought online.

Will long-term stormwater treatment practices be installed at the site?

☒ Yes ☐ No

Existing and proposed culverts and stream fords installed on the ROWs will be protected during the construction phase of the Project. The culvert and overburden are designed to withstand the weight of the construction equipment that will be utilizing the access roads. Stream fords will be protected during construction activity by placing swamp mats across the wetland and watercourses and installed after the construction activity has been completed. All waterbars and other long-term stormwater control devices will be refreshed or repaired, if necessary, during the restoration of the Project ROW.

2.8 Divert or Manage Run-on from Up-gradient Areas

Per RI Stormwater Design and Installation Standards Manual 3.3.7.10:

Is stormwater from off-site areas anticipated to flow onto the project area or onto areas where soils will be disturbed?

☒ Yes ☐ No

Structural control measures will be used to limit stormwater flow from coming onto the project area, and to divert and slow on-site stormwater flow that is expected to impact exposed soils for the purpose of minimizing erosion, runoff, and the discharge of pollutants from the site.

Control measures shall be installed as depicted on the approved plan set and in accordance with the *RI SESC Handbook* or the *RI Department of Transportation Standard Specifications for Road and Bridge Construction*. **Run-on and Run-off Management**				
Construction Phase #	On-site or Off-site Run-on?	Control measure	Identified on Sheet #	Detail(s) is/are on Sheet #
4	On-Site and Off-Site run-on	Vegetated Swale	34, 36, 38, 40, 42, 44, 46, 48, and 50 of 63	62 of 63
4	On-Site and Off-Site run on	Stone Lined Swale	54 and 55 of 63	62 of 63
4	On-Site and Off-Site run-on	Level Spreader	44 and 48 of 63	63 of 63
4	On-Site and Off-Site run-on	Stone Check Dams	36, 40, 42, 44, 46, 48, 50, 54, 55, and 56 of 63	59 of 62

2.9 Retain Sediment Onsite through Structural and Non-Structural Practices

SEDIMENT BARRIERS must be installed along the perimeter areas of the site that will receive stormwater from disturbed areas. This also may include the use of sediment barriers along the contour of disturbed slopes to maintain sheet flow and minimize rill and gully erosion during construction. Installation and maintenance of sediment barriers must be completed in accordance with the maintenance requirements specified by the product manufacturer or the *RI SESC Handbook*.

Will sediment barriers be utilized at the toe of slopes and other downgradient areas subject to stormwater impacts and erosion during construction?

☒ Yes ☐ No

Appropriate sedimentation control devices include but are not limited to: silt fencing, straw bales, wood chip bags, straw wattles and compost socks. Such controls shall be installed between the work area and environmentally sensitive areas such as wetlands, streams, drainage courses, roads and adjacent property when work activities shall disturb soils and result in a potential for causing sedimentation and erosion. The Plans depict proposed sedimentation control devices, however field conditions may warrant additional practices be implemented (e.g., wet conditions, frozen conditions, poorly drained soils, steep slopes, materials used for work pads, transition areas to swamp mats, number of trips across work areas, etc.).

Will sediment barriers be utilized along the contour of slopes to maintain sheet flow and minimize rill and gully erosion during construction?

☐ Yes ☒ No

The Project is not expected to require the creation of steep, long exposed slopes. However, if during construction additional sediment controls are deemed necessary, the Contractor shall install these additional controls to maintain sheet flow and minimize rill and gully erosion during construction. If it is determined that multiple sediment barriers be utilized along the contour of slopes to maintain sheet flow and minimize rill and gully erosion during construction, this table will be updated to reflect these changes.

SEDIMENT BARRIERS			
Construction Phase #	Sediment Barrier Type	Sediment Barrier is Labeled on Sheet #	Detail is on Sheet #
Example: Phase 3	Straw Wattles	Sheet #	59 of 63

INLET PROTECTION will be utilized to prevent soil and debris from entering storm drain inlets. These measures are usually temporary and are implemented before a site is disturbed. ALL stormwater inlets &/or catch basins that are operational during construction and have the potential to receive sediment-laden stormwater flow from the construction site must be protected using control measures outlined in the *RI SESC Handbook*.

For more information on inlet protection refer to the *RI SESC Handbook*, Inlet Protection control measure.

Maintenance

The operator must clean, or remove and replace the inlet protection measures as sediment accumulates, the filter becomes clogged, and/or as performance is compromised. Accumulated sediment adjacent to the inlet protection measures should be removed by the end of the same work day in which it is found or by the end of the following work day if removal by the same work day is not feasible.

Do inlets exist adjacent to or within the project area that require temporary protection?

☐ Yes ☒ No

The Project is located within a transmission line ROW and will not require activities in the vicinity of storm drains.

CONSTRUCTION ENTRANCES will be used in conjunction with the stabilization of construction roads to reduce the amount of sediment tracking off the project. This project has avoided placing construction entrances on poorly drained soils where possible. Where poorly drained soils could not be eliminated, the detail includes subsurface drainage.

Any construction site access point must employ the control measures on the approved SESC site plans and in accordance with the *RI SESC Handbook*. Construction entrances shall be used in conjunction with the stabilization of construction roads to reduce the amount of mud picked up by construction vehicles. All construction access roads shall be constructed prior to any roadway accepting construction traffic.

The site owner and operator must:

1. Restrict vehicle use to properly designated exit points.
2. Use properly designed and constructed construction entrances at all points that exit onto paved roads so that sediment removal occurs prior to vehicle exit.
3. When and where necessary, use additional controls to remove sediment from vehicle tires prior to exit (i.e. wheel washing racks, rumble strips, and rattle plates).

4. Where sediment has been tracked out from the construction site onto the surface of off-site streets, other paved areas, and sidewalks, the deposited sediment must be removed by the end of the same work day in which the track out occurs. Track-out must be removed by sweeping, shoveling, or vacuuming these surfaces, or by using other similarly effective means of sediment removal.

Will construction entrances be utilized at the proposed construction site?

☒ Yes ☐ No

CONSTRUCTION ENTRANCE			
Construction Phase #	Soil Type at the Entrance	Entrance is located on Sheet #	Detail is on Sheet #
All	Existing Improved Stone Access Road Entrance	7, 10, 11, 15, 17, 19, 23, 25, and 29 of 63	60 of 63

A suitable (minimum 15-foot wide by 50-foot long) construction entrance/exit shall be installed at the intersection of the ROW access road/route with public/private paved roads, or other such locations where equipment could track mud or soil onto paved roads. The construction entrance/exit should be comprised of clean stone installed over a geotextile fabric. Geotextile fabric may be omitted for permanent construction entrances/exits on a case-by-case basis and must be approved by the onsite Environmental Monitor. Construction entrance areas shall be monitored and maintained to ensure that stone or other material is not deposited onto the roadway, causing a safety concern. Where track-out of sediment has occurred onto a roadway, it shall be swept off the road by the end of that same work day. If a construction entrance/exit is clogged with sediment and no longer functions, the sediment and stone may require removal and replacement with additional clean stone (clean stone refreshment) to ensure this tracking pad is performing its intended function adequately.

STOCKPILE CONTAINMENT will be used onsite to minimize or eliminate the discharge of soil, topsoil, base material or rubble, from entering drainage systems or surface waters. All stockpiles must be located within the limit of disturbance, protected from run-on with the use of temporary sediment barriers and provided with cover or stabilization to avoid contact with precipitation and wind where and when practical.

Stock pile management consists of procedures and practices designed to minimize or eliminate the discharge of stockpiled material (soil, topsoil, base material, rubble) from entering drainage systems or surface waters.

For any stockpiles or land clearing debris composed, in whole or in part, of sediment or soil, you must comply with the following requirements:

1. Locate piles within the designated limits of disturbance.

2. Protect from contact with stormwater (including run-on) using a temporary perimeter sediment barrier.

3. Where practicable, provide cover or appropriate temporary vegetative or structural stabilization to avoid direct contact with precipitation or to minimize sediment discharge.

4. <u>NEVER</u> hose down or sweep soil or sediment accumulated on pavement or other impervious surfaces into any stormwater conveyance, storm drain inlet, or surface water.

5. To the maximum extent practicable, contain and securely protect from wind.

Soil stockpiles shall be located in upland areas and, if in close proximity to wetlands and wetland buffers, shall be enclosed by staked straw bales or another erosion control barrier. The stockpiling of stone, drill spoils and other unconsolidated material on swamp mats shall be avoided unless determined necessary due to access and work pad constraints. Additional controls, such as watertight mud boxes and geotextile/filter fabric over or between swamp mats shall be used for stockpile management. If material is placed on swamp mats and falls through into wetlands, the material must be removed by hand. Saturated soils shall be allowed to dewater prior to off-site transport for sufficient time to ensure that water/sediment is not deposited onto swamp mats or public roads during transport.

STOCKPILE CONTAINMENT				
Construction Phase #	Run-on measures necessary? (yes/no)	Stabilization or Cover Type	Stockpile Containment Measure	Sheet #
6	No – Contained in Mud box/ drill cutting box	Mud box/ drill cutting box will be covered overnight or during rain events as necessary.	Mud box/ drill cutting box	16 of 63
6	No – Contained in Mud box/ drill cutting box	Mud box/ drill cutting box will be covered overnight or during rain events as necessary.	Mud box/ drill cutting box	17 of 63

CONSTRUCTED SEDIMENT STRUCTURES

2.10 Properly Design Constructed Stormwater Conveyance Channels

Are temporary stormwater conveyance practices required in order to properly manage runoff within the proposed construction project?

☐ Yes ☒ No

No temporary sediment structures or stormwater conveyance channels are proposed.

2.11 Erosion, Runoff, and Sediment Control Measure List

This table and corresponding Inspection Reports will be amended as needed throughout the construction project as control measures are added or modified.

Phase Nos. #3-8 (Control Measures to Remain in Place During Construction)		
Location/Station	**Control Measure Description/Reference**	**Maintenance Requirement**
Approach to wetland crossing (wetland 2) on Sheet 07 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI*	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the

	SESC Handbook.	perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Approach to wetland crossing (wetland 3) on Sheet 09 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*.	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Entrance to ROW from Doe Crossing Drive on Sheet 11 of 63	Stone Stabilized Pad. Section Six: Sediment Control Measures – Construction Entrances –*RI SESC Handbook*.	The entrance shall be maintained in a condition which will prevent tracking or flowing of sediment onto pave surfaces. Provide periodic top dressing with additional stone or additional length as conditions demand. Roads adjacent to entrance shall be clean at the end of each day. If maintenance alone is not enough to prevent excessive track out, increase length of entrance, modify construction access road surface, or install washrack or mudrack.
Approach to wetland (w03pr163) crossing and work pad for Structure 3052-011 on Sheet 12 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*.	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Access road adjacent to wetland (w03pr164) and work pads for Structures 341-121 and 3052-010 on Sheet 12 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*.	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Access road adjacent to wetland (w03pr163) and pull pads for Structures 341-119 and 3052-012 on Sheet 13 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*.	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Access road adjacent to	Section Six, Sediment Control Measures,	Inspection should be made after each storm event or 1/week and repair or replacement should be

wetland (w03pr162) and work pads for Structures 341-117 and 3052-014 on Sheets 13 and 14 of 63	contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Entrance to ROW from Buck Hill Road on Sheet 14 of 63	Stone Stabilized Pad. Section Six: Sediment Control Measures – Construction Entrances –*RI SESC Handbook*.	The entrance shall be maintained in a condition which will prevent tracking or flowing of sediment onto pave surfaces. Provide periodic top dressing with additional stone or additional length as conditions demand. Roads adjacent to entrance shall be clean at the end of each day. If maintenance alone is not enough to prevent excessive track out, increase length of entrance, modify construction access road surface, or install washrack or mudrack.
Access road adjacent to wetland (w03pr158) and work pads for Structures 341-115 and 3052-016	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Entrance to ROW from Wallum Lake Road on Sheet 15 of 63	Stone Stabilized Pad. Section Six: Sediment Control Measures – Construction Entrances –*RI SESC Handbook*.	The entrance shall be maintained in a condition which will prevent tracking or flowing of sediment onto pave surfaces. Provide periodic top dressing with additional stone or additional length as conditions demand. Roads adjacent to entrance shall be clean at the end of each day. If maintenance alone is not enough to prevent excessive track out, increase length of entrance, modify construction access road surface, or install washrack or mudrack.
Access road adjacent to wetland (w03pr156/157) and work pads for Structures 341-113 and 3052-018 on Sheet 15 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Access road adjacent to	Section Six, Sediment Control Measures,	Inspection should be made after each storm event or 1/week and repair or replacement should be

wetlands (w03pr155,154, 153 and 152) and pull/work pads for Structures 341-111 and 3052-202 on Sheet 16 of 63	contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Pull/ work pads for Structures 341-109, 347-033 and 3052-022 adjacent to wetlands w03pr150 and 151 on Sheet 17 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Access road adjacent to wetland (w03pr148) and work pads for Structures 341-108, 347-034 and 3052-023 on Sheet 17 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Access road adjacent to wetland (w03pr148) and work pad for Structure 347-34A on Sheet 18 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Access road adjacent to wetland w03pr146 on Sheet 18 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Access road adjacent to wetland (w03pr143/142) and work pad for Structure 3052-025 on Sheet 19 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Entrance to ROW from East Wallum Lake Road	Stone Stabilized Pad. Section Six: Sediment	The entrance shall be maintained in a condition which will prevent tracking or flowing of sediment onto pave surfaces. Provide periodic top dressing

on Sheet 19 of 63	Control Measures – Construction Entrances –*RI SESC Handbook*.	with additional stone or additional length as conditions demand. Roads adjacent to entrance shall be clean at the end of each day. If maintenance alone is not enough to prevent excessive track out, increase length of entrance, modify construction access road surface, or install washrack or mudrack.
Access road adjacent to wetlands (w03pr141/138) and pull/work pad for Structure 3052-026 on Sheet 19 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Access road adjacent to wetlands (w03pr135/136) on Sheet 20 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Entrance to ROW from Town Farm Road on Sheet 21 of 63	Stone Stabilized Pad. Section Six: Sediment Control Measures – Construction Entrances –*RI SESC Handbook*.	The entrance shall be maintained in a condition which will prevent tracking or flowing of sediment onto pave surfaces. Provide periodic top dressing with additional stone or additional length as conditions demand. Roads adjacent to entrance shall be clean at the end of each day. If maintenance alone is not enough to prevent excessive track out, increase length of entrance, modify construction access road surface, or install washrack or mudrack.
Access road adjacent to wetlands (w03pr132/133) and work pad for Structure 3052-032 on Sheets 21 and 22 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Access road adjacent to wetlands	Section Six, Sediment Control Measures, contractor choice of	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed.

(w03pr131/127) and work pad for Structure 3052-033 on Sheet 22 of 63	appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Access road adjacent to wetlands (w03pr128/127) on Sheet 23 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Entrance to ROW from Stone Barn Road on Sheet 23 of 63	Stone Stabilized Pad. Section Six: Sediment Control Measures – Construction Entrances –*RI SESC Handbook*.	The entrance shall be maintained in a condition which will prevent tracking or flowing of sediment onto pave surfaces. Provide periodic top dressing with additional stone or additional length as conditions demand. Roads adjacent to entrance shall be clean at the end of each day. If maintenance alone is not enough to prevent excessive track out, increase length of entrance, modify construction access road surface, or install washrack or mudrack.
Entrance to ROW from Hill Road on Sheet 23 of 63	Stone Stabilized Pad. Section Six: Sediment Control Measures – Construction Entrances –*RI SESC Handbook*.	The entrance shall be maintained in a condition which will prevent tracking or flowing of sediment onto pave surfaces. Provide periodic top dressing with additional stone or additional length as conditions demand. Roads adjacent to entrance shall be clean at the end of each day. If maintenance alone is not enough to prevent excessive track out, increase length of entrance, modify construction access road surface, or install washrack or mudrack.
Access road adjacent to wetlands (w03pr125/126) and pull/work pad for Structures 347-46 and 3052-035 on Sheet 23 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Approach to wetland crossing (w05pr002)	Section Six, Sediment Control Measures, contractor choice of	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed.

and work pad for Structure 3052-036 on Sheet 24 of 63	appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Work pad for Structure 3052-036 (wetland w03pr123) on Sheet 24 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Work pad for Structure 3052-037 (wetland w05pr005) on Sheet 24 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Approach to wetland crossing (w03pr119) on Sheet 24 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Access road adjacent to wetland (w03pr117) on Sheet 25 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Approach to wetland crossing (w03pr114) on Sheet 25 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Pull pad for Structure 3052-041 (wetland w03pr113 on Sheet 27	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed.

of 63	Erosion Controls - *RI SESC Handbook*. .	Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Entrance to ROW from Round Top Road on Sheet 27 of 63	Stone Stabilized Pad. Section Six: Sediment Control Measures – Construction Entrances –*RI SESC Handbook*.	The entrance shall be maintained in a condition which will prevent tracking or flowing of sediment onto pave surfaces. Provide periodic top dressing with additional stone or additional length as conditions demand. Roads adjacent to entrance shall be clean at the end of each day. If maintenance alone is not enough to prevent excessive track out, increase length of entrance, modify construction access road surface, or install washrack or mudrack.
Work pad for Structure 3052-045 (wetland w03pr110) on Sheet 28 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Access road adjacent to wetlands (w03pr109/110) and work pad for Structure 3052-046 on Sheet 28 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Entrance to ROW from Collins Taft Road on Sheet 29 of 63	Stone Stabilized Pad. Section Six: Sediment Control Measures – Construction Entrances –*RI SESC Handbook*.	The entrance shall be maintained in a condition which will prevent tracking or flowing of sediment onto pave surfaces. Provide periodic top dressing with additional stone or additional length as conditions demand. Roads adjacent to entrance shall be clean at the end of each day. If maintenance alone is not enough to prevent excessive track out, increase length of entrance, modify construction access road surface, or install washrack or mudrack.
Access road adjacent to wetland (w03pr106) and work pad for Structure	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed.

3052-049 on Sheet 29 of 63	Erosion Controls - *RI SESC Handbook*. .	Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Access road adjacent to wetland (w03pr107) on Sheet 30 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Access road adjacent to wetland (w03pr104) on Sheet 31 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Access road adjacent to wetlands w03pr102/100 on Sheet 31 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Pull/work pad for Structure 3052-054 adjacent to wetland w03pr099 on Sheet 32 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Pull/work pad for Structure 3052-55 adjacent to wetland w03pr099 on Sheet 32 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.
Entrance to ROW from Sherman Farm Road on Sheet 33 of 63	Stone Stabilized Pad. Section Six: Sediment Control Measures – Construction Entrances	The entrance shall be maintained in a condition which will prevent tracking or flowing of sediment onto pave surfaces. Provide periodic top dressing with additional stone or additional length as conditions demand.

	–*RI SESC Handbook*.	Roads adjacent to entrance shall be clean at the end of each day. If maintenance alone is not enough to prevent excessive track out, increase length of entrance, modify construction access road surface, or install washrack or mudrack.
Access road adjacent to wetlands (w03pr096/097) and work pads for Structures 3052-56 and 57 on Sheet 33 of 63	Section Six, Sediment Control Measures, contractor choice of appropriate Perimeter Erosion Controls - *RI SESC Handbook*. .	Inspection should be made after each storm event or 1/week and repair or replacement should be made promptly as needed. Cleanout of accumulated sediment behind the perimeter erosion control if sediment accumulates to at least ½ the distance between the top of control and ground surface.

SECTION 3: CONSTRUCTION ACTIVITY POLLUTION PREVENTION

Per RI Stormwater Design and Installation Standards Manual 3.3.7.14:

The purpose of construction activity pollution prevention is to prevent day to day construction activities from causing pollution.

This section describes the key pollution prevention measures that must be implemented to avoid and reduce the discharge of pollutants in stormwater. Example control measures include the proper management of waste, material handling and storage, and equipment/vehicle fueling/washing/maintenance operations.

Where applicable, include *RI SESC Handbook* or the *RI Department of Transportation Standard Specifications for Road and Bridge Construction* (as amended) specifications.

3.1 Existing Data of Known Discharges from Site

Are there known discharges from the project area?

☐ Yes ☒ No

Describe how this determination was made:

- The Project is located within a vegetated transmission line ROW. The limits of work are not within a known stormwater or industrial discharge area.

If yes, list discharges and locations:

- INSERT TEXT HERE

Is there existing data on the quality of the known discharges? No known discharges from the Project.

☐ Yes ☐ No

If yes, provide data:

- INSERT TEXT HERE

3.2 Prohibited Discharges

The following discharges are prohibited at the construction site:

- Contaminated groundwater, unless specifically authorized by the DEM. These types of discharges may only be authorized under a separate DEM RIPDES permit.
- Wastewater from washout of concrete, unless the discharge is contained and managed by appropriate control measures.
- Wastewater from washout and cleanout of stucco, paint, form release oils, curing compounds, and other construction materials.
- Fuels, oils, or other pollutants used in vehicle and equipment operation and maintenance. Proper storage and spill prevention practices must be utilized at all construction sites.
- Soaps or solvents used in vehicle and equipment washing.
- Toxic or hazardous substances from a spill or other release.

All types of waste generated at the site shall be disposed of in a manner consistent with State Law and/or regulations.

Will any of the above listed prohibited discharges be generated at the site?

☒ Yes ☐ No

Wastewater from washout of concrete: Concrete wash outs shall be used for management of concrete waste. Concrete and concrete washout water shall not be deposited or discharged directly on the ground, in wetlands or waterbodies, or in catch basins or other drainage structures. Where possible, concrete washouts shall be located away from wetlands or other sensitive areas. Recommended concrete washout locations are indicated on the RIDEM Permit Drawings. The onsite EM will be consulted- on proposed concrete wash out locations prior to their use. Following the completion of concrete pouring operations, the wash outs shall be disposed of off-site with other construction debris.

Fuels, oils, or other pollutants used in vehicle and equipment operation and maintenance: Spill controls and emergency spill kits shall be provided on every field vehicle. All personnel shall be briefed on spill prevention, response and reporting to the RIDEM prior to the commencement of construction.

3.3 Proper Waste Disposal

Building materials and other construction site wastes must be properly managed and disposed of in a manner consistent with State Law and/or regulations.

- A waste collection area shall be designated on the site that does not receive a substantial amount of runoff from upland areas and does not drain directly to a waterbody or storm drain.

- All waste containers shall be covered to avoid contact with wind and precipitation.

- Waste collection shall be scheduled frequently enough to prevent containers from overfilling.

- All construction site wastes shall be collected, removed, and disposed of in accordance with applicable regulatory requirements and only at authorized disposal sites.

- Equipment and containers shall be checked for leaks, corrosion, support or foundation failure, or other signs of deterioration. Those that are found to be defective shall be immediately repaired or replaced.

Is waste disposal a significant element of the proposed project?

☒ Yes ☐ No

As soon as the structure work has been completed, all used parts and trash are to be picked up and removed from the project site. In some cases, the used material from structure work may be temporarily stored at the work area by placing it out of the wetlands or other sensitive resource area until work in the adjacent areas has been completed. However, treated wood poles shall never be stored in standing water or in wetlands. Excess material brought to the project site shall be removed upon project completion, and will be reclaimed and recycled to the greatest extent feasible.

3.4 Spill Prevention and Control

All chemicals and/or hazardous waste material must be stored properly and legally in covered areas, with containment systems constructed in or around the storage areas. Areas must be designated for materials delivery and storage. All areas where potential spills can occur and their accompanying drainage points must be described. The owner and operator must establish spill prevention and control measures to reduce the chance of spills, stop the source of spills, contain and clean-up spills, and dispose of materials contaminated by spills. The operator must establish and make highly visible location(s) for the storage of spill prevention and control equipment and provide training for personnel responsible for spill prevention and control on the construction site.

Are spill prevention and control measures required for this particular project?

☒ Yes ☐ No

Small equipment such as pumps and generators shall be placed in secondary containment devices such as small swimming pools or on absorbent blankets/pads, to contain any accidental fuel spills. Secondary containment devices with absorbent blankets/pads, and/or other secondary containment, shall be used for refueling of fixed equipment in wetlands and should be maintained to prevent accumulation of precipitation.

Routine vehicle maintenance shall not be conducted on project ROWs.

When other vehicle or equipment maintenance operations (such as emergency repairs) occur, company personnel or contractors at field locations shall bring vehicles or equipment to an access location a minimum of 100 feet away from environmentally sensitive areas (e.g., wetlands or drinking water sources). A paved area, such as a parking lot or roadway, is a preferred field maintenance location to minimize the possibility of spills or releases to the environment. Crews shall take all usual and reasonable environmental precautions during repair or maintenance operations. Occasionally, it is infeasible to move the affected vehicle or equipment from an environmentally sensitive area to a suitable access area. When this situation occurs, precautions shall be taken to prevent oil or hazardous material release to the environment. These precautions include (but are not limited to) deployment of portable basins or similar secondary containment devices, use of ground covers, such as plastic tarpaulins, and precautionary placement of floating booms on nearby surface water bodies.

Cleaning of tools and equipment shall be conducted away from environmentally sensitive areas (such as wetlands, buffer zones or drinking water sources) to the maximum extent possible. A paved area such as a parking lot or roadway is preferred, to minimize the possibility of spill or release to the environment.

Crews shall wipe up all minor drips or spills of grease and oil at field locations. All major vehicle and equipment repairs and maintenance shall be done at an offsite contractor yard or staging area.

3.5 Control of Allowable Non-Stormwater Discharges

Are there allowable non-Stormwater discharges present on or near the project area?

☒ Yes ☐ No

List of allowable non-stormwater discharge(s) and the associated control measure(s):

- Water may be used for dust control in upland areas. During application of water for dust control, care shall be taken to ensure that water does not create run-off or erosion issues.

Are there any known or proposed contaminated discharges, including anticipated contaminated dewatering operations, planned on or near the project area?

☐ Yes ☒ No

If yes, list the discharge types and the RIPDES individual permit number(s) or RIPDES Remediation General Permit Authorization number(s) associated with these discharges.

- Discharge Type and RIPDES Individual Permit number : INSERT TEXT HERE
- Discharge Type and RIPDES Remediation General Permit Authorization number: INSERT TEXT HERE

3.6 Control Dewatering Practices

Site owners and operators are prohibited from discharging groundwater or accumulated stormwater that is removed from excavations, trenches, foundations, vaults, or other similar points of accumulation, unless such waters are first effectively managed by appropriate control measures.

Examples of appropriate control measures include, but are not limited to, temporary sediment basins or sediment traps, sediment socks, dewatering tanks and bags, or filtration systems (e.g. bag or sand filters) that are designed to remove sediment. Uncontaminated, non-turbid dewatering water can be discharged without being routed to a control.

At a minimum the following discharge requirements must be met for dewatering activities:

1. Do not discharge visible floating solids or foam.
2. To the extent feasible, utilize vegetated, upland areas of the site to infiltrate dewatering water before discharge. In no case will surface waters be considered part of the treatment area.
3. At all points where dewatering water is discharged, utilize velocity dissipation devices.
4. With filter backwash water, either haul it away for disposal or return it to the beginning of the treatment process.
5. Replace and clean the filter media used in dewatering devices when the pressure differential equals or exceeds the manufacturer's specifications.

6. Dewatering practices must involve the implementation of appropriate control measures as applicable (i.e. containment areas for dewatering earth materials, portable sediment tanks and bags, pumping settling basins, and pump intake protection.)

Is it at all likely that the site operator will need to implement construction dewatering in order to complete the proposed project?

☒ Yes ☐ No

Where excavations require the need for dewatering of groundwater or accumulated stormwater, the water shall be treated before discharge. Appropriate controls include dewatering basins, flocculent blocks, filter bags, filter socks, or weir tanks. Water trucks or fractionation tanks may be utilized if watertight containers are desired for controlled on-site discharge or for off-site discharge into an approved dewatering area when site restrictions make it difficult to utilize other dewatering methods onsite.

Dewatering discharge water shall never be directed into wetlands, streams/rivers, other sensitive resource areas, catch basins, other stormwater devices, or substation Trenwa trenches. Dewatering flow shall be controlled so that it does not cause scouring or erosion through the use of a dewatering basin, filter sock, or equivalent. If it is determined that the chosen controls are not appropriately filtering the fine sediment from the dewatering pumpate then the controls shall be revised or supplemented.

When establishing a dewatering basin, consideration should be given to the anticipated volume of water and rate of pumping in determining the size of the dewatering basin. Dewatering basins shall be constructed on level ground. Once pumping commences, the basin shall be monitored frequently to assure that the rate of water delivery to the structure is low enough to prevent water from flowing, unfiltered, over the top of the basin walls. The basin shall be monitored throughout the dewatering process because the rate of filtration shall decrease as sediment clogs the filter fabric. If the basin is not appropriately filtering the fine sediment from the dewatering pumpate then the basin may need to be supplemented with a flocculent block. Use of flocculent will require the preparation and implementation of a Treatment Chemical Application Plan.

Field conditions shall dictate how often the basin should be inspected. Distance to sensitive areas, direction of flow (toward or away from protected or sensitive areas, such as wetlands, ponds, or streams), amount of vegetative ground cover between the basin and nearby sensitive areas, ground conditions (ledge, frozen, etc.), volume of water being pumped, and pump-rate, are some of the factors to be considered when determining an inspection frequency. Clogged filter fabric shall be replaced and accumulated sediment shall be removed as necessary from the basins to maintain efficacy.

Unattended dewatering shall never be allowed.

Basins shall be cleaned and removed as soon as dewatering is complete. Sediment removed from the dewatering basin shall be allowed to dry before being disposed of by evenly spreading it over unvegetated upland areas where erosion is not a concern if clean or removing it from the site for proper disposal. Off-site trucking of unmanaged wet soils is prohibited.

3.7 Establish Proper Building Material Staging Areas

All construction materials that have the potential to contaminate stormwater must be stored properly and legally in covered areas, with containment systems constructed in or around the storage areas. Areas must be designated for materials delivery and storage. Designated areas shall be approved by the site owner/engineer. Minimization of exposure is not required in cases where the exposure to precipitation and to stormwater will not result in the discharge of pollutants, or where exposure of a specific material or product poses little risk of stormwater contamination (such as final products and materials intended for outdoor use).

After preparing a site by clearing and/or installing any necessary erosion and sediment controls and prior to the start of construction, material such as poles, cross-arms, cable, insulators, stone and other engineered backfill materials may be placed along the ROW, as part of the project. The stockpiling of stone and other unconsolidated material on swamp mats shall be avoided, if determined necessary due to access and workpad constraints, the material must be placed on a geotextile fabric and be properly contained with a sedimentation barrier such as straw wattle.

No construction material shall be placed in wetlands or other sensitive resource areas.

As soon as the structure work has been completed, all used parts and trash are to be picked up and removed from the project site. Retired poles shall be removed in accordance with National Grid Engineering Standard SP,06.01.301. In some cases, the used material from structure work may be temporarily stored at the work area by placing it out of the wetlands or other sensitive resource area until work in the adjacent areas has been completed. However, treated wood poles shall never be stored in standing water or in wetlands. Excess material brought to the project site shall be removed upon project completion.

3.8 Minimize Dust

Dust control procedures and practices shall be used to suppress dust on a construction site during the construction process, as applicable. Precipitation, temperature, humidity, wind velocity and direction will determine amount and frequency of applications. However, the best method of controlling dust is to prevent dust production. This can best be accomplished by limiting the amount of bare soil exposed at one time. Dust Control measures outlined in the *RI SESC Handbook* shall be followed. Other dust control methods include watering, chemical application, surface roughening, wind barriers, walls, and covers.

Water or application of calcium chloride or other approved equivalent in accordance with the manufacturer's guidelines may be used for dust control along ROWs in upland areas. During application of water for dust control, care shall be taken to ensure that water does not create run-off or erosion issues.

3.9 Designate Washout Areas

At no time shall any material (concrete, paint, chemicals) be washed into storm drains, open ditches, streets, streams, wetlands, or any environmentally sensitive area. The site operator must ensure that construction waste is properly disposed of, to avoid exposure to precipitation, at the end of each working day.

Will washout areas be required for the proposed project?

☒ Yes ☐ No

Concrete wash outs shall be used for management of concrete waste. Concrete and concrete washout water shall not be deposited or discharged directly on the ground, in wetlands or waterbodies, or in catch basins or other drainage structures. Where possible, concrete washouts shall be located away from wetlands or other sensitive areas. Following the completion of concrete pouring operations, the wash outs shall be disposed of off-site with other construction debris.

3.10 Establish Proper Equipment/Vehicle Fueling and Maintenance Practices

Vehicle fueling shall not take place within regulated wetlands or buffer zone areas, or within 50-feet of the storm drain system. Refueling shall not occur within 100 feet of a wetland or watercourse.

Vehicle maintenance and washing shall occur off-site, or in designated areas depicted on the SESC Site Plans or approved of by the site owner. Maintenance or washing areas shall not be within regulated wetlands or buffer zone areas, or within 50-feet of the storm drain system. Maintenance areas shall be clearly designated, and barriers shall be used around the perimeter of the maintenance area to prevent stormwater contamination.

Construction vehicles shall be inspected frequently for leaks. Repairs shall take place immediately. Disposal of all used oil, antifreeze, solvents and other automotive-related chemicals shall be according to applicable regulations; at no time shall any material be washed down the storm drain or in to any environmentally sensitive area.

Small equipment such as pumps and generators shall be placed in secondary containment devices or on absorbent blankets/pads, to contain any accidental fuel spills. Secondary containment devices with absorbent blankets/pads, and/or other secondary containment, shall be used for refueling of fixed equipment in wetlands and should be maintained to prevent accumulation of precipitation.

3.11 Chemical Treatment for Erosion and Sediment Control

Chemical stabilizers, polymers, and flocculants are readily available on the market and can be easily applied to construction sites for the purposes of enhancing the control of erosion, runoff, and sedimentation. The following guidelines should be adhered to for construction sites that plan to use treatment chemicals as part of their overall erosion, runoff, and sedimentation control strategy.

The U.S. Environmental Protection Agency has conducted research into the relative toxicity of chemicals commonly used for the treatment of construction stormwater discharges. The research conducted by the EPA focused on different formulations of chitosan, a cationic compound, and both cationic and anionic polyacrylamide (PAM). In summary, the studies found significant toxicity resulting from the use of chitosan and cationic PAM in laboratory conditions, and significantly less toxicity associated with using anionic PAM. EPA's research has led to the conclusion that the use of treatment chemicals for erosion, runoff, and sedimentation control requires proper operator training and appropriate usage to avoid risk to aquatic species. In the case of cationic treatment chemicals additional safeguards may be necessary.

Application/Installation Minimum Requirements

If a site operator plans to use polymers, flocculants, or other treatment chemicals during construction the SESC plan must address the following:

1. Treatment chemicals shall not be applied directly to or within 100 feet of any surface water body, wetland, or storm drain inlet.

2. Use conventional erosion, runoff, and sedimentation controls prior to and after the application of treatment chemicals. Use conventional erosion, runoff, and sedimentation controls prior to chemical addition to ensure effective treatment. Chemicals may only be applied where treated stormwater is directed to a sediment control (e.g. temporary sediment basin, temporary sediment trap or sediment barrier) prior to discharge.

3. Sites shall be stabilized as soon as possible using conventional measures to minimize the need to use chemical treatment.

4. Select appropriate treatment chemicals. Chemicals must be selected that are appropriately suited to the types of soils likely to be exposed during construction and to the expected turbidity, pH, and flow rate of stormwater flowing into the chemical treatment system or treatment area. **Soil testing is essential. Using the wrong form of chemical treatment will result in some form of performance failure and unnecessary environmental risk.**

5. Minimize discharge risk from stored chemicals. Store all treatment chemicals in leak-proof containers that are kept under storm-resistant cover and surrounded by secondary containment structures (e.g., spill berms, decks, spill containment pallets), or provide equivalent measures,

designed and maintained to minimize the potential discharge of treatment chemicals in stormwater or by any other means (e.g., storing chemicals in covered areas or having a spill kit available on site).

6. Use chemicals in accordance with good engineering practices and specifications of the chemical provider/supplier. You must also use treatment chemicals and chemical treatment systems in accordance with good engineering practices, and with dosing specifications and sediment removal design specifications provided by the supplier of the applicable chemicals, or document specific departures from these practices or specifications and how they reflect good engineering practice.

Will chemical stabilizers, polymers, flocculants or other treatment chemicals be utilized on the proposed construction project?

☐ Yes ☒ No **No stabilizers, flocculants or other treatment chemicals are proposed at this time. This section will be updated as necessary, and coordination with the RIDEM , as necessary.**

If Yes, create a Treatment Chemical Application Plan and describe how the owner or SESC Plan preparer/designer intends to educate the designated operator prior to the application of such treatment chemicals.

Treatment Chemical Application Plan Required Elements

Insert information listed below:

1. *List Manufacturer's name and product name for each treatment chemical proposed for use at the site.*
2. *Attach a copy of applicable Material Safety Data Sheets (MSDSs) or Safety Data Sheets (SDS) for each proposed treatment chemical.*
3. *Provide the results of third party toxicity testing of the materials proposed for use at the site.*
4. *Provide a certification from the site owner and operator that all proposed treatment chemicals are the same as those used in the toxicity tests and will not be altered in any way.*
5. *Provide an explanation as to why conventional erosion, runoff, and sediment control measures, alone or in combination, will not be sufficient to prevent turbidity impacts and sedimentation in downstream receptors.*
6. *Provide a plan prepared in consultation with the chemical treatment manufacturer(s) or authorized manufacturer's representative which includes the following:*
    a. *Identification of the areas of the site where treatment chemicals will be applied and the name, location, and distance to all downstream receptors that have the potential to be impacted from the discharges from the treatment areas.*
    b. *List the expected start and end dates or specific phases of the project during which each treatment chemical will be applied.*
    c. *Provide test results for representative soils from the site, and any recommendations from the manufacturer based on the soil tests, indicating the type of treatment chemical and the recommended application rate.*
    d. *List the frequency, method, and rates of application which are designed to ensure that treatment chemical concentrations will not exceed 50% of the IC25 or NOEC toxicity values, whichever is less, for each treatment chemical proposed.*
    e. *Provide the frequency of inspection and maintenance of the treatment chemical application system.*
    f. *List the method proposed for the collection, removal, and disposal or stabilization of settled particles to prevent re-suspension.*
    g. *Describe the training that will be provided to all persons who will handle and use treatment chemicals at the construction site. Training must include appropriate, product-specific training and proper dosing requirements for each product.*

Treatment Chemical SESC Plan Weekly Inspection Report Documentation Requirements

1. Document the type and quantity of treatment chemicals applied.
2. List the date, duration of discharge, and estimated discharge rate.
3. Provide an estimate of the volume of water treated.
4. Provide an estimate of the concentration of treatment chemicals in the discharge, with supporting calculations.

3.12 Construction Activity Pollution Prevention Control Measure List

Complete the following table for each Phase of construction where Pollution Prevention Control Measures will be implemented. This table is to be used as part of the SESC Plan Inspection Report – please fill out accordingly.

It is expected that this table will be amended as needed throughout the construction project.

Phase No. #6		
Location/Station	**Control Measure Description/Reference**	**Maintenance Requirement**
Concrete Washout Stations	Prefabricated Concrete Washout Container used to contain concrete washout during concrete pouring operations. Section Three: Pollution Prevention and Good Housekeeping, Concrete Washouts, *RI SESC Handbook*.	Verify that concrete washout container(s) are in place prior to pouring concrete. Inspect daily to verify continued proper performance. Check remaining capacity during pouring operations. Check for leaks periodically.

SECTION 4: CONTROL MEASURE INSTALLATION, INSPECTION, and MAINTENANCE

4.1 Installation

Complete the installation of temporary erosion, runoff, sediment, and pollution prevention control measures by the time each phase of earth-disturbance has begun. All stormwater control measures must be installed in accordance with good judgment, including applicable design and manufacturer specifications. Installation techniques and maintenance requirements may be found in manufacturer specifications and/or the *RI SESC Handbook*.

Temporary erosion, runoff, sediment and pollution prevention control measures will be installed in compliance with Sheets 59 and 60 of 63 in the RIDEM Permit Drawings and with National Grid's Access, Maintenance and Construction Best Management Practices - EG-303NE.

4.2 Monitoring Weather Conditions

Anticipating Weather Events - Care will be taken to the best of the operator's ability to avoid disturbing large areas prior to anticipated precipitation events. Weather forecasts must be routinely checked, and in the case of an expected precipitation event of over 0.25-inches over a 24-hour period, it is highly recommended that all control measures should be evaluated and maintained as necessary, prior to the weather event. In the case of an extreme weather forecast (greater than one-inch of rain over a 24-hour period), additional erosion/sediment controls may need to be installed.

Storm Event Monitoring For Inspections - At a minimum, storm events must be monitored and tracked in order to determine when post-storm event inspections must be conducted. Inspections must be conducted and documented at least once every seven (7) calendar days and within twenty-four (24) hours after any storm event, which generates at least 0.25 inches of rainfall per twenty-four (24) hour period and/or after a significant amount of runoff or snowmelt.

The weather gauge station and website that will be utilized to monitor weather conditions on the construction site is as follows:

Weather Underground Echo Lake North Station: https://www.wunderground.com/personal-weather-station/dashboard?ID=KRIPASCO6

4.3 Inspections

Minimum Frequency - Each of the following areas must be inspected by or under the supervision of the owner and operator at least once every seven (7) calendar days and within twenty-four (24) hours after any storm event, which generates at least 0.25 inches of rainfall per twenty-four (24) hour period and/or after a significant amount of runoff or snowmelt:

a. All areas that have been cleared, graded, or excavated and where permanent stabilization has not been achieved;

b. All stormwater erosion, runoff, and sediment control measures (including pollution prevention control measures) installed at the site;

c. Construction material, unstabilized soil stockpiles, waste, borrow, or equipment storage, and maintenance areas that are covered by this permit and are exposed to precipitation;

d. All areas where stormwater typically flows within the site, including temporary drainage ways designed to divert, convey, and/or treat stormwater;

e. All points of discharge from the site;

f. All locations where temporary soil stabilization measures have been implemented;

g. All locations where vehicles enter or exit the site.

Reductions in Inspection Frequency - If earth disturbing activities are suspended due to frozen conditions, inspections may be reduced to a frequency of once per month. The owner and operator must document the beginning and ending dates of these periods in an inspection report.

Qualified Personnel – The site owner and operator are responsible for designating personnel to conduct inspections and for ensuring that the personnel who are responsible for conducting the inspections are "qualified" to do so. A "qualified person" is a person knowledgeable in the principles and practices of erosion, runoff, sediment, and pollution prevention controls, who possesses the skills to assess conditions at the construction site that could impact stormwater quality, and the skills to assess the effectiveness of any stormwater controls selected and installed to meet the requirements of the permit.

Recordkeeping Requirements - All records of inspections, including records of maintenance and corrective actions must be maintained with the SESC Plan. Inspection records must include the date and time of the inspection, and the inspector's name, signature, and contact information.

General Notes

- A separate inspection report will be prepared for each inspection.

- The Inspection Reference Number shall be a combination of the RIPDES Construction General Permit No **-** consecutively numbered inspections. ex/ Inspection reference number for the **4**th inspection of a project would be: RIR10####-**4**

- Each report will be signed and dated by the Inspector and must be kept onsite.

- Each report will be signed and dated by the Site Operator.

- The corrective action log contained in each inspection report must be completed, signed, and dated by the site operator once all necessary repairs have been completed.

- It is the responsibility of the site operator to maintain a copy of the SESC Plan, copies of all completed inspection reports, and amendments as part of the SESC Plan documentation at the site during construction.

Failure to make and provide documentation of inspections and corrective actions under this part constitutes a violation of your permit and enforcement actions under 46-12 of R.I. General Laws may result.

4.4 Maintenance

Maintenance procedures for erosion and sedimentation controls and stormwater management structures/facilities are described on the SESC Site Plans and in the *RI SESC Handbook*.

Site owners and operators must ensure that all erosion, runoff, sediment, and pollution prevention controls remain in effective operating condition and are protected from activities that would reduce their effectiveness. Erosion, runoff, sedimentation, and pollution prevention control measures must be maintained throughout the course of the project.

Note: It is recommended that the site operator designates a full-time, on-site contact person responsible for working with the site owner to resolve SESC Plan-related issues.

4.5 Corrective Actions

If, in the opinion of the designated site inspector, corrective action is required, the inspector shall note it on the inspection report and shall inform the site operator that corrective action is necessary. The site operator must make all necessary repairs whenever maintenance of any of the control measures instituted at the site is required.

In accordance with the *RI SESC Handbook*, the site operator shall initiate work to fix the problem immediately after its discovery, and complete such work by the close of the next work day, if the problem does not require significant repair or replacement, or if the problem can be corrected through routine maintenance.

When installation of a new control or a significant repair is needed, site owners and operators must ensure that the new or modified control measure is installed and made operational by no later than seven (7) calendar days from the time of discovery where feasible. If it is infeasible to complete the installation or repair within seven (7) calendar days, the reasons why it is infeasible must be documented in the SESC Plan along with the schedule for installing the control measures and making it operational as soon as practicable after the 7-day timeframe. Such documentation of these maintenance procedures and timeframes should be described in the inspection report in which the issue was first documented. If these actions result in changes to any of the control measures outlined in the SESC Plan, site owners and operators must also modify the SESC Plan accordingly within seven (7) calendar days of completing this work.

SECTION 5: AMENDMENTS

This SESC Plan is intended to be a working document. It is expected that amendments will be required throughout the active construction phase of the project. **Even if practices are installed on a site according to the approved plan, the site is only in compliance when erosion, runoff, and sedimentation are effectively controlled throughout the entire site for the entire duration of the project.**

The SESC Plan shall be amended within seven (7) days whenever there is a change in design, construction, operation, maintenance or other procedure which has a significant effect on the potential for the discharge of pollutants, or if the SESC Plan proves to be ineffective in achieving its objectives (i.e. the selected control measures are not effective in controlling erosion or sedimentation).

In addition, the SESC Plan shall be amended to identify any new operator that will implement a component of the SESC Plan.

All revisions must be recorded in the Record of Amendments Log Sheet, which is contained in Attachment G of this SESC Plan, and dated red-lined drawings and/or a detailed written description must be appended to the SESC Plan. Inspection Forms must be revised to reflect all amendments. Update the Revision Date and the Version # in the footer of the Report to reflect amendments made.

All SESC Plan Amendments, except minor non-technical revisions, must be approved by the site owner and operator. Any amendments to control measures that involve the practice of engineering must be reviewed, signed, and stamped by a Professional Engineer registered in the State of RI.

The amended SESC plan must be kept on file <u>at the site</u> while construction is ongoing and any modifications must be documented.

Attach a copy of the Amendment Log.

SECTION 6: RECORDKEEPING

RIPDES Construction General Permit – Parts III.D, III.G, III.J.3.b.iii, & V.O

It is the site owner and site operator's responsibility to have the following documents available at the construction site and immediately available for RIDEM review upon request:

- A copy of the fully signed and dated SESC Plan, which includes:

- A copy of all SESC Site Plans (RIDEM Permit Drawings)
INCLUDED AS ATTACHMENT A
- A copy of the RIPDES Construction General Permit
INCLUDED AS ATTACHMENT B
- A copy of any regulatory permits (RIDEM Freshwater Wetlands Permit, CRMC Assent, RIDEM Water Quality Certification, RIDEM Groundwater Discharge Permit, RIDEM RIPDES Construction General Permit authorization letter, etc.)
INCLUDED AS ATTACHMENT C
- Completed Inspection Reports w/Completed Corrective Action Logs
INCLUDED AS ATTACHMENT D
- SESC Plan Amendment Log
INCLUDED AS ATTACHMENT E

SECTION 7: PARTY CERTIFICATIONS

RIPDES Construction General Permit – Part V.G

All parties working at the project site are required to comply with the Soil Erosion and Sediment Control Plan (SESC Plan including SESC Site Plans) for any work that is performed on-site. The site owner, site operator, contractors and sub-contractors are encouraged to advise all employees working on this project of the requirements of the SESC Plan. A copy of the SESC Plan is available for your review at the following location: Insert Onsite Location Here, or may be obtained by contacting the site owner or site operator.

The site owner and site operator and each subcontractor engaged in activities at the construction site that could impact stormwater must be identified and sign the following certification statement.

I acknowledge that I have read and understand the terms and conditions of the Soil Erosion and Sediment Control (SESC) Plan for the above designated project and agree to follow the control measures described in the SESC Plan and SESC Site Plans.

Site Owner:

The Narragansett Electric Company (d/b/a National Grid)
280 Melrose Street
Providence, Rhode Island 02907
(401) 784-7515
Michael Ryan: Michael.Ryan@nationalgrid.com
and
Clear River Invenergy LLC
One South Wacker Drive
Suite 1800
Chicago, Illinois 60606
(781) 424-3223
John Niland: JNiland@invenergyllc.com

____
signature/date

Site Operator:

Insert Company or Organization Name
Insert Name & Title
Insert Address
Insert City, State, Zip Code
Insert Telephone Number, Insert Fax/Email

____
signature/date

Designated Site Inspector:

Insert Company or Organization Name
Insert Name & Title
Insert Address
Insert City, State, Zip Code
Insert Telephone Number, Insert Fax/Email

____
signature/date

SubContractor SESC Plan Contact:

Insert Company or Organization Name
Insert Name & Title
Insert Address
Insert City, State, Zip Code
Insert Telephone Number, Insert Fax/Email

____
signature/date

Insert more contact/signature lines as necessary

LIST OF ATTACHMENTS

Attachment A – RIDEM Permit Drawings

Attachment B - Copy of RIPDES Construction General Permit and Authorization to Discharge *(To save paper and file space, do not include in DEM/CRMC submittal, for operator copy only)*

Attachment C - Copy of Other Regulatory Permits

Attachment D - Inspection Reports w/ Corrective Action Log

Attachment E - SESC Plan Amendment Log

SUBJECT	Reference
Access, Maintenance and Construction Best Management Practices	EP No. 3 – Natural Resource Protection (Chapter 6)

SCOPE: This specification provides Environmental Procedures and Best Management Practices (BMPs) for work on electric and natural gas transmission and distribution rights-of-way (ROWs), fee-owned and easement, cross-country, and public/private roadways, as well as substations, company facilities and on customer-owned projects, and other facilities in New England.

Note that project-specific permits may have other BMPs/constraints that differ from this Environmental Guidance (EG). The projects shall be constructed in accordance with the project-specific permits and this specification. For maintenance work in New Hampshire, there is a state specific BMP manual which supersedes EG-303NE, where applicable[1]. For work in Vermont, there is a state specific BMP manual which may supersede EG-303NE, where applicable[2]. The Massachusetts Runoff, Erosion & Sedimentation Control Field Guide published by the Massachusetts Association of Conservation Commissions (MACC) is incorporated herein as a reference. The MACC Guide is intended as a supplement to EG-303NE and shall be superseded by EG-303NE in the case of an inconsistency or conflict.

PURPOSE: The purpose of this specification is to provide National Grid personnel, consultants and contractors with BMPs to support work that is protective of the environment and that complies with all applicable environmental laws, regulations and company policies and procedures. Environmental policies require the Company to avoid, minimize and mitigate negative impacts to the environment.

POLICY: These BMPs are to be effectively and consistently followed by all personnel accessing Company facilities, ROWs, and customer projects for inspection, maintenance and construction work purposes.

If there are any questions on this guidance, contact the local or project National Grid Environmental Scientist.

These BMPs do not apply to Company employees and contractors performing routine vegetation management activities that are not part of a construction or maintenance project. Employees and contractors maintaining vegetation on Company ROWs and substations shall follow the National Grid Right-of-Way Vegetation Management Plan; Right-of-Way Vegetation Management Specification; Substation, Switch Yard, and Pole Yard Vegetation Management Specification; and Right-of-Way Vegetation Mowing Specification. For more information regarding routine vegetation management, please contact a National Grid Forester.

[1] The "Best Management Practices Manual For Utility Maintenance In And Adjacent To Wetlands and Waterbodies in New Hampshire"
[2] Vermont DEC, 2006. The Vermont Standards and Specifications for Erosion Prevention and Sediment Control.

APPLICABLE REGULATIONS: Refer to Applicable Regulations in state-specific EG-301 documents.

CONTACTS: If there are any questions on this guidance, contact the National Grid Environmental Scientist.

1.0 Definitions

Refer to **Glossary in Appendix 1** and **Acronyms in Appendix 2**.

2.0 Project Planning

Prior to the start of any project (proposed new facilities or maintenance of existing facilities), the Project Engineer or other project planner shall determine whether any environmental permits or approvals are required, per the state-specific EG-301 environmental checklists. Any questions regarding which activities may be conducted in regulated areas or within environmentally sensitive areas shall be referred to the National Grid Environmental Scientist or Project Environmental Consultant

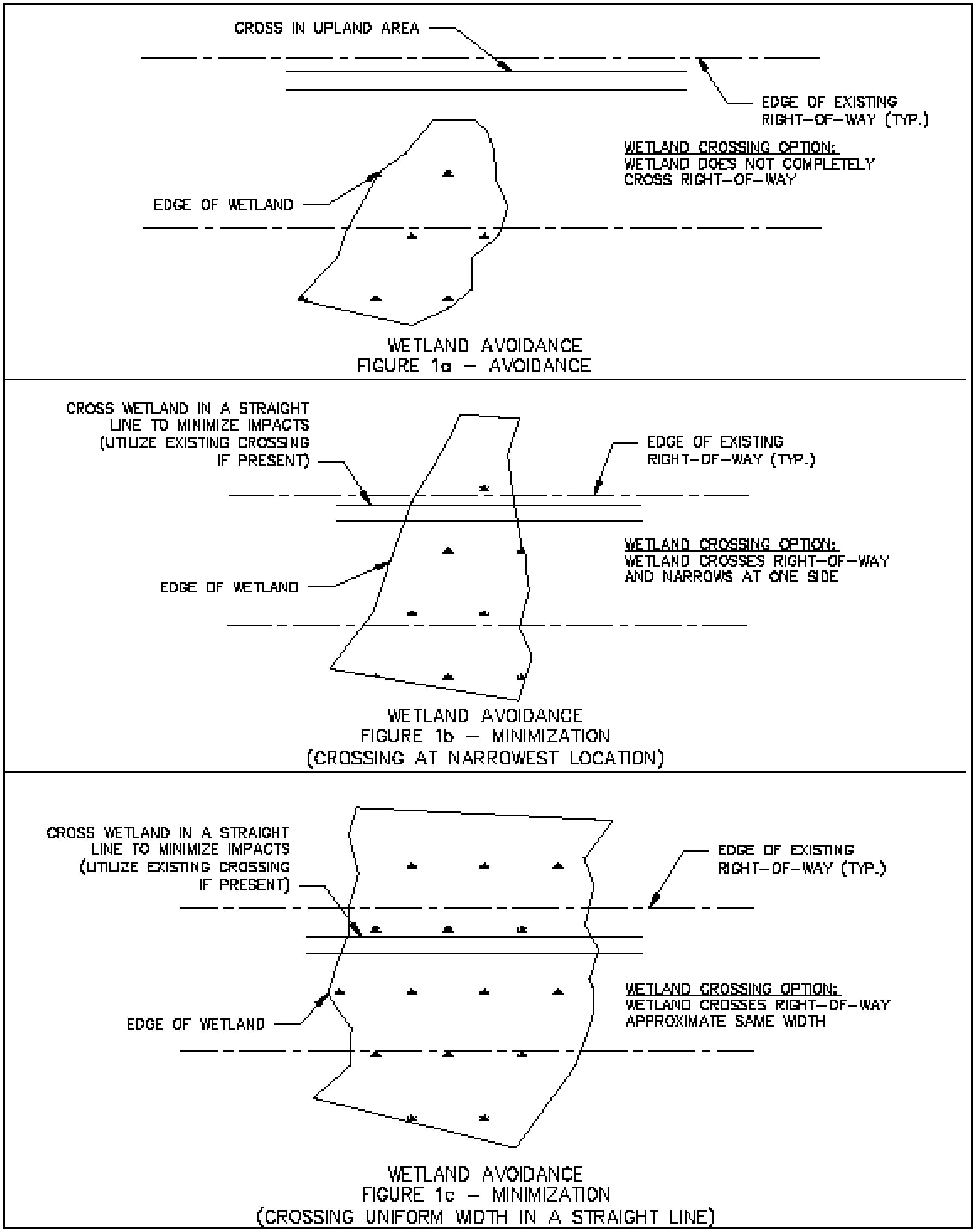
All new construction and maintenance projects shall follow clear and enforceable environmental performance standards, which is the purpose for which these BMPs have been compiled.

2.1 Avoidance and Minimization

Measures shall always be taken to avoid impacts to wetlands, waterways, rare species habitats, known below and above ground historical/archeological resources and other environmentally sensitive areas. If avoidance is not possible, then measures shall be taken to minimize the extent of impacts. Alternate access routes or staging areas shall always be considered. Below is a list of methods that shall be considered where impacts are unavoidable:

- Use existing ROW access where available. Keep to approved routes and roads without deviating from them or making them wider.
- Off-ROW access shall never be assumed and shall be coordinated through National Grid Real Estate before being implemented.
- Where no existing ROW access is present, avoid wetlands and if a wetland crossing is necessary, cross wetlands at the most narrow point possible or at the location of a previously used crossing (if evident). Figure 1 below illustrates this minimization technique.
- Avoid and minimize stream crossings;
- Minimize the width of typical access roads through wetlands to a maximum width of 16 feet;
- Conduct work manually (without using motorized equipment) in wetlands, wherever possible;

- Use swamp, timber, or similar mats in wetlands to minimize soil disturbance and rutting when crossing or working within wetlands. When not using mats for access, standard vehicles shall not be allowed to drive across wetlands without the prior approval of the National Grid Environmental Scientist. Use of a low ground pressure (LGP) vehicle may be a feasible alternative to mats provided that such LGP vehicle use has been reviewed and approved by the National Grid Environmental Scientist. See Section 8.5.
- Coordinate the timing of work to cause the least impacts during the regulatory low-flow period under normal conditions, when water/ground is frozen, after the spring songbird nesting season, and, outside of the anticipated amphibian migration window (mid-February to mid-June). The United States Army Corps of Engineers (USACE) defines the low-flow period as July 1 through August 30 in MA, July 1 through October 1 in RI, July 1 through October 1 in NH, and July 1 through October 1 in VT.
- Seek alternative routes or work methods to minimize impact.



CROSS IN UPLAND AREA
EDGE OF EXISTING RIGHT-OF-WAY (TYP.)
WETLAND CROSSING OPTION:
WETLAND DOES NOT COMPLETELY CROSS RIGHT-OF-WAY
EDGE OF WETLAND
WETLAND AVOIDANCE
FIGURE 1a – AVOIDANCE
CROSS WETLAND IN A STRAIGHT LINE TO MINIMIZE IMPACTS (UTILIZE EXISTING CROSSING IF PRESENT)
EDGE OF EXISTING RIGHT-OF-WAY (TYP.)
WETLAND CROSSING OPTION:
WETLAND CROSSES RIGHT-OF-WAY AND NARROWS AT ONE SIDE
EDGE OF WETLAND
WETLAND AVOIDANCE
FIGURE 1b – MINIMIZATION
(CROSSING AT NARROWEST LOCATION)
CROSS WETLAND IN A STRAIGHT LINE TO MINIMIZE IMPACTS (UTILIZE EXISTING CROSSING IF PRESENT)
EDGE OF EXISTING RIGHT-OF-WAY (TYP.)
WETLAND CROSSING OPTION:
WETLAND CROSSES RIGHT-OF-WAY APPROXIMATE SAME WIDTH
EDGE OF WETLAND
WETLAND AVOIDANCE
FIGURE 1c – MINIMIZATION
(CROSSING UNIFORM WIDTH IN A STRAIGHT LINE)

2.2 Historically Significant Areas

Areas that have been identified as historically and/or culturally significant shall be avoided in accordance with site-specific avoidance plans, as applicable. Refer to the project-specific Environmental Field Issue (EFI) for any applicable avoidance plans or consult with the National Grid Environmental Scientist. Demarcation of these areas to be avoided shall use staked orange snow fencing or an equivalent physical barrier (not just ribbon flagging) and signage. Refer to Section 16.0 for signage guidance.

2.3 Rare Species Habitat

Work within areas that have been identified as mapped rare species habitat shall follow site-specific requirements, as applicable. In Massachusetts, maintenance activities within mapped habitat (known as Priority Habitat of Rare Species) shall follow the BMPs outlined in the Natural Heritage Endangered Species Program (NHESP)-approved National Grid Operation and Maintenance Plan. Work in mapped rare species habitat may require, at a minimum, turtle training for crews and sweeps of work areas for turtles, botanist identification of rare plant locations and avoidance of these locations, and protection of vernal pools, all prior to the start of work. Demarcation of these areas to be avoided (e.g., rare plant populations, overwintering turtles, nests) shall use staked orange snow fencing or an equivalent physical barrier (not just ribbon flagging) and signage. Refer to Section 16.0 for signage guidance.

Other requirements may apply in NH, VT and RI. Refer to the project-specific EFI for any applicable measures or consult with the National Grid Environmental Scientist.

2.4 Meetings

Pre-permitting meetings shall take place early in the project development process to determine what permits are triggered by the proposed work and the timeline required for permitting. During these meetings, the team shall develop access plans and BMPs to be used during construction of the project.

Field / Constructability review meetings shall take place on-site to evaluate construction site access and job site set-up, to ensure that the project can proceed as permitted. It is at this point in time where work areas, pulling locations, laydown areas, parking areas, and equipment storage areas are evaluated and located. Off-ROW areas under consideration should be included in this discussion.

Prior to submitting permit plans to regulatory authorities, the construction group (contractor or National Grid) shall review the plans for final sign off.

Pre-construction meetings are typically held prior to the commencement of all work to appoint responsible parties, discuss timing of work, and further consider options to avoid and/or minimize impacts to sensitive areas. These meetings can occur on- or off-site and shall include all the willing and available stakeholders (i.e., utility employees, contractors, consultants, inspectors, and/or monitors, and regulatory personnel). Training of crews and supervisors of the EFI, Stormwater Pollution Prevention Plan (SWPPP), rare species, and other permit requirements shall be conducted at a pre-construction meeting.

Pre-job briefings shall be conducted daily or otherwise routinely scheduled meetings shall be conducted on-site with the work crew throughout the duration of the work. These meetings are a way of keeping everyone up to date, confirming there is consensus on work methods and responsibilities, and ensuring that tasks are being fulfilled with as little impact to the environment as possible.

The Project Environmental Scientist/Monitor and Construction Project Manager shall communicate regularly (e.g. weekly or bi-weekly meetings or phone conversations) to discuss the work completed since last communication (i.e. work locations, wetland impacts, equipment used, and unexpected delays or work conditions). These meetings or calls shall include the expected schedule of construction for the upcoming week, the long term construction plans, and planned methods for working near/in wetlands. Both the Project Environmental Scientist/Monitor and Construction Project Manager shall work together so the Project complies with all environmental permits and regulations. When changes to the Project scope or agreed work plan are proposed they shall be done so with the final approval of the National Grid Environmental Scientist.

2.5 Communication of Project Specific Environmental Requirements

Project specific environmental concerns, to include sensitive resources, permits, approved access and time-of-year or other restrictions, shall be communicated to the project team and be included as part of the Pre-Bid and Pre-Construction Meetings. Project specific requirements shall be communicated to the project manager/construction manager/engineering group using the following guidelines:

<u>Environmental Field Issue</u> – The EFI will be a full document consisting of narrative, project permits, access and matting plans. A table summarizing pertinent (but not all) permit conditions and the responsible party for those conditions shall be included in the EFI. Copies of all permits should be included as attachments. This will be prepared for most projects with multiple permits or large, complex projects (siting board, Section 404, 401 WQC, SWPPP). There should be EFI training at the pre-construction meeting. Appendix 3 is a sample EFI template.

<u>Simplified Environmental Field Issue</u> – The Simplified EFI is a memorandum containing environmental resources present, project permit(s), access and matting plans and a table summarizing relevant permit conditions and responsible party for those conditions. Copies of all permits should be included as attachments. The Simplified EFI will be prepared for most projects with 1 or 2 permits (Order of Conditions, S404 Cat 1). The Simplified EFI should also be provided for projects that have environmental resources present, but the scope of the project

does not trigger environmental permitting (e.g., the scope of work qualifies for maintenance exemption(s)). The resources present shall be discussed at the Pre-Bid and Pre-Construction meetings and any changes in scope will require additional review by the National Grid project team.

E-mail delivery of Permit and any Sediment/Erosion control or BMP plan – For those projects with only one permit (eg., MA Order of Conditions, RI DEM permit, RI CRMC permit, NH Utility Notification) or projects with a sediment & erosion control plan (local town requirement or for exempt maintenance work), a copy of the permit and any applicable plan will be emailed to the PM (and the project team where deemed necessary) to be incorporated into the Construction Field Issue.

STORMS work management system input – For STORMS work, no EFI is prepared unless multiple permits are required for the project (see guidance above). If only a MA Order of Conditions, MA Determination of Applicability, RI DEM permit, RI CRMC permit, RI SESC Approval, or NH Utility Notification is required, then the permit is attached in Documents tab and conditions noted in Remarks/comments section. Appendix 5 contains standard STORMS boilerplate language.

2.6 Timing of Work

Regulatory authorities may place seasonal or time-of-year restrictions on project construction elements. These time-of-year restrictions may be state or permit-specific, and shall be adhered to.

Work during frozen conditions. Activities conducted once wetland areas are frozen sufficient to minimize rutting and other impacts to the surrounding environment may be authorized by the National Grid Environmental Scientist. Work during this time also generally reduces disturbance of aquatic and terrestrial wildlife movement by avoiding sensitive breeding and nesting seasons. When not using mats for access, vehicles shall not be allowed to drive across wetlands without the prior approval of the National Grid Environmental Scientist.

Work during the regulatory low-flow period. Conducting work during the low-flow period can reduce impacts to surface water and generally avoids spawning and breeding seasons of aquatic organisms. If the water is above normal seasonal levels, adjustments to work activities and methods are required.

2.7 Alternate Access

2.7.1 Manual Access

In some cases such as for smaller projects, work areas can be accessed manually. This includes access on foot through upland and shallow wetland areas, access by boat through open water or ponded areas, and climbing of structures where possible. Smaller projects, such as repair of individual structures, or parts of structures, that do not categorically require the use of heavy machinery, shall be accessed manually to the greatest extent practicable.

2.7.2 Use of Overhead/Aerial Access

Using helicopters can be expensive and is not always feasible, but it may be appropriate in some situations in order to get workers and equipment to a site that otherwise may be very difficult to access. The use of overhead and/or aerial equipment may be beneficial for work in areas where larger water bodies, deep crevices, or mountainous areas hinder ground access. The landing area for helicopters shall be reviewed for environmentally sensitive resources. Use of helicopters requires Project Manager and Senior Management approval.

3.0 Inspection, Monitoring and Maintenance

All construction practices and controls shall be inspected on a regular basis and in accordance with all applicable permits and local, state, and federal regulations to avoid and correct ANY damage to sensitive areas.

The construction crews shall be responsible for completing daily inspections, and IMMEDIATELY bring any **damage or observed erosion, or failed erosion controls** to the attention of the Person-In-Charge and the National Grid Environmental Scientist. Where applicable and/or as directed by environmental permits issued for the project, the Project Environmental Consultant shall conduct weekly (at a minimum) inspections of the project work areas and shall document their inspection using the Stormwater, Wetlands & Priority Habitat Environmental Compliance Site Inspection / Monitoring Report form found in Appendix 6 and issue the report within 24 hours. The Person-in-Charge shall work with the National Grid Environmental Scientist and the Project Environmental Consultant to determine when and how the repairs shall be made.

Project-specific Action Logs and Long-Term Restoration Logs are prepared as needed by the National Grid Environmental Scientist or the Project Environmental Consultant to track issues and/or repairs and assign responsible parties.

4.0 Best Management Practices

The BMP sections presented in this EG address access, construction, snow and ice management, structures in wetlands, access road maintenance and repair, clean-up and restoration standards, ROW gates, field refueling and maintenance operations, management of spills/releases, and a summary of key construction BMPs.

Note that BMPs shown on any permit drawings for a specific project may need to be revised and or supplemented during the execution of a project based on unforeseen or unexpected factors such as extreme weather or unknown subsurface conditions. It is the responsibility of the Contractor to work with the National Grid Environmental Scientist and/or the Project

Environmental Consultant to identify necessary changes and to ensure that construction-related impacts to wetlands, water bodies and other environmentally sensitive areas are avoided.

Any deviation from the approved Best Management Practices shown in the EFI and/or SWPPP plans shall be communicated immediately to the National Grid Environmental Scientist as it may require additional permitting or could result in a permit violation.

4.1 Wetland Boundary Demarcation

Prior to the start of any activity conducted under an environmental permit, wetland boundaries shall be reviewed. Flagging for wetland boundaries, stream banks and other resource areas shall be refreshed as needed. This may become particularly important when the original flagging was placed in previous seasons and now may have become obscured.

4.2 Sedimentation and Erosion Controls

Appropriate sedimentation and erosion control devices shall be installed at work sites, in accordance with permit conditions and/or regulatory approvals, and as needed to prevent adverse impacts to water resources and adjacent properties.

The overall purpose of such controls is to prevent and control the movement of disturbed soil and sediment from work sites to adjacent, undisturbed areas, and particularly to water resources, public roads and adjacent properties. All proprietary controls shall be installed per manufacturer's recommendations and specifications.

Appropriate sedimentation and erosion control devices include but are not limited to: silt fencing, straw bales, wood chip bags, straw wattles, compost socks, erosion control blankets, mulch, slope interruption practices, flocculent powder/blocks and storm drain/catch basin inlet protection. Such controls shall be installed between the work area and environmentally sensitive areas such as wetlands, streams, drainage courses, roads and adjacent property when work activities shall disturb soils and result in a potential for causing sedimentation and erosion.

Staked straw bales often serve as the demarcation of the limits of work and/or sensitive areas to be avoided. Work shall never be conducted outside the limit of erosion controls without prior approval from the National Grid Environmental Scientist.

Project plans depict proposed erosion controls, however field conditions may warrant additional practices be implemented (e.g., wet conditions, frozen conditions, poorly drained soils, steep slopes, materials used for work pads, transition areas to swamp mats, number of trips across work areas, etc.).

Any deviation from the approved erosion controls shown in the EFI and/or SWPPP plans needs to be communicated immediately to the National Grid Environmental Scientist as it may require additional permitting or result in a permit violation.

Appendix 7 provides typical sketches of common sedimentation and erosion controls. If a SWPPP is required for the project, maintenance and inspection of erosion controls shall follow the SWPPP requirements. Sedimentation and erosion controls shall be properly maintained and inspected on a periodic basis, until work sites are properly stabilized and restored. Inspections shall be documented using the Inspection Form "Storm Water, Wetlands & Priority Habitat Environmental Compliance Site Inspection/Monitoring Report" (**Appendix 6**).

The sequence and timing of the installation of sedimentation and erosion control measures is critical to their success. Sedimentation and erosion controls shall be installed prior to commencing construction activities that may result in any soil disturbance or cause otherwise polluted site runoff. Inspection of these devices may be required by the National Grid Environmental Scientist or by regulators prior to the start of work. The installation of water bars and other erosion control measures shall be installed shortly thereafter.

4.3 Concrete Wash Outs

Concrete wash outs shall be used for management of concrete waste. Concrete and concrete washout water shall not be deposited or discharged directly on the ground, in wetlands or waterbodies, or in catch basins or other drainage structures. Where possible, concrete washouts shall be located away from wetlands or other sensitive areas. Consult the National Grid Environmental Scientist on proposed concrete wash out locations prior to their use. Following the completion of concrete pouring operations, the wash outs shall be disposed of off-site with other construction debris. Refer to BMPs in Appendix 7.

4.4 Construction Activities in Standing Water

The use of silt curtains or turbidity barriers may be required when working in or adjacent to standing water such as ponds, reservoirs, low flowing rivers/streams, or coastal areas. Silt curtains and turbidity barriers prevent sediment from migrating beyond the immediate work area into the resource areas.

Coffer dams constructed using sheet piling or large sandbags (Trade names such as "the Big Bag" or "DamItDams") may be used to temporarily isolate and contain a work area in standing water.

When working in standing water, an oil absorbent boom, in addition to a silt curtain or other temporary barrier, shall be placed around the work area for spill prevention.

Work in drinking water reservoirs or other waters may require extensive regulatory agency review, even for maintenance work, which could result in additional time required for permitting, review and material procurement prior to the start of work.

4.5 Dewatering

Where excavations require the need for dewatering of groundwater or accumulated stormwater, the water shall be treated before discharge. Appropriate controls include dewatering basins, flocculent blocks, filter bags, filter socks, or weir tanks. Schematics of these BMPs are included as in Appendix 7. Water trucks or fractionation tanks may be utilized if watertight containers are desired for controlled on-site discharge or for off-site discharge into an approved dewatering area when site restrictions make it difficult to utilize other dewatering methods on-site. Dewatering discharge water shall never be directed into wetlands, streams/rivers, other sensitive resource areas, catch basins, other stormwater devices, or substation Trenwa trenches. Dewatering flow shall be controlled so that it does not cause scouring or erosion through the use of a dewatering basin, filter sock, or equivalent. If it is determined that the chosen controls are not appropriately filtering the fine sediment from the dewatering pumpate then the National Grid Environmental Scientist shall be notified immediately and the controls shall be revised or supplemented.

When establishing a dewatering basin, consideration should be given to the anticipated volume of water and rate of pumping in determining the size of the dewatering basin. Dewatering basins shall be constructed on level ground. Once pumping commences, the basin shall be monitored frequently to assure that the rate of water delivery to the structure is low enough to prevent water from flowing, unfiltered, over the top of the basin walls. The basin shall be monitored throughout the dewatering process because the rate of filtration shall decrease as sediment clogs the filter fabric. If the basin is not appropriately filtering the fine sediment from the dewatering pumpate then the basin may need to be supplemented with a flocculent block. Field conditions shall dictate how often the basin should be inspected.

Distance to sensitive areas, direction of flow (toward or away from protected, or sensitive areas, such as wetlands, ponds, or streams), amount of vegetative ground cover between the basin and nearby sensitive areas, ground conditions (ledge, frozen, etc.), volume of water being pumped, and pump-rate, are some of the factors to be considered when determining an inspection frequency. Clogged filter fabric shall be replaced and accumulated sediment shall be removed as necessary from the basins to maintain efficacy.

Unattended dewatering shall never be allowed. If 24-hour dewatering is required for on-site construction activities, a designated attendee shall be trained by the National Grid Environmental Scientist.

Basins shall be cleaned and removed as soon as dewatering is complete. Sediment removed from the dewatering basin shall be allowed to dry before being disposed of by evenly spreading it over unvegetated upland areas where erosion is not a concern if clean or removing it from the site for proper disposal. Off-site trucking of wet soils is prohibited. The sediment disposal area shall be approved by the National Grid Environmental Scientist or the Project Environmental Consultant prior to use. Stabilization measures shall also need to implemented and approved by the National Grid Environmental Scientist or the Project Environmental Consultant. Soils/sediments shall be dewatered or mixed with dry material such that they are appropriate for off-site transport.

Any new dewatering location (not previously reviewed and approved by the National Grid Environmental Scientist during project planning or permitting) shall be reviewed and the discharge location approved by the National Grid Environmental Scientist before use.

Complex projects that require large scale dewatering shall require individual review by the National Grid Environmental Scientist and may trigger additional permitting.

Dewatering in areas of known chemical contamination may require a separate NPDES permit, or other approval, and treatment or containment system. Consult with the National Grid Environmental Scientist.

4.6 Check Dams

Check dams are a porous physical barrier installed perpendicular to concentrated storm water flow. They are used to reduce erosion in a swale by reducing runoff energy (velocity), while filtering storm water, thereby aiding in the removal of suspended solids.

Check dams should only be used in small drainage swales that shall not be overtopped by flow once the dams are constructed. These dams should not be placed in streams. Check dams are typically installed in ROWs or on other construction sites prior to the start of soil disturbing work. Per the Rhode Island Soil Erosion and Sediment Control Handbook, no formal design is required for a check dam if the contributing drainage area is 2 acres or less and its intended use is shorter than 6 months; however, the following criteria should be adhered to when specifying check dams.

- The drainage area of the ditch or swale being protected should not exceed 10 acres.
- The maximum height of the check dam should be 2 feet.
- The center of the check dam must be at least 6 inches lower than the outer edges.
- The maximum spacing between the dams should be such that the toe at the upstream dam is at the same elevation as the top of the downstream dam.

Per the NHDES stormwater manual, the use of check dams should be limited to swales with longitudinal slopes that range between 2 to 5 percent that convey drainage from an area less than 1 acre. Existing conditions that exceed these limitations should be assessed in the field and discussed with the National Grid Environmental Scientist to determine the viability of this BMP for the specific application. Check dams are often comprised of stone, straw bales, sand bags, or compost/silt socks. Use of check dams should be coordinated with the National Grid Environmental Scientist to ensure that the material selection, spacing and construction method are appropriate for the site. Check dams composed of biodegradable materials (e.g. straw bales or wattles, wood chip bags) may require periodic replacement for continued proper functioning[3]. Refer to BMPs in Appendix 7.

4.7 Water Bars

Water bars should be used on sloping ROWs to divert storm water runoff from unstabilized or active access roads when needed to prevent erosion. Surface disturbance and tire compaction promote gully formation by increasing the concentration and velocity of runoff. Water bars are constructed by forming a ridge or ridge and channel diagonally across the sloping ROW. Each outlet should be stable. The height and side slopes of the ridge and channel are designed to divert water and to allow vehicles to cross. When siting water bars, consideration shall be given to the sensitivity of the area receiving the diverted runoff. For example, runoff should not be directed into a wetland, waterbody, other environmentally sensitive areas, or to private property or public roadways. Refer to BMPs in Appendix 7.

4.8 Retaining Walls

In some situations, retaining walls comprised of concrete blocks, gabions, boulders or other comparable materials may be required to stabilize the shoulder of existing access roads and/or supplement required erosion controls. Installation of such measures shall not be allowed as a maintenance activity. Should these controls be considered for a project, it shall be reviewed by the National Grid Environmental Scientist, as design and additional permitting may be required.

4.9 Slope Stabilization

Temporary slope stabilization practices help to keep exposed, erodible soils stabilized while vegetation is becoming established. Acceptable temporary slope stabilization practices may include the use of erosion control blankets, or hydraulic erosion control. Erosion control blankets, often comprised of natural fibers (e.g., jute, straw, coconut, or other degradable materials) are a useful slope stabilization, erosion control and vegetation establishment practice for ditches or steep slopes. Blankets are typically installed after final grading and seeding for temporary or permanent seeding applications. Hydraulic erosion control practices, including Bonded Fiber Matrix or hydroseed with a soil stabilizer (e.g., tackifier and/or mulch) may be an acceptable or desirable alternative form of temporary slope stabilization. For all practices, manufacturer's specifications should be followed for installation depending on slope and other field conditions. Consult the National Grid Environmental Scientist prior to selecting and installing any slope stabilization practices. Refer to BMPs in Appendix 7.

4.10 Maintenance of Sedimentation and Erosion Controls

Sedimentation and erosion controls shall be maintained in good operational condition during the course of the work. This includes , but is not limited to, replacing straw bales that are no

[3] Grass growth on a biodegradable type check dam is evidence that the material is decomposing. While this doesn't mean it is no longer functioning, it means it may be in a weakened condition and could potentially fail under high flow velocity. It is acceptable for grass to be growing on a stone check dam.

longer in good condition, re-staking straw bales, replacing or re-staking silt fence, and removing accumulated sediment. Remove sediment before it has accumulated to one half the height of any exposed silt fence fabric, straw bales, other filter berm, check dams or water bars. Accumulated sediment shall be removed from sedimentation basins to maintain their efficacy. Manage the removed sediment by evenly spreading it over unvegetated upland areas where erosion is not a concern, by stockpiling and stabilizing, or by disposing of off-site. Stabilization measures shall also need to be implemented and approved by the National Grid Environmental Scientist or the Project Environmental Consultant. Where a SWPPP has been prepared for a specific site, the guidelines documented therein shall govern the management of sediment.

5.0 Right-of-Way (ROW) Access

Whenever possible, access shall be gained along existing access routes or roads within the ROW. However, in some cases there is no existing access. In many cases, temporary access can be utilized. The following practices provide general guidance on accessing a ROW. Check with a National Grid Environmental Scientist to determine if any environmental permitting is required before utilizing a temporary access.

National Grid operates substations and has cross-country ROW with overhead electric power lines in four New England States. MA, NH and RI also have transmission and distribution natural gas pipelines. Access is needed to substations, ROWs, and customer property, for inspection, maintenance and construction activities. Many projects are located in or near environmentally sensitive areas, such as rivers/streams, wetlands, floodplains, or rare species habitat, etc., which are protected from activities that may disturb these resources.

Note that the building of new roads or enlargement of existing roads is **prohibited** unless this activity is allowed by a project-specific permit, and the new roads appear on the Site Plans that were authorized in the regulatory approvals.

5.1 Off-ROW Access

Off-ROW access shall be evaluated for wetlands, rare species, cultural resources and other potential sensitive receptors, as applicable. National Grid Real Estate and Stakeholder Relations shall also be contacted as soon as possible once off-ROW access is determined to be needed.

5.2 Stabilized Construction Entrance/Exit for Access to ROWs from Public or Private Roads

A suitable (minimum 15-foot wide by 50-foot long) construction entrance/exit shall be installed at the intersection of the ROW access road/route with public/private paved roads, or other such locations where equipment could track mud or soil onto paved roads. The construction entrance/exit should be comprised of clean stone installed over a geotextile fabric. Geotextile fabric may be omitted for permanent construction entrances/exits on a case-by-case basis with the approval of the National Grid Environmental Scientist. Refer to BMPs in Appendix 7.

Construction entrance areas shall be monitored and maintained to ensure that stone or other material is not deposited onto the roadway, causing a safety concern. Where track-out of sediment has occurred onto a roadway, it shall be swept off the road by the end of that same work day.

If a construction entrance/exit is clogged with sediment and no longer functions, the sediment and stone may require removal and replacement with additional clean stone (clean stone refreshment) to ensure this tracking pad is performing its intended function adequately. Heavier traffic use may require this clean stone refreshment multiple times throughout a project. Reinforcement of these stabilized construction entrance/exits with asphalt binder or asphalt millings is not likely to be considered "maintenance" and may trigger additional permitting requirements[4]. In some cases, heavily used construction entrances/exits may benefit from the installation of a 5-15 foot strip of asphalt binder or asphalt millings closest to the paved roadway to capture any stone that is tracked from the stone apron. Such cases shall be evaluated on an individual basis with the National Grid Environmental Scientist.

Once work is complete, the construction entrance/exit shall either be removed or retained, depending upon future maintenance-related access needs, property ownership, and/or project-specific approvals. If removed, the area shall be graded, seeded (if adequate root and seed stock are absent) and mulched. Proper approvals for leaving access roads in place shall be obtained; contact the National Grid Environmental Scientist and Property Legal.

5.3 Maintenance of Existing Access Roads

In many cases, the existing access road may need to be maintained to allow passage of the heavy equipment required for scheduled maintenance work. Access roads cannot deviate from the approved and permitted access plans. Maintenance of these roads may include adding clean gravel or clean crushed stone to fill depressions and eroded areas. This activity shall be conducted only within the width of the existing access road footprint and does not include widening existing access roads

If gravel begins to migrate onto the existing vegetated road shoulder, this gravel shall be removed during the project and/or after the completion of use of the road to ensure the road fill is not spreading into adjacent resource areas, or resulting in the road becoming much wider than its pre-existing or permitted condition. In some areas of mapped rare species habitat or other sensitive areas where project-specific permit conditions require the prevention of the migration of sediments into adjacent resources, an engineered stabilization system (e.g.,

[4] Depending on the road, use of an asphalt binder or asphalt millings as a construction entrance/exit may trigger state or local permit requirements.

GeoWeb or similar) may be suitable to prevent sedimentation while allowing for unrestricted wildlife migration.

Major reconstruction projects may require multiple permits. In all cases, the fill to be used for existing access roads shall be clean and free of construction debris, trash or woody debris. Use of processed gravel may be approved by the Person-In-Charge or the National Grid Environmental Scientist, on a case-by-case basis. If clean stone is used then addition of more erosion controls may not be necessary.

5.4 Maintenance of Existing Access Routes (Cross Country Routes)

Ruts and depressions along existing access routes and within the existing ROW may only be leveled and graded. Addition of fill or stone may require permitting as well as additional erosion controls, and needs to be approved by the National Grid Environmental Scientist

5.5 Maintenance of Existing Culverts

Damaged culverts may not be repaired or replaced without consulting with the National Grid Environmental Scientist to determine if a permit is required. For functioning culverts, care shall be taken to protect adjacent wetlands and watercourses by installing appropriate sedimentation and erosion controls around the downstream end of the culvert. Culverts shall be repaired/replaced in kind and shall not be changed in size unless approval has been obtained from the National Grid Environmental Scientist. In-kind replacement is replacement using the same material, functional inverts, diameter and length as the existing culvert. Changes to any of these characteristics shall require permitting. Installation of any **new** culvert is not allowed without obtaining all necessary permits first. Refer to BMPs in Appendix 7.

If, at the time of anticipated replacement, there is heavy flow through the culvert, the Person-In-Charge shall consult with the National Grid Environmental Scientist, to verify whether the culvert shall be replaced at that time. Water may need to be temporarily diverted during culvert repair/replacement. There typically are seasonal restrictions limiting both the replacement of existing culverts as well as installation of new culverts to the low-flow period. The low-flow period can vary from state to state. If any unexpected conditions are encountered during culvert replacement, the National Grid Environmental Scientist shall be contacted immediately prior to the work being completed for additional consultation.

5.6 Temporary Construction Access over Drainage Ditch or Swale

In some situations, construction access from paved roads onto ROWs may require the crossing of drainage ditches or swales along the road shoulder. In these situations, the installation of swamp mats, mat bridges or temporary culverts may facilitate construction access over the ditches or swales. These culverts shall be temporary only, sized for peak flow, and shall be removed after construction is complete. Consult with the National Grid Environmental

Scientist prior to installation. In addition, if access over existing culverts may require extending the culvert, consult with the National Grid Environmental Scientist. Refer to BMPs in Appendix 7.

5.7 Construction Material along ROW

After preparing a site by clearing and/or installing any necessary erosion and sediment controls and prior to the start of construction, material such as poles, cross-arms, cable, insulators, stone and other engineered backfill materials may be placed along the ROW, as part of the project. The stockpiling of stone and other unconsolidated material on swamp mats shall be avoided, if determined necessary due to access and workpad constraints, the material must be placed on a geotextile fabric and be properly contained with a sedimentation barrier such as straw wattle. No construction material shall be placed in wetlands or other sensitive resource areas unless authorized by the National Grid Environmental Scientist or Project Environmental Consultant

6.0 Winter Conditions

6.1 Snow Management

DO NOT stockpile or dispose of snow in any water body, including wetlands, rivers/streams, the ocean, reservoirs, ponds, or stormwater catch basins. A buffer of at least 25 feet shall be maintained between any snow disposal area and any the high water mark of any surface water. A silt fence or equivalent barrier shall be securely placed between the snow storage area and the high water mark of rivers, streams, ponds, or the ocean. In addition to water quality impacts and flooding, snow disposed in surface water can cause navigational hazards when it freezes into ice blocks. Some state and local authorities have specific snow management requirements. Consult with the National Grid Environmental Scientist on specific restrictions.

DO NOT deposit snow within a wellhead protection area (e.g., a Zone II), in a high or medium-yield aquifer, or within 200 feet of a private well, where road salt may contaminate water supplies**. Consult with the National Grid Environmental Scientist to determine if a proposed disposal area is located within one of these sensitive areas.**

Avoid disposing of snow on top of storm drain catch basins or in storm water drainage swales or ditches. Snow combined with sand and debris may block a storm drainage system, causing localized flooding. A high volume of sand, sediment, and litter released from melting snow also may be quickly transported through the system into surface water and could also result in fines or a violation being assessed against National Grid.

All debris in a snow storage area shall be cleared from the site and properly disposed of no later than May 15 of each year.

Care shall be taken not to plow road materials away when removing snow.

6.2 De-Icing

Where allowed, calcium chloride is preferred as a de-icing agent when applied according to manufacturer's guidelines in upland areas. Sand shall be used on swamp mats through wetland areas.

Consult with the National Grid Environmental Scientist on de-icing agents when working in a facility or substation close to resource areas. Many municipalities have specific requirements for de-icing agents allowed within 100 feet of wetland resources and other sensitive areas.

6.3 Snow and Ice Management on Swamp Mats

Proper snow removal on swamp mats shall avoid the formation of ice. To avoid the formation of ice, snow shall be removed from swamp mats before applying sand. Prior to their removal from wetlands, sand shall be collected from the swamp mats and disposed of in an upland area. A round street sweeping brush mounted on the front of a truck may be an effective way to remove snow from swamp mats. Propane heaters may also be suitable solutions for snow removal and/or de-icing of swamp mats.

Once swamp mats are removed, wetlands shall be inspected for build up of sand that may have fallen through swamp mats. Care shall be taken to inspect wetland crossings as each mat is removed to ensure sand is properly removed and disposed of off-site.

7.0 Swamp Mats

The use of swamp mats allows for heavy equipment access within wetland areas. The use of swamp mats minimizes the need to remove vegetation beneath the access way and helps to reduce the degree of soil disturbance and rutting in soft wetland soils. Swamp mats most often used by National Grid are wooden timbers bolted together typically into 4-ft by 16-ft sections, wooden lattice mats, or composite mats. In some cases, swamp mats or other mats are used for staging or access in upland areas based on site conditions (e.g., agricultural field access). Refer to BMPs in Appendix 7.

Typically swamp mats may be installed on top of the existing vegetation, however in some instances cutting large woody vegetation may be required. Check with National Grid Environmental Scientist prior to cutting or clearing vegetation for swamp mat placement.

Follow the approved plans in the EFI for swamp mat installation and do not deviate from the plans. **Any deviation from the approved plans needs to be communicated immediately to the National Grid Environmental Scientist as it may require additional permitting, require stopping the project or result in a permit violation or revocation.**

7.1 Swamp Mats and Mowing

Close coordination with the mowing contractor shall be required to ensure that access plans are followed, and swamp mats are utilized when necessary. Sometimes mowing contractors may have to work off the leading edge of a swamp mat to mow in order to lay the next swamp mat and continue further into the wetland. Under no circumstances shall trees or shrubs be allowed to be pulled out of the wetland by the root ball. The root ball of trees and shrubs shall remain intact. Chipping debris and excessive amounts of slash shall not be placed in wetlands or other resource areas. In some instances, it may be beneficial to pile a reasonable amount of slash within a nearby upland area to create habitat for wildlife. This activity shall be approved by the National Grid Environmental Scientist.

7.2 Stream Crossings and Stream Bank Stabilization

Stream crossings shall be bridged with swamp mats or other temporary minimally-intrusive measures unless fording is acceptable for the site and is authorized by the National Grid Environmental Scientist. Care shall be taken when installing a swamp mat bridge to insure that the stream bed and banks are not damaged during installation and removal and that stream flow is not unduly restricted. An environmental permit may be required to cross or disturb protected waters, depending upon state-specific regulatory requirements. Refer to BMPs in Appendix 7. Immediately following swamp mat removal, all stream banks shall be stabilized and restored to prevent sedimentation and erosion.

7.3 Cleaning of Swamp Mats

Mats shall be certified clean by the vendor prior to installation. The vendor shall use the certification form provided as Appendix 8 to document compliance. Clean is defined as being free of plant matter (stems, flowers, roots, etc), soil, or other deleterious materials prior to being brought to the project site. Any equipment or timber mats that have been placed or used within areas containing invasive species within the project site shall be cleaned of plant matter (stems, flowers, roots, etc), soil, or other deleterious materials at the site of the invasive species prior to being moved to other areas on the project site to prevent the spread of invasive species from one area to another[5]. **Mats shall be cleaned prior to being removed at the completion of the project: exceptions to this requirement may be made on a case-by-case basis.** Consult with the National Grid Environmental Scientist prior to discharging or disposing of any waste water or waste material from the cleaning of swamp mats.

7.4 Stone Removal for Swamp Mat Placement

For situations where the matting contractor determines that stones or boulders must be removed or relocated within wetland areas in order to install safe and level structure work pads or access roads the boulders shall be moved in a manner which does not result in significant soil disturbance (i.e., pushing with a bull dozer is not allowed). The boulders shall not be placed on any existing vegetated areas within wetlands or within vernal pools. When numerous boulders shall be removed from a wetland area, they shall be deposited in an upland area outside of the

[5] On ROW projects where multiple wetlands may be dominated by the same invasive species, cleaning may not be required for movement along the ROW. Check with the National Grid Environmental scientist for guidance.

flagged wetland limits, outside of any cultural resource areas and outside of any RTE species populations. Any boulders that shall be placed within buffers (In MA, the 100-foot buffer zone, and in RI, the 50-foot Perimeter Wetland, 100-foot or 200-foot Riverbank Wetlands) shall be placed to avoid causing soil disturbance and they shall be within an approved limit of work. When there is a significant number of boulders that shall be removed, the National Grid Environmental Scientist shall be consulted for guidance.

7.5 Transition onto Mats

Erosion controls and stone or wood chip ramps shall be installed to promote a smooth transition to and minimize sediment tracking onto swamp mats. Geotextile may be added beneath stone or wood chip transitions to facilitate removal, as necessitated by site or permit conditions. Mat transitions shall be removed once swamp mats have been removed and during restoration. Refer to BMPs in Appendix 7.

7.6 Corduroy Roads

Corduroy roads are a wetland crossing method where logs are cut from the immediate area and used as a road bed to prevent rutting from equipment crossing. This technique is designed to be used in areas of wetland crossings where there is no defined channel or stream flow and should never be used in streams. Corduroy logs shall be placed in the narrowest area practicable for crossing with the logs placed perpendicular to the direction of travel across wet area. The use of corduroy logs shall only be in emergencies when approved by the National Grid Environmental Scientist or when they have been specifically permitted as part of a project. Refer to BMPs in Appendix 7.

7.7 Swamp Mat Removal

Once swamp mats are removed, wetlands shall be inspected for build up of sand or other materials that may have fallen through swamp mats. Care shall be taken to inspect wetland crossings as each mat is removed to ensure any materials are properly removed and disposed of off-site.

7.8 Bridging over other utility facilities

In ROWs where other utility facilities (including but not limited to gas, oil, fiber optic, electric, water, and sewer) are co-located within the transmission ROW, bridging may be required to cross those facilities. The project team shall coordinate with the respective utility company prior to determining if bridging or permanent crossings are required.

8.0 LGP Equipment Use

Only when approved by the National Grid Environmental Scientist on a case-by-case basis shall equipment with LGP of **less than 3 psi when loaded** be allowed to access through wetlands. The National Grid Environmental Scientist's approval of the use of LGP equipment through wetlands depends on several criteria including:

- Time of year. LGP equipment use may be allowed if weather and field conditions at the time of construction are suitable to eliminate/minimize the concern of rutting or other impacts. Frozen, frozen snow pack, low flow, or drought conditions are typically acceptable conditions. Spring and fall construction, due to the typical higher precipitation, are not suitable times of year for LGP equipment use.
- Number of trips. Multiple trips through a wetland have shown to increase the potential for damage and require matting. LGP equipment use shall likely only be approved if trips are limited to one trip in and one trip out.
- Type of wetland system. Some wetlands have harder soils/substrate, and may be passable without causing significant damage. Some of the wetlands along National Grid ROWs have existing hard bottom roads that have been vegetated over time and may be traversed with LGP equipment without swamp mats.
- Emergencies. LGP equipment use may be allowed during emergency or storm conditions for outage restoration.
- State-specific USACE General Permit Performance Standards. The standard is for no impact to the wetland, which may be obtained by using LGP equipment (<3 psi **when loaded**). "*Where construction requires heavy equipment operation in wetlands, the equipment shall either have low ground pressure (<3 psi), or shall not be located directly on wetland soils and vegetation; it shall be placed on swamp mats that are adequate to support the equipment in such a way as to minimize disturbance of wetland soil and vegetation*."
- Local bylaws. Municipal wetland bylaws, where applicable, shall be reviewed for prohibitive conditions or applicable performance standards.

LGP equipment approval is required **at the time of construction for each wetland crossing** and shall be dependent upon the above conditions. In addition, LGP equipment use and approval shall be assessed by the National Grid Environmental Scientist during construction on a continuing basis; LGP equipment use shall cease immediately if field conditions are found to be unsuitable. ***Please note that if LGP vehicles are used, and wetlands damage occurs, the use of the LGP equipment shall be suspended.***

9.0 Soil Disturbing Activities

9.1 Dust Control

Cutting activities shall be conducted to minimize the impacts of dust on the surrounding areas. Dust suppression is an important consideration. Water or application of calcium chloride or other National Grid approved equivalent in accordance with the manufacturer's guidelines may be used for dust control along ROWs in upland areas. During application of water for dust control, care shall be taken to ensure that water does not create run-off or erosion issues. Refer to BMPs in Appendix 7.

9.2 Clearing

Clearing is not allowed without specific permission as it constitutes soil disturbance under several regulatory programs and may trigger permitting by increasing the project's footprint of disturbance. If clearing is required for a project, the limit of clearing shall be established with flagging or construction fencing and/or erosion controls. Clearing shall be done in accordance with project specific permits. Following the completion of clearing, the limits of work shall be re-established. Refer to BMPs in Appendix 7.

9.3 Grubbing

Grubbing is not allowed without specific permission as it constitutes soil disturbance under several regulatory programs and likely triggers permitting by increasing the project's footprint of disturbance. If grubbing is required for a project, the limit of grubbing shall be re-established after clearing has been completed. The area of grubbing shall be identified with flagging or construction fencing and/or erosion controls. Grubbing shall be conducted in accordance with project-specific permits.

9.4 Blasting, Noise and Vibration Control

If blasting is anticipated, the project team, including the National Grid Environmental Scientist, shall be consulted.

If possible, plan work in residential areas to avoid noisy activities at night, weekends or during evenings. Emergency work in residential areas should be carried out in such a way as to keep noise to a minimum at night and weekends. Equipment should be maintained as per the manufacturer's guidance to minimize noise and vibration.

Work plans must consider local noise ordinances and provide specific controls to ensure noise levels are maintained within specified limitations.

All equipment shall be maintained in good working condition in order to minimize noise and vibration impacts.

9.5 Site Grading

The work site shall not be graded other than in accordance with project permits. Any proposed grading shall be reviewed by the National Grid Environmental Scientist for wetlands, rare species habitat, areas of cultural and historical significance, and other environmentally sensitive areas prior to start of work. In some cases, additional testing for cultural or historical resources may be triggered by proposed grading; alternatives to grading may be sought due to protracted time frame of obtaining the permit associated with testing and performing the testing. Grading outside of a regulated area shall be kept to the minimum extent necessary for safe and efficient operations and shall comply with the project permit plans.

Grading shall be performed in a manner which does not increase the erosion potential at the Site (e.g., terraces or slope interruptions shall be utilized). Graded sites shall be promptly stabilized by applying a National Grid approved seed mix (if adequate root and seed stock are absent), and mulching with hay, straw or cellulose (use straw or cellulose hydromulch where the potential introduction of invasive plant species is of concern) to reduce erosion and visual impact, as soon as possible following completion of work at the site. Grading within a regulated area shall be subject to the review and approval of the National Grid Environmental Scientist.

In some municipalities, site grading activities require the prior approval of the Town Engineer, Building and Zoning Official, or Public Works Director. Local ordinances or bylaws should be reviewed for applicable restrictions and permitting thresholds

9.6 Site Staging and Parking

During the project planning and permitting process, locations shall be identified for designated crew parking areas, material storage, and staging areas. Where possible, these areas should be located outside of buffer zones, watershed protection areas, and other environmentally sensitive areas. Any proposed locations shall be evaluated for all sensitive receptors and for new projects requiring permitting, shall be incorporated onto permitting and access plans.

9.7 Soil Stockpiling

Soil stockpiles shall be located in upland areas and, if in close proximity to wetlands and wetland buffers, shall be enclosed by staked straw bales or another erosion control barrier. The stockpiling of stone, drill spoils and other unconsolidated material on swamp mats shall be avoided unless determined necessary due to access and work pad constraints. Additional controls, such as watertight mud boxes and geotextile/filter fabric over or between swamp mats shall be considered for stockpile management. If material is placed on swamp mats and falls through into wetlands, the material must be removed by hand. Saturated soils shall be allowed to dewater prior to off-site transport for sufficient time to ensure that water/sediment is not deposited onto swamp mats or public roads during transport.

9.8 Top Soil/High Organic Content Soil

When the work site requires excavation and grading, the top soil shall be stockpiled separately from the material excavated. This top soil shall be spread as a top dressing over the disturbed area during restoration of the site.

In some instances where work is occurring within wetlands, high organic content soil may be displaced. Such high organic content soil shall be segregated from other excavated materials and stockpiled for use in wetland restoration areas. Care shall be taken to minimize the handling of high organic content soil. Preferably, the soil shall be stockpiled in one location until it is moved to the restoration area.

10.0 Stone Wall Dismantling and Re-building

Removal or alteration of stonewalls shall be avoided, whenever possible. As appropriate, some stonewalls removed or breached by construction activities shall be repaired or rebuilt. Rebuilt stone walls shall be placed on the same alignment that existed prior to temporary removal, to the extent that it shall not interfere with operations. The removal and rebuilding of stone walls requires approval from the National Grid Environmental Scientist and Property Legal, and may require several weeks lead time for coordination. Note that not all states allow this technique. Dismantling may not be allowed at all due to quality or significance of the wall. Once a stone wall has been identified as requiring dismantling, the following procedures shall be followed:

- Identify stone wall that is required to be temporarily dismantled and notify project team that a site visit is warranted to review the stone wall.
- The National Grid Environmental Scientist, with support from Property Legal and/or cultural/historical consultant, shall determine if permitting or additional permissions are required prior to dismantling stone wall.
- Once permit or permissions have been received, full documentation of wall dimensions (measurements and photographs) shall be submitted to the National Grid Environmental Scientist. Documentation of the wall dimensions shall be marked onto a copy of the applicable EFI access plan (or equivalent plan) with a useful reference for future locating such as GPS coordinates and/or measurement from a permanent reference point (closest structure location or closest cross street, etc.). The wall shall be photographed from all sides with a written description of the photograph (i.e. southern side of wall looking north). In addition, documentation of the length of wall to be dismantled shall be recorded. Take special care to note if granite property bounds (or other marker) are located within the wall so additional survey can be accomplished prior to dismantling in cases where the stone wall represents a property boundary. Site visits by project team (which shall include the National Grid Environmental Scientist) are a mandatory requirement prior to dismantling.
- No dismantling shall take place until documentation has been submitted to the National Grid Environmental Scientist and approved as sufficient documentation.

- Stones from the wall shall be removed from the work area and temporarily stored in nearby location, away from wetlands; buffer zones; rare species habitat and other historical/archeological concerns.
- Avoid dismantling via the "bulldozer" method when possible as this method makes it nearly impossible to rebuild the wall in the same alignment due to its uncontrolled nature. Dismantling shall be conducted either by hand, with stones stacked as they are removed, or on less "sensitive" walls to use an excavator with a thumb to grab each stone and build a stockpile. Significant ground disturbance below the wall shall be avoided.

Once construction and access in the area has been completed, the wall shall be rebuilt to pre-dismantled conditions or better. If rebuilding a stone walls can not be placed on the same alignment that existed prior to temporary removal, approval from the National Grid Environmental Scientist and Property Legal is required. **Note that if the wall represents a legal property boundary or is historically or culturally significant (or was previously determined to be in a very high quality condition), a professional stone masonry company may be required to document wall alignment, and conduct the dismantling and rebuilding**

11.0 Avian Nest Removal

Avian nest removal shall be done in accordance with EG-304. Consult the National Grid Environmental Scientist prior to removing any nests. There are seasonal restrictions of the removal of avian nests and federal or state permits may be necessary prior to removal

12.0 Drilling Fluids and Additives

Notify the National Grid Environmental Scientist if drilling fluids/additives are proposed to be used on a project. Use and disposal of spent drilling fluids/slurries shall be approved by the National Grid Environmental Scientist, as regulatory approvals and drinking water wells may be of concern. Deactivation and sampling may be required prior to disposal.

13.0 Grounding Wells

The installation of grounding wells shall require erosion controls and proper soil management. Due to the typical depth required for grounding wells (typically 50 to 200 feet or more), erosion controls shall be installed around the proposed well location when working in buffer zone, in proximity to sensitive resources or near slopes. Also, dewatering basins may be required for the proper management of groundwater. The National Grid Environmental Scientist shall be consulted for the disposal of any excess soil.

14.0 Counterpoise and Cathodic Protection

The installation of counterpoise or cathodic protection shall require erosion controls and proper soil management. The National Grid Environmental Scientist shall be consulted for the disposal of any excess soil.

15.0 Gates

When not in use, gates shall be locked with a company-approved lock or double locked with the property owner's lock. New gates may be installed during a project, however, installation of a gate requires permission from the property owner, and may require environmental permitting. Consult with National Grid Real Estate and the National Grid Environmental Scientist prior to installing a new gate, as well as with the appropriate engineering department for the current company gate specifications. Refer to BMPs in Appendix 7. Installation of ROW access restrictions (e.g., stone, bollards, other) at road crossings also require consultation with the National Grid Environmental Scientist and Property Legal.

16.0 Signage

Specific signage may be required by permits or be specified in the EFI to limit access in certain sensitive areas. Signs shall be used to clarify allowed access and sensitive areas, such as:

- "No snow stockpiling beyond this point,"
- "Approved access (to structures A-F)";
- "Do not cross this area until swamp mats are in place";
- "No vehicle crossing";
- "Areas to avoid"; and
- "Environmentally Sensitive Area – Keep Out."

Signs shall be used in conjunction with snow fencing or other physical barriers as demarcation for sensitive areas (e.g., rare species areas, sensitive archeological locations, etc.) that need to be protected and avoided by construction activities. In addition, permit signs required by the regulatory agencies shall be present (i.e. MADEP, RIDEM, EPA (SWPPP), ACOE, etc) at construction sites and/or ROW access points. Construction signage shall be installed and maintained by the contractor performing the work during the project. Absence of signage does not eliminate the need to comply with access plans, permit conditions, and other regulatory requirements. Refer to BMPs in Appendix 7.

17.0 Refueling and Maintenance Operations

17.1 Spill Prevention and Response Plan

Spill controls shall be provided on every field vehicle. Bulk storage of fuels (55 gallons or greater) shall be approved by the National Grid Environmental Scientist prior to being brought on site. The need for a field spill plan shall be evaluated specific to the project for regulatory requirements under SPCC regulations or local ordinances. A field spill plan would include information on fuels and oils being used, approximate amounts in each container or type of equipment, location, fueling location, secondary containment, response and notification procedures, including contact phone numbers, etc. All personnel shall be briefed on spill prevention and response prior to the commencement of construction. The state-specific EG-501 and EG-502 shall be followed in the event of a spill.

Typical construction activities do not require the use or storage of large quantities of oil or hazardous materials (i.e., greater than 55 gallons). However, oil and/or hazardous materials (OHM) may be required in limited quantities to support construction or vehicle operations. Best practices shall be followed in the use and storage of OHM which include but are not limited to: storage and refueling greater than 100 feet from resource areas; maintenance of spill response equipment at work locations sufficient to handle incidental releases from operating equipment; general training for on-site personnel for spill clean up response for incidental releases of OHM; and contracting with an on-call spill response contractor that is capable of managing incidental and significant releases of OHM. There may situations that additional precautions shall be required for the storage or use of OHM (i.e., within wellhead protection areas, GA/GAA areas, Zone IIs). Storage of OHM shall be done in accordance with any applicable regulatory requirements.

17.2 Field Refueling

Small equipment such as pumps and generators shall be placed in small swimming pools or on absorbent blankets/pads, to contain any accidental fuel spills. Small swimming pools with absorbent blankets/pads, and/or other secondary containment, shall be used for refueling of fixed equipment in wetlands and should be maintained to prevent accumulation of precipitation.

17.3 Grease, Oil, and Filter Changes

Routine vehicle maintenance shall not be conducted on project sites.

17.4 Other Field Maintenance Operations

When other vehicle or equipment maintenance operations (such as emergency repairs) occur, company personnel or contractors at field locations shall bring vehicles or equipment to an access location a minimum of 100 feet away from environmentally sensitive areas (e.g., wetlands or drinking water sources). A paved area, such as a parking lot or roadway, is a preferred field maintenance location to minimize the possibility of spills or releases to the environment.

Crews shall take all usual and reasonable environmental precautions during repair or maintenance operations. Occasionally, it is infeasible to move the affected vehicle or equipment from an environmentally sensitive area to a suitable access area. When this situation occurs, precautions shall be taken to prevent oil or hazardous material release to the environment. These precautions include (but are not limited to) deployment of portable basins or similar secondary containment devices, use of ground covers, such as plastic tarpaulins, and precautionary placement of floating booms on nearby surface water bodies.

17.5 Tools and Equipment

Cleaning of tools and equipment shall be conducted away from environmentally sensitive areas (such as wetlands, buffer zones or drinking water sources) to the maximum extent possible. A paved area such as a parking lot or roadway is preferred, to minimize the possibility of spill or release to the environment. Crews shall wipe up all minor drips or spills of grease and oil at field locations.

18.0 Stabilization Deadlines for Projects Subject to EPA Construction General Permit

18.1 Deadlines to Initiate Stabilization Activities (Permanent and Temporary)

Soil stabilization measures shall be implemented immediately whenever earth-disturbing activities have permanently or temporarily ceased on any portion of the project. The following are some examples of activities that constitute initiation of stabilization:

- Preparing the soil for vegetative or non-vegetative stabilization;
- Applying mulch or other non-vegetative product to the exposed area;
- Seeding or planting the exposed area;
- Finalizing the arrangements to have stabilization product fully installed in compliance with the deadlines to complete stabilization in Section 18.2 below.

18.2 Deadlines to Complete Stabilization Activities (Permanent and Temporary)

As soon as practicable, but no later than 14 calendar days or 7 calendar days (for areas discharging to a sensitive water) after the initiation of soil stabilization measures commence the following should be completed:

- For vegetative stabilization, all activities necessary to initially seed or plant the area to be stabilized; and
- For non-vegetative stabilization, the installation or application of all such non-vegetative measures.

18.3 Vegetative Stabilization (all except for arid, semi-arid, or on agricultural lands)

- Provide established uniform vegetation (e.g., evenly distributed without large bare areas), which provides 70% or more of the density of coverage that was provided by vegetation prior to commencing earth-disturbing activities. Avoid the use of invasive species as cover.
- For final stabilization, vegetative cover must be perennial; and
- Immediately after seeding or planting a disturbed area to be vegetatively stabilized, a non-vegetative erosion control must be implemented to the area while the vegetation is becoming established. Examples include; mulch and rolled erosion control products.

18.4 Vegetative Stabilization (Agricultural Lands)

- Disturbed areas on land used for agricultural purposes that are restored to their pre-construction agricultural use are not subject to vegetative stabilization standards.

18.5 Non-Vegetative Stabilization

If using non-vegetative controls to stabilize exposed portions of your site, or if you are using such controls to temporarily protect areas that are being vegetatively stabilized, you must provide effective non-vegetative cover to stabilize any such exposed portions of the site. Examples of non-vegetative stabilization techniques include, but are not limited to, rip-rap, gabions, and geotextiles.

19.0 Clean-up and Restoration Standards

The following steps shall be taken once construction has been completed at each location along the ROW or within the project site. The following are minimum guidelines for clean-up and stabilization standards. Please refer to permit conditions for project-specific related standards. Refer to the EFI for applicable permit requirements andto determine if the site needs to be reviewed and approved by the permitting authorities prior to removal of erosion controls.

19.1 Removal of Sedimentation and Erosion Controls

After all work has been satisfactorily completed and vegetation has been re-established to a minimum of 75% cover, and upon approval by the National Grid Environmental Scientist, all non-biodegradable materials (e.g., siltation fencing, straw bale strings, stakes, straw wattle mesh casing, etc.) shall be disposed of properly off-site.

Dependent on permit requirements, sedimentation and erosion controls may not be allowed to be removed until after inspection and approval by one or more permitting authority. In most cases, removed straw bales may be used to mulch disturbed areas. Remaining straw bales that do not block the flow of water may be left in place unless they are required to be removed pursuant to permit conditions. Straw bales that block the flow of water shall be removed.

Prior to project construction being completed, the project team will develop post-construction inspection intervals to ensure timely removal of temporary BMPs. BMPs will be removed when the area is stabilized, which typically occurs when the area has either naturally stabilized (75 % cover), or seed and mulch that was installed has achieved 75% cover.

19.2 In-Situ Restoration

Unless otherwise specified in permits or prescribed by the National Grid Environmental Scientist or the Project Environmental Consultant, all disturbed areas, including stream banks, wetlands and access routes, shall be restored following the completion of work. When the work is completed and swamp mats have been removed, the National Grid Environmental Scientist or Project Environmental Consultant shall conduct an inspection. Wetlands shall be inspected for build up of sand or other materials that may have fallen through swamp mats. Care shall be taken to inspect wetland crossings carefully after swamp mat removal to ensure any materials are properly removed and disposed of off-site.

Restoration of Soil Compaction. If rutting or soil compaction following swamp mat removal is observed, the area shall be returned to pre-existing conditions, and comparable to the surrounding area, by light hand raking or by back-blading with machinery. Restoration shall be overseen by the Project Environmental Consultant or National Grid Environmental Scientist. Deep ruts (>12”) shall be filled in using available, loose soil from the work area.

Seeding and Mulching. If adequate root and seed stock are absent and have been stripped from the area, graded sites shall be promptly stabilized by applying an approved seed mix and mulching with straw to reduce erosion and visual impact. Seeding and mulching shall be completed as soon as possible following completion of work at the site. For some wetland areas, natural re-vegetation may be more appropriate than seeding disturbed sites. Wetland areas where adequate root and seed stock are absent will be seeded using an approved wetland native seed mix. For some wetland areas, natural re-vegetation may be more appropriate than seeding disturbed sites. Refer to BMPs in Appendix 7 for seed mix tables and mulch ratio tables.

If needed, the import of quality topsoil onto the ROW will be required. Topsoil should be tested, and approved by the Project Environmental Consultant or National Grid Environmental Scientist to determine its suitability for site conditions. Fertilizers will be approved on a case-by-case basis.

For upland areas, the disturbed vegetation and soil shall be restored and stabilized[6] by regrading the area to pre-existing conditions, if needed, seeding (if adequate root and seed stock are absent) and mulching the exposed soil, and removing strings and stakes from straw bales and using broken up straw bales for the mulch. Siltation fencing, strings and stakes shall be removed for disposal as ordinary waste. Refer to BMPs in Appendix 7 for seed mix tables and mulch ratio tables.

Excess boulders. Additional boulders could be used at proposed and existing gate locations to use on either side of the gates as a deterrent for unauthorized vehicle access or be placed along the edges of work pads where steep slopes are present for safety purposes. The final placement of boulders should be reviewed prior to installation with Stakeholder Relations and the National Grid Environmental Scientist or Project Environmental Consultant.

[6] For projects subject to the 2012 CGP, stabilization is required within 14 days, or within 7 days for sensitive areas.

Unless otherwise specified in Project-specific permit conditions, the National Grid Environmental Scientist or Project Environmental Consultant shall develop an inspection frequency to monitor restored areas for stabilization, germination and successful revegetation.

19.3 Invasive Species

All equipment shall be certified clean[7] utilizing the attached form (Appendix 8) or equivalent as approved by by the vendor prior to mobilization to the work site. The vendor shall use the certification from provided as Appendix 8 to document compliance with invasive species management BMPs, Clean is defined as being free of plant matter (stems, flowers, roots, etc), soil, or other deleterious materials prior to being brought to the project site. Any equipment that has been placed or used within areas containing invasive species within the project site shall be cleaned of plant matter (stems, flowers, roots, etc), soil, or other deleterious materials at the site of the invasive species prior to being moved to other areas on the project site to prevent the spread of invasive species from one area to another[8]. **Equipment shall be cleaned prior to being removed at the completion of the project: exceptions to this requirement shall be determined on a case-by-case basis.** Consult with the National Grid Environmental Scientist prior to discharging or disposing of any waste water or waste material from the cleaning of equipment.

19.4 Cleaning of Equipment

At the completion of the project, Equipment shall be cleaned prior to being de-mobilized to prevent tracking of material onto roads and causing safety issues. Consult with the National Grid Environmental Scientist prior to discharging or disposing of any waste water or waste material from the cleaning of equipment

19.5 Access Routes (Cross Country Routes)

Cross country access routes shall be returned to pre-construction grade (if needed), seeded (if adequate root and seed stock are absent) and mulched. Pre-existing sandy soils within mapped rare turtle habitat shall not be seeded unless directed by the National Grid Environmental Scientist so as to not alter nesting habitat.

19.6 Access Roads

Constructed gravel roads shall be left in place following project completion unless permit conditions require their removal. Refer to the specific permit conditions for these provisions. If the road is to be removed, the crushed stone and geotextile fabric shall be removed from the work site. This excess material can be retained off-site for future maintenance-related access needs.

[7] The Appendix 8 certification form (or equivalent as approved by National Grid Environmental scientist) shall be used to document the clean certification

[8] On ROW projects where multiple wetlands may be dominated by the same invasive species, cleaning may not be required for movement along the ROW. Check with the National Grid Environmental scientist for guidance.

Seeding and/or mulching of gravel roads is generally not required, unless necessary to prevent erosion.

19.7 Stone Work Pads

Unless permit conditions or property owner's require the removal of constructed stone work pads following project completion, constructed work pads shall be left in place. Refer to the specific permit conditions for these provisions.

19.8 Construction Materials on ROWs

As soon as the structure work has been completed, all used parts and trash are to be picked up and removed from the project site. Retired poles shall be removed in accordance with National Grid Engineering Standard SP,06.01.301. In some cases, the used material from structure work may be temporarily stored at the work area by placing it out of the wetlands or other sensitive resource area until work in the adjacent areas has been completed. However, treated wood poles shall never be stored in standing water or in wetlands. If the project is cancelled, all material shall be removed from the project site. Excess material brought to the project site shall be removed upon project completion. Consult with the National Grid Environmental Scientist on whether the work site shall be restored in addition to the measures outlined in 8.14.1 to 8.14.5 above

19.9 Improved Areas

Yards, lawns, agricultural areas, and other improved areas shall be returned to a condition at least equal to that which existed at the start of the project. Alternately, if requested, the property owner may be reimbursed to perform their own restoration, after the site has been left in an environmentally sound manner. If this option is requested, it shall be documented in a written release signed by the property owner. Consult with National Grid Real Estate and/or Stakeholder Relations for the details on existing agreements. Off-ROW access shall never be assumed and shall be coordinated through Real Estate before being implemented. Depending on the access point, swamp matting, composite matting or other BMPs may be required to prevent ruts, lawn damage, or other property damage. Restoration following the completion of work and any use of improved areas shall be conducted in accordance with 8.14.2 above

19.10 Property Damage

All damage to property occurring as a result of a project shall be immediately repaired or replaced. In some locations, it may be desirable to document pre-existing damage prior to work commencing in that area in order to demonstrate afterwards that the damage did not result from the project. Work crews, the Project Environmental Consultant or the National Grid Environmental Scientist shall document repairs that were performed in response to damage from unauthorized vehicle use.

19.11 Overall Work Site

Upon satisfactory completion of work, the construction personnel shall remove all work-related trailers, buildings, rubbish, waste soil, temporary structures, and unused materials belonging to them or used under their direction during construction, or waste materials from previous construction and maintenance operations. All areas shall be left clean, without any litter or equipment (wire, pole butts, anchors, insulators, cross-arms, cardboard, coffee cups, water bottles, etc.) and restored to a stable condition and as near as possible to its original condition, where feasible. Debris and spent equipment shall be returned to the operating facility or contractor staging area for disposal or recycling (cardboard) as appropriate in accordance with EG-111.

19.12 Material Storage/Staging and Parking Areas

Upon completion of all work, all material storage yards, staging areas, and parking areas shall be completely cleared of all waste and debris. Unless otherwise directed or unless other arrangements have been made with an off ROW or off-property owner, material storage yards and staging areas shall be returned to the condition that existed prior to the installation of the material storage yard or staging area. Regardless of arrangements made with a landowner, all areas shall be restored to their pre-construction condition or better. Also any temporary structures erected by the construction personnel, including fences, shall be removed by the construction personnel and the area restored as near as possible to its original condition, including seeding and mulching as needed.

20.0 Notification of Emergency Work

Because it is sometimes difficult to identify wetlands and other sensitive environmental areas, the National Grid Environmental Scientist shall be notified within 24 hours or by the next working day whenever emergency off-road repair work takes place. Although the routine maintenance and emergency repair work is generally allowed, due to site conditions or the scope of the project, notification to the regulating agencies may be required

21.0 Appendices

APPENDIX 1:	Glossary
APPENDIX 2:	Acronyms
APPENDIX 3:	EFI Template
APPENDIX 4:	Simplified EFI Template
APPENDIX 5:	Standard STORMS boilerplate language
APPENDIX 6:	Storm Water, Wetlands & Priority Habitat Environmental Compliance Site Inspection / Monitoring Report Form
APPENDIX 7:	BMP Drawings and Guidelines
APPENDIX 8:	Certification Sheet for Invasive Species Control

Appendix 1 – Glossary

Access Road – An existing, periodically maintained road often consisting of gravel and/or exposed soils or vegetated with grasses but devoid of woody vegetation, that is visible on aerial photography and shown on ROW T-sheets. May include newly permitted permanent roads (i.e., roads to be constructed in accordance with a project-specific permit).

Access Route - A pathway previously used or proposed to be used by crews for access along the ROW. Routes may be shown on ROW T-sheets or previous project access plans but are not improved as maintained gravel/exposed soil roads. Access routes may be mown and can consist of trails utilized by recreational vehicles.

Action Logs – Project-specific log used to document action items required for permit compliance. The log identifies timeframes for completion and responsible parties. The log is typically updated by the Project Environmental Consultant or the National Grid Environment Scientist and circulated to the project team on a weekly, or more frequent, basis.

Bank – The transitional slope immediately adjacent to the edge of a surface water body, the upper limit of which is usually defined by a break in slope, or, for a wetland, where a line delineated in accordance with applicable state and federal regulations that indicates a change from wetland to upland.

BMP – Best Management Practice. Individual engineered constructions or operating procedures intended to minimize and mitigate soil disturbance, erosion, sedimentation, turbid discharges, and/or impacts to sensitive receptors.

Clean - free of plant matter (stems, flowers, roots, etc), soil, or other deleterious materials prior to being brought to the project site.

Clean Gravel – Gravel is a type of coarse-grained soil that consists of small stones and other mineral particles. Clean Gravel shall meet the requirements in accordance with National Grid Standard Construction Specification for Electric Stations (Engineering Standard SP.08.00.001) Clean Gravel will not have fine materials that could lead to a turbid discharge.

Clean Stone (Crushed Stone) – Clean Stone (Crushed Stone) shall meet the requirements in accordance with National Grid Standard Construction Specification for Electric Stations (Engineering Standard SP.08.00.001). Clean Stone will not have fine materials that could lead to a turbid discharge.

Clearing – The cutting of trees and large bushes by hand and/or mechanical means.

Compost Socks – Tubular devices comprised of non-degradable, photodegradable, or biodegradable mesh tubing containing organic compost matrix. Compost socks are effective for intercepting site runoff, trapping sediment, and treating for soluble pollutants by filtering stormwater runoff. .

Compost socks are a useful sedimentation control device along construction site perimeters, as check dams in drainage channels, as a slope interruption practice on long and/or steep slopes, and around drain or street curb inlets.

Corduroy Road – Corduroy roads are cut trees and/or saplings with the crowns and branches removed, and the trunks lined up next to one another.

Dewatering Basin – An established containment area for saturated materials and pumped discharges. This measure is used for the purpose of de-watering soils prior to transport off site or for use in another location on site, and for allowing suspended sediment to settle out of pumped discharges.

Detention/Retention Basin – A detention/retention basin is designed for the purpose of detaining or retaining water. A dewatering basin is a form of detention basin

Dewatering – Use of a system of pumps, pipes and temporary holding dams to drain or divert waterways or wetlands, or lower the groundwater table before and during excavation activities.

Drainage Ditch or Swale – a clearly noticeable channel that is typically dry, except after precipitation events. Intermittent and perennial streams and rivers are not included in this definition.

Dredge – To dig, excavate, or otherwise disturb the contour or integrity of sediments in the bank or bed of a wetland, a surface water body, or other area within the regulating bodies' jurisdiction.

Dredge Spoils – Material removed as the result of dredging.

Embankment – A protective bank constructed of mounded earth or fill materials located between a roadway (or rail bed) and a seasonal stream or other wetland.

Environmental Field Issue – Document that contains copies of all project-specific environmental permits and summarizes all environmental permit conditions. The EFI is prepared by the Project Environmental Consultant or the National Grid Environment Scientist and copies are provided to the Project Manager, Construction Supervisor(s), and other team members as appropriate.

Environmental Monitoring Records – Examples of checklists and/or monitoring reports suggested for use by the Company Environmental Engineer to document conformance of the project with this Environmental Guidance and or project specific permit/license conditions.

Environmental Scientist – Formerly Environmental Engineer. The National Grid Environmental Department representative for the project or the territory where the work is located. For a map of Environmental Department staff territories, refer to the Environmental page of the National Grid infonet.

Environmentally Sensitive Areas – Examples of environmentally sensitive areas that may be found on National Grid properties are rivers, streams, ponds, lakes, wetlands, bogs, swamps, salt marshes, rare species habitat, wellhead protection areas, cultural sites, parks, preserves, schools and as otherwise defined by Federal, State or local regulations. Refer to EG-301.

Erosion Controls – The utilization of methods to prevent soil detachment and minimize displacement or washing down slopes by rainfall or run-off. Common practices include, but are not limited to:

(a) Temporary and Permanent Seeding

(b) Mulching, Soil Binders, Tackifiers

(c) Erosion Control Blankets

(d) Hydraulic Erosion Control

Excavate/Excavation – To dig, remove, or form a cavity or a hole in an area within the department's jurisdiction.

Fill (n.) – Any rock, soil, gravel, sand or other such material that has been deposited or caused to be deposited by human activity.

Fill (v.) – To place or deposit materials in or on a wetland, surface water body, bank or otherwise in or on an area within the jurisdiction of the department.

Flats – Relatively level landforms composed of unconsolidated mineral and organic sediments usually mud or sand, that are alternately flooded and exposed by the tides and that usually are continuous with the shore.

Frozen condition – Field conditions when the upper portion of the ground surface freezes or when areas of standing water freeze solid such that vehicle passage over these areas is supported without any resulting soil disturbance. The frozen conditions must have been affected by severe cold (maximum daily temperatures less than 32 degrees F) for a continuous 2-week period.

GAA – Rhode Island groundwater classification, groundwater resources that are know or presumed to be suitable for drinking water use without treatment and are located in one of the three areas described below.

a) The state's major stratified drift aquifers that are capable of serving as a significant source for a public water supply ("groundwater reservoirs") and the critical portion of their recharge area as delineated by DEM;

b) The wellhead protection area for each public water system community water supply well. Community watrer supply wells are those that serve resident populations and have at least 15 service connections or serve at least 25 individuals, e. g. municipal wells and wells serving nursing homes, condominiums, mobile home parks, etc.; and

c) Groundwater dependent areas that are physically isolated from reasonable alternative water supplies and where existing groundwater warrants the highest level of protection. At present only Block Island has been designated as meeting this criterion..

GA – Rhode Island groundwater classification, groundwater resources that are know or presumed to be suitable for drinking water use without treatment. However, groundwater classified by GA does not fall within any of the three priority areas described under the GAA classification.

Grade/Grading – The movement of soil and fill material to change the elevation of the land. The term refers to the combined actions of excavating and filling to change elevation or shape.

Grubbing – The removal of stumps/roots by mechanical means during site preparation activities.

Immediately - As soon as practicable, but no later than the end of the next work day, following the day when the earth-disturbing activities have temporarily or permanently ceased.

In-kind replacement - replacement using the same material, functional inverts, diameter and length as the existing item. In-kind replacement includes the substitution of a structure with a similar structure in approximately the same location as is practicable, and is approximately the same in design. The design may be altered to meet applicable utility standards, and may include alternate materials designed to prolong the life of that service.

Intermittent Stream – A stream that flows for sufficient time to develop and maintain a defined channel, but which might not flow during dry portions of the year.

In the Dry – Work done either during periods of low water or behind temporary diversions, such as Earth Dike / Drainage Swale and Lined Ditches designed and installed in accordance with best management practices.

Limit of Work/Disturbance – The approved project limits within regulated areas. All project related activities in regulated areas must be conducted within the approved limit of work/disturbance. The limit of work/disturbance shall be depicted on the approved permit site plans and in the EFI plans. Where it is warranted National Grid may require that these limits be identified in the field by flagging, construction fencing, and/or perimeter erosion controls.

Long-Term Restoration Logs - Project-specific log used to document restoration required following the completion of construction or as areas of the project have been completed (i.e., segments of ROW for a multi-mile project). The log is typically updated by the Project Environmental Consultant or the

National Grid Environment Scientist Environment Scientist and circulated to the project team on a weekly basis.

Low Flow Conditions – Low water flow that generally occurs during the summer, as a result of decreased precipitation and the removal of water by increased evaporation and evapotranspiration by vegetation. Work done under low-flow conditions minimizes the potential for environmental damage. The USACE defines the calendar dates for low flow conditions in its New England state-specific Programmatic General Permits.

Low Ground Pressure – equipment that meets the regulatory requirement of < 3 Pounds per Square Inch (PSI) ground pressure when loaded. Use of LGP equipment ***requires approval*** from the National Grid Environmental Scientist.

Marsh – A wetland:

a) That is distinguished by the absence of trees and shrubs;
b) Dominated by soft-stemmed herbaceous plants such as grasses, reeds, and sedges; and
c) Where the water table is at or above the surface throughout the year, but can fluctuate seasonally.

Methods – Are the construction practices and procedures that take place through choosing the proper equipment, trucks and labor to execute the earth moving activities based on the existing conditions and implementing creative and sensitive scheduling for the daily activities.

NHESP - Natural Heritage Endangered Species Program; a department within the Massachusetts Division of Fisheries and Wildlife that is responsible for protecting the 176 species of vertebrate and invertebrate animals and 259 species of native plants that are officially listed as Endangered, Threatened or of Special Concern in Massachusetts.

Perennial – A stream that contains water at all times except during extreme drought.

Permanently Ceased – Is applicable to earth disturbance activities when clearing and excavation within any area of the Project that will not include permanent structures has been completed.

Person-in-Charge – A National Grid Project Engineer, Manager, Supervisor, Field Construction Coordinator or equivalent Contractor personnel assigned to oversee and coordinate work activities.

Processed Gravel – Processed Gravel shall meet the requirements in accordance with National Grid Standard Construction Specification for Electric Stations (Engineering Standard SP.08.00.001) Processed Gravel will not have fine materials that could lead to a turbid discharge. Gravel consisting of inert material that is hard, durable stone and is free from loam and clay, surface coatings and deleterious materials.

Regulating Body – Federal, State, or local authority that has jurisdiction over resource areas that may be impacted by company operations

Regulated Wetland Area – Those areas that are subject to federal, state or local wetland regulation, including certain buffer or adjacent areas.

Repair – The restoring of an existing legal structure by partial replacement of work, or broken, or unsound parts (Env-Wt 101.73).

Replacement – The substitution of a new structure for an existing legal structure with no change in size, dimensions, location, configuration, construction, or which conforms in all material aspects to the original structure

Right-of-Way – A corridor of land where National Grid has legal rights (either fee ownership, lease or easement) to construct, operate, and maintain an electric power line and/or natural gas pipeline and may include work on customer owned properties.

River – A watercourse that is larger than a perennial stream and flows all year long.

Routine Utility Rights-of-Way Maintenance Activity – Includes but is not limited to vegetation management and repair or replacement of existing utility structures.

Sedimentation Controls – Silt fences, straw bales, compost socks/berms and other barrier devices strategically placed to intercept and treat sediment-laden site runoff.

Sensitive Water - Includes any sediment or nutrient impaired water or a water that is identified by the state, tribe or EPA as Tier 2, 2.5 or Tier 3 for antidegradation purposes.

Siltation Curtain – An impervious barrier erected to prevent silt and sand and/or fines from being washed into a wetland, surface water body or other area of concern.

Surface Water Body or Surface Waters – Those portions of waters which have standing or flowing water at or on the surface of the ground.

Spill Prevention, Control and Countermeasure Plans – Required for site operations that involve the storage of 1,320 gallons or greater of fuel and oils, both in storage containers and stored in equipment. Response actions to spills and releases are specified in these plans.

Swamp Mats – Components of a temporary wood, plastic or other suitable material used as a BMP to cross sensitive areas or provide a stable working surface.

Stormwater Pollution Prevention Plan – A site-specific, written document that, among other things: (1) identifies potential sources of stormwater pollution at a construction site; (2) describes stormwater control measures to reduce or eliminate pollutants in stormwater discharge from a construction site;

and (3) identifies procedures the operator will implement to comply with the terms and conditions of EPA NPDES Construction General Permit (CGP). SWPPPs must be prepared, maintained on-site, and amended as necessary in order to obtain NPDES permit coverage for specific construction site stormwater discharges under the EPA NPDES CGP.

Temporarily Ceased - Is applicable when there are earth disturbance activities such as clearing, grading, and/or excavation that are not complete, but will be idle in one area for a period of up to 14 or more calendar days, and which will resume in the future. The 14 calendar day timeframe begins as soon as you now that construction work on a portion of the Project will be left incomplete and idle. In circumstances where there are unanticipated delays and you do not know at first how long the work stoppage will continue, the requirement to immediately initiate stabilization is triggered as soon as you know with reasonable certainty that work will be stopped for 14 or more additional calendar days.

Tidal Wetlands – A wetland whose vegetation, hydrology or soils are influenced by periodic inundation or tidal waters.

Topsoil – The uppermost part of the soil, ordinarily moved in tillage, or its equivalent in uncultivated soils and ranging in depth from 2 to 10 inches.

Turbidity – The condition in which solid particles suspended in water make the water cloudy or even opaque in extreme cases.

United States Geological Survey topographic map – A map that uses contour lines to represent the three-dimensional features of a landscape on a two-dimensional surface. These maps use a line and symbol representation of natural and artificially created features in an area.

Wetland – An area that is inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal conditions does support, a prevalence of vegetation (more than 50 percent) typically adapted for life in saturated soil conditions (hydric soils). Wetlands include but are not limited to swamps, marshes, bogs, and similar areas.

Work Site – An area where work is performed.

Worker – Company employee, contractor, consultant working on site.

Zone II - Massachusetts - That area of an aquifer which contributes water to a well under the most severe pumping and recharge conditions that can be realistically anticipated (180 days of pumping at safe yield, with no recharge from precipitation). It is bounded by the groundwater divides which result from pumping the well and by the contact of the aquifer with less permeable materials such as till or bedrock. In some cases, streams or lakes may act as recharge boundaries. In all cases, Zone IIs shall extend up gradient to its point of intersection with prevailing hydrogeologic boundaries (a groundwater flow divide, a contact with till or bedrock , or a recharge boundary).

Appendix 2 – Acronyms

ASTM	American Society for Testing and Materials
BMP	Best Management Practices
EFI	Environmental Field Issue
EG	Environmental Guidance
EPA	Environmental Protection Agency
GA/GAA	Rhode Island Groundwater Classifications – see glossary
LGP	Low Ground Pressure
MA	Massachusetts
MA DEP	Massachusetts Department of Environmental Protection
MassDOT	Massachusetts Department of Transportation
NE	New England
NH	New Hampshire
NH DES	New Hampshire Department of Environmental Services
NHESP	Natural Heritage Endangered Species Program
NPDES	National Pollutant Discharge Elimination System
OHM	Oil and/or Hazardous Materials
PSI	Pounds per square inch
RI	Rhode Island
RI DEM	Rhode Island Department of Environmental Management
RI CRMC	Rhode Island Coastal Resources Management Council
RI SESC	Rhode Island soil erosion and sediment control
ROW	Right-of-Way
RTE	Rare, Threatened or Endangered
SPCC	Spill Prevention, Control and Countermeasure
SWPPP	Storm Water Pollution Prevention Plan
TOY	Time-of-Year
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
VT	Vermont
VT DEC	Vermont Department of Environmental Conservation

Zone II Massachusetts Groundwater Protection district – see glossary

Appendix 3 – EFI template

See EG303NE_Form1 for the EFI template

Appendix 4 – Simplified EFI template

See EG303NE_Form2 for the Simplified EFI template

Appendix 5 – Standard STORMS boilerplate language

See EG303NE_Form3 for examples of standard STORMS boilerplate language

Appendix 6

See EG303NE_Appendix6_Reporting Form published separately

Appendix 7 – BMPs

See EG303NE_Form4 for a list of BMPS

See EG303NE_Form5 for BMP details

APPENDIX 8
CERTIFICATION FORM FOR INVASIVE SPECIES CONTROL

Certain permit conditions, therefore a Condition of Contracts for the Prime Contractor, any Subcontractors, and any equipment or mat vendors for ***National Grid Projects*** shall be required to Certify their equipment[9] {each piece of equipment used on site} as 'clean'[10].

____ (*name of firm*) hereby Certifies that

____ (*make, model, and/or type*)

____ (*equipment ID tag or #)* meets the following

1. before entry on to the job site, has been sufficiently cleaned to remove all accumulated mud, debris, plant fragments, and detritus that could harbor seeds, roots, or plant fragments of so-called invasive plant species; and

2. that the above piece of equipment has neither been off-loaded nor operated in the interval between cleaning and delivery to the jobsite.

3. that equipment deployed in areas of invasive species (as identified in project plans) shall be cleaned prior to redeployment

______________________________ (*signed*) _______________ (*dated*)

______________________________ (*printed name*) ________________________________ (*title*)

______________________________ (*Firm*)

The signed original of this form {one for each piece of equipment (or lot[11] of mats)} is to be given to the NG Field Construction Coordinator assigned to the project.

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9 Equipment may include, but is not limited to bulldozers, excavators, backhoes, bucket trucks (tracked or wheeled), pulling equipment, concrete trucks, compressors, drilling equipment, and mats (composite, wood, or other materials).

10 With regard to invasive species, the definition of clean means free of accumulated mud, debris, plant fragments, and detritus that could harbor seeds, roots, or plant fragments of so-called invasive plant species.

11 Lot of mats is the number of mats that may be transported by one forwarder/truck at a time.

Record of Change		
Date of Review/Revision:		
Revision	**Date**	**Description**
0	1/23/12	Issued New England Specific EG-303 NE
1	04/22/13	Stone wall dismantling edits.
2	1/23/14	added bmp # 39, edited text on p40 to reference form1 and form2
3	08/29/14	Added section on communication of project specific environmental requirements (2.5), added appendices for EFI, simplified EFI, and STORMS boilerplate language. Added language concerning removal of BMPs (18.1). Minor edits to BMP details, and renumbered appendices. Added swamp mat transition, mat air bridge and silt sack BMP details.
4	2/5/15	Adding additional language about signage and demarcation of rare species populations and historic resources.
5	07/01/2015	Revised construction entrances/exits (5.2) per R170 audit findings.
6	09/28/2015	Added 4.1 (Refreshing of wetland flagging), revised 9.7 (stockpiling on mats), added 18.0 (stabilization deadlines) revised 19.2 (in-situ restoration), and edited BMP details (straw wattle, seeding options), added rock ford detail.
7	10/03/16	Added text to 2.5 for Simplified EFI (documentation of environmental resources present on projects where no permitting required).
8	10/21/2016	Amended Sections 9.1 and 9.4, adding guidance on dust, noise and vibration control requirements.

	BMP #	Measure
Sediment & Erosion Controls	1	Weed free bale barrier
	2	Sediment control fence
	3	Silt fence / weed free barrier
	4	Silt Soxx
	5	Straw Wattle
	6	Erosion Control Blanket - Ditch
	7	Erosion Control Blanket - Slope
	8	Hydroseeding with Tackifier (slope stabilization)
	9	Mulch materials, rates and uses (from NY)
	10	Seeding options - Upland Seed Mixes
	11	Seeding options - Wetland Seed Mix
Crossing Measures	12	Prefabricated mats
	13	Mat bridge
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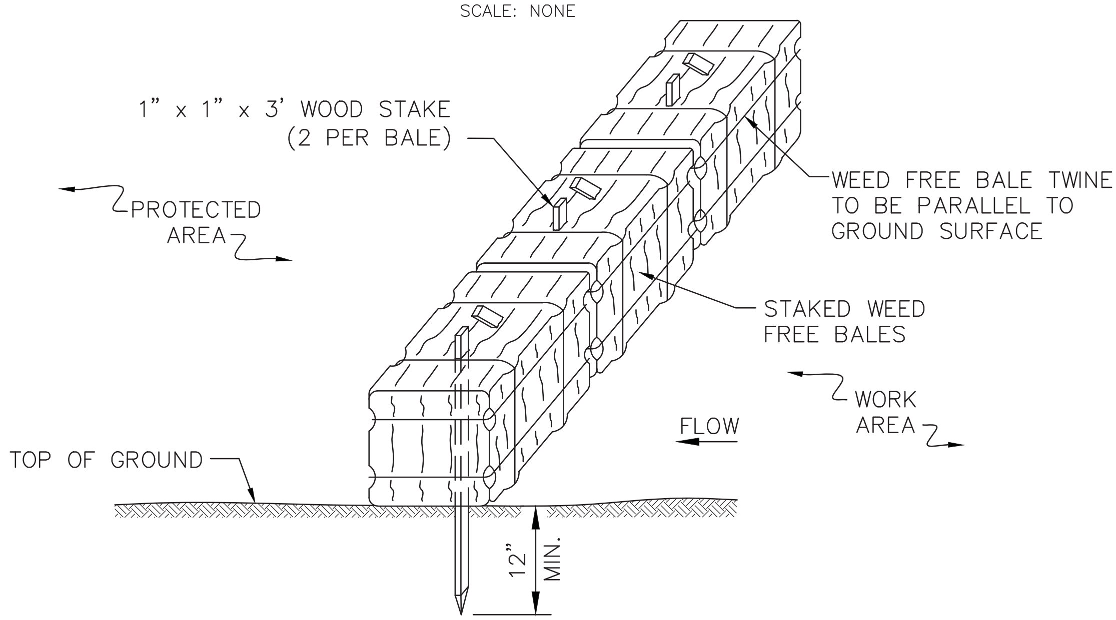
BMP DETAIL

SCALE: NONE



NOTES:

1. THE GROUND SHALL BE PREPARED TO PROVIDE COMPLETE CONTACT WITH THE BALES.

BMP PICTURE

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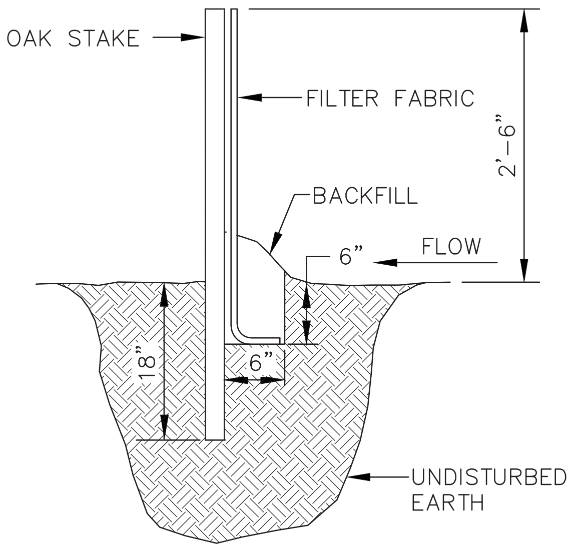
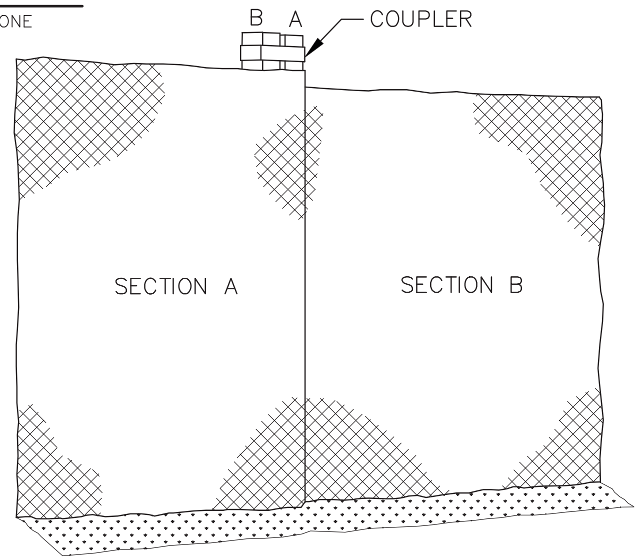
BMP # 1
WEED FREE BALE BARRIER

BMP DETAIL

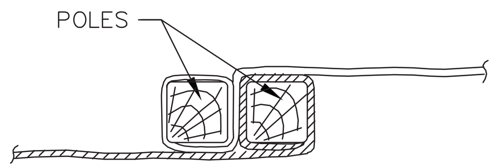
SCALE: NONE



PROFILE



SECTION



PLAN

BMP PICTURE

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BMP # 2
SEDIMENT CONTROL FENCE

File: Sediment_Fence.dwg

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Reference
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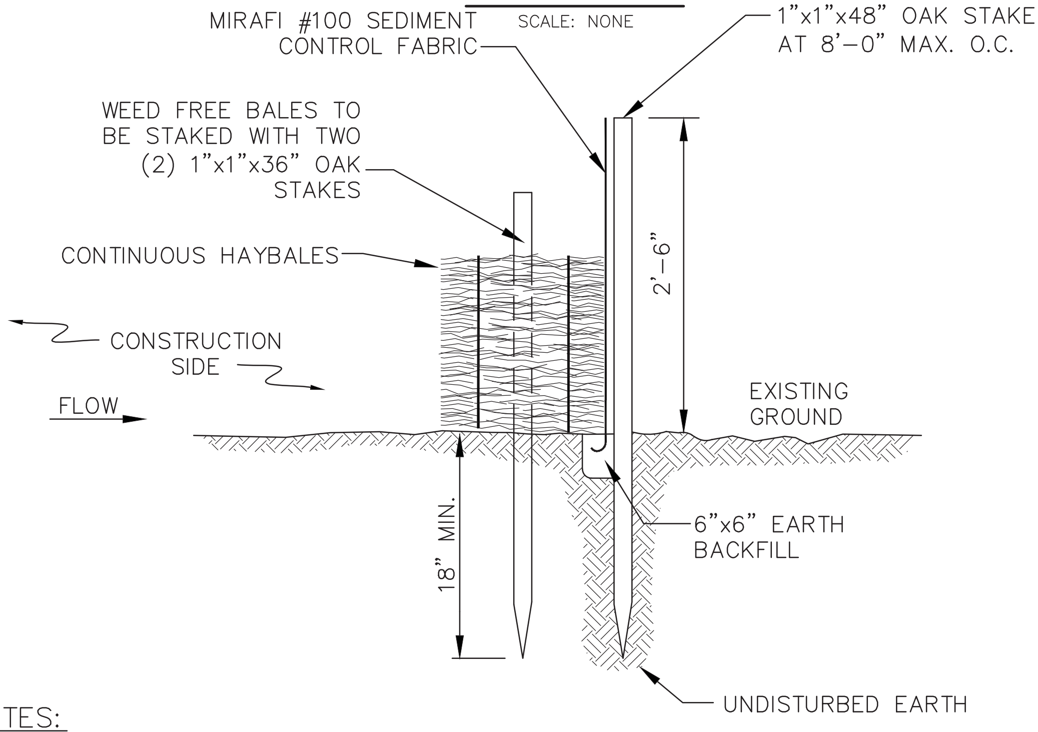
BMP DETAIL



NOTES:

1. BALES SHALL BE PLACED IN A ROW WITH THE ENDS TIGHTLY ABUTTING THE ADJACENT BALES.
2. BALES SHALL BE SECURELY ANCHORED IN PLACE BY TWO (2) 1"X1"X36" OAK STAKES DRIVEN THROUGH THE BALES. THE FIRST STAKE IN EACH BALE SHALL BE ANGLED TOWARD PREVIOUSLY LAID BALE TO FORCE BALES TOGETHER.
3. INSPECTION SHALL BE FREQUENT AND REPAIR OR REPLACEMENT SHALL BE MADE PROMPTLY AS NEEDED.
4. BALES SHALL BE REMOVED AND REPLACED WHEN THEY BECOME FILLED WITH SEDIMENT AND BLOCK OR IMPEDE STORM FLOW OR DRAINAGE.
5. BALES SHALL BE REMOVED WHEN THE EMBANKMENTS STABILIZE.
6. BALES TO BE TWINE BOUND.

BMP PICTURE

File: Silt_Fence_&_Barrier.dwg

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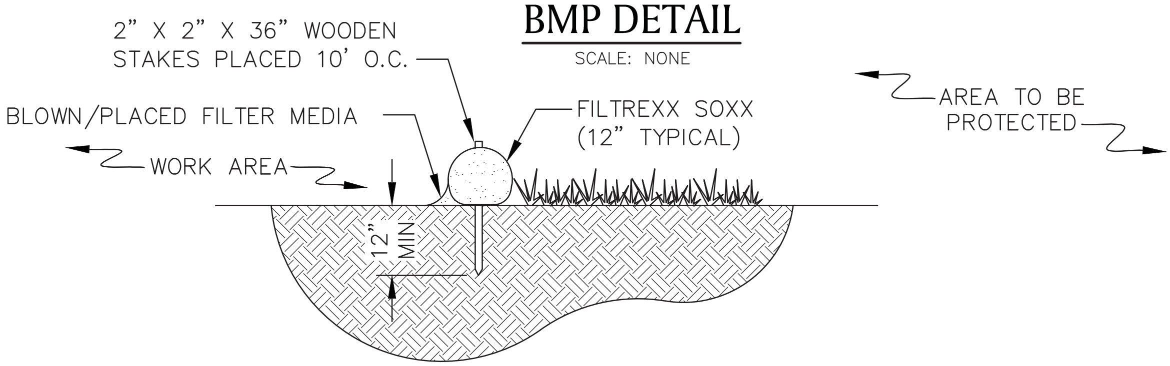
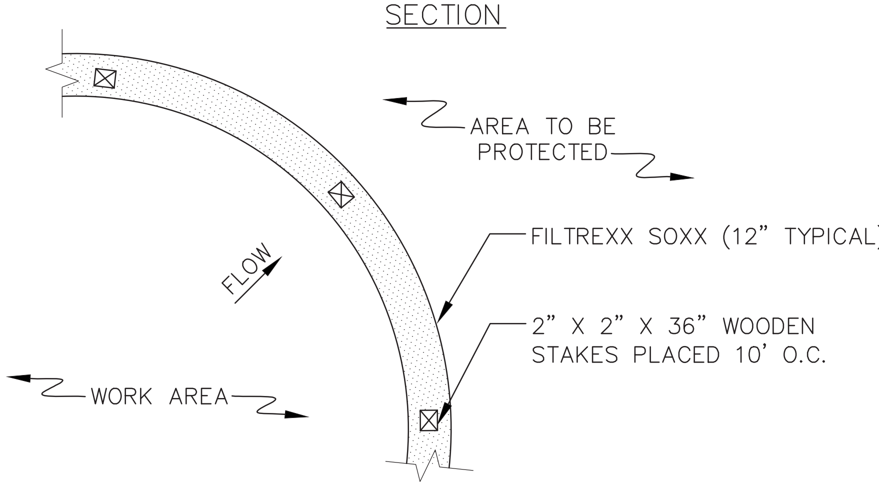
BMP # 3
SILT FENCE / WEED FREE BARRIER

BMP DETAIL

SCALE: NONE



SECTION



PLAN

NOTES

1. PRODUCT TO BE FILTREXX SILT SOXX OR APPROVED EQUAL BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. ALL MATERIAL TO MEET FILTREXX SPECIFICATIONS.
3. FILTER MEDIA FILL TO MEET APPLICATION REQUIREMENTS.
4. COMPOST MATERIAL TO BE DISPERSED ON SITE, AS DETERMINED BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.

BMP PICTURE

File: SiltSOXX.dwg

* PICTURE AND DETAIL PROVIDED BY FILTREXX LAND IMPROVEMENT SYSTEMS

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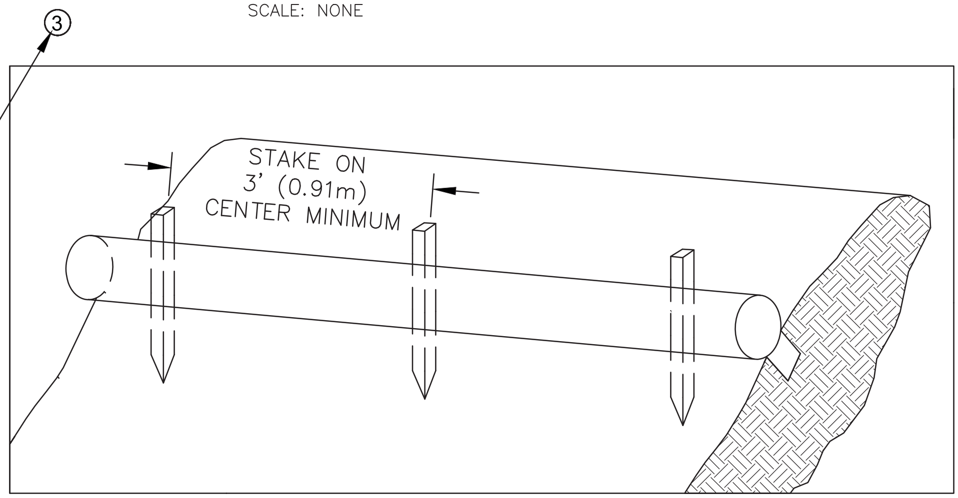
BMP # 4
SILT SOXX *

BMP DETAIL

SCALE: NONE

CIRCLED NUMBERS CORRESPOND TO INSTALLATION NOTES FOR THIS STRAW WATTLE BMP DETAIL (TYP.)



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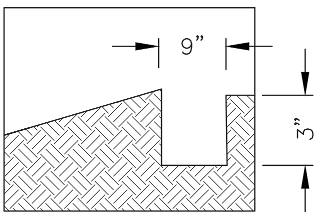

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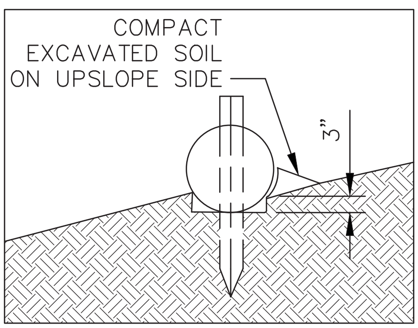
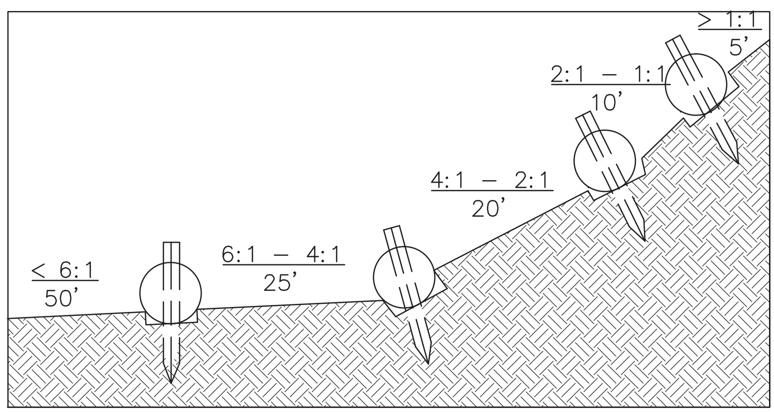




TYPICAL WATTLE SPACING DETAIL

NOTES:

1. PRODUCT TO BE TENSAR NORTH AMERICAN GREEN STRAW WATTLE OR APPROVED EQUAL BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. TYPICAL WATTLE SPACING BASED ON SLOPE GRADIENT. COORDINATE SPACING AND LOCATION WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.
3. MINIMUM 12" DIAMETER WATTLES SHOULD BE USED FOR HIGHLY DISTURBED AREAS (I.E., HEAVILY USED ACCESS ROAD WITH ADJACENT WETLAND) AND MINIMUM 9–10" WATTLES SHOULD BE USED FOR LESS DISTURBED SOILS.

INSTALLATION NOTES:

1. BEGIN AT THE LOCATION WHERE THE WATTLE IS TO BE INSTALLED BY EXCAVATING A 2–3" DEEP X 9" WIDE TRENCH ALONG THE CONTOUR OF THE SLOPE. EXCAVATED SOIL SHOULD BE PLACED UPSLOPE FROM THE ANCHOR TRENCH.
2. PLACE THE WATTLE IN THE TRENCH SO THAT IT CONTOURS TO THE SOIL SURFACE. COMPACT SOIL FROM THE EXCAVATED TRENCH AGAINST THE WATTLE ON THE UPHILL SIDE. ADJACENT WATTLES SHOULD TIGHTLY ABUT.
3. SECURE THE WATTLE WITH 18–24" STAKES EVERY 3–4' AND WITH A STAKE ON EACH END. STAKES SHOULD BE DRIVEN THROUGH THE MIDDLE OF THE WATTLE LEAVING AT LEAST 2–3" OF STAKE EXTENDING ABOVE THE WATTLE. STAKES SHOULD BE DRIVEN PERPENDICULAR TO THE SLOPE FACE.

BMP PICTURE

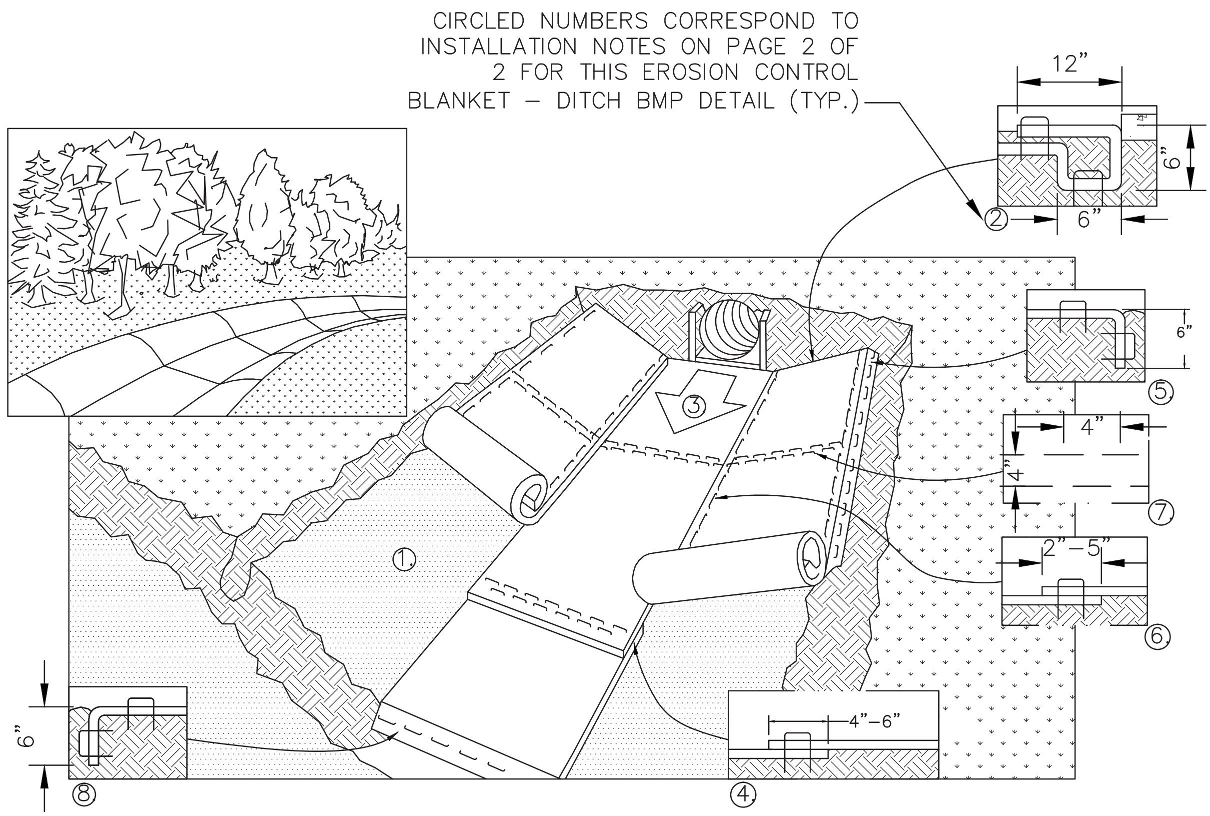
STRAW WATTLE – SHALLOW SLOPE (≤4:1)
(ALTERNATE STAKING)

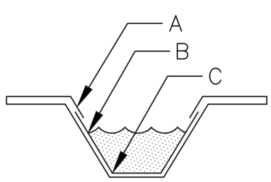
ALTERNATE STAKING INSTALLATION NOTES:

1. ON SHALLOW SLOPES (≤4:1), STRAW WATTLE MAY BE SECURED WITH 18–24" STAKES DRIVEN AGAINST THE SIDES OF THE WATTLE INSTEAD OF THROUGH. STAKES SHALL ALTERNATE SIDES, AND BE SPACED 3–4' MAX.
2. TWINE SHALL BE TIED FROM STAKE TO STAKE, CRISS–CROSSING THE STRAW WATTLE. TIE TWINE TO STAKES BELOW THE HEIGHT OF THE WATTLE.

BMP DETAIL

SCALE: NONE





CRITICAL POINTS
A. OVERLAPS AND SEAMS
B. PROJECTED WATER LINE
C. CHANNEL BOTTOM/SIDE SLOPE VERTICES

NOTES:
1. PRODUCT TO BE NORTH AMERICAN GREEN EROSION CONTROL BLANKET OR APPROVED EQUAL BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. HORIZONTAL STAPLE SPACING SHOULD BE ALTERED IF NECESSARY TO ALLOW STAPLES TO SECURE THE CRITICAL POINTS ALONG THE CHANNEL SURFACE.
3. IN LOOSE SOIL CONDITIONS, THE USE OF STAPLE OR STAKE LENGTHS GREATER THAN 6” (15 CM) MAY BE NECESSARY TO PROPERLY ANCHOR THE ROLLED EROSION CONTROL PRODUCTS (RECP’s).

BMP DETAIL

INSTALLATION NOTES:

1. PREPARE SOIL BEFORE INSTALLING ROLLED EROSION CONTROL PRODUCTS (RECP's), INCLUDING ANY NECESSARY APPLICATION OF LIME, FERTILIZER, AND SEED. NOTE: WHEN USING CELL-O-SEED DO NOT SEED PREPARED AREA. CELL-O-SEED MUST BE INSTALLED WITH PAPER SIDE DOWN.
2. BEGIN AT THE TOP OF THE CHANNEL BY ANCHORING THE RECP's IN A 6" (15 CM) DEEP X 6" (15 CM) WIDE TRENCH WITH APPROXIMATELY 12" (30 CM) OF RECP's EXTENDED BEYOND THE UP-SLOPE PORTION OF THE TRENCH. ANCHOR THE RECP's WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30 CM) APART IN THE BOTTOM OF THE TRENCH. BACKFILL AND COMAPCT THE TRENCH AFTER STAPLING. APPLY SEED TO COMPACTED SOIL AND FOLD REMAINING 12" (30 CM) PORTION OF RECP's BACK OVER SEED AND COMPACTED SOIL. SECURE RECP's OVER COMPACTED SOIL WITH A ROW OF STAPLES/STAKES SPACED APPROXIMATELY 12" (30 CM) ACROSS THE WIDTH OF THE RECP's.
3. ROLL CENTER RECP's IN DIRECTION OF WATER FLOW IN BOTTOM OF CHANNEL. RECP's WILL UNROLL WITH APPROPRIATE SIDE AGAINST THE SOIL SURFACE. ALL RECP's MUST BE SECURELY FASTENED TO SOIL SURFACE BY PLACING STAPLES/STAKES IN APPROPRIATE LOCATIONS AS SHOWN IN THE STAPLE PATTERN GUIDE. ™ WHEN USING THE DOT SYSTEM , STAPLES/STAKES SHOULD BE PLACED THROUGH EACH OF THE COLORED DOTS CORRESPONDING TO THE APPROPRIATE STAPLE PATTERN.
4. PLACE CONSECUTIVE RECP's END OVER END (SHINGLE STYLE) WITH A 4" - 6" (10 CM -15 CM) OVERLAP. USE A DOUBLE ROW OF STAPLES STAGGERED 4" (10 CM) APART AND 4" (10 CM) ON CENTER TO SECURE RECP's.
5. FULL LENGTH EDGE OF RECP's AT TOP OF SIDE SLOPES MUST BE ANCHORED WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30 CM) APART IN A 6" (15 CM) DEEP X 6" (15 CM) WIDE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.
6. ADJACENT RECP's MUST BE OVERLAPPED APPROXIMATELY 2" - 5" (5 CM -12.5 CM) (DEPENDING ON RECP's TYPE) AND STAPLED.
7. IN HIGH FLOW CHANNEL APPLICATIONS, A STAPLE CHECK SLOT IS RECOMMENDED AT 30 TO 40 FOOT (9 M - 12 M) INTERVALS. USE A DOUBLE ROW OF STAPLES STAGGERED 4" (10 CM) APART AND 4" (10 CM) ON CENTER OVER ENTIRE WIDTH OF THE CHANNEL.
8. THE TERMINAL END OF THE RECP's MUST BE ANCHORED WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30 CM) APART IN A 6" (15 CM) DEEP X 6" (15 CM) WIDE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.

BMP PICTURE

* PICTURE AND DETAIL PROVIDED BY TENSAR NORTH AMERICAN GREEN

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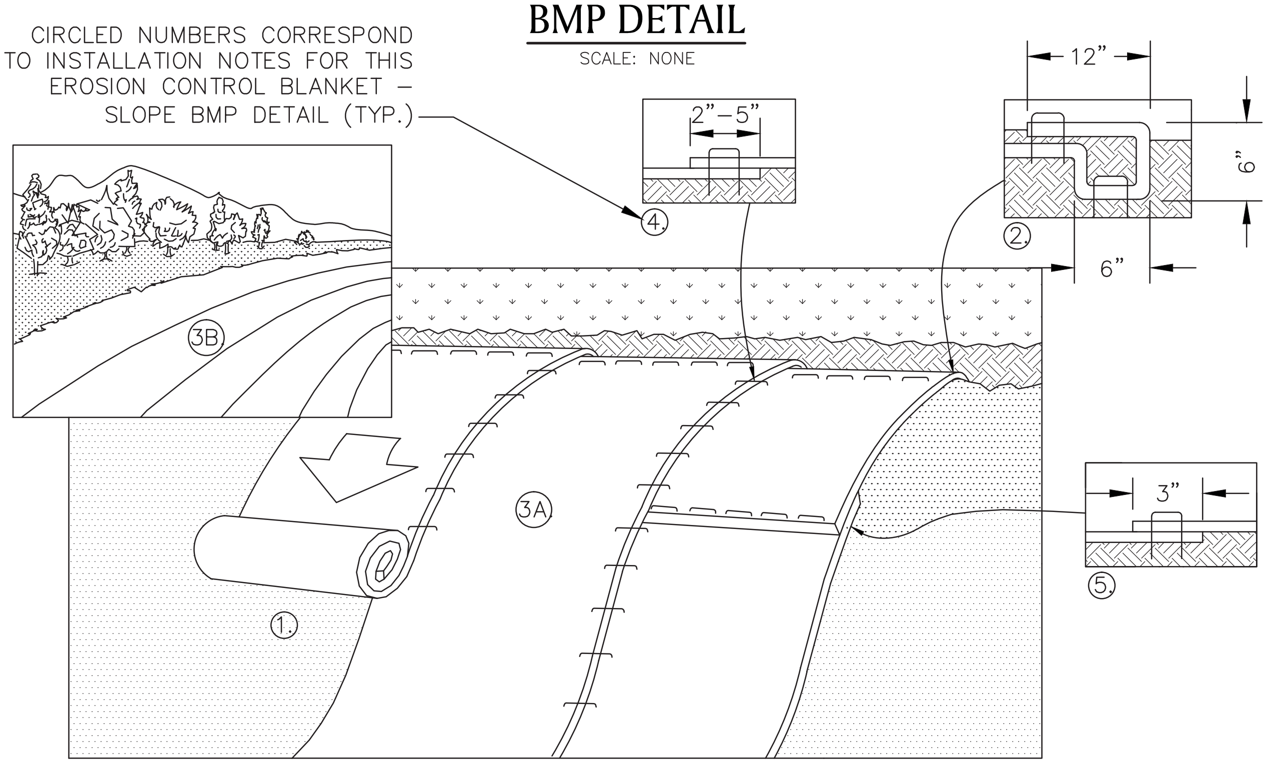
BMP # 6
EROSION CONTROL BLANKET - DITCH * (2 OF 2)

BMP DETAIL

SCALE: NONE



NOTES:

1. PRODUCT TO BE NORTH AMERICAN GREEN EROSION CONTROL BLANKET OR APPROVED EQUAL BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. IN LOOSE SOIL CONDITIONS, THE USE OF STAPLES OR STAKE LENGTHS GREATER THAN 6" (15 CM) MAY BE NECESSARY TO PROPERLY SECURE THE RECP's.

INSTALLATION NOTES:

1. PREPARE SOIL BEFORE INSTALLING ROLLED EROSION CONTROL PRODUCTS (RECP's), INCLUDING ANY NECESSARY APPLICATION OF LIME, FERTILIZER, AND SEED. NOTE: WHEN USING CELL–O–SEED DO NOT SEED PREPARED AREA. CELL–O–SEED MUST BE INSTALLED WITH PAPER SIDE DOWN.
2. BEGIN AT THE TOP OF THE SLOPE BY ANCHORING THE RECP's IN A 6" (15 CM) DEEP X 6" (15 CM) WIDE TRENCH WITH APPROXIMATELY 12" (30 CM) OF RECP's EXTENDED BEYOND THE UP–SLOPE PORTION OF THE TRENCH. ANCHOR THE RECP's WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30 CM) APART IN THE BOTTOM OF THE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING. APPLY SEED TO COMPACTED SOIL AND FOLD REMAINING 12" (30 CM) PORTION OF RECP's BACK OVER SEED AND COMPACTED SOIL. SECURE RECP's OVER COMPACTED SOIL WITH A ROW OF STAPLES/STAKES SPACED APPROXIMATELY 12" (30 CM) APART ACROSS THE WIDTH OF THE RECP's.
3. ROLL THE RECP's (A.) DOWN OR (B.) HORIZONTALLY ACROSS THE SLOPE. RECP's WILL UNROLL WITH APPROPRIATE SIDE AGAINST THE SOIL SURFACE. ALL RECP's MUST BE SECURELY FASTENED TO SOIL SURFACE BY PLACING STAPLES/STAKES ™ IN APPROPRIATE LOCATIONS AS SHOWN IN THE STAPLE PATTERN GUIDE. WHEN USING THE DOT SYSTEM , STAPLES/STAKES SHOULD BE PLACED THROUGH EACH OF THE COLORED DOTS CORRESPONDING TO THE APPROPRIATE STAPLE PATTERN.
4. THE EDGES OF PARALLEL RECP's MUST BE STAPLED WITH APPROXIMATELY 2" – 5" (5 CM – 12.5 CM) OVERLAP DEPENDING ON RECP's TYPE.
5. CONSECUTIVE RECP's SPLICED DOWN THE SLOPE MUST BE PLACED END OVER END (SHINGLE STYLE) WITH AN APPROXIMATE 3" (7.5 CM) OVERLAP. STAPLE THROUGH OVERLAPPED AREA, APPROXIMATELY 12" (30 CM) APART ACROSS ENTIRE RECP's WIDTH.

* PICTURE AND DETAIL PROVIDED BY TENSAR NORTH AMERICAN GREEN

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BMP # 7

EROSION CONTROL BLANKET - SLOPE * (1 OF 2)

BMP PICTURE

* PICTURE AND DETAIL PROVIDED BY TENSAR NORTH AMERICAN GREEN

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BMP # 7
EROSION CONTROL BLANKET - SLOPE * (2 OF 2)

BMP PICTURE

NOTES:

1. COORDINATE MIXTURE TYPE AND APPLICATION AREAS WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST PRIOR TO CONSTRUCTION.
2. A MINIMUM OF 1500 LBS. PER ACRE OF A PAPER/CORN FIBER OR EQUIVALENT WITH NATURAL TACKIFIERS WILL BE USED ON SLOPES LESS THAN 3:1.
3. A BFM (BONDED FIBER MATRIX) WILL BE USED ON SLOPES GREATER THAN 2:1.
4. A FGM (FLEXIBLE GROWTH MATRIX) OR ESM (EXTREME SLOPE MATRIX) WILL BE USED ON SLOPES GREATER THAN 1:1.
5. REFER TO BMP #10 FOR SEED MIXTURE OPTIONS.

* PICTURE PROVIDED BY TENSAR NORTH AMERICAN GREEN
* TACKIFIER INFORMATION PROVIDED BY FILTREXX LAND IMPROVEMENT SYSTEMS AND TENSAR NORTH AMERICAN GREEN

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BMP # 8
HYDROSEEDING WITH TACKIFIER
(SLOPE STABILIZATION) *

BMP

Definition

Applying coarse plant residue or chips, or other suitable materials, to cover the soil surface.

Purpose

The primary purpose is to provide initial erosion control while a seeding or shrub planting is establishing. Mulch will conserve moisture and modify the surface soil temperature and reduce fluctuation of both. Mulch will prevent soil surface crusting and aid in weed control. Mulch is also used alone for temporary stabilization in non-growing months.

Conditions Where Practice Applies

On soils subject to erosion and on new seedings and shrub plantings. Mulch is useful on soils with low infiltration rates by retarding runoff.

Criteria

Site preparation prior to mulching requires the installation of necessary erosion control or water management practices and drainage systems.

Slope, grade and smooth the site to fit needs of selected mulch products.

Remove all undesirable stones and other debris to meet the needs of the anticipated land use and maintenance required.

Apply mulch after soil amendments and planting is accomplished or simultaneously if hydroseeding is used.

Select appropriate mulch material and application rate or material needs. Determine local availability.

Select appropriate mulch anchoring material.

NOTE: The best combination for grass/legume establishment is straw (cereal grain) mulch applied at 2 ton/ acre (90 lbs./1000sq.ft.) and anchored with wood fiber mulch (hydromulch) at 500 – 750 lbs./acre (11 – 17 lbs./1000 sq. ft.). The wood fiber mulch must be applied through a hydroseeder immediately after mulching.

NOTE:

1. PICTURE DEPICTS STRAW MULCH APPLICATION (FROM MULCH SPREADER) ON STEEP SLOPE WITH AN IMPROVED DRAINAGE SWALE.
2. COORDINATE MULCH MATERIALS AND RATES WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.

* BMP INFORMATION FROM "NEW YORK STANDARDS AND SPECIFICATIONS FOR EROSION AND SEDIMENT CONTROL (AUGUST, 2005)." INFORMATION OBTAINED VIA WEBSITE: http://www.dec.ny.gov/chemical/29066.html

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BMP # 9
MULCH MATERIALS, RATES AND USES (FROM NY) *

UPLAND ROW RESTORATION MIX – GENERAL

Species Composition Options:

- Andropogon gerardii; Niagra Big Bluestem
- Schizachyrium scoparium; Little Bluestem
- Elymus Canadensis; Canada Wild Rye
- Elymus virginicus; Virginia Wildrye
- Lolium multiflorum; Annual Ryegrass
- Sorghastrum nutans; Indiangrass
- Chamaecrista fasciculate; Partridge Pea
- Desmodium canadense; Showy Tick Trefoil
- Helioposis helianthoides; Ox–Eye Sunflower
- Panicum virgatum; Switchgrass
- Rudbeckia hirta; Black Eyed Susan
- Poa palustris; Fowl Bluegrass
- Agrostis perennans; Upland Bentgrass
- Agrostis alba; Redtop
- Festuca rubra; Red Fescue
- Lotus corniculatus; Birds–Foot Trefoil
- Chrysanthemum leucanthem; Ox–Eye Daisy
- Aster novae–angliae; New England Aster

Example Seed Mixes:

1. Native Upland wildlife forage and Cover Meadow Mix – Ernst Conservation Seeds (ERNMX–123)
2. Eastern Ecotype Native Grass Mix– Ernst Conservation Seeds (ERNMX–177)
3. New England Native Warm Season Grass Mix – New England Wetland Plants, Inc.
4. New England Logging Road Mix – New England Wetland Plants, Inc.
5. Northeast Upland Wildflower/Restoration Erosion Mix – Southern Tier Consulting (STCMX–2)

UPLAND ROW RESTORATION MIX – DRY/ROCKY SITES

Species Composition Options:

- Festuca rubra; Red Fescue
- Schizachyrium scoparium; Little Bluestem
- Elymus Canadensis; Canada Wild Rye
- Bouteloua gracillis; Blue Grama
- Lolium multiflorum; Annual Ryegrass
- Lolium perenne; Perennial Ryegrass
- Agrostics scabra; Rough Bentgrass
- Agrostis perennans; Upland Bentgrass
- Sorghastrum nutans; Indiangrass

Example Seed Mixes:

1. New England Erosion Control/ Restoration Mix for Dry Sites – New England Wetland Plants, Inc.
2. Ernst Conservation Seeds and similar companies can create a custom seed mix matching the composition above (with site specific additions if necessary).

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WETLAND ROW RESTORATION MIX

Species Composition Options:

- Agrostis stolonifera; Creeping Bentgrass
- Poa trivialis; Rough Bluegrass
- Alopecurus arundinaceus; Creeping Meadow Foxtail
- Lolium multiflorum; Annual Ryegrass
- Festuca rubra; Creeping Red Fescue
- Elymus virginicus; Virginia Wildrye
- Schizachyrium scoparium; Little Bluestem
- Andropogon gerardii; Niagra Big Bluestem
- Carex vulpinoidea; Fox sedge
- Panicum virgatum; Switchgrass
- Agrostis scabra; Rough Bentgrass
- Aster novae-angliae; New England Aster
- Eupatorium perfoliatum; Boneset
- Euthamia graminifolia; Grass Leaved Goldenrod
- Scirpus atrovirens; Green Bulrush
- Verbene hastate; Blue Vervain
- Juncus effusus; Soft Rush
- Scirpus cyperinus; Wool Grass
- Panicum clandestinum; Deertongue

Example Seed Mixes

1. New England Erosion Control/Restoration Mix for Detention Basins and Moist Sites – New England Wetland Plants, Inc.
2. Northeast Wetland Grass Seed Mix – Southern Tier Consulting (STCMX-7)
3. Ernst Conservation Seeds and similar companies can create a custom seed mix matching the composition above (with site specific additions if necessary).

GERNERAL NOTES:

1. Seed mixes described herein are intended to cover a variety of typical new england landscapes. However, site specific seed mixes will need to be evaluated in coastal or mountainous regions.
2. Seed mixes described herein are intended for general ROW restoration. Site specific wetland seed mixes may be required by local, state and/or federal regulators for certain impacts to wetlands.
3. All seed mixes are to be approved by National Grid Environmental Scientist prior to construction and must conform with all project permits.
4. Seedbed preparation and maintenance as well as temporary erosion and sediment controls are crucial to the establishment of newly seeded areas. Coordinate with National Grid Environmental Scientist on seed bed preparation and maintenance as well as temporary erosion and sediment controls prior to construction.

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BMP PICTURE

SCALE: NONE

NOTES:

1. PRODUCT TO BE ALTURNAMATS' PREFABRICATED MATS OR APPROVED EQUAL BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. PRODUCT AVAILABLE IN 4X8' UNITS.
3. IF MATS ARE INSTALLED IN A WETLAND AREA, INSTALL EROSION CONTROLS TO CONTAIN MATERIAL UTILIZED IN THE MAT TRANSITIONS.

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BMP # 12
PREFABRICATED MATS *

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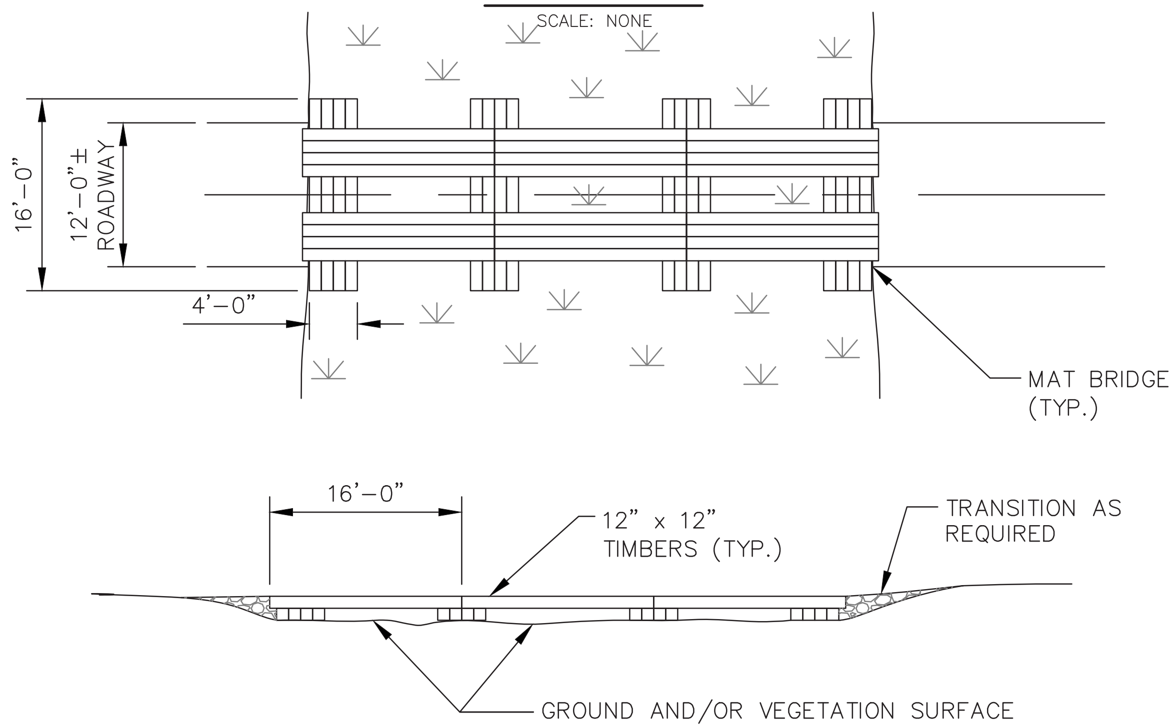
BMP DETAIL

SCALE: NONE



NOTES:

1. IF MATS ARE INSTALLED IN A WETLAND AREA, INSTALL EROSION CONTROLS TO CONTAIN MATERIAL UTILIZED IN THE MAT TRANSITIONS.

BMP PICTURE

File: Mat_Bridge.dwg

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BMP # 13

MAT BRIDGE

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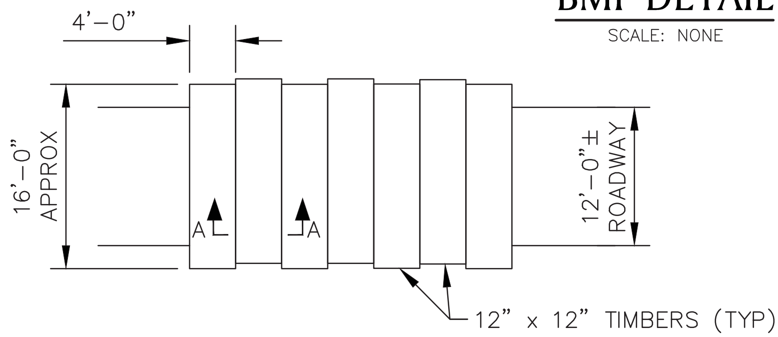
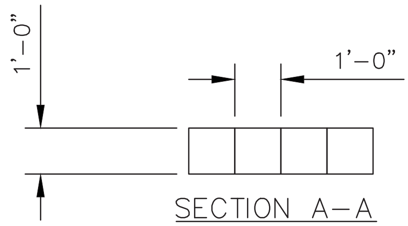
BMP DETAIL

SCALE: NONE

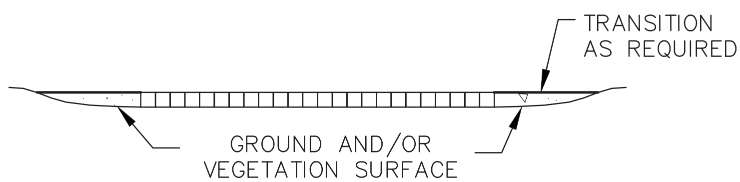


TYPICAL PLAN VIEW



SECTION A–A

TYPICAL MAT SECTION
BOLTED TOGETHER



TYPICAL SECTION VIEW

NOTES:

1. TO BE INSTALLED IF NECESSARY TO PREVENT RUTTING, TO ACCESS STRUCTURES.
2. THIS DETAIL SHOWS TYPICAL DIMENSIONS. SOME CONTRACTOR'S SWAMP MATS ARE DIMENSIONALLY DIFFERENT FROM WHAT IS SHOWN HERE.
3. DEPENDENT ON SITE CONDITIONS, MULTIPLE LAYERS OF SWAMP MATS MAY BE INSTALLED.

BMP PICTURE

File: Swamp_Mat_Layout.dwg

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BMP # 14
SWAMP MAT LAYOUT
(WITH TRANSITION)

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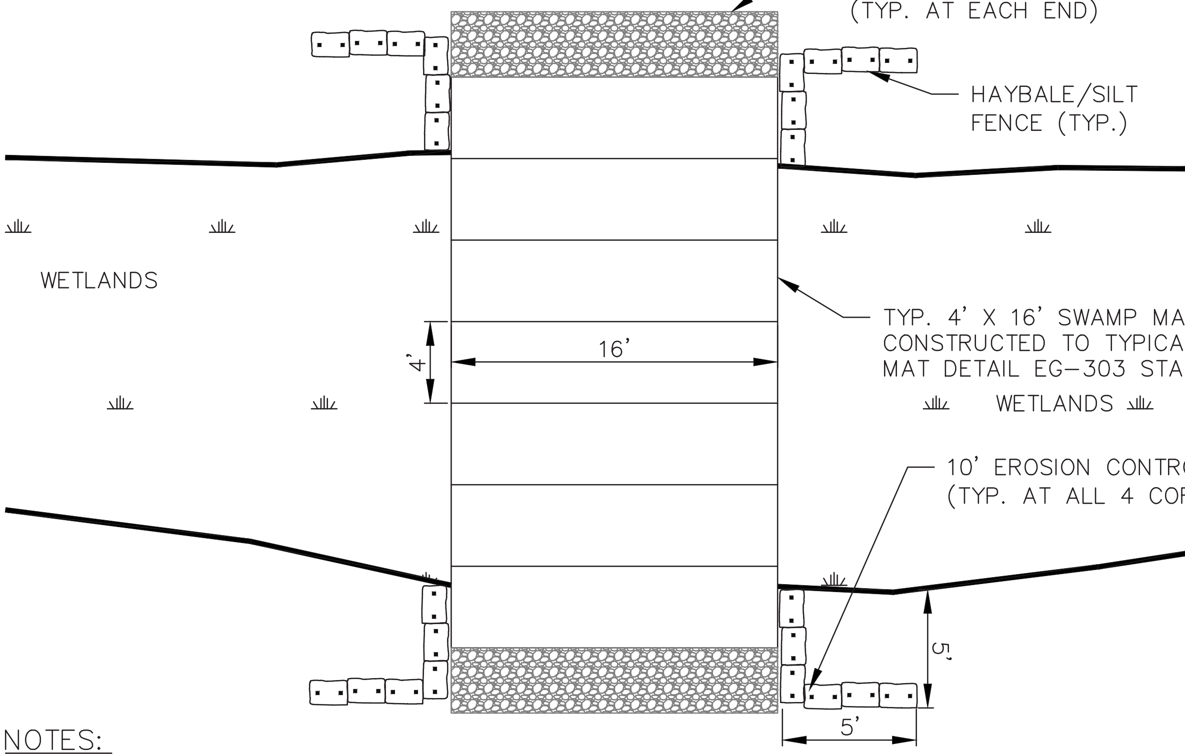
BMP DETAIL

SCALE: NONE



NOTES:
1. ADD FILTER FABRIC AS NEEDED UNDER STONE TRANSITION RAMPS.
2. ALL MEASUREMENTS AND LOCATIONS ARE APPROXIMATE.

BMP PICTURE

File: Swamp_Mat_Transition and BMPs.dwg

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BMP # 15
SWAMP MAT LAYOUT
(WITH TRANSITION AND BMPs)

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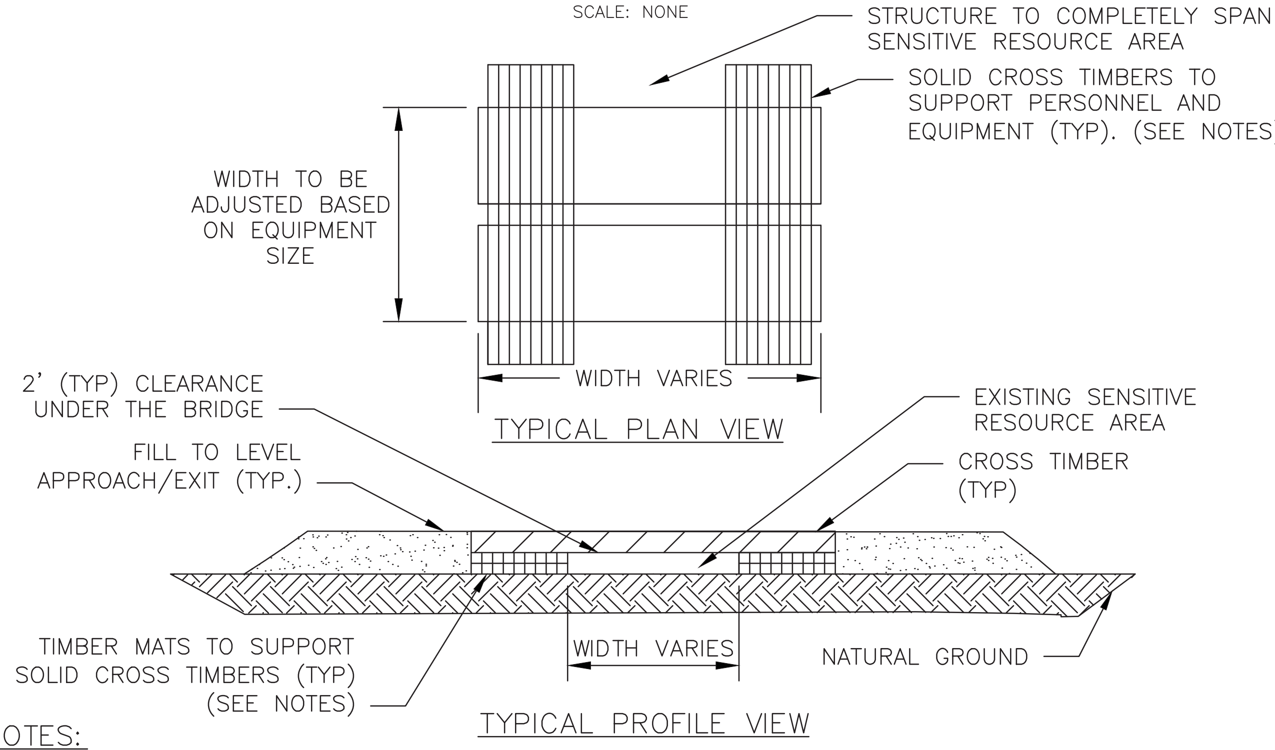
BMP DETAIL

SCALE: NONE



NOTES:

1. THE DETAIL SHOWN IS CONCEPTUAL. TIMBER MATS AND CROSS TIMBERS SHALL BE SIZED AND SELECTED BASED ON SPAN WIDTH, CROSSING EQUIPMENT AND FIELD CONDITIONS.
2. THE NUMBER OF TIMBER MATS MAY VARY DEPENDING ON THE CLEARANCE HEIGHT.
3. EQUIPMENT AND PERSONNEL LOAD SHALL BE DISTRIBUTED ON ALL TIMBERS.
4. EACH EQUIPMENT OPERATOR AND USER OF THE FIELD BRIDGE SHALL BE FAMILIAR WITH THE DESIGN AND THE MAXIMUM EQUIPMENT AND PERSONNEL LOADS.
5. THIS DETAIL MAY NOT BE APPLICABLE IN ALL FIELD CONDITIONS.
6. INSTALL EROSION CONTROLS ADJACENT TO THE CULVERT ENDS TO PROTECT THE WATERWAY FROM ROADWAY DEBRIS.

BMP PICTURE

File: Swamp_Mat_AIR BRIDGE.dwg

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BMP # 16

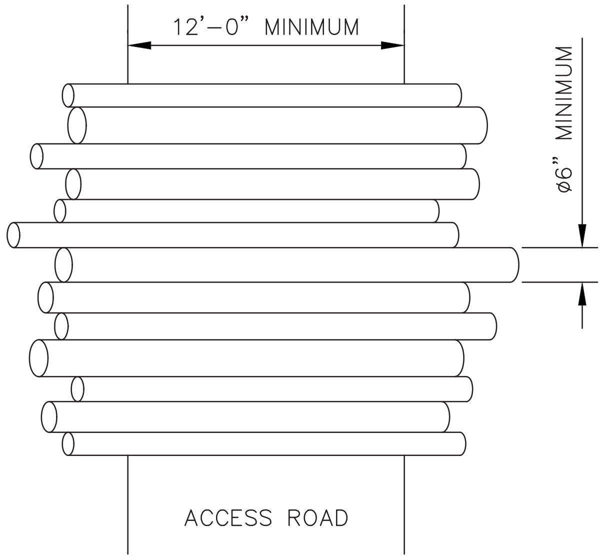
SWAMP MAT - AIR BRIDGE

SUBJECT
Access, Maintenance and Construction Best Management Practices

Reference
EP No. 3 - Natural Resource Protection (Chapter 6)

BMP DETAIL

SCALE: NONE



RANDOM LENGTH AND DIAMETER LOGS PLACED ACROSS AN ACCESS ROAD

NOTE:

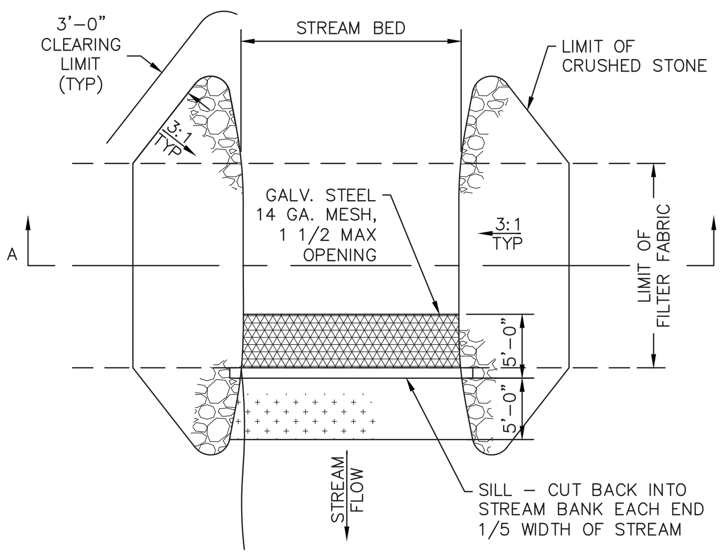
1. A SIMILAR BRUSH MAT INSTALLATION CONSISTING OF SMALLER DIAMETER STEMS AND LOGS CAN BE USED.
2. CORDUROY ROADS SHALL ONLY BE USED IN EMERGENCIES OR AFTER APPROVAL FROM THE PROJECT ENVIRONMENTAL CONSULTANT OR NATIONAL GRID ENVIRONMENTAL SCIENTIST.

BMP PICTURE

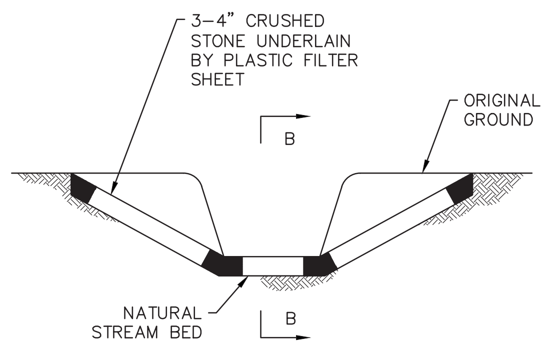
BMP # 17
CORDUROY ROAD

BMP DETAIL

SCALE: NONE

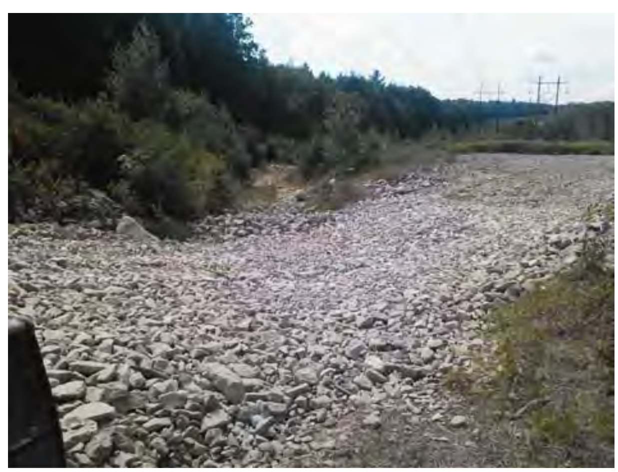


PLAN VIEW



SECTION 'A–A'

BMP PICTURE



File: Rock_Ford.dwg

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BMP # 18

ROCK FORD

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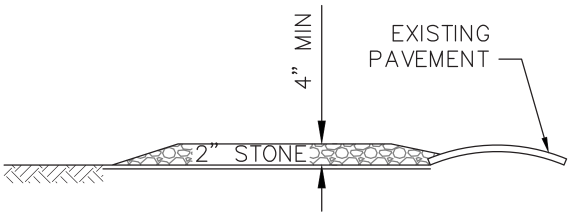
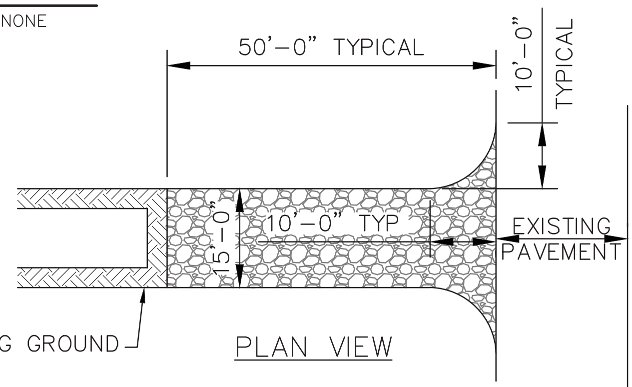
BMP DETAIL

SCALE: NONE



CROSS–SECTION



PLAN VIEW

NOTES:

1. STONE SIZE – USE 2" STONE (MINIMUM) TO 6" STONE (MAXIMUM)
2. LENGTH – GREATER THAN OR EQUAL TO 50 FEET
3. THICKNESS – 4"
4. WIDTH – FIFTEEN (15) FOOT TYP., BUT NOT LESS THAN FULL WIDTH AT POINTS WHERE INGRESS OR EGRESS OCCURS.
5. SURFACE WATER – ALL SURFACE WATER FLOWING OR DIVERTED TOWARD CONSTRUCTION ENTRANCES SHALL BE PIPED ACROSS ENTRANCE. IF PIPING IS IMPRACTICAL, MOUNTABLE BERM SHALL BE PERMITTED.
6. MAINTENANCE – THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION WHICH SHALL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHTS–OF–WAY. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL STONE AS CONDITIONS DEMAND AND REPAIR OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT. ALL SEDIMENT SPILLED, DROPPED, WASHED OR TRACKED ONTO PUBLIC RIGHTS–OF–WAY MUST BE REMOVED IMMEDIATELY.
7. PERIODIC INSPECTION AND NEEDED MAINTENANCE SHALL BE PROVIDED.
8. THE CLEAN STONE SHOULD BE INSTALLED OVER A GEOTEXTILE FABRIC. GEOTEXTILE FABRIC MAY BE OMITTED FOR PERMANENT CONSTRUCTION ENTRANCES/EXITS ON A CASE–BY–CASE BASIS WITH THE APPROVAL OF THE NATIONAL GRID ENVIRONMENTAL SCIENTIST.
9. FOLLOWING CONSTRUCTION, THE CONSTRUCTION ENTRANCE/EXIT SHALL BE REMOVED AND THE AREA GRADED, SEEDED, AND MULCHED AS NEEDED. ENTRANCE/EXITS MAY REMAIN DEPENDING UPON FUTURE ACCESS NEEDS AND/OR PROJECT–SPECIFIC APPROVALS BUT REQUIRES APPROVALS FROM THE NATIONAL GRID ENVIRONMENTAL SCIENTIST AND PROPERTY LEGAL.

BMP PICTURE

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BMP # 19
TEMPORARY CONSTRUCTION ENTRANCE/ EXIT

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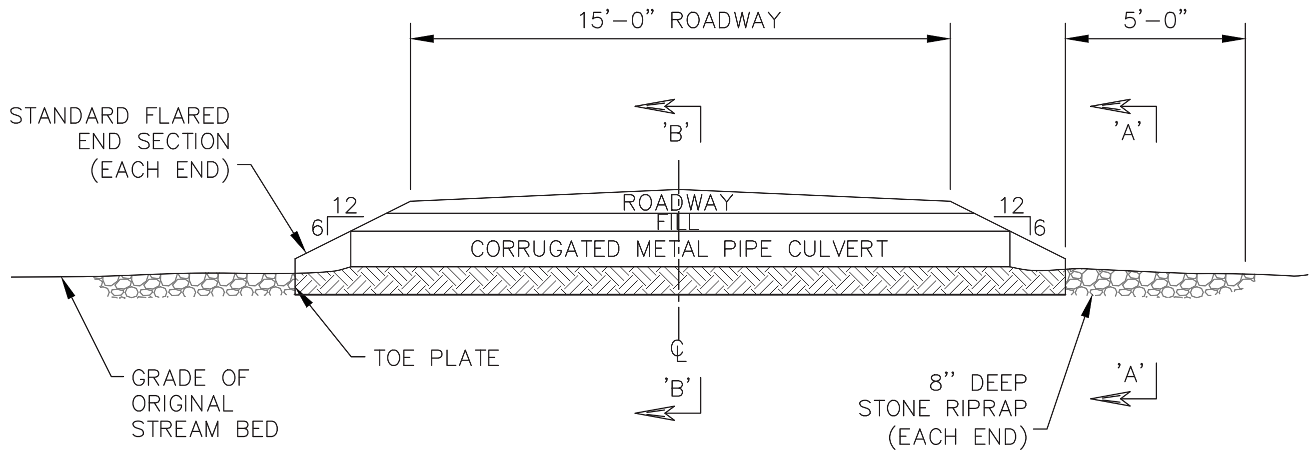
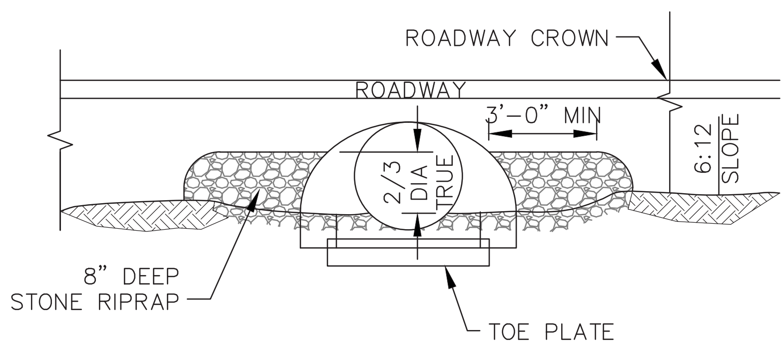
BMP DETAIL

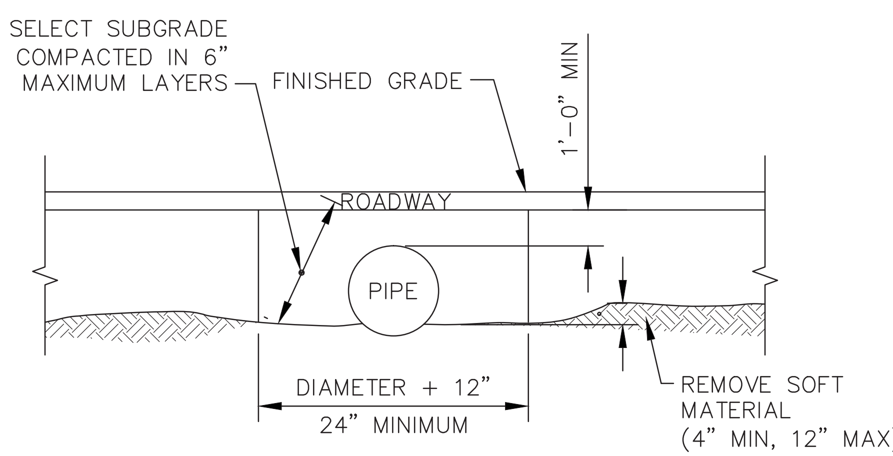
SCALE: NONE



CROSS SECTION



SECTION 'A–A'
(SAME BOTH ENDS)



SECTION 'B–B'

File: Temp_Constr_Culvert.dwg

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BMP # 19
TEMPORARY CONSTRUCTION CULVERT (1 OF 2)

BMP DETAIL

SCALE: NONE

NOTES:

1. CULVERT DESIGN AND LAYOUT SHALL BE COORDINATED WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST (NGES).
2. CROWN ROADWAY 1/2 INCH PER FOOT.
3. LAY THE CULVERT STRAIGHT AND AS NEARLY AS POSSIBLE ALONG THE EXISTING STREAM BED AND WITH THE INVERTS AT OR SLIGHTLY BELOW BED ELEVATION.
4. CORRUGATED METAL PIPE IS TO BE GALVANIZED STEEL, OR ALUMINIZED STEEL (TYPE 2), WITH BOLTED CONNECTORS.
5. DIAMETERS SHALL BE AS PER THE PROJECT DRAWINGS AND THE SPECIFICATION. THE PIPE GAGE SHALL BE AS FOLLOWS:

DIAMETER (INCHES)	GAGE
12" – 15"	.004"
18" – 24"	.079"
30" – 36"	.109"

6. INSTALLATION OF CULVERTS LARGER THAN 36 INCH DIAMETER SHALL REQUIRE SPECIAL ENGINEERING DESIGN.
7. SELECT SUBGRADE SHALL BE A GRANULAR MATERIAL AS DESCRIBED IN NYSDOT SPECIFICATION ITEM 203–2.02C, OR AS APPROVED BY A NGES.
8. STONE RIPRAP SHALL BE AS DESCRIBED IN NYSDOT SPECIFICATION ITEM 203–2.02D, WITH 8 INCH MAXIMUM SIZE, OR AS APPROVED BY A NGES. EXCEPT WHERE PROTECTED BY STONE, ALL EMBANKMENT SLOPES ARE TO BE STABILIZED, MULCHED AND SEEDED AS PER PROJECT SPECIFICATIONS.
9. OUTLET SHOULD BE CONFIGURED NOT TO CREATE HYDRAULIC JUMP OR PLUNGE POOL.
10. INSTALL EROSION CONTROLS ADJACENT TO THE CULVERT ENDS TO PROTECT THE WATERWAY FROM ROADWAY DEBRIS.

BMP PICTURE

BMP PICTURE

NOTE:

1. PICTURE SHOWS VIEW OF ACCESS WAY STABILIZATION ADJACENT TO A WETLAND.
2. COORDINATE STABILIZATION DESIGN AND PRODUCT WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.

File: Access_Stabilization.dwg

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BMP PICTURE

NO ACCESS – WETLAND/STREAM CROSSING MATS REQUIRED

NO ACCESS – A.) PROJECT LIMITS E.G. ROW LIMITS
B.) HISTORICAL/CULTURAL
C.) ENVIRONMENTALLY SENSITIVE E.G. THREATENED & ENDANGERED
D.) OTHER

APPROVED ACCESS

File: Construction_Signage.dwg

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BMP # 22
CONSTRUCTION SIGNAGE

BMP DETAIL

SCALE: NONE

WIRE BACKED SILT FENCE

MUTUAL INDUSTRIES WIRE BACKED SILT FENCE
PART # 1776–14–24
36" X 100'
36" MISF 1776 FABRIC
24" 14GA WIRE MESH
OPENING OF MESH 2" X 4"
FABRIC HOG RINGED EVERY 12"–18" ALONG THE TOP OF THE FENCE

ROLL WEIGHT 40 LBS

32 ROLLS PER PALLET

NOTES:

1. PRODUCT TO BE MUTUAL INDUSTRIES' WIRE BACKED SILT FENCE OR APPROVED EQUAL BY NATIONAL ENVIRONMENTAL SCIENTIST.
2. COORDINATE INSTALLATION METHOD AND LOCATION WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.

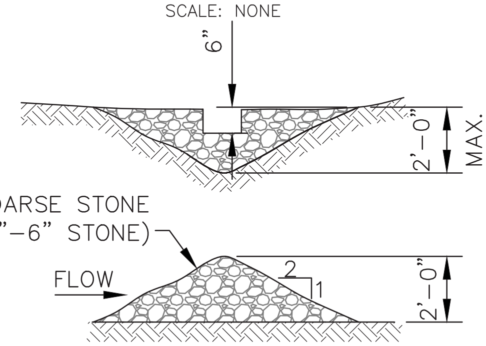
BMP PICTURE

NOTE:

1. PICTURE SHOWS SEDIMENT FILTER WITHIN A WETLAND.

BMP DETAIL

SCALE: NONE



STONE CHECK DAM

NOTES:

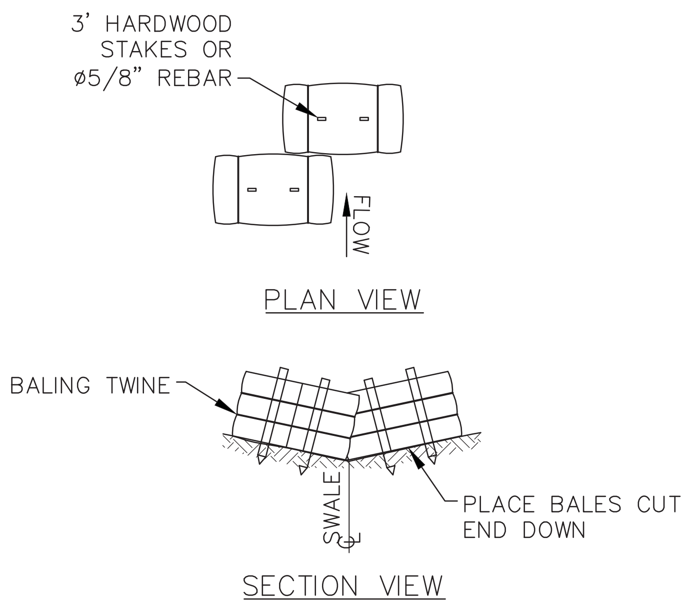
1. USE CHECK DAMS TO SLOW WATER FLOWS AND AS SMALL SEDIMENT TRAPS IN DITCHES ALONG ACCESS ROADS.
2. CLEAN SEDIMENT AND REPLACE DAMS AS NECESSARY.
3. THE CENTER OF THE CHECK DAM MUST BE AT LEAST 6" LOWER THAN THE OUTER EDGES.
4. COORDINATE SPACING WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.
5. MAX. SPACING: TOE OF THE UPSTREAM DAM IS SAME ELEVATION AS TOP OF DOWNSTREAM DAM.
6. STONE SHALL BE FREE OF FINE PARTICLES TO PREVENT TURBID DISCHARGES.

BMP PICTURE

NOTE: A SMALLER STONE SIZE IS SHOWN IN THIS PICTURE.

BMP DETAIL

SCALE: NONE



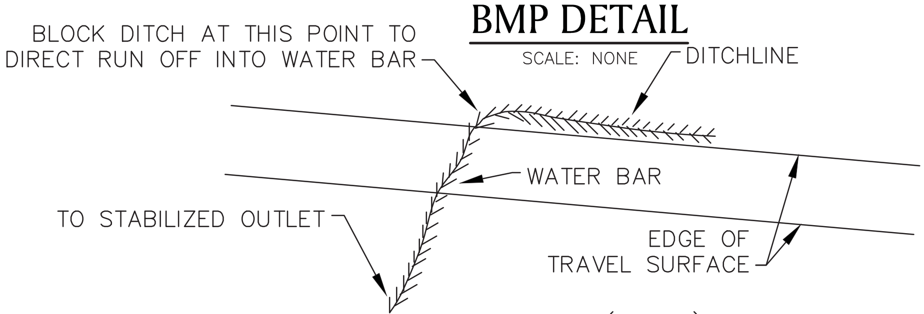
NOTES:
1. USE CHECK DAMS TO SLOW WATER FLOWS AND AS SMALL SEDIMENT TRAPS IN DITCHES ALONG ACCESS ROADS.
2. CLEAN SEDIMENT AND REPLACE DAMS AS NECESSARY.
3. COORDINATE SPACING WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.

BMP PICTURE

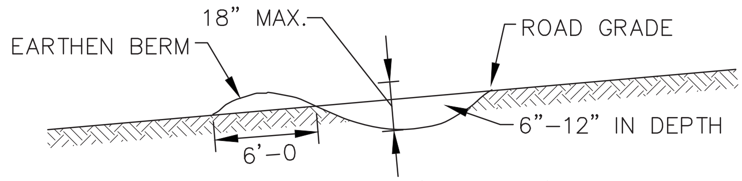
BMP # 26
STRAW / HAYBALE CHECK DAM

BMP DETAIL

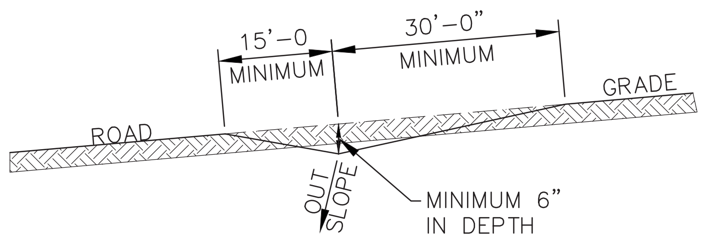
SCALE: NONE



WATERBAR (PLAN)



WATERBAR (SECTION)



DISCHARGE (SECTION)

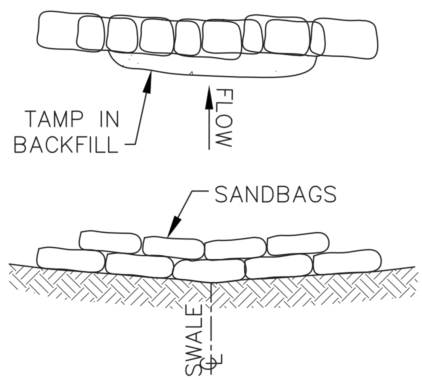
NOTE:

1. LINE WITH 2"–6" STONE UNDERLAIN BY GEOTEXTILE FILTER FABRIC, KEYED INTO ROAD SURFACE AT LEAST 10 FEET EACH SIDE OF WATERBAR.
2. COORDINATE SPACING WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.

BMP PICTURE

BMP DETAIL

SCALE: NONE



SANDBAG
CHECK DAM

NOTES:

1. USE CHECK DAMS TO SLOW WATER FLOWS AND AS SMALL SEDIMENT TRAPS IN DITCHES ALONG ACCESS ROADS.
2. CLEAN SEDIMENT AND REPLACE DAMS AS NECESSARY.
3. COORDINATE SPACING WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.

BMP PICTURE

NOTE:

1. PICTURE DOES NOT DEPICT "TAMP IN BACKFILL"

BMP PICTURE

NOTE:

1. EXACT SIZE, LOCATION AND DESIGN IS DEPENDANT ON SITE CONDITIONS, AND LOCAL AND STATE REGULATIONS. COORDINATE THIS BMP WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST PRIOR TO CONSTRUCTION.

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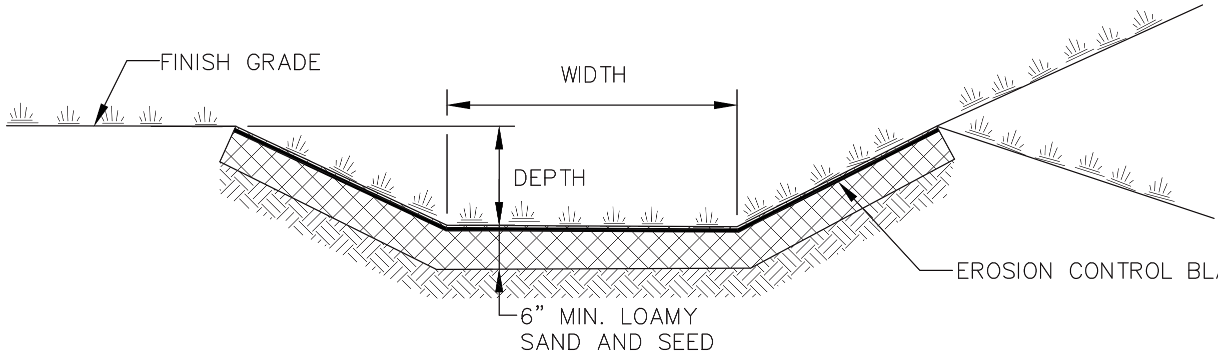
BMP DETAIL

SCALE: NONE



NOTES:

1. WIDTH AND DEPTH OF SWALE, AND EROSION CONTROL BLANKET TYPE TO BE COORDINATED WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. REFER TO BMP # 10 FOR SEED MIXTURE OPTIONS.

BMP PICTURE

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BMP # 30
DRAINAGE SWALE AND LINED DITCH

File: Lined_Drainage_Swale.dwg

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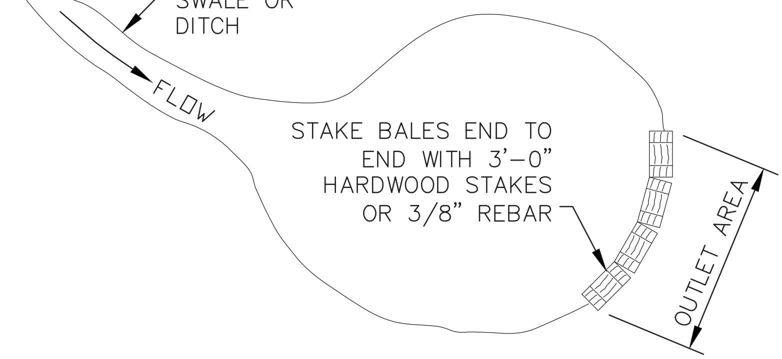
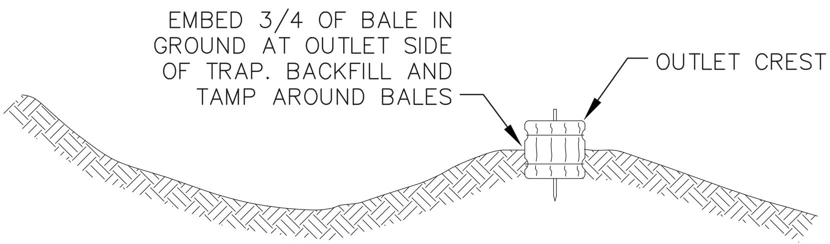
BMP DETAIL

SCALE: NONE





TYPICAL PROFILE

NOTES

1. SIZE, SHAPE AND PROFILE OF SEDIMENT WILL VARY ACCORDING TO ANTICIPATED FLOW VOLUME AND SURROUNDING TERRAIN AND SHALL BE COORDIANTED WITH THE NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. THE BASIN SHALL BE CUT BELOW THE GROUNDLINE. FILL SHALL NOT BE USED TO HOLD WATER UNLESS ROLLED AND COMPACTED.
3. OUTLET AREA IS TO REMAIN FREE OF EXCAVATION SPOILS.
4. OUTLET CREST ELEVATION SHALL BE LOWER THAN INLET ELEVATION AND AT LEAST 1'–0" BELOW THE TOP OF THE BASIN.ARMOUR SLOPES >8% IN OUTLET AREA WITH STONE OF APPROPRIATE SIZE TO PREVENT SCOUR.
5. ARMOUR SLOPES >8% IN OUTLET AREA WITH STONE OF APPROPRIATE SIZE TO PREVENT SCOUR.

BMP PICTURE

File: Sedimentation_Basin.dwg

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BMP # 31
SEDIMENTATION BASIN

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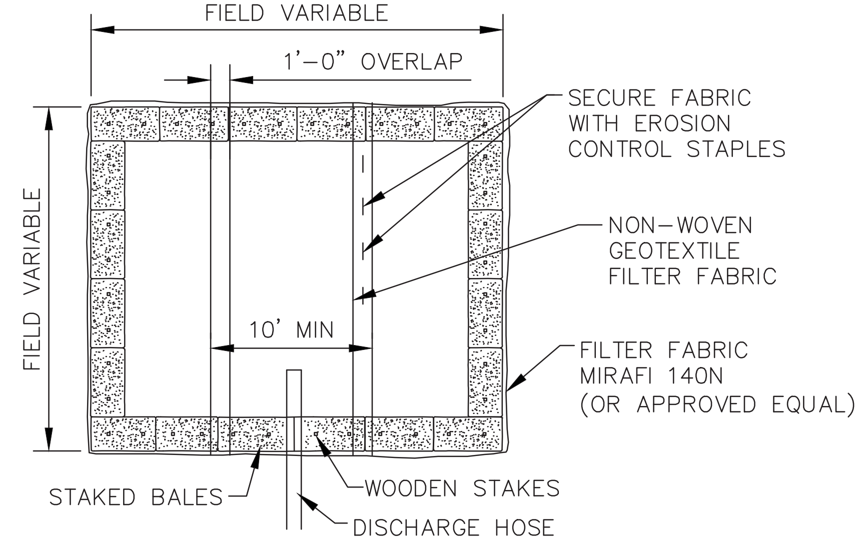
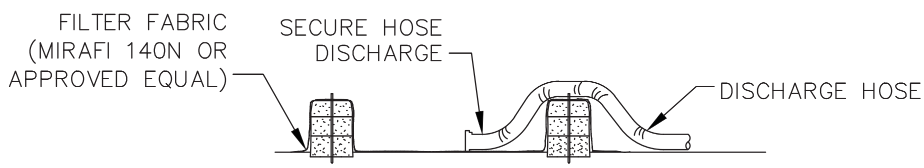
BMP DETAIL

SCALE: NONE



PLAN VIEW



CROSS–SECTION

NOTES:

1. NUMBER OF BALES MAY VARY DEPENDING ON SITE CONDITIONS,
2. THE BASIN TO BE SIZED TO PREVENT DISCHARGE WATER FROM OVERTOPPING BASIN.
3. KEEP AS FAR FROM WETLANDS AS PRACTICAL.
4. CLEAN AND REMOVE AS SOON AS DEWATERING IS COMPLETE.

BMP PICTURE

File: Dewat_Bas_Small.dwg

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BMP # 32
DEWATERING BASIN (SMALL SCALE)

BMP PICTURE

NOTE:

1. EXACT SIZE, LOCATION AND DESIGN IS DEPENDANT ON SITE CONDITIONS, AND LOCAL AND STATE REGULATIONS. COORDINATE THIS BMP WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST PRIOR TO CONSTRUCTION.

BMP # 33
DEWATERING BASIN -
LARGE SCALE

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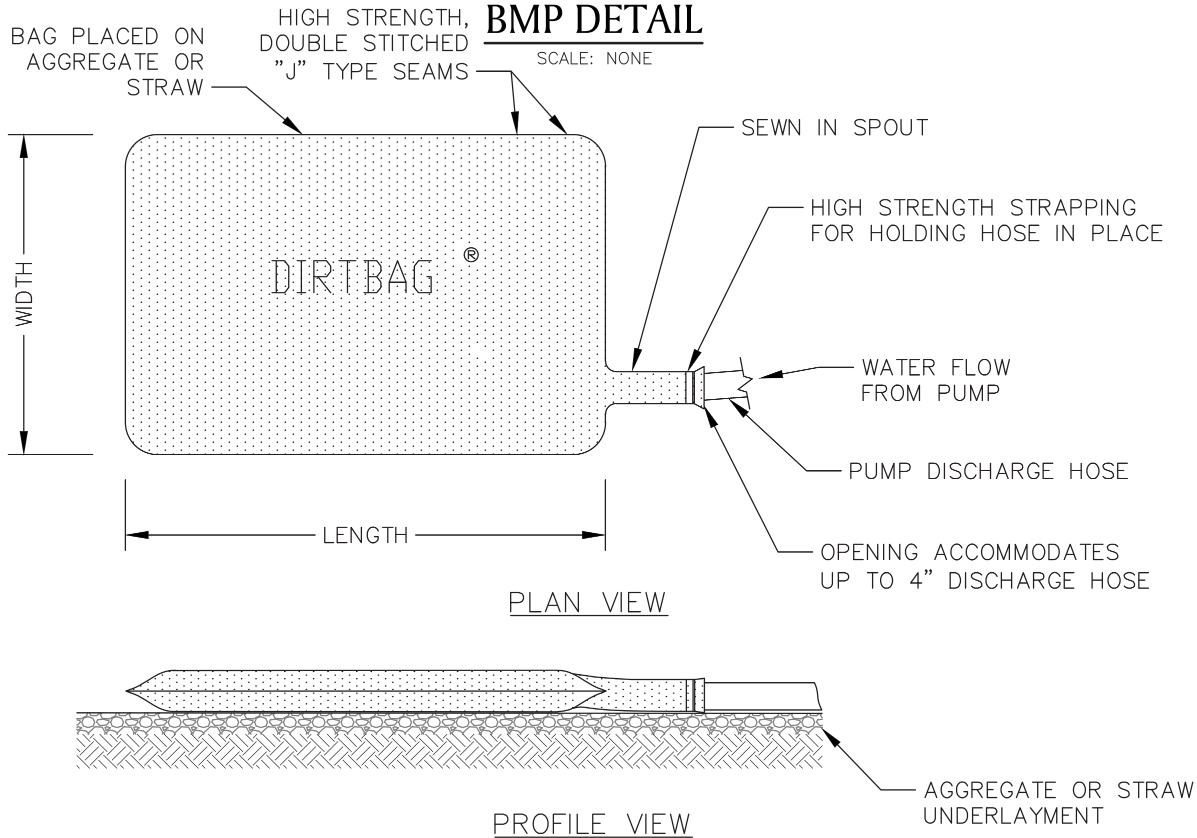
BMP DETAIL

SCALE: NONE



BMP PICTURE

File: Dirtbag.dwg

* PICTURE AND DETAIL PROVIDED BY ACF ENVIRONMENTAL
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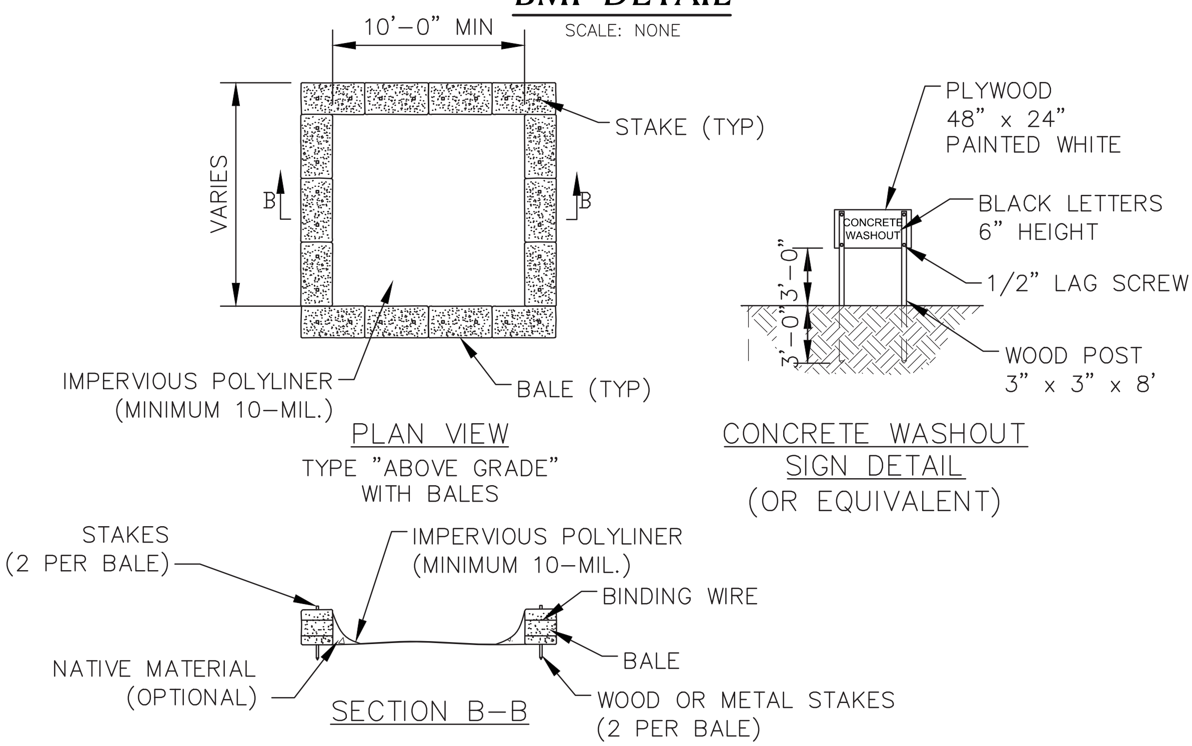
BMP # 34
DIRTBAG *

BMP DETAIL



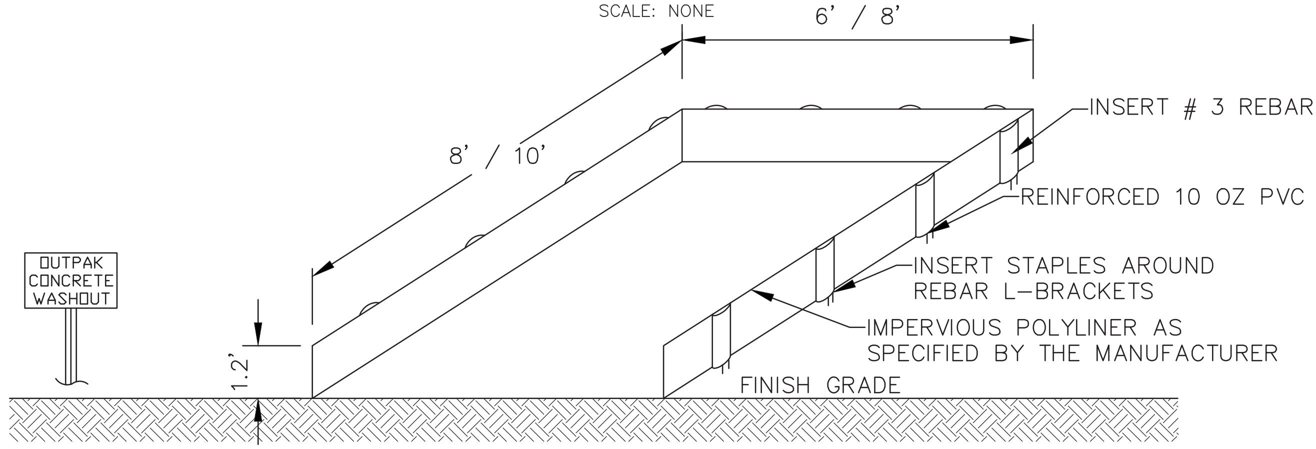
NOTES:

1. NUMBER OF BALES MAY VARY DEPENDING ON SITE CONDITIONS. COORDINATE SIZE AND LOCATION OF CONCRETE WASTE SUMP WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. KEEP AS FAR FROM DRAINAGE CHANNELS AND WETLAND AREAS AS PRACTICAL.
3. SUMPS TO BE CLEANED AND WASTE CONCRETE REMOVED AND PROPERLY DISPOSED OF UPON COMPLETION OF WORK.
4. SEE ADDITIONAL NOTES ON BMP #35.

BMP PICTURE

BMP DETAIL

SCALE: NONE



CROSS SECTION

NOTES:

1. PRODUCT TO BE OUTPAK PVC CONCRETE WASHOUT OR APPROVED EQUAL BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. THE CONCRETE WASHOUT AREA SHALL BE INSTALLED PRIOR TO ANY CONCRETE PLACEMENT.
3. SIGNS SHALL BE PLACED AS NECESSARY TO CLEARLY INDICATE THE LOCATION OF THE CONCRETE WASHOUT.
4. THE CONCRETE WASHOUT AREA WILL BE REPLACED AS NECESSARY TO MAINTAIN CAPACITY FOR WASTE CONCRETE AND OTHER LIQUID WASTE.
5. WASHOUT RESIDUE SHALL BE REMOVED FROM THE SITE AND DISPENSED OF AT AN APPROVED WASTE SITE.
6. DO NOT MIX EXCESS AMOUNTS OF FRESH CONCRETE OR CEMENT ON-SITE.
7. DO NOT WASH OUT CONCRETE TRUCKS INTO STORM DRAINS, OPEN DITCHES, STREETS, OR STREAMS.
8. AVOID DUMPING EXCESS CONCRETE IN NON-DESIGNATED DUMPING AREAS.
9. LOCATE WASHOUT AREA AT LEAST 50' FROM STORM DRAIN, OPEN DITCHES, OR WATERBODIES. COORDINATE LOCATION WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.
10. WASH OUT WASTES INTO THE OUTPAK WASHOUT WHERE THE CONCRETE CAN SET, BE BROKEN UP, AND THEN DISPOSED OF PROPERLY.
11. A SECURE, NON-COLLAPSING, NON-WATER COLLECTING COVER MUST BE PLACED OVER CONCRETE WASHOUT PRIOR TO PREDICTED WET WEATHER TO PREVENT ACCUMULATION AND OVERFLOW OF PRECIPITATION.

BMP PICTURE

* PICTURE AND DETAIL PROVIDED BY OUTPAK WASHOUT

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BMP # 36

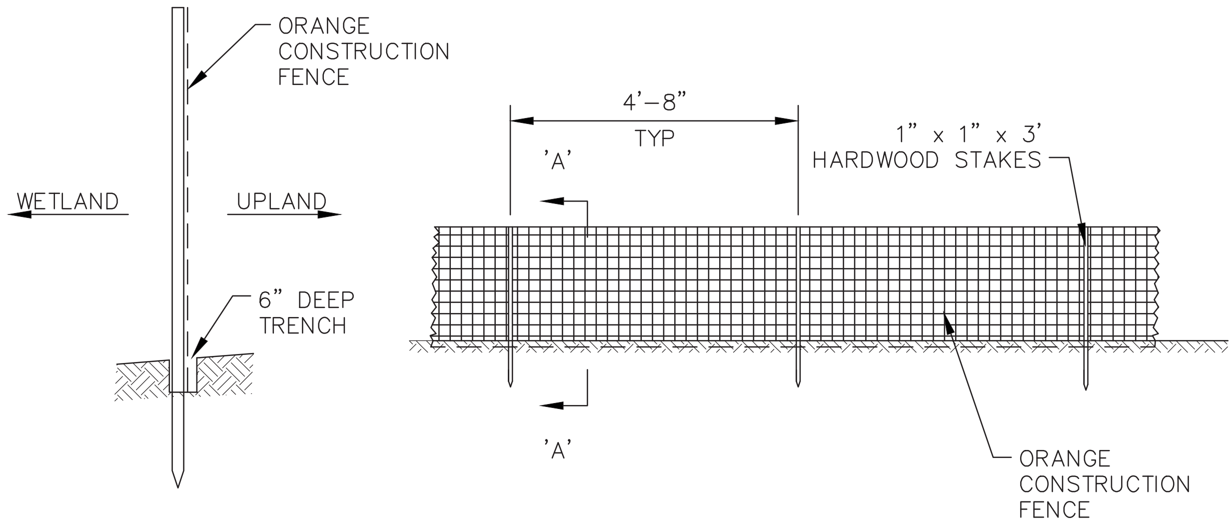
OUTPAK CONCRETE WASHOUT *

nationalgrid	ENVIRONMENTAL GUIDANCE	Doc. No.	EG-303NE
		Page: 7-41	Rev. No. 3
		Date	09/14/15

SUBJECT	Reference
Access, Maintenance and Construction Best Management Practices	EP No. 3 - Natural Resource Protection (Chapter 6)

BMP DETAIL

SCALE: NONE



SECTION A–A

BMP PICTURE

File: Barrier_Fence.dwg

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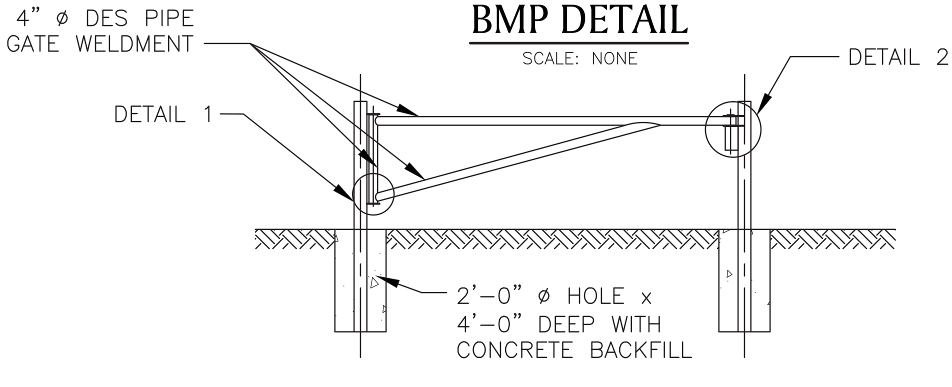
BMP # 37
BARRIER FENCE
(CONSTRUCTION FENCE)

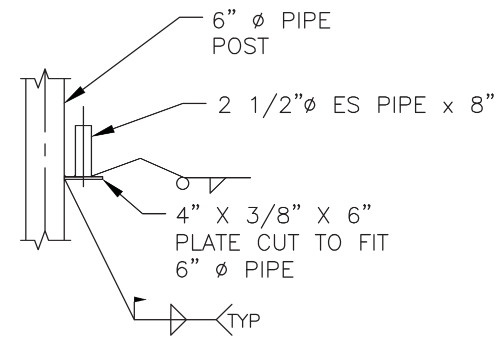
SUBJECT
Access, Maintenance and Construction
Best Management Practices

Reference
EP No. 3 - Natural Resource
Protection (Chapter 6)

BMP DETAIL

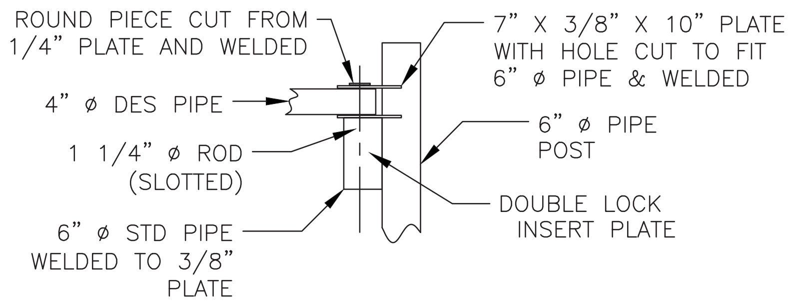
SCALE: NONE





DETAIL 1

SIMILAR DETAIL AT TOP



DETAIL 2

NOTES:

1. ALL GATE STEEL PIPES SHALL BE IN ACCORDANCE WITH ASTM A–501, PLATES SHALL BE ASTM A–36.
2. ALL STEEL PIPES SHALL BE PRIMED WITH ZINC–CHROMATE PRIMER AND FINISHED WITH AN APPROVED OSHA "SAFETY YELLOW" TOP COAT COMPATIBLE WITH THE PRIMER AND FOR EXTERIOR EXPOSURE.
3. REFLECTORS SHALL BE SPACED AT 3 FEET ALONG THE LENGTH OF THE CROSSBAR AND BRACE
4. BACKFILL AT POSTS TO BE COMPACTED.

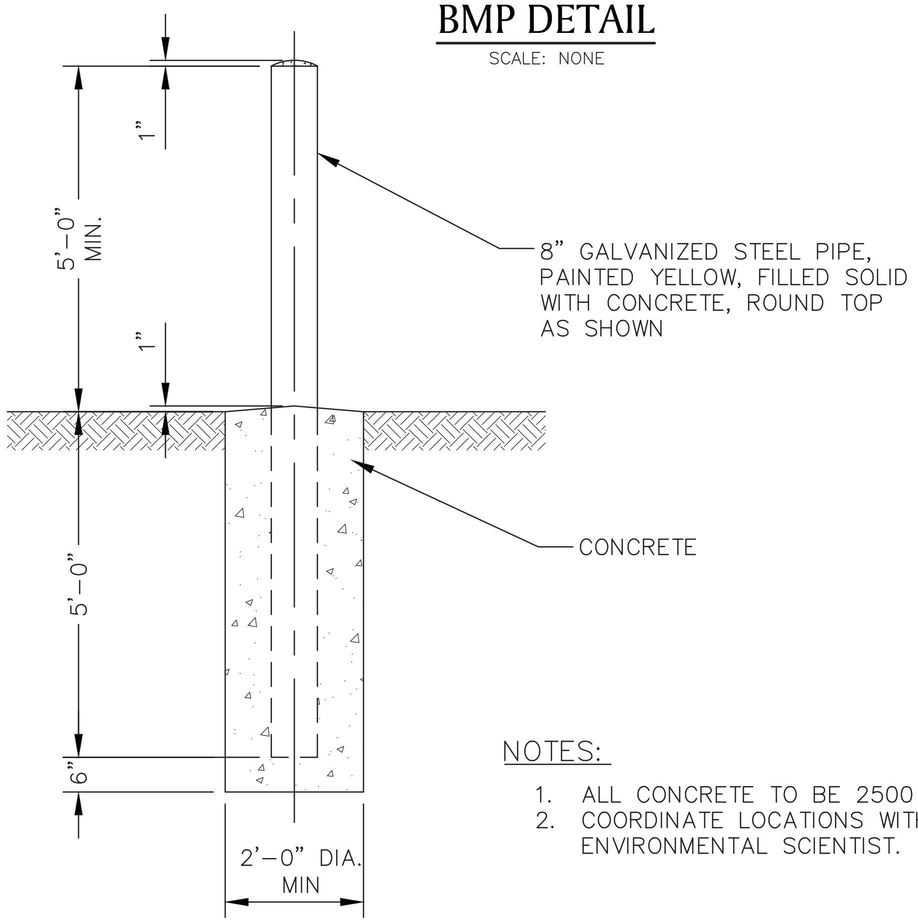
BMP PICTURE

File: ROW_Gates.dwg

BMP # 38
ROW GATE / FENCE

BMP DETAIL

SCALE: NONE



NOTES:

1. ALL CONCRETE TO BE 2500 P.S.I. MINIMUM.
2. COORDINATE LOCATIONS WITH NATIONAL GRID ENVIRONMENTAL SCIENTIST.

BMP PICTURE

BMP # 39
BOLLARD

BMP

Definition

The control of dust resulting from land-disturbing activities.

Purpose

To prevent surface and air movement of dust from disturbed soil surfaces that may cause off-site damage, health hazards, and traffic safety problems.

Conditions Where Practice Applies

On construction roads, access points, and other disturbed areas subject to surface dust movement and dust blowing where off-site damage may occur if dust is not controlled.

Design Criteria

Construction operations should be scheduled to minimize the amount of area disturbed at one time. Buffer areas of vegetation should be left where practical. Temporary or permanent stabilization measures shall be installed. No specific design criteria is given; see construction specifications below for common methods of dust control.

Water quality must be considered when materials are selected for dust control. Where there is a potential for the material to wash off to a stream, ingredient information must be provided to the local permitting authority.

Construction Specifications

A. Non-driving Areas – These areas use products and materials applied or placed on soil surfaces to prevent airborne migration of soil particles.

Vegetative Cover – For disturbed areas not subject to traffic, vegetation provides the most practical method of dust control (see Section 3).

Mulch (including gravel mulch) – Mulch offers a fast effective means of controlling dust. This can also include rolled erosion control blankets.

Spray adhesives – These are products generally composed of polymers in a liquid or solid form that are mixed with water to form an emulsion that is sprayed on the soil surface with typical hydroseeding equipment. The mixing ratios and application rates will be in accordance with the manufacturer's recommendations for the specific soils on the site. In no case should the application of these adhesives be made on wet soils or if there is a probability of precipitation within 48 hours of its proposed use. Material Safety Data Sheets will be provided to all applicators and others working with the material.

B. Driving Areas – These areas utilize water, polymer emulsions, and barriers to prevent dust movement from the traffic surface into the air.

Sprinkling – The site may be sprayed with water until the surface is wet. This is especially effective on haul roads and access routes.

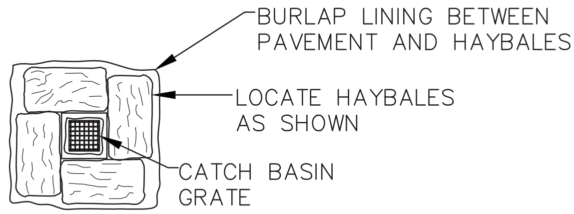
Polymer Additives – These polymers are mixed with water and applied to the driving surface by a water truck with a gravity feed drip bar, spray bar or automated distributor truck. The mixing ratios and application rates will be in accordance with the manufacturer's recommendations. Incorporation of the emulsion into the soil will be done to the appropriate depth based on expected traffic. Compaction after incorporation will be by vibratory roller to a minimum of 95%. The prepared surface shall be moist and no application of the polymer will be made if there is a probability of precipitation within 48 hours of its proposed use. Material Safety Data Sheets will be provided to all applicators working with the material.

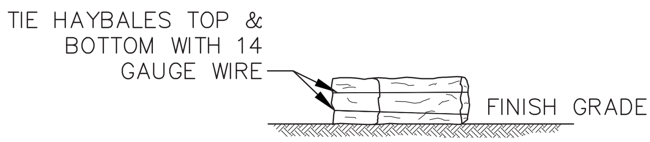
Barriers – Woven geotextiles can be placed on the driving surface to effectively reduce dust throw and particle migration on haul roads. Stone can also be used for construction roads for effective dust control.

Windbreak – A silt fence or similar barrier can control air currents at intervals equal to ten times the barrier height. Preserve existing wind barrier vegetation as much as practical.

BMP DETAIL

SCALE: NONE





NOTES:

1. SURROUND STREET DRAINAGE STRUCTURE INLET WITH HAY BALES PRIOR TO CONSTRUCTION AND MAINTAIN UNTIL CONSTRUCTION IS COMPLETED. ACCUMULATED SEDIMENTS SHALL BE REMOVED.
2. HAYBALES PLACED ON PAVEMENT SHALL HAVE BURLAP PLACED BETWEEN PAVEMENT AND HAYBALE

BMP PICTURE

File: CB_Inlet_Protection.dwg

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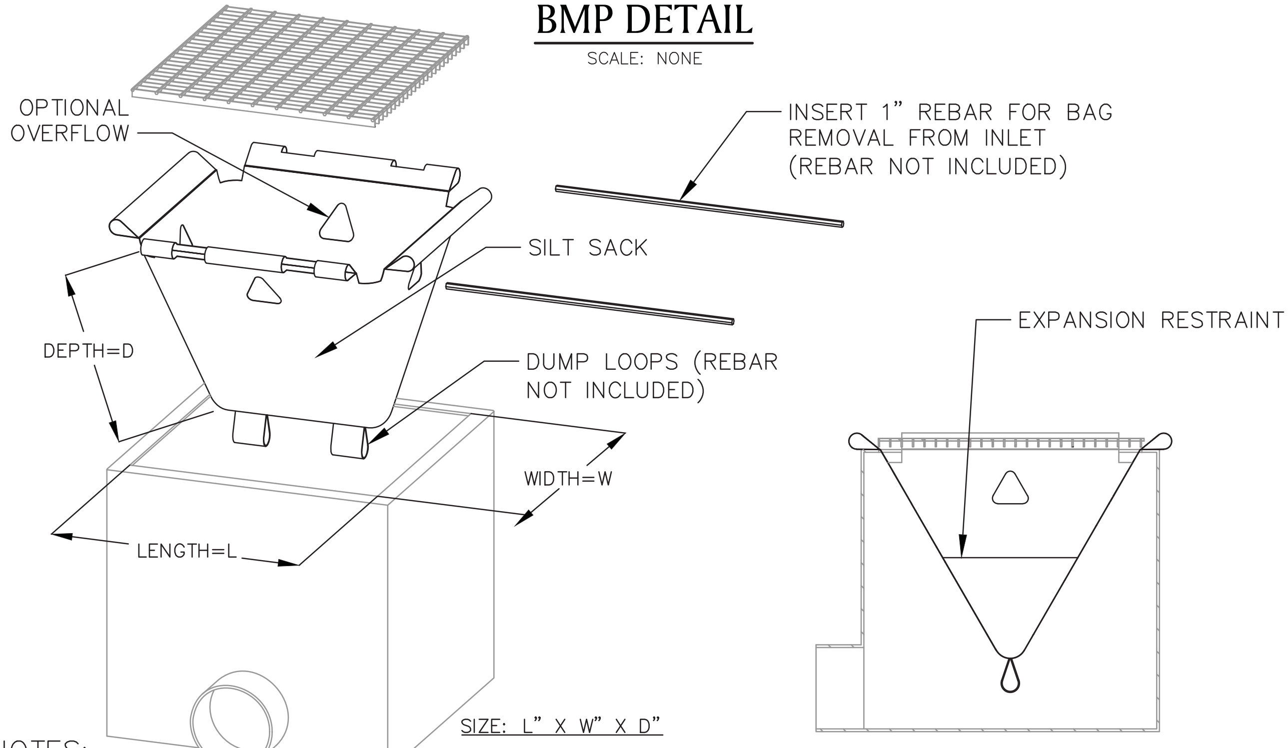
BMP # 41
CATCH BASIN INLET PROTECTION

BMP DETAIL

SCALE: NONE



PROFILE VIEW

NOTES:

1. PRODUCT TO BE SILT SACK OR APPROVED EQUAL BY NATIONAL GRID ENVIRONMENTAL SCIENTIST.
2. THE USE OF A SILT SACK OPTIONAL OVERFLOW AND OVERALL DIMENSIONS ARE TO BE COORDINATED WITH A NATIONAL GRID ENVIRONMENTAL SCIENTIST.

BMP PICTURE

File: SILT SACK.dwg

* DETAIL PROVIDED BY ACF ENVIRONMENTAL

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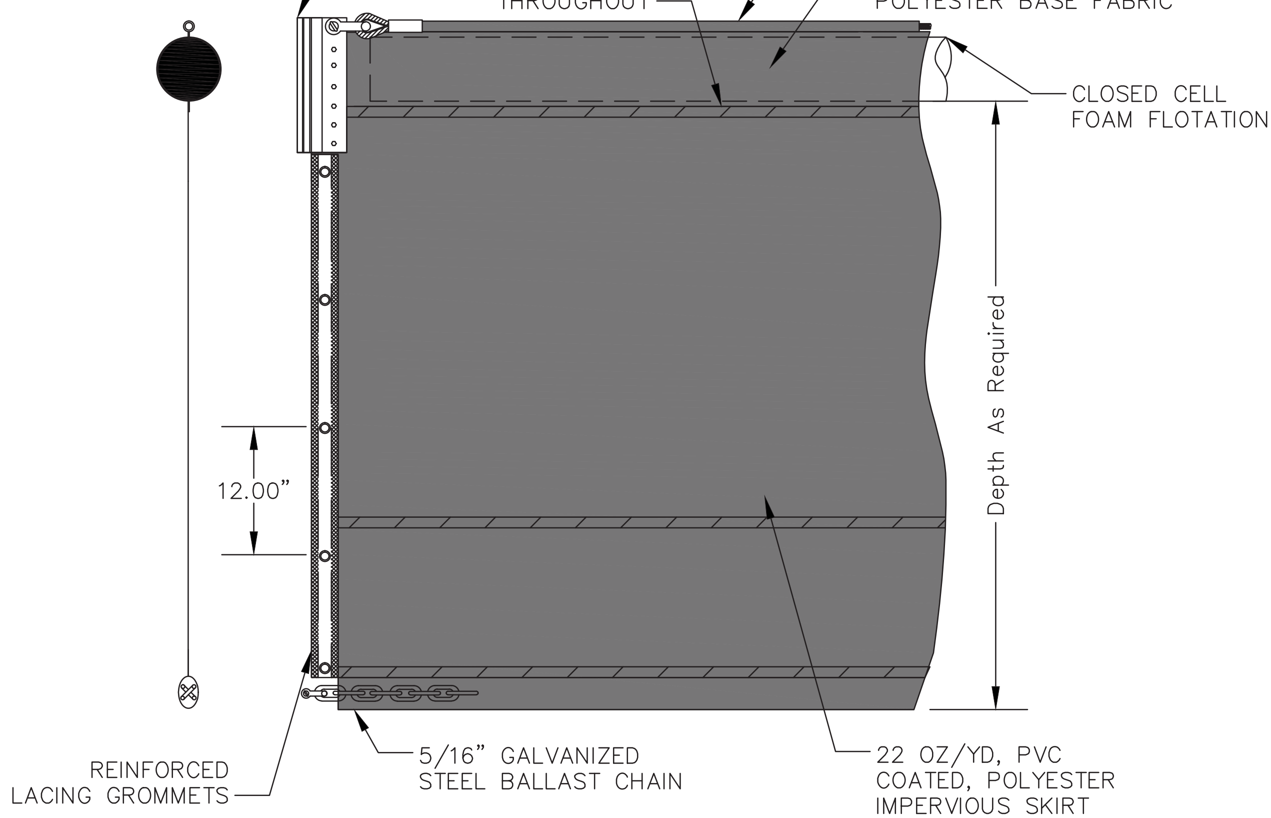
BMP # 42

SILT SACK *

BMP DETAIL

SCALE: NONE



BMP PICTURE

* DETAIL PROVIDED BY BROCKTON EQUIPMENT / SPILLDAM INC.
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BMP # 43
TURBIDITY CURTAIN *

APPENDIX 8
CERTIFICATION FORM FOR INVASIVE SPECIES CONTROL

Certain permit conditions, therefore a Condition of Contracts for the Prime Contractor, any Subcontractors, and any equipment or mat vendors for ***National Grid Projects*** shall be required to Certify their equipment[1] {each piece of equipment used on site} as 'clean'[2].

____ (*name of firm*) hereby Certifies that

____ (*make, model, and/or type*)

________________________________ (*equipment ID tag or #)* meets the following

1. before entry on to the job site, has been sufficiently cleaned to remove all accumulated mud, debris, plant fragments, and detritus that could harbor seeds, roots, or plant fragments of so-called invasive plant species; and

2. that the above piece of equipment has neither been off-loaded nor operated in the interval between cleaning and delivery to the jobsite.

3. that equipment deployed in areas of invasive species (as identified in project plans) shall be cleaned prior to redeployment

______________________________ (*signed*) ______________ (*dated*)

_______________________________ (*printed name*) _______________________________ (*title*)

_______________________________ (*Firm*)

The signed original of this form {one for each piece of equipment (or lot[3] of mats)} is to be given to the NG Field Construction Coordinator assigned to the project.

---

1 Equipment may include, but is not limited to bulldozers, excavators, backhoes, bucket trucks (tracked or wheeled), pulling equipment, concrete trucks, compressors, drilling equipment, and mats (composite, wood, or other materials).

2 With regard to invasive species, the definition of clean means free of accumulated mud, debris, plant fragments, and detritus that could harbor seeds, roots, or plant fragments of so-called invasive plant species.

3 Lot of mats is the number of mats that may be transported by one forwarder/truck at a time.