Jordan Cove LNG℠

# LNG Terminal Storm Water Management Plan

STRUCTURAL REGISTERED PROFESSIONAL ENGINEER 90384PE OREGON MARCH 14, 2017 KATHY ALEXANDER

Kathy Alexander

RENEWS: 12/31/2019

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | KKH | CAF | DMR | |
| 3 | 26-Mar-19 | Revised Issued for FERC Filing | KKH | CAF | DMR | |
| 2 | 20-Nov-17 | Issued for FERC Filing | KML | CAF | SPH | |
| 1 | 02-Aug-17 | Issued for FERC Filing | KML | CAF | SPH | |
| **REV** | **DATE** | **DESCRIPTION** | **BY** | **CHKD** | **APPVD** | **COMPANY APPROVAL** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **IP SECURITY** | ☐ **Confidential** | | **Total amount of pages including coversheet:** | | | | **470** |
| **FOR CONTRACTOR DOCUMENTS** | **Contract No.** | | **Contractor Document No.** | | | | **Contractor Rev.** |
| | **KBJ-120** | | **189980-0000-FS0165** | | | | **3** |
| **JCL DOCUMENT NUMBER** | **Proj. Code** | **Unit / Location** | **Discipline** | **Doc. Type** | **Orig. Code** | **Sequence No.** | **Sheet No.** |
| | J1 | 000 | CIV | RPT | KBJ | 50002 | 00 |

## Revision Modification Log

| | | | |
|---|---|---|---|
| **Document Title :** | LNG Terminal Storm Water Management Plan | **Rev. :** | 2 |
| **Document No. :** | J1-000-CIV-RPT-KBJ-50002-00 | **Rev. Date :** | 20-Nov-17 |

| Page No. | Section | Change Description |
|---|---|---|
| Varies | Varies | Extensive revisions. |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

# LNG Terminal Storm Water Management Plan

**Jordan Cove Energy Project**
**Coos Bay, Oregon**

Prepared for:

Jordan Cove LNG
111 SW Fifth Ave, Suite 1100
Portland, OR 97204
Site Contact: Derik Vowels
971-940-7800

ACOE Project Number: TBD
ODEQ NPDES permit number: TBD
DSL project number: TBD

Prepared by:
KBJ
11401 Lamar Avenue
Overland Park, KS 66211
(913) 458-2000

March 2019

[ENGINEER SEAL]
[SEE COVER SHEET]

# Table of Contents

**1.0 Purpose ..... 11**
**2.0 Introduction ..... 11**
**3.0 Compliance Requirements and Certifications ..... 12**
3.1 Plan ..... 12
3.2 Plan Implementation ..... 12
3.3 Plan Amendments ..... 12
3.4 Availability of Plan ..... 13
**4.0 Native Features ..... 13**
4.1 Elevation Datum ..... 13
4.2 Project Location ..... 13
4.3 Native Soils ..... 13
4.4 Existing Development ..... 14
4.5 Existing Hydrology ..... 14
4.6 Water Quality Criteria ..... 15
4.7 Climate ..... 16
4.8 Groundwater ..... 16
4.8.1 Groundwater Resources ..... 16
4.8.2 Facility Impact to Groundwater and Wetlands ..... 16
4.8.3 Groundwater Wells ..... 18
4.8.4 Underground Injection ..... 18
4.9 Tide Levels ..... 18
**5.0 Facility Description ..... 18**
5.1 LNG Terminal Site Areas ..... 18
5.2 Facility Project Description ..... 19
5.3 Off-Site Project Areas ..... 20
5.3.1 Off-Site Areas Managed under this SWMP ..... 20
5.3.2 Off-Site Areas Managed Under Separate SWMPs ..... 21
5.4 Finished Grading and Surfacing ..... 22
5.4.1 Ingram Yard Finished Grade Elevations ..... 22
5.4.2 Ingram Yard Finished Surfacing ..... 22
5.4.3 South Dunes Finished Grade Elevations ..... 22
5.4.4 South Dunes Finished Surfacing ..... 23
5.4.5 Construction Facility Areas ..... 23
5.4.6 Off-Site Permanent Project Areas Finished Surfacing ..... 26
5.5 Storm and Waste Transport Systems ..... 26
5.5.1 Storm Water System ..... 26

5.5.2 Oily Waste System ..... 26
5.5.3 Sanitary Waste System ..... 30
5.6 Chemical Containment Systems ..... 30
5.6.1 ARGU Module Amine ..... 30
5.6.2 LNG and Refrigerant ..... 30
5.6.3 Refrigerant Makeup ..... 31
5.6.4 Liquid Nitrogen, Amine, Diesel, and Aqueous Ammonia Storage Areas ..... 31
5.7 Storm Water Quality and Potential Pollutants ..... 31
5.8 Selections of Storm Water Controls ..... 33
5.8.1 Infiltration – Treatment for Suspended Solids and Metals ..... 33
5.8.2 Filter Strips – Treatment for Suspended Solids and Metals ..... 34
5.8.3 Bioslopes – Treatment for Suspended Solids and Metals ..... 34
5.8.4 Treatment Swales – Treatment for Suspended Solids and Metals ..... 35
5.8.5 Proprietary Device – Treatment for Suspended Solids and/or Metals ..... 35
5.9 Facility Area Treatment ..... 35
5.9.1 Parking Lots, Roads, and Roof Drains ..... 35
5.9.2 Concrete and Aggregate Surfacing ..... 37
5.9.3 Tug Boat Dock ..... 39
5.9.4 Vegetation ..... 39
5.9.5 Oil and Grease ..... 39
**6.0 Nonstructural BMPs ..... 41**
**7.0 Storm Water Quantity ..... 42**
7.1 Storm Water Conveyance System ..... 42
7.2 Outfall Design ..... 43
**8.0 Structural Controls Design ..... 43**
8.1 Filtration Facilities (Infiltration Controls) ..... 43
8.1.1 Pretreatment ..... 44
8.1.2 Water Quality Mix ..... 44
8.1.3 Infiltration Basins ..... 45
8.1.4 Buried Infiltration Chambers ..... 46
8.1.5 Infiltration Basin and Buried Infiltration Chamber Analysis ..... 47
8.1.6 Bioslopes ..... 48
8.2 Biofiltration Facilities ..... 48
8.2.1 Filter Strips ..... 48
8.2.2 Treatment Swales ..... 49
8.3 Proprietary Devices ..... 49

8.3.1 Technology Assessment Protocol Program ..... 50
8.3.2 Pretreatment ..... 50
8.3.3 Water Quality Flow Rate ..... 51
8.3.4 Cartridge Filter Devices ..... 51
8.3.5 Peak Flow Diversion ..... 51
8.3.6 Backflow Prevention ..... 52
8.4 Drainage Areas ..... 52
8.5 Outfalls ..... 53
8.6 Storm Water Conveyance System Analysis ..... 53
**9.0 Monitoring Program ..... 54**
9.1 Purpose ..... 54
9.2 Weather, Rain, and Discharge Event Tracking ..... 54
9.2.1 Outfall Discharge Event Tracking ..... 55
9.3 Monitoring Locations ..... 55
9.4 Visual Observation Procedures ..... 55
9.4.1 Monthly Visual Observations ..... 55
9.4.2 Sampling Event Visual Observations ..... 56
9.4.3 Visual Monitoring Follow-Up and Reporting ..... 57
9.4.4 Visual Monitoring Locations ..... 57
9.5 Potential Sampling and Analysis Procedures ..... 57
9.5.1 Example Sampling Schedule ..... 57
9.5.2 Example Sampling Locations ..... 57
9.5.3 Monitoring Preparation ..... 58
9.5.4 Sample Collection ..... 59
9.5.5 Sample Analysis ..... 60
9.5.6 Data Evaluation and Reporting ..... 60
9.6 Training of Sampling Personnel ..... 60
9.7 Sample Collection and Handling ..... 60
9.7.1 Sample Collection ..... 60
9.7.2 Sample Handling ..... 61
9.7.3 Sample Documentation Procedures ..... 62
9.8 Quality Assurance and Quality Control ..... 62
9.8.1 Field Logs ..... 62
9.8.2 Clean Sampling Techniques ..... 63
9.8.3 Chain-of-Custody ..... 63
9.8.4 Data Verification ..... 63
9.9 Records Retention ..... 64
**10.0 Operations and Maintenance Plan ..... 65**

**11.0 Conclusion** ..... **65**
**12.0 References** ..... **65**

## ATTACHMENTS

Attachment A. Figures and Drawings
Attachment B. Forms
Attachment C. NPDES Permits Near the Project
Attachment D. Section 401 Water Quality Certification Post-Construction Storm Water Management Plan Submission Guidelines
Attachment E. Oregon's 2012 Integrated Report Database Search Results
Attachment F. NRCS Soils Survey
Attachment G. ODOT Water Quality Design Storm
Attachment H. ODOT Rainfall Intensity-Duration-Frequency Table
Attachment I. Storm Water System Drainage Structure Table, Culvert Table, and Flow Calculations
Attachment J. Storm Water System HGL Calculations
Attachment K. Drainage Areas
Attachment L. Infiltration Controls Summary
Attachment M. Infiltration and Bioslope Controls Calculations (PondPack)
Attachment N. Bioslope Calculations
Attachment O. Filter Strip Calculations
Attachment P. Treatment Swales Calculations
Attachment Q. MGS Flood Results, StormFilter Calculations, Contech StormFilter Details, and TideFlex CheckMate Inline Check Valve Brochure
Attachment R. Contech CDS Pretreatment Calculations and Details
Attachment S. Solidification Products International Petro-Barrier – Product Information Booklet, Application Drawings, and Laboratory Testing
Attachment T. Norwesco Sanitary Holding Tank Detail
Attachment U. Spill Control Manhole

## LIST OF TABLES

Table 4-1 Wetland Cowardin Classification ..... 17
Table 4-2 Facility Tide Levels in Coos Bay ..... 18
Table 5-1 Petro Barrier Devices ..... 28
Table 5-2 Potential Pollutants ..... 32
Table 8-1 Water Quality Soil Media Gradation ..... 45
Table 8-2 Size and Depth Summary of Infiltration Control Areas ..... 47
Table 8-3 Filter Strip Design Summary ..... 49
Table 8-4 CDS Systems ..... 50
Table 8-5 Drainage Areas ..... 52
Table 9-1 Outfall Locations ..... 58

Table 9-2 Example Table for Sample Collection, Preservation, and Analysis for Water Quality Samples ..... 59

## Signatory Authorization

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 ensure 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.

Signed: _____

Natalie Eades

Manager, Environment

Date: _____

Note: Updates and revisions to this plan are also to be signed in this manner and require an updated signature and date to reflect the changes herein.

## Record of Plan Amendments

This Storm Water Management Plan (SWMP) will be amended or modified whenever there is a change in design, construction, operation, or maintenance that has a significant effect on the potential for discharge of pollutants to waters of the United States or state or if the SWMP is ineffective in achieving the objectives of reducing pollutants in storm water. This SWMP has been amended as described below to eliminate or further minimize pollutants in storm water discharges associated with operation of the Jordan Cove LNG Facility. This SWMP will be updated within 30 days of operational changes affecting storm water controls and the information herein.

| Amendment Number | Date of Amendment | Description of Amendment |
|---|---|---|

# 1.0 Purpose

Jordan Cove Energy Project, L.P. (JCEP) proposes to site, construct, and operate a liquefied natural gas (LNG) export facility (Project) located on the bay side of the North Spit of Coos Bay, Oregon.

It is the intent of this document to fulfill Oregon Department of Environmental Quality (DEQ) 401 Water Quality Certification review requirements. This Storm Water Management Plan (SWMP or Plan) is considered to be part of the facility operation and management documents. The Plan includes storm water monitoring and controls required during operation of the Project.

A copy of this Plan will be kept on-site for use by affected or interested personnel. Updating of the Plan due to changes in facility operations that may affect storm water quality is the responsibility of JCEP. In the case of significant operational changes, this Plan will be amended.

JCEP acknowledges that KBJ prepared this Plan on behalf of JCEP based on a conceptual layout and storm water design of the facility. All preliminary storm water discharges at the LNG Terminal site have been identified in this Plan. Best management practices (BMPs) have been outlined for incorporation into facility operations, including a sampling program for constituents of concern.

This post-construction LNG Terminal SWMP covers the scope by KBJ, the main construction contractor. Additional SWMPs will be provided as necessary for other off-site facilities being managed by JCEP directly.

# 2.0 Introduction

This Plan has been prepared to comply with the Section 401 Water Quality Certification - Post-Construction Storm Water Management Plan Submission Guidelines (March 2018) from the DEQ (Attachment D; Reference 7). This reference is noted herein as the DEQ Guidelines.

The Plan includes BMPs proposed to minimize exposure of storm water to pollutants, including sediments, oil and grease, chemicals, wastes, and debris. Additionally, training programs, housekeeping measures, inspections, and preventive maintenance will be employed to meet the storm water protection challenges.

This Plan will be a “living” plan; the performance and adequacy of the training program and other nonstructural controls, as well as the structural controls and BMPs proposed for the Project, will be evaluated continuously throughout the life of these facilities with the goal to maintain performance. Ongoing training and inspections will provide opportunities to evaluate any shortcomings in training, performance, maintenance procedures, and schedules and to apply “lessons-learned” throughout the facilities. Inspection reports and their findings, as well as corrective measures and modifications to the Plan, will be retained in the Plan. A copy of the Plan will be maintained within the Project offices and available for review.

The storm water management philosophy detailed in this Plan has been selected on the basis of the most recent design information, which is still in a preliminary stage. Further refinement of the Plan will be completed as JCEP progresses toward a final design for the Project.

# 3.0 Compliance Requirements and Certifications

## 3.1 PLAN

This Plan addresses the items required in the DEQ Guidelines. Additionally, this Plan follows many of the design procedures outlined in the Oregon Department of Transportation (ODOT) Hydraulics Manual (Reference 6). This manual and other references are specifically noted in the text.

Additional BMP selection, operation, and design information from SLOPES V for Stormwater, Transportation, and Utilities, Section 36D (National Marine Fisheries Service Consultation NWR-2013-10411) is also provided in this Plan. A specific monitoring program has also been included.

This Plan takes into consideration only the operational period design state of the facility. This Plan does not include construction period BMPs typically associated with 1200-C. Construction pollution prevention measures are addressed in the 1200-C application for the Project and the Erosion and Sediment Control Plan.

Future modifications, adoption, and implementation of additional BMPs, plan modifications, training, sampling, and recordkeeping are the responsibility of the facility operators.

## 3.2 PLAN IMPLEMENTATION

This Plan shall be effective immediately upon receipt of JCEP's 401 Water Quality certification and approval by DEQ. Since this Plan is based on preliminary design, it provides general guidance to the final design for implementation of the water treatment objectives provided herein.

## 3.3 PLAN AMENDMENTS

This Plan shall be amended to reflect final design and be reviewed at least once a year to determine if any amendments are necessary. The plan shall be amended whenever any of the following occur:

- The site manager identifies that this Plan does not meet minimum requirements or is in violation of water quality standards. Within the specified time period, the facility may be required to implement any required Plan revisions, and the site manager and/or a professional engineer may be required to submit written certification to DEQ that the Plan has been revised to reflect the necessary changes.
- There is a change in industrial activities that:
    - May significantly increase the quantities of pollutants in storm water discharge,
    - Cause a new area of industrial activity at the facility to be exposed to storm water, or
    - Begin an industrial activity that would introduce a new pollutant source at the facility.
- There are any changes to the site affecting the storm water management practices.

In the event of changes to the facility or industrial activities, or storm water management practices, the Plan will be updated within 30 days of the change.

## 3.4 AVAILABILITY OF PLAN

A current copy of this Plan shall be retained on-site at all times and made available upon request by a representative of the DEQ. This plan is a public document pursuant to Section 308(b) of the federal Clean Water Act (CWA).

Data from historic sampling events should be retained on-site. It is the responsibility of the facility to document sampling events and results and to verify compliance with the standards described herein.

# 4.0 Native Features

## 4.1 ELEVATION DATUM

All elevations presented in this Plan are in reference to the North American Vertical Datum of 1988 (NAVD 88), unless noted otherwise.

## 4.2 PROJECT LOCATION

The LNG Terminal site will be located on the bay side of the North Spit of Coos Bay, Oregon, located in unincorporated Coos County, north of the Cities of North Bend and Coos Bay (refer to Attachment A). The LNG Terminal site is defined to include Ingram Yard, the Access and Utility Corridor, and South Dunes (refer to Attachment A for figures). The site is approximately 1.5 miles north of the city of North Bend and the Southwest Oregon Regional Airport, with the Ingram Yard and the South Dunes areas approximately 1 mile apart.

Access to the LNG terminal site is via the Trans Pacific Parkway (TPP) which runs along the north side of the site from Highway 101. The parkway is a county-owned, two-lane paved roadway with no curb and gutter. The Ingram Yard entrance will be about 1.2 miles west of Jordan Cove Road. The entrances to Ingram Yard and South Dunes will be paved upon completion of construction.

Waters of the United States and state associated with the LNG Terminal site include Coos Bay, Jordan Cove, and various wetland areas.

Off-site project areas are described below. The locations of these various areas can be seen on the figures and drawings in Attachment A.

## 4.3 NATIVE SOILS

Soils are classified by the Natural Resources Conservation Service (NRCS) as Hydrologic Soil Groups A, B, C, and D. The primary soil types found on the project site are Heceta and Waldport sands (refer to Attachment F for the NRCS Soil Survey map). These are well-drained soils in Hydrologic Soil Group A.

On-site infiltration testing was performed in November 2018 at 14 locations at the proposed LNG Terminal, including 13 locations at Ingram Yard and one at South Dunes. These infiltration tests were performed in conformance with ASTM D3385-18, Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer. The infiltrometer used in the testing had inner and outer ring diameters of about 12 inches and 24 inches, respectively. The infiltration testing

locations were prepared by excavating test pits to a depth of about 3 feet below the ground surface where fine-grained sand with variable amounts of silt was generally observed. Preliminary results from this infiltration testing indicated that the tests at Ingram Yard had an average infiltration rate of 29.5 inches per hour. The measured rates from the 13 locations ranged from a low of 17.0 inches per hour to a maximum of 50.5 inches per hour. The location at South Dunes had a measured rate of 6.6 inches per hour.

During construction of the LNG Terminal, excavation from the existing dune, slip, and access channel will be placed and compacted on Ingram Yard, the Access and Utility Corridor, the Roseburg site, and South Dunes. Compaction requirements will be finalized in detailed design. To test if compaction would affect the infiltration rate of the native sand, bulk samples collected during the geotechnical investigation were compacted in the laboratory and then tested with constant head permeability tests. The compaction was compacted to 95 percent of its maximum dry density by the Modified Proctor method (ASTM D1557). Two samples were collected from the west side of Ingram Yard and two from the dune at Ingram Yard. Preliminary results of the infiltration rates of these compacted samples range from a low of 35.7 inches per hour to a high of 66.2 inches per hour.

Based on these preliminary results, infiltration controls are feasible at all locations of the LNG Terminal. These results also indicate that excavation, filling, and compaction will not lower the infiltration rate. Therefore, infiltration controls will be feasible in both cut and fill areas.

Appendix E.3.3 of the DEQ Guidelines states that if the infiltration rate is greater than 9 inches per hour, then it is too rapid, and pretreatment or soil amendments may be required in the structural storm water control. The native sand infiltrates at a rate higher than 9 inches per hour; therefore, soil amendment will be utilized at all infiltration controls.

Infiltration areas will be set back as far as possible from steep slopes. Final slope angles will be selected during detailed design but will likely be 2.5(H)-3(H):1(V) or shallower. The drawings in Attachment A show the location of the proposed infiltration areas with respect to nearby slopes.

## 4.4 EXISTING DEVELOPMENT

The LNG Terminal site has areas that were previously developed and areas that are native. Foundations from previously developed areas at South Dunes will be perforated to allow infiltration from the raised pad to infiltrate down through the fill material and through the perforations of the existing foundations. Tanks and other miscellaneous items on South Dunes will be removed prior to construction. Existing firewater tanks on Ingram Yard will be relocated prior to construction to an area east of the raised Roseburg pad. An existing building on the northwest side of the northern Roseburg area that will be filled will be taken down prior to construction.

## 4.5 EXISTING HYDROLOGY

Coos Bay is the second largest estuary in Oregon, accounting for about 27 percent of the state's estuarine resources. The surface area of the bay is approximately 11,000 acres at high tide and approximately 5,800 acres at low tide, with tidelands covering approximately 4,600 acres (2,700 acres of tidal marsh and 1,400 acres of eelgrass beds).

Currently, the project site ranges in elevation from elevation (El) 15 feet to greater than El 100 feet. Site drainage generally flows from north to south at both Ingram Yard and South Dunes. Existing site drainage patterns are shown on the contour drawings in Attachment A.

The Coos Bay and Coos River Basin are located within Oregon's South Coast Basin, Hydrologic Unit Code (HUC) 171003. Coos Bay drains a total of 605 square miles in southwestern Oregon, and its HUC is 17100304.

## 4.6 WATER QUALITY CRITERIA

Under Section 303(d) of the CWA, the Environmental Protection Agency (EPA) or its state delegates are required to develop a list of the surface waters in each state that do not meet water quality criteria. These criteria are developed by each of the states to protect beneficial uses and are approved by the EPA. The beneficial uses listed for the South Coast Estuaries in Appendix F.3 of the DEQ Guidelines include the following:

- Industrial Water Supply
- Fish and Aquatic Life
- Wildlife and Hunting
- Fishing
- Boating
- Water Contact Recreation
- Aesthetic Quality
- Commercial Navigation and Transportation

The DEQ has adopted numeric and narrative water quality standards to protect these designated beneficial uses. Specific beneficial uses for Coos Bay have been determined by the Oregon Administrative Rules (OAR 340-041-0300, Table 300A, November 2003).

The 303(d) listed water bodies are based upon the best available data and, in most cases, the list must be revised every 2 years. An impaired water body must have a total maximum daily load (TMDL) developed for each applicable pollutant. Coos Bay has numerous sloughs and bays and is fed by more than 30 tributaries (the major one being the Coos River), which together comprise the Coos Subbasin. Based on the review of the DEQ's Water Quality Assessment Database (Attachment E, Reference 4), sampling of Coos Bay in the vicinity of Jordan Cove has shown elevated concentrations of fecal coliform year-round, which warrant placing this segment of Coos Bay on the 303(d) list of impaired waters for shellfish growing.

Most of the sanitary wastewater generated during operation of the Project will be treated by package sanitary treatment devices and discharged through a permitted National Pollutant Discharge Elimination System (NPDES) outfall; therefore, the Project is not likely to add fecal coliform to Coos Bay. Permits will be obtained for all wastewater discharges as required by the DEQ. Outlying buildings will have buried sanitary holding tanks. JCLNG will maintain a service contract with a sewage disposal service licensed under OAR 340-071-0600 to provide for regularly

inspecting and pumping the holding tanks for offsite discharge. Currently, there is only one buried holding tank in the design. There will be no seepage pits for sanitary effluent. The holding tanks will not have laterals for on-site dispersion.

In addition, concentrations of chromium, copper, lead, nickel, tributyltin, and zinc raise potential concerns for drinking water, resident fish, and aquatic life, as well anadromous fish passage (Reference 4). A TMDL has not been developed for the Coos River, which is presently undergoing the initial scoping and data collection phase required to develop the TMDL.

The Project is not located within either an EPA-designated sole source aquifer or Oregon state groundwater management area. A list of the active NPDES permits within a 2-mile radius of the Project can be found in Attachment C.

## 4.7 CLIMATE

The climate in the region of the JCEP site is characterized as moderate, with wet and dry seasons. The rainy season begins in October and continues through May, accounting for most of the annual precipitation. The facility receives an average of 63 inches of precipitation per year, with the highest monthly averages occurring in November, December, and January (approximately 10 inches per month).

The average temperature at the facility ranges between approximately 51° F and 55° F in the winter months and 59° F to 65° F in the summer months. The average minimum temperatures occur in the winter months and range between 40° F and 42° F.

## 4.8 GROUNDWATER

### 4.8.1 Groundwater Resources

The North Spit of Coos Bay where the facility is planned to be located is at the southern edge of the 19.5 square mile (12,480 acre) Dune Sand Aquifer. The Dune Sand Aquifer is an unconfined (having no overlying impervious rock layer), unconsolidated deposit aquifer composed primarily of loosely compacted and uncemented fine- to medium-grained sand with areas of discontinuous silt and clay (Reference 11). At the LNG Terminal, the sand aquifer extends to a depth of 160 feet below sea level, and groundwater elevations have varied from a high of approximately El 18 feet to approximately El 1 foot. The groundwater levels fluctuate seasonally in response to rainfall and have varied by up to approximately 4 feet. Groundwater elevations increase with distance to the north away from Coos Bay. Groundwater levels fluctuate with the Coos Bay tides and fluctuate seasonally in response to rainfall. At the South Dunes site, the groundwater elevation is at approximately El 10 feet.

### 4.8.2 Facility Impact to Groundwater and Wetlands

Development of the facility will create a new impervious area. Most of this new impervious area will be directed to infiltration controls. These controls will be at several localized areas whereas the existing site infiltrates storm water more uniformly across the existing pervious surface. Transporting storm water to localized infiltration control locations via impervious sheet flow, swales, and a storm water piping network will alter the location where the current rainfall infiltrates; however, this is not expected to significantly alter the groundwater table which feeds the

wetlands surrounding the facility. The drawings in Attachment A show the locations of these wetlands. The Cowardin classification of these wetlands can be found in Table 4-1.

These wetlands were created and are maintained by localized depressions in the ground surface that intersect the regional groundwater table, which is fed primarily from the 12,480 acre aquifer to the north. These wetlands are not maintained by existing overland drainage flow from the dune or other land on Ingram Yard, which will be modified from a pervious to impervious area. Therefore, minimal alteration to the groundwater level and wetlands surrounding the facility is expected to occur due to the addition of impervious area and redirecting existing storm water drainage patterns to localized infiltration areas.

**Table 4-1 Wetland Cowardin Classification**

| WETLAND AND ESTUARINE RESOURCES | COWARDIN CLASS TYPE | COWARDIN DESCRIPTION |
|---|---|---|
| Eelgrass | E1/E2AB | Estuarine Subtidal/Estuarine Intertidal Aquatic Bed |
| Intertidal Sand/Mudflat | E2US | Estuarine Intertidal Unconsolidated Shore |
| Shallow Subtidal | E1UB | Estuarine Subtidal Unconsolidated Bottom |
| Salt March | E2EM | Esuarine Intertidal Emergent |
| Deep Subtidal | E1UB | Estuarine Subtidal Unconsolidated Bottom |
| 2013-6 | PEMF | Palustrine Emergent, Semipermanently Flooded |
| 2012-2 | PSSC, PEMF | Palustrine Shrub, Seasonally Flooded/Palustrine Emergent, Semipermanently Flooded |
| Wetland C | PFO | Palustrine Forested |
| Wetland E | PABH | Palustrine Aquatic Bed, Permanently Flooded |
| Wetland F | PUBKx | Palustrine Unconsolidated Bottom, Artificially Flooded, Excavated |
| Wetland G | PUBKx | Palustrine Unconsolidated Bottom, Artificially Flooded, Excavated |
| Wetland H (East) | PEMA | Palustrine Emergent, Temporarily Flooded |
| Wetland H (West) | PEMA | Palustrine Emergent, Temporarily Flooded |
| Wetland I (North) | PEMA | Palustrine Emergent, Temporarily Flooded |
| Wetland I (South) | PSS | Palustrine Shrub |
| Wetland J | PEMA | Palustrine Emergent, Temporarily Flooded |
| Wetland N | PEM | Palustrine Emergent |

### 4.8.3 Groundwater Wells

The DEQ Drinking Water Protection database, which includes public drinking water source areas for groundwater and surface water, as well as the locations of public water system intakes and public groundwater wells, indicates that there are no groundwater wells that supply public drinking water systems within 400 feet of the JCEP Project area (Reference 10). Data maintained by the Oregon Water Resources Department indicates that there are four groundwater wells located just east of the LNG Terminal site that are permitted for industrial use and fire protection at the Roseburg Forest Products Company (RFP) property.

### 4.8.4 Underground Injection

There are no waste injection wells, seepage pits, or dry wells associated with the Project for storm water drainage, sanitary drainage, or process flows.

## 4.9 TIDE LEVELS

Table 4-2 provides the tide levels of Coos Bay at the location of the facility.

**Table 4-2 Facility Tide Levels in Coos Bay**

| DESCRIPTION | LEVEL (FEET NAVD 88) |
|---|---|
| Highest Measured Tide (HMT) | 10.26 |
| Mean Higher High Water (MHHW) | 7.46 |
| Mean High Water (MHW) | 6.81 |
| Mean Sea Level (MSL) | 3.70 |
| Mean Low Water (MLW) | 0.36 |
| Mean Lower Low Water (MLLW) | -0.97 |

# 5.0 Facility Description

## 5.1 LNG TERMINAL SITE AREAS

The following main components make up the LNG Terminal site areas.

**Ingram Yard**

- Access channel from the existing Coos Bay navigation channel and a terminal marine slip with a berth for one LNG vessel, a disabled ship berth, and a dock for tug and escort security boats.
- Material off-loading facility (MOF).
- Gas pretreatment unit.
- Refrigerant storage and resupply system.

- Liquefaction facilities.
- Natural gas fired combustion turbines inclusive of heat recovery steam generator (HRSG) units and ancillary facilities.
- Aerial cooling system (fin-fan).
- LNG storage system, consisting of two full-containment storage tanks.
- Boil-off gas recovery system used to control the pressure in the LNG storage tanks.
- LNG loading platform and transfer line.
- Emergency and hazard systems, plant systems, and electrical systems.
- Water Treatment Building.
- Diesel storage.
- Electrical, nitrogen, fuel gas, lighting, instrument/plant air, potable water, and service water systems.
- Emergency vent system (ground flare).
- LNG spill containment system.
- Fire water system and various other hazard detection, control, and prevention systems.
- New secondary access road to Ingram Yard from TPP.

**Access and Utility Corridor**

- New main access road to Ingram Yard from existing Jordan Cove Road.
- Main guard house, buildings, support facilities, Fire Department, plant utility services, and fire water tanks.
- New secondary access road to South Dunes from existing Jordan Cove Road.

**South Dunes**

- New main access road from existing Old Jordan Cove Road.
- Administrative Building.
- Southwest Oregon Regional Safety Center (SORSC) Building.
- Gas metering station.
- Helipad.

## 5.2 FACILITY PROJECT DESCRIPTION

The JCEP facility will consist of equipment to remove carbon dioxide, hydrogen sulfide, water, mercury, and other impurities that could damage equipment during liquefaction of natural gas. Once such impurities are removed, natural gas will be sent to the LNG trains for liquefaction and then to the on-site LNG storage tanks. The facility will also have piping to transfer LNG from the

LNG storage tanks to a marine facility, which will include a marine berth, capable of mooring the oceangoing vessels used for export of the LNG.

The MOF at the LNG marine area will allow delivery of overweight materials during the construction period that the existing roadway and rail link to the project site cannot handle.

The facility will be operational 24 hours per day, 365 days per year. The Project will be highly secured. Chain link fencing with three-strand barb wire, security cameras, and lighting will be installed to detect and prevent trespassing and vandalism.

Outdoor activities affecting this Plan at the site will be those typical of industrial facilities and will include, but are not limited to, the following:

- Loading and unloading of liquids and materials.
- Bulk liquid storage.
- Bulk materials storage.
- Vehicle/equipment/machinery repair and/or maintenance.
- Vehicle/equipment washing.
- Building and structural maintenance.
- Parking lots.
- Waste management (including office wastes, recyclable materials, garbage, other nonhazardous wastes, and hazardous wastes) prior to off-site disposal.
- Landscaping activities (including periodic use of fertilizers and approved chemicals).

## 5.3 OFF-SITE PROJECT AREAS

In the context of this Plan, the off-site project areas are identified as follows.

### 5.3.1 Off-Site Areas Managed under this SWMP

The following main components make up the off-site project areas that are covered under this Plan. Note that areas marked with an asterisk (*) are for temporary construction use only.

**Meteorological Station**

- Construction of a tower, at the west side of the lagoon on the North Spit, used to measure wind speed, direction, and other weather data to provide weather information to the LNG Terminal facility and to support ship navigation.

**Roseburg Forest Products Property***

- Excess excavation from Ingram Yard, including the slip and access channel, and the Access and Utility Corridor will be placed at the RFP property. Also, the RFP property will be utilized for construction laydown.

**Boxcar Hill***

- Construction laydown.
- Orientation facilities.
- Construction parking.
- Concrete batch plant operation, covered under a separate 1200-A permit (or equivalent) that will be provided by the subcontractor who manages the temporary mobile facility.

**APCO Site 1 (East)***

- Construction laydown.

**Port Laydown***

- Construction laydown.

**Myrtlewood Off-Site Park and Ride***

- Construction parking.

### 5.3.2 Off-Site Areas Managed Under Separate SWMPs

The following main components make up the off-site project areas that are covered under separate Plans, developed by others. Stormwater design for these areas is being developed by other contractors.

**Trans Pacific Parkway/US-101 Intersection**

- Provide a turning lane to manage traffic entering US-101 from the west.
- Provide automated traffic control.

**Kentuck Project**

- Involves wetland mitigation encompassing more than 100 acres of wide-ranging habitat of mudflats, salt marsh, willowed scrub/shrubs, and fish structures.
- Will require approximately 300,000 cubic yards of material to be transported from the dredge activities adjacent to the slip area to the Kentuck Project site via marine transport barges.

**APCO Site 2 (West)**

- Dredge disposal from the Navigation Reliability Improvements (Dredge Areas 1 to 4).
- Construction of a single-lane permanent bridge to span an existing tidal mudflat for access to this site.
- Construction of a temporary bridge to construct the permanent bridge.

**Utility Pipelines – Industrial Wastewater Pipeline (IWWP), Water Pipeline Relocation, and Utility Tie-Ins (Permitted Separately as Needed)**

- During site preparation of Ingram Yard, relocation of the IWWP and the raw water pipeline to a route along the existing TPP. Currently, the IWWP carries water from the two existing biosolids

ponds at South Dunes to the existing ocean outfall via the Lagoon site that is southwest of the proposed LNG Terminal.

- Portions of the existing IWWP will be abandoned in place.

## 5.4 FINISHED GRADING AND SURFACING

### 5.4.1 Ingram Yard Finished Grade Elevations

The finished grade of Ingram Yard will be relatively flat to provide access for maintenance of equipment. External side slopes will be utilized, where possible, and retaining walls will be utilized where space constraints are present and to protect existing wetlands. Road access will be provided at multiple points which will place constraints on the finished grade elevation. Also, the finished grade elevation must be above all potential natural hazards to provide safety to the plant. In general, the finished grade elevation at Ingram Yard will be lower than the highest elevation of the existing dune and higher than native ground away from the existing dune. The finished grade will be approximately 25 to 50 feet higher than the water level of the bay, except for the MOF, which is required to be approximately 10 feet higher than the bay. Existing material on Ingram Yard, including materials from the slip and potential dredge from the access channel, will be utilized for earthwork in fill locations.

### 5.4.2 Ingram Yard Finished Surfacing

In the process area of Ingram Yard, vegetation is not acceptable because of the risk of fire hazard. The following surface types will contribute water to the storm water system:

- Roads and general parking areas will be asphalt.
- Operational laydown areas, hard standing working areas for operational maintenance, and sidewalks will be concrete.
- General surfacing in areas where operational maintenance access will potentially be required will be dense-graded aggregate.
- Internal side slopes will be surfaced with aggregate of a size large enough to prevent erosion.
- External side slopes outside of the security fence will be vegetated. Topsoil, peat, or processed woody materials will be used to develop a seed bed. A native species will be planted within this seed bed for permanent vegetation for stabilizing the slopes.
- Surface infiltration basins will be surfaced with open-graded aggregate above the amended treatment zone. A geofabric will be used for separation between the amended treatment material and open-graded aggregate top surfacing layer.

### 5.4.3 South Dunes Finished Grade Elevations

South Dunes will be filled with excavated materials from Ingram Yard, including materials from the slip and potential dredge from the access channel. The overall quantity of material excavated at Ingram Yard will be the primary influence of the finished grade elevation of South Dunes. The elevation must also be above all potential natural hazards to provide safety to the buildings located at the top of the fill.

### 5.4.4 South Dunes Finished Surfacing

In the areas of the Administration Building and SORSC Building, finished surfacing will consist of asphalt roads and parking lots and concrete sidewalks. The area around the buildings will also include landscaping features. The helipad touchdown and liftoff area (TLOF) will be concrete surfaced and the final approach and takeoff area (FATO) around the TLOF will be aggregate surfaced. The gas metering station will be surfaced with dense-graded aggregate.

### 5.4.5 Construction Facility Areas

The following construction facility areas are a part of this Plan. The construction surfacing material will remain on these areas permanently. There are no planned industrial activities or materials on these areas after their use as construction facility areas is completed.

#### 5.4.5.1 Roseburg Site

Part of the Roseburg site will be filled with a portion of the excavated materials from Ingram Yard, including materials from the slip and potential dredge from the access channel, to provide a level pad for construction laydown and to provide a location for fill placement. The dredge material will be placed in lifts and decanted as required to meet compaction requirements. Because the Roseburg site borders Ingram Yard on both the north and the west sides, its elevation will be set to match the Ingram Yard finished grade elevation on those sides for ease of access during construction. This will result in the filled RFP property elevation being higher than the adjacent RFP property to the south, which is currently developed as a wood chip facility.

Finished surfacing material to stabilize the area for use as a construction facility area will be provided above the dredge material. Aggregate with a high infiltration rate (open-graded) will be placed over part of the construction facility area. Areas for foot traffic or higher vehicle traffic will be surfaced with dense-graded aggregate (3/4-inch minus or similar). The construction aggregate surfacing will be left in place following construction and will remain on this area permanently.

The finished grading of the Roseburg site will include the construction of low-lying areas on both the east and west sides of the raised pad that will serve as infiltration areas and reduce the risk of excess runoff from the aggregate surfacing from running off to the southern Roseburg site, to Ingram Yard to the north, or to the wetland to the east. An above grade vapor barrier wall will block any potential storm water flow from the Roseburg site to the west onto Ingram Yard. All the aggregate surfacing left from the construction facility area, which does not infiltrate directly, will drain to these low-lying areas and infiltrate. See the drawings in Attachment A for the locations of these low-lying areas. There will be no outfalls to Coos Bay from these infiltration areas for a design storm up to a 100-year return interval. These infiltration areas will not be designed to provide treatment with a water quality mix. They will consist of native sand and an open-graded aggregate covering. An overflow path (rip rap chute or similar) will be provided for these low-lying areas to handle extreme storm events to safely direct overflow runoff from the raised Roseburg construction facilities area to the lower existing RFP property to the south or Wetland 2012-1 to the east.

#### 5.4.5.2 Ingram Yard

The northern part of Ingram Yard will be used for construction facilities. The existing dune will be excavated in the east and existing grade will be filled to the west of the dune to match the finished grade elevations of the facility for ease of access during construction.

Aggregate with a high infiltration rate (open-graded) will be placed over part of the construction facility area. Areas for foot traffic or higher vehicle traffic will be surfaced with dense-graded aggregate (3/4-inch minus or similar). The construction aggregate surfacing will be left in place following construction and will remain on this area permanently.

Finished grade storm water will flow to low-lying infiltration areas. See the drawings in Attachment A for the locations of these low-lying areas. All the aggregate surfacing left from the construction facility area, which does not infiltrate directly, will drain to these low-lying areas and infiltrate. There will be no outfalls to Coos Bay from these infiltration areas for a design storm up to a 100-year return interval. These infiltration areas will not be designed to provide treatment with a water quality mix. They will consist of native sand and an open-graded aggregate covering. An overflow path (rip rap chute or similar) will be provided for these infiltration areas to handle extreme storm events to safely convey storm water down the side slopes to Wetland 2013-1 to the east or Wetland 2013-3 to the west.

#### 5.4.5.3 South Dunes

The western part of South Dunes will be used for construction facilities. The height of the pad will be set by the amount of excess fill from the other parts of the LNG Terminal site.

Aggregate with a high infiltration rate (open-graded) will be placed over part of the construction facility area. Areas for foot traffic or higher vehicle traffic will be surfaced with dense-graded aggregate (3/4-inch minus or similar). The construction aggregate surfacing will be left in place following construction and will remain on this area permanently. A permanent aggregate road on top of the pad will connect the secondary entrance road to South Dunes from the west to the buildings to the east.

Finished grade storm water will flow to low-lying infiltration areas. See the drawings in Attachment A for the locations of these low-lying areas. All the aggregate surfacing left from the construction facility area and the permanent aggregate road, which does not infiltrate directly, will drain to these low-lying areas and infiltrate. There will be no outfalls to Jordan Cove from these infiltration areas for a design storm up to a 100-year return interval. These infiltration areas will not be designed to provide treatment with a water quality mix. They will consist of native sand and an open-graded aggregate covering. An overflow path (rip rap chute or similar) will be provided for these infiltration areas to handle extreme storm events to safely convey storm water down the side slopes to Jordan Cove.

#### 5.4.5.4 Boxcar Hill

The Boxcar Hill site will be used for construction facilities only, including a construction batch plant. Operation of the batch plant will be managed under a separate permit (1200-A or equivalent). Following construction, aggregate surfacing from the construction facilities and the batch plant's discontinued operation (batch plant will be removed) will be left in place.

Storm water from the northern area of Box Car Hill will flow south and down a swale along the new road between the northern and southern area of Box Car Hill. The swale will outlet to the southern area of Box Car Hill.

Storm water from the southern area of Boxcar Hill will flow generally from north to south and to the existing wetlands (Wetland 4-A and Wetland 4-B) in the area, similar to the existing drainage pattern. A filter strip will be replanted within the LOD, adjacent to Wetland 4-A. The edge of the filter strip will be approximately 30-50 feet away from Wetland 4-A. The side slope between the filter strip and Wetland 4-A will be vegetated.

#### 5.4.5.5 APCO Site 1 East

Following construction, aggregate surfacing added for the construction facilities will be left in place. The APCO Site 1 East construction laydown area will be crowned with a high point ridge line running north-south down the middle of the site. Storm water will flow from this center crown outward to both the west and east.

A vegetated swale along both the west and east sides of the site, within the LOD, will provide flow-through treatment for storm water. These swales will discharge to a replanted filter strip along the south end of the site. The south end of the site is approximately 350 feet wide. This area will be replanted with a filter strip, 50 feet wide, within the LOD. The swales will discharge to the northern (higher) end of the filter strip. The filter strip will discharge the storm water directly offsite and to the Wetland (existing swale) to the south of the site.

#### 5.4.5.6 Port Laydown

Following construction, aggregate surfacing added for the construction facilities will be left in place. A natural buffer zone, approximately 130-feet wide, will be preserved and maintained between the LOD and Coos Bay to the east. Another natural buffer zone, at least 50-feet wide, will be preserved and maintained between the LOD and wetlands to the west.

Following construction, approximately 25 acres of the site will drain to the east, per the existing drainage patterns, toward Coos Bay. A portion of the site, approximately 8 acres, will drain to the west, toward the existing wetlands along the east side of TPP. Due to the natural buffer zones that will be left in place on both the east and west sides of the site, outside of the LOD, no revegetation will occur following construction. The construction aggregate will drain directly to these on-site natural buffer zones.

Minimal storm water currently drains offsite to the north or south. The construction grading plan is to preserve existing drainage patterns and prevent offsite drainage to the north or south. Therefore, no revegetation is planned along the north or south borders of the site. All the construction aggregate along the north and south borders will drain to either the east or west natural buffer zones. If during construction, drainage patterns are altered such that storm water from new aggregate surfacing will drain offsite to either the north or south, then filter strips will be replanted within the LOD along the north and south edges.

#### 5.4.5.7 Myrtlewood Off-Site Park & Ride

The Myrtlewood site is an existing asphalt parking lot. The existing drainage system will be used and will not be modified.

### 5.4.6 Off-Site Permanent Project Areas Finished Surfacing

Finished surfacing at the Meteorological Station will be dense-graded aggregate. The disturbed area is approximately 25 feet away from an existing wetland area. A filter strip will be replanted within the LOD outside of the Meteorological Station fence. Existing drainage patterns to the wetland area will be maintained.

Finished surfacing for the IWWP and other utility easements will be native vegetation.

## 5.5 STORM AND WASTE TRANSPORT SYSTEMS

Runoff from rain or washdown will be separated into two major systems, defined in this document as the storm water system and the oily waste system. The sanitary system will handle domestic sewage flows from buildings.

### 5.5.1 Storm Water System

The storm water system refers to the system that does not include runoff potentially contaminated with oil or grease. This includes the following areas:

- Parking lots.
- Roads.
- Roof drains.
- Dense-graded aggregate process areas.
- Concrete process areas.

### 5.5.2 Oily Waste System

For oil pollution prevention, the requirements in 40 CFR 112 will be met, including the provisions in Section 112.7(c) for secondary containment requirements. Secondary containment will be provided for all oil-filled vessels, tanks, bulk storage containers, and oil-filled equipment with a capacity that is equal to or greater than 55 gallons.

The oily waste system refers to the system that contains, transports, and treats runoff from the plant and oil discharges that are potentially contaminated with oil or grease.

The oily waste system includes drainage from the following areas.

**Areas Requiring Secondary Containment**

- Drain cups (bell-ups) from equipment with localized oil discharge points.
- Floor drains from containment areas for oil-filled equipment, tanks, etc.

**Areas Not Requiring Secondary Containment**

- Outdoor storage areas.
- Areas subjected to vehicle or equipment washdown.
- Floor drains from buildings with potential for oil spills:

- Fire Department.
- Plant Warehouse.
- Maintenance Building.

#### 5.5.2.1 Containment

Secondary containment is required for oil-filled vessels, tanks, bulk storage containers, and oil-filled equipment with a capacity that is equal to or greater than 55 gallons. Areas not requiring secondary containment will drain directly to area inlets or floor drains are not applicable in this section.

There will be three types of oil containment areas, described as follows. These oil containment areas are labeled on the drawings in Attachment A. Currently, the design includes mostly Type A containment areas, a few Type B containment areas in remote locations, and no Type C containment areas. Type C containment areas may be added in detailed design.

- Oil Containment Area Type A
  - A curbed containment area with an open drain(s) to the oily waste system piping network, discharging to the oil/water separator.
  - Oil/water separator(s) providing secondary containment.
  - Drain(s) sized for the maximum fire water flow rate.
  - Curbs sized to contain the entire oil volume of the largest tank within the containment area to prevent a sudden rupture of the tank from overtopping the curbs prior to draining.
  - Curbs not sized to handle retention of storm water or fire water flow.
- Oil Containment Area Type B
  - A curbed containment area with a filter-type oil blocking device. These devices do not have an open drain to the oily waste system piping network.
  - For these areas, secondary containment will be provided by curbs/walls (minimum of 6 inches high). The curbs/walls will be sized to contain the oil volume of the largest tank within the containment area, plus the storm water volume from the 25-year, 24-hour rainfall event, plus the design fire flow volume.
  - The device will contain filter media that plugs upon contact with oil. On spills of low volumes of oil, the filter media will hold the oil and begin to plug. On spills of large quantities of oil, the filter media will fully plug and block the outlet from the containment area.
  - When water is being held, and if it is determined that the device has plugged due to an oil spill, the contents of the containment area will be either vacuumed up and removed off-site or pumped with a portable sump pump to the oily waste system piping network.
  - The Type B containment areas will contain a Solidification Products International Petro Barrier device. See Attachment S for details and laboratory research of this

product. The Petro Barriers will be 18-inch inside diameter corrugated HDPE barrel with a solid bottom. They will have outlet pipes to discharge to a nearby drainage structure in the storm water system. The Petro Barriers will have three layers of the typical product media. The first media is for filtering oil sheen, the second is a more active absorption media, and the third is the most active media. The media will provide 100% oil spill protection and non-detectable oil levels in discharge water. Table 5-1 lists the Petro Barriers. See the drawings in Attachment A.

- Oil Containment Area Type C
  - A curbed containment area with a normally-closed manual valve. These devices do not have an open drain to the oily waste system piping network.
  - For these areas, secondary containment will be provided by curbs/walls (minimum of 6 inches high). The curbs/walls will be sized to contain the oil volume of the largest tank within the containment area, plus the storm water volume from the 25-year, 24-hour rainfall event, plus the design fire flow volume.
  - A visual inspection will be made after a rain event to determine whether an oil sheen is present. When an oil sheen is not visible, the valve will be opened to release the contained liquid to the storm water system. When an oil sheen is visible, the contents of the containment area will be either vacuumed up and removed off-site or pumped with a portable sump pump to the oily waste system piping network.

**Table 5-1 Petro Barrier Devices**

| PETRO BARRIER | LOCATION | DOWNSTREAM DISCHARGE CONTROL / OUTFALL |
|---|---|---|
| PB-A | Tug Building Transformer | CF-A / Outfall 001 |
| PB-B | Marine Powerhouse Enclosure Transformer | Basin C / Outfall 013 |
| PB-C | Marine Powerhouse Enclosure Transformer | Basin C / Outfall 013 |

#### 5.5.2.2 Transport

The main transport network for the oily waste system is a buried gravity drain piping network, which will drain to a single buried oil/water separator in a centralized location of Ingram Yard. Oily water lift stations, using positive displacement type pumps so as not to emulsify the oily waste, may also be utilized in conjunction with the buried gravity system to transport oily drainage from localized areas to the buried piping network.

During detailed design, it will be evaluated if multiple oil/water separators in parallel or a pumped network with an above grade oil/water separator(s) would be more efficient than a single buried oil/water separator.

For areas not requiring secondary containment, drainage to the piping network will come from area inlets and floor drains receiving surface runoff.

Oil containment areas with open drains to the oily waste system will drain directly to the piping network via floor drains.

Drain cups are vertical pipes with a top elevation set above grade such that no rainwater will enter the system through those points. Above grade drain piping from equipment containing oil will be piped from the drip pans under the equipment to the drain cups and will either be hard-piped to the drain cup or will discharge to the drain cup with an air gap. The drain cups will be connected to the piping network and ultimately to the oil/water separator which will provide secondary containment.

#### 5.5.2.3 Treatment - Oil/Water Separator

The oil/water separator at Ingram Yard will be sized to handle an emergency oil spill from the largest oil-filled vessel or piece of equipment being drained to it. The oil/water separator will also be sized to handle the highest flow rate that could be drained to it, which will typically be the highest design fire flow consisting of hose plus fixed deluge flow. The oil/water separator will be designed to meet the effluent requirements of the NPDES permit for the facility discharge to the IWWP .

The oil/water separator at Ingram Yard will include a series of baffles and plates to coalesce the oil into sheets. The coalesced oil will rise to the surface of the downstream collection chamber where the separated oil will accumulate. An oil level sensor shall alarm at high oil levels and provide direction to pump oil out of the separator and discharge off-site. Solids will collect at the upstream end of the separator and will be removed through a manway.

#### 5.5.2.4 Discharge to IWWP

The buried oil/water separator at Ingram Yard will contain a lift station at the downstream end after the oil/water separation has taken place. The treated water will be pumped automatically to the wastewater sump located near the oil/water separator. The purpose of the wastewater sump is to provide a single location to pump all required liquid streams to the IWWP. In addition to the treated water from the oil/water separator, the following liquid streams will be drained to the wastewater sump and pumped automatically to the IWWP.

- Process wastewater will consist of the following flows:
  - Reverse osmosis units reject.
  - Pressure filters backwash.
  - Condensate polishers regeneration discharge.
  - HRSG blowdown.
- Treated domestic wastewater from one of two on-site package plants.

The facility discharges to the IWWP will be permitted under an NPDES permit. Currently, work is underway to modify existing NPDES Permit 101499 with an application to request authorization for a change in waste streams discharged to the receiving waterbody.

### 5.5.3 Sanitary Waste System

Separate sanitary waste systems will be constructed at Ingram Yard and South Dunes. At each location, the system will drain to a single, new, above ground package sanitary treatment plant. Drainage will be primarily by gravity except for a lift station and force main from both the Tug Boat Building and Marine Powerhouse Enclosure since their locations are relatively far from the other buildings. An influent lift station at the inlet of each package plant will pump the raw sewage through the plant. An effluent lift station will pump the treated effluent from the plant at Ingram Yard to the wastewater sump, where the flow will combine with other waste flows and will be pumped to a new connection to the rerouted IWWP. The package plant at South Dunes will either drain by gravity or be pumped to a new connection to the IWWP at the TPP/Jordan Cove Road intersection.

The guard house at the northwest secondary entrance will have a buried sanitary holding tank adjacent to it (see the drawings in Attachment A) for sanitary drainage from the guard house. The tank will be 2,500 gallons and will be a Norwesco model 44079, or equivalent (see detail in Attachment T). The tank will be pumped out periodically and discharged offsite.

## 5.6 CHEMICAL CONTAINMENT SYSTEMS

### 5.6.1 ARGU Module Amine

The area in Ingram Yard under the ARGU module in the gas conditioning area will be curbed to catch any spill of amine. This area will drain to a sump at one end which will have a normally closed drain that is connected to the oily waste system. After a rain event, the liquid in the curbed area will be analyzed with a pH reading and/or other methods. If it is found that the liquid has been contaminated with amine, it will be disposed of off-site via a vacuum truck to a location that is to be determined during detailed design. If it is found to be free from amine, the valve will be opened and the rain or wash water will be drained via the oily waste system, through the oil/water separator to the IWWP connection.

### 5.6.2 LNG and Refrigerant

Areas of the site with the potential to incur LNG or refrigerant spills from piping and process equipment will be contained and drained via concrete LNG drainage trenches to one of two LNG impoundment basins. The areas of Ingram Yard required to be contained include the following:

- Slabs under the liquefaction trains.
- Slabs under the pipe racks containing LNG piping.
- Below grade trench carrying LNG piping.
- Earthen berm area around the LNG tanks.

The LNG impoundment basins will include sump pumps to pump out rainwater when LNG or refrigerant is not present. In accordance with 49 CFR 193.2173, the requirement for the water removal system is to have the capacity to remove water at a rate of 25 percent of the maximum predictable collection rate from a storm of 10-year frequency and 1-hour duration. The 10-year frequency storm with 1-hour duration is 1.2 inches (Reference 1). The discharged rainwater will be

pumped directly to the oily waste system via hard piping. The sump pumps will run on automatic mode and will include instrumentation to detect and shut down upon the presence of LNG or refrigerant.

### 5.6.3 Refrigerant Makeup

Concrete paving with a 6 inch high containment curb will be provided around the perimeter of the refrigerant makeup storage area. The truck unloading manifolds will reside within this curbed area with speed bumps on each side of the truck unloading area. Rainwater falling in the unloading area will drain to a rainwater trench internal to the refrigerant makeup storage area. Rainwater in the refrigerant makeup storage area will also drain to this trench. The trench will drain to an adjacent containment pit. The containment pit will be sized to contain 110 percent of the total quantity of the largest tank plus a 10 minute flow rate of fire water and the volume from the design storm event.

A pump system will be installed at the low point of the containment pit bottom slab. The pump system will discharge rainwater to the oily waste system. The pumps will either be on manual mode and will be turned on after operator inspection of the contained liquid following a rain event, or the pumps will be on automatic mode with instrumentation to detect and shut down upon the presence of refrigerant.

In the unlikely event of a refrigerant leak, the fluid will be contained inside the containment pit and will be vacuumed up and trucked off-site.

### 5.6.4 Liquid Nitrogen, Amine, Diesel, and Aqueous Ammonia Storage Areas

The containment areas for these chemicals will include concrete paving with a containment curb to catch any spills. These areas will drain to a location at one end of the containment area that will have a wall pipe with a normally closed valve. After a rain event, the liquid in the curbed area will be inspected and if it is found that the liquid has been contaminated with a chemical leak, it will be disposed of off-site via a vacuum truck to a location that is to be determined during detailed design. If it is found to be free from a chemical leak, the valve will be opened and the rain or wash water will be drained to grade, where overland flow will take it to the storm water system.

## 5.7 STORM WATER QUALITY AND POTENTIAL POLLUTANTS

Operational activities at the JCEP Project have the potential to be the source of a variety of storm water pollutants. This section discusses these potential pollutants and where each potential pollutant might be found within the Project. Storm water will be treated prior to discharge for the pollutants expected to be found.

Table 5-2 provides a summary of the potential pollutants which might be found at the Project, the likely sources and activities that may cause these pollutants, along with the selected BMPs/controls to prevent, reduce, and treat these pollutants. The following sections describe in further detail the potential pollutants and the activities within the Project where they might occur. Refer to the drawings in Attachment A for locations of these activities. The Overall Plot Plan, Liquefaction Plot Plan, and South Dunes Plot Plan in Attachment A also show a detailed listing of the project components.

Storm water pollution control measures for the Project consist of both structural and non-structural control measures. Structural controls include exposure minimization BMPs and structural storm water controls. Nonstructural controls implemented by the Project will include operations and maintenance (O&M) manuals, good housekeeping measures, preventive maintenance, spill and leak prevention, materials handling and waste management, erosion and sediment controls, training programs, and quality assurance and recordkeeping.

For further discussion, refer to the Spill Prevention, Control, and Countermeasure Plan - Operation (project report number J1-000-CIV-RPT-KBJ-50005-00) for materials that will be stored onsite during operation. This document will be updated in detailed design.

**Table 5-2 Potential Pollutants**

| PRIMARY POLLUTANT | CONSTITUENT POLLUTANTS | POLLUTANT SOURCES | SITE ACTIVITIES | BMPS/CONTROLS |
|---|---|---|---|---|
| Suspended Solids | • Sediment<br>• Aggregate and tire particles<br>• Exhaust gas particulates<br>• Heavy metals | • Trucks and vehicles<br>• Soil erosion | • Parking lots<br>• Laydown areas<br>• Concrete surfaces<br>• Aggregate surfaces | • Buried infiltration chamber with amended soil<br>• Open-graded aggregate infiltration basin with amended soil<br>• Vegetated infiltration basin with amended soil<br>• Cartridge filtration with media for Basic treatment -TAPE GULD<br>• Filter strip with amended soil<br>• Bioslope<br>• Vegetated side slopes<br>• Stabilized surfaces<br>• Geotextile separation of subgrade<br>• Periodic cleaning of catch basins<br>• Commercial street sweepers |
| Oil, Grease, and Hydrocarbons | • Automotive fluids<br>• Gas and diesel<br>• Oil and grease<br>• Transformer oil<br>• Washdown water<br>• Amine | • Trucks and vehicles<br>• Leaks and spills<br>• Equipment (pumps, etc.)<br>• Transformers<br>• Diesel fueling<br>• Heavy equipment<br>• Oil or diesel storage<br>• Equipment maintenance | • Process areas<br>• Equipment<br>• Vehicles<br>• Laydown areas | • Secondary containment<br>• Drip pans for spills, leaks<br>• Curbed hydrocarbon areas<br>• Storm water pretreatment manholes<br>• Oil/water separator<br>• Preventive maintenance |
| Liquid Chemicals | • Process chemicals | • Chemical tanks<br>• Loading and unloading of chemicals | • Process areas | • Secondary containment<br>• Containment curbs |

| PRIMARY POLLUTANT | CONSTITUENT POLLUTANTS | POLLUTANT SOURCES | SITE ACTIVITIES | BMPS/CONTROLS |
|---|---|---|---|---|
| Bacteria and Viruses | • Pathogens | • Broken sanitary sewer lines | • General areas | • Polyvinyl chloride (PVC) pipe with watertight joints |
| Nutrients | • Nitrogen<br>• Phosphorous | • Fertilizers<br>• Landscape materials<br>• Soil erosion | • Vegetated areas | • Using proper fertilization techniques<br>• Stabilized surfaces |
| Solid Waste | • Paper<br>• Garbage<br>• Debris | • Loading and unloading of materials<br>• Littering | • Buildings<br>• Parking lots<br>• Outdoor trash receptacles | • Good housekeeping<br>• Routine waste removal<br>• Routine inspections |
| Metals | • Copper | • Trucks and vehicles | • Parking lots<br>• Roads | • Buried infiltration chamber with compost amended soil<br>• Open-graded aggregate infiltration basin with compost amended soil<br>• Vegetated infiltration basin with compost amended soil<br>• Cartridge filtration with media for Enhanced treatment – TAPE CULD<br>• Filter strip with amended soil<br>• Bioslope |
| TAPE = Technology Assessment Protocol-Ecology<br>CULD = Conditional Use Level Designation<br>GULD = General Use Level Designation | | | | |

## 5.8 SELECTIONS OF STORM WATER CONTROLS

The following storm type water controls have been selected to provide treatment for the pollutants of concern.

### 5.8.1 Infiltration – Treatment for Suspended Solids and Metals

Suspended solids can be found in storm water runoff from many sources, including soil erosion, aggregate surfacing, and impervious areas. Metals, including copper, can be found in storm water from sources such as vehicle brake pads and vehicle servicing and cleaning. In the process of selecting controls to treat runoff for suspended solids and metals, preference was given to on-site infiltration since the native sand has a high infiltration rate. DEQ Fact Sheet - Reducing Copper in Industrial Stormwater (Reference 5) states that infiltration is a low impact development that may reduce copper concentrations in runoff. All infiltration will occur on-site.

#### 5.8.1.1 Groundwater Elevation

The ODOT Hydraulics Manual states that a minimum distance of 3 feet from the basin bottom or drain rock bed bottom to bedrock or seasonally high water table is required (Reference 6, Appendix C, Section 2.1.1). The bottom of the infiltration controls are at least 8 feet above the seasonally high groundwater elevation as shown in Attachment L.

#### 5.8.1.2 Primary Option – Surface Infiltration

Surface infiltration was the preferred option. Surface infiltration controls are utilized where possible and include vegetated infiltration basins where vegetation is allowed (South Dunes and the NW Ingram Yard entrance) and open-graded aggregate infiltration basins where vegetation is not allowed because of the inherent fire hazard in an LNG facility. Within the process area of Ingram Yard and the Access and Utility Corridor, swales, vegetated infiltration basins, and similar controls were eliminated from consideration because vegetation is not suitable because of the risk of fire hazard.

#### 5.8.1.3 Secondary Option – Buried Infiltration

For areas of the site that are not able to be drained to a surface infiltration control because of space and elevation constraints, buried infiltration chambers were chosen. The buried infiltration chambers will be constructed of precast concrete sections. They will be rated for American Association of State Highway and Transportation Officials (AASHTO) HS-20 truck loading. The precast sections have circular openings in the bottom slabs which allow for infiltration.

The buried infiltration chambers are not considered underground injection control structures.

For drainage areas comprised of solely dense-graded aggregate surfacing and no asphalt roadways where plant maintenance is very intermittent, a proprietary device with a General Use Level Designation (GULD) for Basic treatment by the Washington State Department of Ecology Technology Assessment Protocol - Ecology (TAPE) program was selected; namely, a Contech StormFilter with ZPG media.

For drainage areas comprised of both dense-graded aggregate surfacing and paved roadways, a proprietary device with a Conditional Use Level Designation (CULD) for Enhanced treatment by the TAPE program was selected; namely, a Contech StormFilter with MetalRX media.

### 5.8.2 Filter Strips – Treatment for Suspended Solids and Metals

For drainage of roads outside the main plant area, filter strips were generally chosen. The filter strips are designed using the ODOT Hydraulics Manual.

### 5.8.3 Bioslopes – Treatment for Suspended Solids and Metals

For drainage of roads outside the main plant area adjacent to wetlands, bioslopes were chosen to limit the footprint of disturbance. The bioslopes are designed using the ODOT Hydraulics Manual.

### 5.8.4 Treatment Swales – Treatment for Suspended Solids and Metals

A treatment swale was chosen for drainage of the northwest secondary entrance road because either a filter strip or bioslope would cause disturbance of the wetland adjacent to the road. This swale is designed using the ODOT Hydraulics Manual.

### 5.8.5 Proprietary Device – Treatment for Suspended Solids and/or Metals

At locations of the site where either the groundwater table is too low to infiltrate or there is not available space for either a surface or buried infiltration control, filter strip or bioslope, a proprietary device was selected to treat for suspended solids and/or metals, depending on the potential pollutants in the drainage area.

## 5.9 FACILITY AREA TREATMENT

### 5.9.1 Parking Lots, Roads, and Roof Drains

Trucks and vehicles can track or disturb aggregate, sediment, or debris that has accumulated on paved road surfaces. Particulates from tires, exhaust, and vehicle brakes may also accumulate and be transported in storm water runoff. Heavy metals from brake pads may also be present in parking lots or road surfaces. All asphalt and aggregate parking lot and road surfacing will have a geotextile fabric filter separating the native sand subgrade from the road layers. This will reduce the migration of native soil to the surface and lessen the potential for sediment-laden runoff. Roof drains also have the potential to contribute to suspended solids in storm water runoff.

#### 5.9.1.1 Road Traffic Frequency

The LNG Terminal will be an industrial facility with relatively minimal traffic. At Ingram Yard, approximately 100 to 150 people per day will work at the facility. At the Administration and SORSC Buildings at South Dunes, approximately 200 people will work per day. Therefore, the number of passenger vehicle trips over the main entrance road from Jordan Cove Road to the Ingram Yard main entrance will be less than 300 passes per day and the number of passenger vehicle trips over the main entrance road to South Dunes from Old Jordan Cove Road will be less than 400 passes per day. Most passenger trips to Ingram Yard will utilize the parking spots in the Access and Utility Corridor near the Maintenance Building, Operations Building and Control Room, and Fire Department.

Personnel on-site for ship loading activities will be less frequent. Semi-trailers and other large vehicles to bring bulk materials and supplies for facility operations will be intermittent, as will bulk chemical deliveries. Expected delivery traffic is less than on a daily basis.

Internal plant roadways within Ingram Yard will have daily maintenance traffic and will be utilized by trucks bringing bulk chemical deliveries.

In summary, being an industrial facility, the main entrance road and main parking areas at Ingram Yard will have less traffic than a typical commercial or residential type facility. Traffic to the South Dunes site will be more typical of a commercial type facility, but will still have much less traffic than public residential roadways. In-plant roadways will primarily be used for daily maintenance activities and infrequent bulk chemical deliveries. Because of the minimal traffic loads expected,

the risk of oil and metal pollutant loads from vehicle traffic are minor compared with other residential and commercial activities.

#### 5.9.1.2 Parking Lots and Roof Drains

There will be approximately 150 to 200 vehicle parking spaces in the Access and Utility Corridor for employees, vendors, and visitors. Storm water from this area, as well as from roof drains from the buildings, will be drained via area inlets and a buried storm water system, Buried Infiltration Chamber A in the marine area, south of the liquefaction trains. Overflows from the buried infiltration chamber will be released to the slip at Outfall 003.

There will be approximately 5 to 10 vehicle parking spaces at the secondary (northwest) entrance to Ingram Yard for employees. Storm water from this area will be drained to Vegetated Infiltration Basin D to the west of the parking lot and Bioslope A. A channel in the side slope, covered in rip-rap, will direct overflows from the vegetated infiltration basin to existing grade, which will flow to Wetland 2013-4. The bioslope will discharge to existing grade which will also flow to Wetland 2013-4.

There will be approximately 20 to 30 vehicle parking spaces total at various locations within the process area at Ingram yard for employees. Storm water from these parking lots will be drained via the buried storm water system to one of the two buried infiltration chambers (A and B) and Open-Graded Aggregate Infiltration Basin A. Overflows from these controls will be released to the slip at Outfalls 002 and 003.

There will be approximately 230 to 280 vehicle parking spaces at South Dunes for employees and visitors to the Administration Building and SORSC Building. Storm water from this area, as well as from roof drains from the buildings, will be drained via the buried storm water system to Vegetated Infiltration Basin E between the Administration Building and the gas metering station. Overflows from this vegetated infiltration basin will be released into Jordan Cove on the north side of Coos Bay at Outfall 007.

#### 5.9.1.3 Roads

Asphalt and aggregate roads within Ingram Yard and the Access and Utility Corridor will primarily be drained via the buried storm water system to one of the two buried infiltration chambers (A or B) or to one of three open-graded aggregate infiltration basins (A, B, or C). Overflows from these controls will be released to the slope at their corresponding outfall.

The asphalt road from the secondary (northwest) entrance, which is too low to drain to the buried storm water system at Ingram Yard, will sheet flow from east to west across the entire roadway cross section to a curb on the west side of the road which will direct the water to the north. At the low end of the road, just south of the railroad crossing, the curb will outlet the water to Treatment Swale A.

The asphalt road from the Tug Boat Building to the tug boat dock, which is too low to drain to the buried storm water system at Ingram Yard, will be drained to Cartridge Filter CF-A, Contech StormFilter with MetalRX media prior to being released to the slip via Outfall 001. There is not available space for an infiltration area near this road.

The asphalt road in the Access and Utility Corridor from Jordan Cove Road to the main guard house will be cross-sloped across all lanes to drain from the south to the north side of the road. Along the western and middle portions of this road, Filter Strip A will treat this storm water. After passing through the filter strip, the storm water on the western portion of this road will flow off-site to the natural drainage pattern and the storm water on the middle portion of this road will be released to an existing low spot in the natural topography on JCEP property, approximately 150 feet west of Wetland 2013-6, where it will infiltrate. Bioslope B will treat the eastern portion of the road. The side slope below the bioslope discharges to Wetland 2013-6.

The asphalt road from Old Jordan Cove Road to the raised South Dunes pad will be cross-sloped across all lanes to drain away from the retaining wall located on the east side of the road. Filter Strip D, running downhill from south to north, will treat this storm water. At the low end of the filter strip, the storm water will be released to a newly graded stormwater transport swale to handle the runoff between Old Jordan Cove Road and the raised South Dunes pad. A new culvert will be installed under the asphalt road to the raised South Dunes pad that the storm water from the road will pass through. The drainage flow path of the swale will be from west to east, matching the direction where Old Jordan Cove Road decreases in elevation. The new transport swale will continue to the east of the new asphalt road to the raised South Dunes pad and will wrap around the retaining wall to discharge to Wetland L. This is the existing discharge location of storm water in this area.

The asphalt road to the gas metering station on South Dunes will drain via overland flow, a transport swale, and a culvert to Vegetated Infiltration Basin E between the Administration Building and the gas metering station. Overflows from the vegetated infiltration basin will be released into Jordan Cove on the north side of Coos Bay at Outfall 007.

The aggregate road from Jordan Cove Road to South Dunes will be crowned. Filter Strips B and C along the shoulders will treat the storm water. Downstream of the filter strips, storm water runoff will flow down the vegetated side slopes and will be discharged to either Jordan Cove, Wetland B, Wetland C, Wetland D, Wetland E, or Wetland M.

### 5.9.2 Concrete and Aggregate Surfacing

Within Ingram Yard, suspended solids may be present on concrete and dense-graded aggregate surfacing used for operational access and occasional maintenance activities. All concrete and aggregate surfacing will have a geotextile fabric filter separating the native sand subgrade from the surfacing material. This will reduce the migration of native soil to the surface and lessen the potential for sediment-laden runoff.

Where there is not a risk for oil contamination, storm water from these areas will be drained via the buried storm water system piping network to one of following infiltration treatment areas when space for infiltration is possible and when the groundwater elevation is high enough to allow for an infiltration control:

- Buried Infiltration Chamber A
- Buried Infiltration Chamber B
- Open-Graded Aggregate Infiltration Basin A

- Open-Graded Aggregate Infiltration Basin B
- Open-Graded Aggregate Infiltration Basin C

Overflows from these infiltration controls for storms greater than the design storm event will be released to the slip at Outfalls 002, 003, 004, and 013. The overflow from Open-Graded Aggregate Infiltration Basin A will flow to Buried Infiltration Chamber A, and they will share the same outfall.

The west disabled ship berth will be surfaced with aggregate and is too low to drain to the buried storm water system at Ingram Yard. It will be drained to Cartridge Filters CF-F and CF-G. These cartridge filters will be Contech StormFilter with ZPG media. There are no asphalt roads or concrete surfacing on this area of the disabled ship berth except for marine dolphins (concrete structures with quick release hook and integral capstan) to berth and moor a vessel. Maintenance access to this area will be very intermittent. Enhanced treatment is not required in this area. These cartridge filters will discharge to the slip via Outfalls 010 and 011.

The MOF, located at the southern end of Ingram Yard, will be utilized to receive materials during construction. It will be aggregate surfaced with a concrete slab to unload materials onto and will drain to the north, away from Coos Bay. The MOF will be at El 13 feet and a construction transport road will slope up from the MOF to the liquefaction units at Ingram Yard. The construction transport road will be aggregate surfaced and approximately 150 feet wide. The construction transport road will be crowned and will drain to aggregate storm water transport swales on both sides. These swales will slope down toward the MOF. Since the MOF elevation will be close to the water level of Coos Bay, it is not possible to locate an infiltration control near it. Therefore, Cartridge Filters CF-D and CF-E will receive the storm water runoff from the MOF and construction transport road. These cartridge filters will be Contech StormFilter with ZPG media. There are no asphalt roads and maintenance access to this area will be very intermittent. Enhanced treatment is not required in this area. These cartridge filters will discharge to the slip via Outfalls 005 and 006, to the slip and access channel, respectively.

At South Dunes, the gas metering station will be surfaced with dense-graded aggregate for a working surface and will also include concrete foundations. Preliminary design has the gas metering station crowned in the middle with runoff flowing to both the north and south ends. Runoff to the north will flow to Vegetated Infiltration Basin E between the Administration Building and the gas metering station. Overflows from this vegetated infiltration basin will be released into Jordan Cove on the north side of Coos Bay at Outfall 007. Runoff to the south will flow to Vegetated Infiltration Basin F in the southern area of South Dunes. Overflows from this vegetated infiltration basin will be released into Jordan Cove on the north side of Coos Bay at Outfall 012.

At the off-site project facility locations that will be surfaced with dense-graded aggregate (Boxcar Hill and the Meteorological Station), existing drainage patterns will be preserved to the maximum extent practical. Storm water will be treated primarily by vegetated swales and filter strips. During detailed design, these areas will be developed further.

Storm water falling on the Roseburg site will primarily infiltrate because it is surfaced primarily with aggregate with a high infiltration rate. Detailed design will determine the locations and sizes of any infiltration controls required.

### 5.9.3 Tug Boat Dock

The tug boat dock will be a fixed dock, supported on piers, with road access from the west emergency lay berth. Storm water falling on the tug boat dock will be directed to cartridge filter devices on the dock itself to treat any suspended solids and metals which are present on the dock. The outlet of the cartridge filters will discharge to the slip. Preliminary design has located two cartridge filters – Cartridge Filters CF-A and CF-B; Contech StormFilter with MetalRX media and two outfalls – Outfalls 008 and 009, for this purpose. The cartridge filters are planned to be hung underneath the deck of the tug boat dock and will receive surface drainage from the dock through a grate opening in the top of each cartridge filter.

### 5.9.4 Vegetation

The following areas of the site will be vegetated. Vegetation is not allowed within the process areas of the facility due to the fire hazard risk.

#### 5.9.4.1 External Side Slopes

All external side slopes of the project site will be vegetated to stabilize the slopes and to serve as an extra filter for storm water runoff before draining off the site. The vegetation type will be chosen during detailed design.

#### 5.9.4.2 Landscaping

Landscaping will be provided in the Access and Utility Corridor and at South Dunes around the buildings. Final landscaping design will be performed during detailed design. Landscaping will be designed to encourage infiltration and retention of storm water.

#### 5.9.4.3 Other Areas

After construction of the IWWP pipeline and other utility lines, the area will be revegetated with native vegetation. Existing storm water flow patterns will be maintained.

### 5.9.5 Oil and Grease

#### 5.9.5.1 Outdoor Storage Areas

Outdoor areas designed for storage of materials, steel, equipment, or vehicles have the potential for contributing oil, in addition to suspended solids and metals, to storm water runoff. Based on guidance from the DEQ Industrial Stormwater Best Management Practices Manual (Reference 3), these areas will contain equipment covers (IS BMP 19) and will drain to an oil/water separator (IS BMP 9). The term "IS BMP" is used herein to refer to the DEQ Industrial Stormwater BMPs.

Outdoor storage areas will contain equipment covers consisting of permanent covers, tarps, plastic sheeting, or similar measures to reduce the amount of rainfall in contact with the equipment. If tarps or sheeting are used, they will be securely anchored. Equipment will be placed on pallets, when possible, to further reduce the amount of storm water coming in contact with the equipment.

Outdoor storage areas will be drained to the oily waste system, which will be treated by an on-site buried oil/water separator in Ingram Yard. The effluent from the oil/water separator will be pumped to the rerouted IWWP and permitted under an NPDES permit.

The outdoor materials storage area within the Access and Utility Corridor is located north of the Warehouse. Also, outdoor storage for large equipment is provided between the Warehouse and Maintenance Building and the Operations Building. These areas will be concrete surfaced. These areas are connected and will be separated from adjacent areas by concrete curbing. These areas will drain to area inlets within the curbed area which will connect to the oily waste system.

#### 5.9.5.2 Parking Lots

Potential releases of fuels (gasoline and diesel) and oil and grease may occur from cars parked in parking lots. Eugene City Code EC 9.6794 requires that oil control provisions be provided for parking lots with at least 100 off-street parking spaces. Both the Access and Utility Corridor and South Dunes have more than 100 parking spaces. This requirement will be followed at the plant; therefore, all of the parking spaces at each of these locations will be provided with oil control provisions.

The parking lot near the main guard house, east of the Warehouse and Maintenance Building, will contain spill control manholes. Also, at South Dunes, the parking lots for the Administration and SORSC Buildings will contain spill control manholes. According to the City of Eugene Stormwater Management Manual (Reference 8), spill control manholes rely on passive mechanisms that take advantage of oil being lighter than water. Oil rises to the surface and can be periodically removed. They consist of a simple underground manhole with a "T" outlet designed to trap small spills. The spill control manholes will connect to the storm water system.

The parking lot to the east of the Operations Building is adjacent to the large equipment outdoor storage area. Therefore, it will be curbed within the same area as the outdoor storage area and will drain to the oily water system.

There are smaller parking lots at various locations within Ingram Yard which have between 5 and 20 parking spaces. These are isolated parking lots for low frequency usage during plant operations and, therefore, will not contain specific oil control provisions.

#### 5.9.5.3 Wash Bays

Wash bays for vehicle or equipment washing are likely to have oil and grease present which can be transported in storm water runoff.

Wash bays will be provided in the SORSC Building at South Dunes and in the Fire Department in Ingram Yard. Vehicle and equipment washdown will also occur in the Maintenance Building in the Access and Utility Corridor.

The wash bay from the SORSC Building will contain an oil/water separator. This oil/water separator will be designed during detailed design. Effluent from the oil/water separator will drain by gravity to a new connection to the existing IWWP and permitted under an NPDES permit.

The wash bays from the Fire Department and the Maintenance Building will drain to the oily waste system, which will be treated by the on-site buried oil/water separator at Ingram Yard. The effluent from the oil/water separator will be pumped to the wastewater sump, then pumped to the rerouted IWWP and permitted under an NPDES permit.

#### 5.9.5.4 Helipad

The touchdown and liftoff area (TLOF) of the helipad at South Dunes will be concrete surfaced. There is the potential for oil leaks from helicopters and vehicles utilizing the helipad; therefore, the area will be sloped to a drain within the paved surface that will either connect to the oil/water separator in the wash bay at the SORSC Building or drain to a dedicated oil/water separator or cartridge filter device to treat the stream of oily water before being discharged to the storm water system.

# 6.0 Nonstructural BMPs

Nonstructural control measures are comprised of management procedures and practices used in facility operations to minimize the presence of potential pollutants in areas where they may intermix with the storm water runoff. These procedures and practices generally include routine facility inspections; preventive maintenance of equipment; employee training to promote recognition of potential problems and proper response to prevent or minimize the opportunities for storm water pollution; and spill response and reporting.

An inspection and maintenance program will be established and contained in an O&M Manual for structural control measures. Routine maintenance measures will be scheduled during the annual dry season at the facility (approximately May to October). As part of the maintenance program, an Inspection and Maintenance Log will be kept on file at the facility. The log will record the inspection dates, the areas that were inspected, and any maintenance or repairs required and made.

In addition to inspection and maintenance of structural controls, a training schedule for non-structural controls will be established. Training will have a storm water protection awareness component to encourage staff to recognize storm water issues that may be present in their work area, proper housekeeping practices that reduce the potential for negative storm water impacts, and spill prevention. Training will include, but not be limited to, chemical handling and management during delivery and storage, spill prevention, handling of hazardous substances, management of waste materials, and proper spill response.

Information packets on housekeeping, proper storage and handling of waste materials, and spill awareness will be provided to personnel.

Spill prevention and control is an integral part of pollution prevention. A Spill Prevention, Control and Countermeasures Plan for operations will be prepared in accordance with 40 CFR 112 after the final design is established. Personnel will be trained in spill awareness and prevention and spill kits and tools will be available at the diesel fuel storage tank, hazardous materials storage area, and other selected sites around the facility where releases of oils could be reasonably expected to occur. Additional spill response supplies will also be kept on-site.

Nonstructural BMPs used to minimize or eliminate the storm water contact with potential pollutants include the following:

- Maintaining good housekeeping and waste management practices.
- Using nontoxic chemicals and biodegradable nonphosphate detergents as cleaners, when available.

- Inspecting and sweeping the paved roads and parking areas to remove sand as well as other particulate pollutants.
- Regularly inspecting and collecting litter and debris from drainage courses and cleaning catch basins of accumulated solids or oils, as required.
- Inspecting trucks and equipment, as well as performing preventive and scheduled maintenance.
- Inspecting fuel and other delivery vehicles upon arrival, clearing them for access, and accompanying them during delivery, as needed, to ensure proper delivery procedures are followed.
- Inspecting stored vehicles, equipment, and materials for leaks and installing drip pans, absorbent pads, coverings, and other measures, as required, to collect and contain leaks or spills to prevent storm water exposure.
- Regularly inspecting the facility for potential pollutants.
- Selecting native plants that require less intensive care, mowing, or maintenance.
- Avoiding overwatering or overuse of fertilizers, herbicides, or pesticides.
- Providing spill awareness and initial response training.
- Providing education and training programs that include orientation upon initial hire, follow-up training to reinforce initial training, and job-specific annual refreshers.
- Regularly cleaning oil/water separators.
- Regularly inspecting for accumulated sediment in infiltration areas.
- Using regular weed abatement.
- Inspecting sediment or debris on roadways.

# 7.0 Storm Water Quantity

Operational activities will increase the amount of impervious areas at the project site. Also, runoff patterns will be changed from their existing directions. Runoff in both the storm water system and oily waste system will be concentrated into below grade piping networks. These factors will result in storm water being discharged at a shorter time of concentration and to localized outfall locations. Infiltration methods utilized in the design will help to alleviate this effect. This section discusses storm water quantity, namely the flow rates and velocities expected to be experienced in the piping networks and at the outfalls, and the requirements for design.

## 7.1 STORM WATER CONVEYANCE SYSTEM

The storm water conveyance system will transport storm water from the surface of the plant to the storm water quality controls and, ultimately, to the outfall locations for storm water that are not infiltrated by the controls. The conveyance system will consist of swales, culverts, and a buried piping network containing inlets and manholes.

The following storm return intervals will be used to design the storm water conveyance system:

- Piping – 25 years

- Culverts – 25 years
- Swales – 10 years

The Project will use a 25-year design storm to size all buried storm water and oily waste piping for the maximum instantaneous flow for the design storm, based on the applicable time of concentration. A 100-year check storm will be utilized to ensure that backup of the piping networks will not flood buildings or equipment foundations. The oily waste piping network will also be sized to handle the maximum instantaneous fire flows expected.

Culverts will be sized to pass the 25-year maximum instantaneous flow without overtopping the roadways under which they are located. Culverts will be checked with the 100-year storm to ensure that backup does not flood buildings or equipment foundations.

Swales will be sized to handle the 10-year maximum instantaneous flow, at a minimum. When possible, swales will be designed to handle the 25-year flow. Swales will be checked with the 100-year storm to ensure that backup does not flood buildings or equipment foundations.

## 7.2 OUTFALL DESIGN

All new piped discharges for storm water (outfalls) will be located on-site or in the slip, access channel, or Jordan Cove.

Outfalls will transport overflow storm water from the infiltration controls ultimately to Coos Bay and Jordan Cove. Outfalls will also transport storm water from the in-line cartridge filter controls ultimately to Coos Bay. Because the quantity of water that will be released at the outfalls is small in comparison to the quantity of water in Coos Bay, the controls will not be sized to limit the outfall flow rates. Rather, the controls will be sized for the water quality criteria and not for flow rates at the outfalls. The infiltration controls, which were selected when possible, will provide retention and will assist in providing flow control by reducing the volume of water released into Coos Bay.

Outfalls will contain engineered erosion prevention measures. These measures may include concrete aprons, or other similar measures, to be determined during detailed design. The erosion prevention measures will be designed based on the outfall flow rates and velocities experienced during the 25-year storm.

Outfalls will discharge at as high an elevation as possible. Backflow prevention will be provided when the elevation of the outfall pipe is at a level where water during a storm event has a relative likelihood of reaching the pipe.

# 8.0 Structural Controls Design

## 8.1 FILTRATION FACILITIES (INFILTRATION CONTROLS)

The infiltration type control facilities selected for pollution removal are considered filtration facilities according to Chapter 14, Appendix C of the ODOT Hydraulics Manual (Reference 6). These controls will be sized to detain and infiltrate all the runoff generated by the water quality design storm from their contributing drainage areas. The contributing drainage areas include all areas

that drain to the control facility. For the purposes of this Plan, this total area will be designated as the contributing impervious area (CIA). Curve numbers, to be utilized in the USDA TR-55 (Reference 9) method to determine peak flows and volumes of infiltration facilities, will be chosen based on the surface type and relative impervious percentage of the CIA. The controls for the Project that fall under this category are vegetated infiltration basins, open-graded aggregate infiltration basins, buried infiltration chambers, and bioslopes.

Section 14.10.2 of Reference 6 states "the water quality design storm is designated as a percentage of the 2-year 24-hour storm and is used to determine the water quality design flow rate or water quality design volume. The maximum design storm depth is 2.5 inches and the minimum water quality design storm depth is 0.7 inches." For the area of Coos Bay, the design storm factor is 50-percent of the 2-year, 24-hour storm (Attachment G). For the area of the Project, the 2-year, 24-hour storm rainfall depth is 3.5 inches (Reference 2); therefore, 50-percent of the 2-year, 24-hour storm is 1.8 inches.

The Project has elected to use 100 percent of the 2-year, 24-hour storm (3.5 inches) as the water quality design storm depth for infiltration basins and buried infiltration chambers to infiltrate a wider range of storm events. All infiltration basins and buried infiltration chamber control facilities will be sized to detain and infiltrate all the runoff generated by this water quality design storm depth.

For bioslopes, the water quality design flow rate (Q-highway) will be set to the peak flow resulting from the USDA TR-55 (Reference 9) SCS method. A design storm depth of 50-percent of the 2-year, 24-hour depth (1.8 inches) will be utilized in the calculation.

### 8.1.1 Pretreatment

Each infiltration control will include a pretreatment component to extend its life and efficiency and to minimize the maintenance requirements of the control itself. The pretreatment component will remove coarse sediment and trash. Vegetated infiltration basins and open-graded aggregate infiltration basins will include forebay sediment basins at the upstream end. Buried infiltration chambers will include a pretreatment manhole upstream of the inlet. The specific design of the pretreatment manhole will be finalized in detailed design.

### 8.1.2 Water Quality Mix

The infiltration rate of the native soil will be greater than 9 inches per hour when excavated, filled, and compacted under the infiltration control areas. Because of this high infiltration rate of the native sand, the water quality mix outlined in Chapter 14, Appendix E, Section 2.0 of the ODOT Hydraulics Manual (Reference 6) will be placed at the bottom and side slopes of the open-graded aggregate infiltration basins and in the bottom of the buried infiltration chambers (on top of the bottom slab) to reduce the infiltration rate. The water quality mix will also enhance pollutant removal by including organic content to the filtration media (Reference 6). For the infiltration controls, the water quality mix will contain 20 to 25 percent compost and 75 to 80 percent water quality soil media.

In accordance with the ODOT Hydraulics Manual, the water quality soil media must meet the following requirements and the gradation in Table 8-1. During construction, it will be determined if native soil will be excavated that meets these criteria or if imported material will be required.

- Sampling must meet the requirements of AASHTO T2.
- Sieve analysis must meet the requirements of AASHTO T27 and AASHTO T11.
- Soil pH – 5.5 to 8.0.

**Table 8-1 Water Quality Soil Media Gradation**

| SIEVE SIZE | PERCENT PASSING (BY WEIGHT) |
|---|---|
| No. 4 | 100 |
| No. 10 | 95 – 100 |
| No. 40 | 40 – 60 |
| No. 100 | 10 – 25 |
| No. 200 | 5 – 10 |

The compost will be medium type compost according to ODOT Special Provision 3020.

The ODOT Hydraulics Manual (Chapter 14, Appendix C, Section 2.2) states that the infiltration rate used in the design of the water quality mix is 3 inches per hour (Reference 6). Therefore, all infiltration controls will assume a 3 inch per hour infiltration rate to size the dimensions and height of the control utilizing the Bentley PondPack pond routing program.

### 8.1.3 Infiltration Basins

Infiltration basins will contain 24 inches of the water quality mix. A geotextile designed for both separation and reinforcement will be placed between the water quality mix and the native sand. Storm water entering the basin will infiltrate through the water quality mix and then through the native sand, which has a higher infiltration rate than the water quality mix; therefore, no underdrain will be provided. Side slopes will be 3(H):1(V) and will include 24 inches of the water quality mix, up to the 100-year storm elevation.

Vegetated infiltration basins will include native vegetation in the water quality mix. Open-graded aggregate infiltration basins will be non-vegetated. The water quality mix will be covered with open-graded aggregate to reduce the fire hazard risk that on-site vegetation poses within areas of the plant where these controls were selected. A geotextile fabric will be placed between the water quality mix and the open-graded aggregate to provide separation.

A pretreatment sediment basin (forebay) will be provided for each basin. A 16 foot access ramp will be provided to the bottom of each basin and will be located in detail design. No bottom marker will be included for open-graded gravel infiltration basins. The geotextile will provide reinforcement for maintenance vehicle traffic. A bottom marker will be included for vegetated infiltration basins. No dewatering risers will be included since the infiltration rate will allow for the basins to naturally drain prior to maintenance.

Riprap will be used for energy dissipation for the inlet pipe discharge. Riprap will also be placed for an emergency weir to be utilized during overtopping events of extreme storms.

The main outlet structure from Basin A will be a culvert pipe, with invert above the 2-year water surface elevation of the basin. The main outlet structure from the other basins will be an outflow structure with a riser box. Flow will enter the riser box from the top after the basin fills and the riser box will have an outflow pipe at the bottom of the box. The top of the riser box will be set above the 2-year water surface elevation of the basin. Upon less frequent storms (greater than 2-year return interval), the water will overtop the main outlet structure and be discharged directly to the outfall.

An emergency weir will be set at the 100-year water surface elevation of the pond. The top of the basin will be at least 12 inches higher than the main outlet structure and at least 4 inches higher than the emergency weir.

See the calculations in Attachments L and M for details of the analysis.

See the drawings in Attachment A for locations of the infiltration basins. See drawings J1-150-CIV-SCT-KBJ-04950-01 and J1-150-CIV-SCT-KBJ-04951-01 for typical sections of the infiltration basins.

### 8.1.4 Buried Infiltration Chambers

There will be two buried infiltration chambers in Ingram Yard because of the lack of available space to utilize basins with side slopes to infiltrate the entire water quality design volume.

The inlet pipe from the storm water system will enter the chamber from one end. Flow will spread out across the bottom of the chamber and will infiltrate through 24 inches of the water quality mix which will be placed inside the chamber, at the bottom. After infiltrating through the water quality mix, the water will infiltrate through the fill and native sand via the circular openings in the bottom slabs. At the downstream end of the chamber, a precast structure will have a steel plate weir set above the 2-year storm water surface elevation. Upon less frequent storms (greater than 2-year return interval), the water will overtop the weir and be discharged directly to the outfall via an overflow pipe. The basic construction steps are typically as follows:

1. Place level pad of open-graded aggregate beneath the footprint.
2. Place bottom row of precast modules (with circular openings in bottom for infiltration) side-by-side via cast in lifting anchors.
3. Apply sealant to external joints.
4. Place top row of precast modules (if two rows are needed for the depth required).
5. Apply mastic tape across the top of the joints.
6. Backfill.

Maintenance for the buried infiltration chambers will be provided by access openings in the top, with a maximum 50 foot distance between openings. The entire volume of the chamber is available to be accessed to clear sediment with vactor trucks. In addition to the pretreatment manhole upstream of the chamber, high weir panels may also be placed near the inlet end of the buried chamber so that 80 to 90 percent of the fines/sediment will deposit at the initial precast units and make maintenance simpler. Typically, maintenance is required on a yearly or longer basis.

See the calculations in Attachments L and M for details of the analysis.

See the drawings in Attachment A for locations of the chambers. See drawing J1-150-CIV-SCT-KBJ-04950-01 for a typical section of the chambers.

### 8.1.5 Infiltration Basin and Buried Infiltration Chamber Analysis

Bentley PondPack software was utilized to analyze the infiltration control areas on-site. A summary of the size and depth of the infiltration control areas is shown in Table 8-2. The SCS Unit Hydrograph method was utilized. USDA TR-55 (Reference 9) was used to obtain runoff curve numbers (CN). Inputs to the hydrologic design include the storm water quality, 24-hour precipitation depth, drainage areas, CN-values for the final surfacing materials, and the time of concentration, representing the time it takes for runoff to travel from the hydraulically most distant point to the infiltration location.

The site is in an area with rainfall distribution, IA. The hydrologic soil group of the native soil is A. In Ingram Yard, the majority of the site contributing runoff to the infiltration areas will be impervious, consisting of roofs, concrete, asphalt, and dense-graded aggregate. For Ingram Yard, the CN-value used for all infiltration areas for preliminary design is 98, representing a mixture of impervious roof, concrete, and asphalt area (CN = 98) and dense-graded aggregate (CN = 98). At South Dunes, a CN-value of 90 was used for preliminary design of Basin F, representing a mixture of impervious roof, concrete, and asphalt area (CN = 98); dense-graded aggregate (CN =98); and landscaping (CN= 39). At South Dunes, a CN-value of 80 was used for preliminary design of Basin G because of the portion of the CIA that includes open-graded construction aggregate surfacing.

Inputs and results of the PondPack modeling are provided in Attachment M. Preliminary sizes of the infiltration facilities were determined from this modeling and will be updated during detailed design.

**Table 8-2 Size and Depth Summary of Infiltration Control Areas**

| | LOCATION | BASIN DIMS (TOP) (FT X FT) | | 2-YEAR DEPTH (FT) | OVERFLOW DEPTH (FT) | 100-YEAR DEPTH (FT) | OVERALL DEPTH (FT) |
|---|---|---|---|---|---|---|---|
| Chamber A | Marine Area | 155 | 140 | 10.47 | 10.50 | 12.54 | 15.0 |
| Chamber B | West of LNG Tanks | 100 | 90 | 6.37 | 6.50 | 7.37 | 11.0 |
| Basin A | West of STGs | 362 | 86 | 6.82 | 7.00 | 8.13 | 11.0 |
| Basin B | Marine Area North | 100 | 60 | 3.78 | 4.00 | 4.26 | 6.0 |
| Basin C | Marine Area South | 175 | 60 | 6.94 | 7.00 | 7.58 | 8.0 |
| Basin D | NW Secondary Entrance | 60 | 50 | 4.34 | 4.50 | 4.67 | 6.0 |
| Basin E | South Dunes Buildings | 170 | 130 | 6.80 | 7.00 | 7.83 | 10.0 |
| Basin F | South Dunes Metering Station | 110 | 60 | 4.19 | 4.50 | 4.82 | 6.0 |

### 8.1.6 Bioslopes

A bioslope is a flow-through type storm water runoff treatment device. There will be two bioslopes on-site. One bioslope will be placed along the new secondary access road in the northwest corner of Ingram Yard. The second bioslope will be placed along the northern edge of the main access road to Ingram Yard in the Access and Utility Corridor.

Pretreatment for bioslopes will consist of a 3 foot wide filter strip placed between the impervious drainage area and the bioslope.

The bioslopes are ideal for roads adjacent to wetlands to minimize the footprint of disturbance. The bioslopes will use a sheet flow application without an underdrain. Each bioslope will consist of a non-vegetation zone, a filter strip, an ecology mix, and a geotextile for underground drainage. The ecology mix will be designed with a long-term infiltration rate of 10 inches per hour in accordance with Appendix C of the ODOT Hydraulics Manual (Reference 6).

See the calculations in Attachment M and N for details of the analysis.

## 8.2 BIOFILTRATION FACILITIES

Filter strips and swales qualify as biofiltration facilities according to Chapter 14, Appendix B of the ODOT Hydraulics Manual (Reference 6). The vegetation type will be native vegetation for the area.

### 8.2.1 Filter Strips

Filter strips will be placed by outlying roads where transport via the storm water system piping network to infiltration controls is not feasible. They will consist of gently sloped grassed or vegetated areas for storm water to flow through to receive treatment via filtration and sedimentation. Filter strips will be a minimum of 5 feet wide with a maximum lateral slope of 5 percent and will have a 12 foot aggregate setback distance from the edge of pavement. Planting requirements shall be in accordance with the ODOT Hydraulics Manual, and the water quality mix will be included as a planting medium for the filter strip. Refer to Table 8-3 for the filter strip design summary.

See the calculations in Attachment 0 for details of the analysis.

#### 8.2.1.1 Filter Strip Locations

There will be four filter strips on-site. The main access road filter strip, designated as FS-A, will be on the north side of the main access road to Ingram Yard in the Access and Utility Corridor. The road will be sloped so that all storm water will flow from south to north and flow through the filter strip. There will be two filter strips placed parallel to the aggregate-surfaced Secondary Access Road, designated as FS-B and FS-C; one will be on the north side of the road and one will be on the south side. The road will be crowned at the centerline and each filter strip will treat storm water from its respective drainage area. There will be one filter strip on the west side of the asphalt road from Old Jordan Cove Road to the top of South Dunes, designated as FS-C. This road will be sloped so that all storm water will flow from east to west and flow through the filter strip.

**Table 8-3 Filter Strip Design Summary**

| | FS-A | FS-B | FS-C | FS-D |
|---|---|---|---|---|
| Filter Strip Length (ft) | 1391 | 1745 | 1745 | 1250 |
| Lateral Slope of Filter Strip (%) | 2 | 2 | 2 | 2 |
| Longitudinal Slope of Filter Strip (%) | 5 | 5 | 5 | 5 |
| Longitudinal Slope of Contributing Impervious Area (%) | 5 | 5 | 5 | 5 |
| Filter Strip Width (ft) | 13 | 5 | 5 | 8 |

### 8.2.2 Treatment Swales

One treatment swale, Treatment Swale A, will be placed by the new secondary access road in the northwest corner of Ingram Yard. This swale will treat the drainage area from the access road which climbs in elevation as it heads south from the new connection at TPP. A bioslope is not feasible for this drainage area because of the proximity to the groundwater table. A filter strip is not feasible for this drainage area because of space constraints between the road and Wetland 2013-4 to the west. The road within the drainage area will be curbed on the west side and drainage will flow across both lanes to the west and run down the curb where it will discharge to the swale.

This treatment swale will meet the planting requirements in accordance with the ODOT Hydraulics Manual. The swale will be 88 feet long, which is the required calculated length according to the procedures in Chapter 14, Appendix B, Section 2.2 of the ODOT Hydraulics Manual (Reference 6). This is slightly less than the desired minimum length of 100 feet; however, a longer swale is not possible because of space constraints. The bottom width will be 16 feet wide with a design water depth of 3 inches. A bottom marker made of porous pavers will be included. The outlet of this swale will drain to Wetland 2013-4.

See the calculations in Attachment P for details of the analysis.

## 8.3 PROPRIETARY DEVICES

Where infiltration is not feasible because of inadequate space or too high of a water table, and where treatment by vegetated devices are not feasible because of the associated fire hazard within the facility, a proprietary device will be selected. When the proprietary device is selected for Basic treatment, a device designated as GULD by the Washington State Department of Ecology TAPE program will be used. When the proprietary device is selected for Enhanced treatment, a device designated as CULD by the Washington State Department of Ecology TAPE program will be used.

The devices selected are cartridge filter type flow-through controls. These controls will be sized for a water quality design flow rate. The design information presented for the flow-through type controls is preliminary and will be confirmed during detailed design. The current design is to use Contech StormFilters with ZPG media for areas requiring Basic treatment and MetalRX media for areas requiring Enhanced treatment.

### 8.3.1 Technology Assessment Protocol Program

The TAPE program is the process used by the Washington State Department of Ecology to evaluate storm water controls based on specific criteria. If controls meet the criteria, they are approved for the program.

A GULD is a technology whose evaluation report demonstrates confidently that it can achieve the Department of Ecology's performance goals. Structures obtaining GULD through the TAPE program are placed on the ODOTs Quality Products List (Reference 6, Section 14.8.5) and are noted as being highly capable of removing the category or target pollutant.

A CULD is a technology that shows a high likelihood of meeting performance goals.

The Basic treatment category has the following specific sampling criteria in the TAPE evaluation process:

- 80 percent removal of total suspended solids (TSS) for influent concentration range of 100 mg/L to 200 mg/L.
- 20 mg/L effluent for influent concentration range less than 100 mg/L.

The enhanced treatment category has the following specific sampling criteria in the TAPE evaluation process:

- Meet basic treatment goal.
- 30 percent removal of dissolved copper for influent concentration range of 0.005 mg/L to 0.02 mg/L.
- 60 percent removal of dissolved zinc for influent concentration range of 0.02 mg/L to 0.30 mg/L.

### 8.3.2 Pretreatment

A Contech CDS model hydrodynamic separator pretreatment inlet will be installed upstream of each cartridge filter and buried infiltration chamber (see the drawings in Attachment A). The TAPE program gives a GULD rating to a Contech CDS model (see Attachment R for a copy of the TAPE designation). The design path in sizing the CDS systems can be found in Appendix R. The CDS systems are shown in Table 8-4.

Forebays for pretreatment will be placed before each infiltration basin on-site. The forebays were sized to be a minimum of 10 percent of the infiltration basin volume in accordance with the ODOT Hydraulics Manual. In the calculations, the forebays are assumed to be plugged with 6 inches of solids and have zero infiltration. The design summary can be found in Appendix R.

**Table 8-4 CDS Systems**

| | MGS FLOOD 50% Q2 (CFS) | CONTECH CDS MODEL |
|---|---|---|
| CF-A | 0.26 | CDS 2015-4 |

| | MGS FLOOD 50% Q2 (CFS) | CONTECH CDS MODEL |
|---|---|---|
| CF-D | 0.87 | CDS 2020-5 |
| CF-E | 1.03 | CDS 2020-5 |
| CF-F, G | 1.06 | CDS 2020-5 |
| Chamber A | 1.37 | CDS 3020-6 |
| Chamber B | 4.41 | CDS 4030-8 |

### 8.3.3 Water Quality Flow Rate

The cartridge filters and pretreatment CDS devices are sized on the basis of a water quality flow rate calculated from an approved continuous model. This project has elected to utilize MGSFlood as the approved continuous model. A representative area in Washington with a similar yearly rainfall amount as the site was used to calculate the water quality flow rates with MGSFlood. The flow-based method will be used to determine the number of individual cartridge filters within each cartridge filter vault.

See Attachment Q for the results from the MGS Flood program.

### 8.3.4 Cartridge Filter Devices

#### 8.3.4.1 Media

The MOF and West Berth will consist solely of aggregate surfacing with infrequent road access and, therefore, will have little chance of dissolved metal pollutants in the storm water runoff. The StormFilter devices in these areas will use GULD approved ZPG media for Basic treatment (see Attachment Q for a copy of the TAPE designation).

A total of three StormFilter devices will use CULD approved MetalRX media for Enhanced treatment (see Attachment Q for a copy of the TAPE designation). Two devices will be located on the tug dock and one device will be located near the Tug Boat Building.

#### 8.3.4.2 Sizing

Using the flow-based method, the water quality flow rate is divided by the cartridge flow rate to determine the number of cartridges required. The number of cartridges is calculated using the contributing drainage area in Table 8-5, the time of concentration, the runoff factor, the water quality flow rate, and the treated flow rate per cartridge.

### 8.3.5 Peak Flow Diversion

Peak flow diversion is required for flow rates higher than the water quality flow rate. An online device has a peak diversion vault placed within the same structure; however, flow rates higher than the water quality flow rate bypass the cartridge filter units. An offline device has a peak diversion vault as an external structure to the main cartridge filter vault. The online placement minimizes the number of structures and requires less space. Online units will be used when possible. Offline

cartridge filter units will be utilized when there is not enough room in a vault to fit the required number of cartridges.

### 8.3.6 Backflow Prevention

Each cartridge filter unit will have an outfall pipe to the slip or access channel. To protect the cartridge filter devices from backflow during storm events, backflow prevention will be provided when the elevation of the outfall pipe is at a level where water during a storm event has a relative likelihood of reaching the pipe.

The 2014 Coos County Flood Insurance Study (Reference 13) provides an extreme still water level at Ingram Yard of 12.1 feet for an event with a 100-year return period. The elevation of the outfall pipes from all of the cartridge filters are below this elevation and will, therefore, include backflow preventers.

The backflow preventers will be inline CheckMate Valves manufactured by TideFlex. They will be located at the end of the pipe and will either have a downstream flange that will mount to the retaining wall or will be a thimble insert valve that is inserted into the plain end pipe. These valves are maintenance free and provide passive operation. The valves will not require a dedicated manhole.

## 8.4 DRAINAGE AREAS

The drainage areas shown in Table 8-5 will contribute storm water flow to each of the following controls. Impervious areas consist of concrete, asphalt, and dense-graded aggregate surfacing.

**Table 8-5 Drainage Areas**

| CONTROL | | CIA (SF) |
|---|---|---|
| Basin A | Open-Graded Aggregate Infiltration Basin | 692,100 |
| Basin B | Open-Graded Aggregate Infiltration Basin | 98,500 |
| Basin C | Open-Graded Aggregate Infiltration Basin | 271,300 |
| Basin D | Vegetated Infiltration Basin | 44,900 |
| Basin E | Vegetated Infiltration Basin | 751,400 |
| Basin F | Vegetated Infiltration Basin | 238,100 |
| Chamber A | Buried Infiltration Chamber | 1,103,700 |
| Chamber B | Buried Infiltration Chamber | 342,400 |
| FS-A | Filter Strip | 69,700 |
| FS-B | Filter Strip | 87,000 |
| FS-C | Filter Strip | 47,500 |
| FS-D | Filter Strip | 62,000 |
| SW-A | Swale | 12,200 |

| CONTROL | | CIA (SF) |
|---|---|---|
| CF-A | Cartridge Filter | 66,200 |
| CF-B | Cartridge Filter | 9,400 |
| CF-C | Cartridge Filter | 7,400 |
| CF-D | Cartridge Filter | 217,800 |
| CF-E | Cartridge Filter | 257,000 |
| CF-F | Cartridge Filter | 132,900 |
| CF-G | Cartridge Filter | 132,900 |

## 8.5 OUTFALLS

Preliminary routings of storm drainage conveyance piping and locations of associated outfalls have been determined. See Table 9-1 and the drawings in Attachment A. The number of outfalls and locations are subject to change during detailed design.

For infiltration controls, excess runoff from storm events greater than the water quality design storm event will be conveyed to the piped outfalls. For cartridge filter, all storm events will be conveyed to the piped outfalls.

## 8.6 STORM WATER CONVEYANCE SYSTEM ANALYSIS

Preliminary hydrological design for the storm water conveyance system was performed utilizing the rational method.

The rainfall intensity-duration-frequency (IDF) curves from Attachment A of the ODOT Hydraulics Manual (Reference 6) were utilized. Coos Bay falls within Zone 3. The IDF curves for Zone 3 are provided in Attachment H.

The runoff coefficient C-values from Tables 1 and 2 of the ODOT Hydraulics Manual (Reference 6) were utilized in the analysis. The ODOT Hydraulics Manual also requires a multiplier of 1.1 of the C-values for a 25-year return interval, which is the return interval used for design of the storm water conveyance system. The following C-values were utilized in the preliminary analysis:

- Pavement and roofs: C = 0.90 x 1.1 = 0.95 (upper limit by engineering judgment)
- Dense-graded aggregate: C = 0.85 x 1.1 = 0.94
- Grass side slopes: C = 0.30 x 1.1 = 0.33
- Grass open areas: C = 0.17 x 1.1 = 0.19

The HEC-22 (2001) hydraulic analysis was performed on the system. Storm pipes were sized to flow by gravity under the chosen flood control design storm event. The hydraulic grade line was checked at each inlet and manhole to ensure they did not overtop or surcharge. The inputs and results of this analysis and the flow calculations are provided in Attachments I and J. The 100-year

check storm event will be analyzed and the system adjusted accordingly during detailed design to ensure that any backups that may occur during a 100-year storm will not flood buildings or equipment foundations.

# 9.0 Monitoring Program

## 9.1 PURPOSE

This Monitoring Program was developed to address the following objectives:

- Identify the need for monitoring storm water discharge.
- Describe weather and rain event tracking procedures.
- Describe discharge locations and visual observation procedures.
- Describe visual observation response procedures.
- Describe sample collection and handling procedures.
- Describe field instrumentation calibration instructions and intervals.
- Provide an example Chain of Custody (C of C) form to be used when handling and shipping water quality samples to the laboratory.
- Provide guidelines for constituents to test for in storm water discharge.
- Ensure practices at the facility to control pollutants in storm water discharges and authorized non-storm water discharges are evaluated and revised to meet changing conditions.
- Observe the effectiveness of BMPs in removing or reducing pollutants in storm water discharge and authorized non-storm water discharges.

## 9.2 WEATHER, RAIN, AND DISCHARGE EVENT TRACKING

Storm water sampling and visual observations should be conducted during measureable storm events (MSEs). A MSE is defined as a precipitation event that produces a discharge for at least one drainage area and is preceded by 72 hours with no discharge from any drainage area. Weather and precipitation forecasts will be tracked to identify potential MSEs.

When targeting a MSE for storm water sampling, the appropriate team member will consult weekly National Oceanographic and Atmospheric Administration weather forecasts. These forecasts can be obtained at http://www.srh.noaa.gov/. If weekly forecasts indicate potential for significant precipitation, the weather forecast will be closely monitored during the 48 hours preceding the event.

An on-site weather station and rain gauge will be installed at the SORSC Building. The weather station will be capable of storing hourly data, and the rain gauge will be equipped with a tipping bucket to record precipitation from MSEs.

### 9.2.1 Outfall Discharge Event Tracking

In the event that JCEP elects to install electronic flow sensors on the outfalls at the JCEP facility, the data collected should be included in the discharge monitoring reports. The electronic flow sensors should have the capability of recording flow, date, time, and duration while transmitting via remote wireless connection to the JCEP environmental site manager or designated representative.

## 9.3 MONITORING LOCATIONS

Whenever changes in facility operations might affect the appropriateness of sampling locations, the sampling locations will be revised accordingly. Revisions will be implemented as soon as feasible and the Plan will be updated.

## 9.4 VISUAL OBSERVATION PROCEDURES

Visual monitoring includes observations of drainage areas, BMPs, and discharge locations as follows:

- Observations of the drainage areas are required to identify any spills, leaks, uncontrolled pollutant sources, and non-storm water discharges.
- Observations of BMPs are to identify and record BMPs that need maintenance to operate effectively, that have failed, or that could fail to operate as intended.
- Observations of discharge locations are required to identify the presence of visible pollutants in storm water discharged from the facility.

Visual observations will be performed at least once every calendar month during dry conditions. Visual observations will also be performed during storm water sampling events when discharge is occurring.

Visual monitoring should be conducted by a Jordan Cove environmental team member whose contact information is to be determined at a later time.

Visual observations should be documented on the Visual Observation Log found in Attachment B. Visual observations will be supplemented with a site-specific BMP inspection checklist.

The completed logs and checklists should be kept on-site as part of recordkeeping.

### 9.4.1 Monthly Visual Observations

Monthly visual observations are used to document the presence and source of any pollutants and non-storm water flows. These should consist of observations of the outdoor facility operations, BMPs, and non-storm water discharge observations.

#### 9.4.1.1 Outdoor Facility Operations Observations

Potential sources of industrial pollutants should be observed, including industrial equipment and storage areas and outdoor industrial activities. The following observations should be recorded:

- Spills or leaks.
- Uncontrolled pollutant sources.

#### 9.4.1.2 BMP Observations

BMPs should be observed to identify and record BMPs that:

- Are properly implemented.
- Need maintenance to operate effectively.
- Have failed.
- Could fail to operate as intended.

#### 9.4.1.3 Non-Storm Water Discharge Observations

Each industrial activity area should be observed for the presence of or indications of prior unauthorized and authorized non-storm water discharges. The following should be recorded:

- Presence or evidence of any non-storm water discharge (authorized or unauthorized).
- Pollutant characteristics (floating and suspended material, sheen, discoloration, turbidity, odor, etc.).
- Source of discharge.

For authorized non-storm water discharges, it should also be documented whether BMPs are in place and are functioning to prevent contact with materials or equipment that could introduce pollutants.

### 9.4.2 Sampling Event Visual Observations

Sampling event visual observations evaluate the general appearance of the storm water as an indicator of potential pollutants. These observations will be conducted at the same time sampling occurs at the discharge locations.

At each discharge location where a sample is obtained, the following observations should be recorded:

- Floating and suspended materials.
- Oil and grease.
- Discoloration.
- Turbidity.
- Odors.
- Trash.

When pollutants are observed in the discharged storm water, follow-up observations of the drainage area will be conducted to identify the probable source of the pollutants. In the event that a discharge location is not visually observed during the sampling event, the location of the discharge and reasoning for not obtaining observations should be recorded.

### 9.4.3 Visual Monitoring Follow-Up and Reporting

Correction of deficiencies identified by the observations, including required repairs or maintenance of BMPs, will be initiated and completed as soon as possible. Response actions will include the following:

- Report observations to the JCEP facility manager or designated individual.
- Identify and implement appropriate response actions.
- Verify completion of response actions.
- Document response actions.

If identified deficiencies require design changes, including additional BMPs, the implementation of changes will be completed as soon as possible.

BMP deficiencies identified in site observation reports and correction of deficiencies will be tracked on the Visual Inspection Checklist and should be retained on-site.

Results of visual monitoring should be summarized and reported in the Visual Inspection Checklist.

### 9.4.4 Visual Monitoring Locations

The monthly visual observations and sampling event visual observations identified will be conducted at the locations identified in this section.

Proposed storm water discharge locations are shown in Attachment A.

## 9.5 POTENTIAL SAMPLING AND ANALYSIS PROCEDURES

This section describes an example of the methods and procedures that may be followed for storm water sampling and analysis, depending on final permit requirements. It contains information for an example sampling schedule, sampling locations, monitoring preparation, analytical constituents, sample collection, sample analysis, and data evaluation and reporting.

### 9.5.1 Example Sampling Schedule

Minimum monitoring must occur four times per year, with two samples on or before December 31 and two samples on or after January 1. Cadmium, chromium, and nickel must be monitored eight times over the first 3 years of permit coverage. Storm water samples will be collected from each discharge location and analyzed from one MSE within the first half of each reporting year (July 1 to December 31) and one MSE within the second half of each reporting year (January 1 to June 30).

### 9.5.2 Example Sampling Locations

Sampling locations will include locations where storm water is discharged from the site, representative of permitted outfalls. Final sampling locations will be selected during detailed design at all outfalls that will enable representative monitoring of stormwater discharges from site drainage areas with industrial activities and/or materials.

The current piped discharge locations are shown in Attachment A and are included in Table 9-1.

**Table 9-1 Outfall Locations**

| STORM WATER OUTFALL | LOCATION[1] |
|---|---|
| Outfall-001 | Slip |
| Outfall-002 | Slip |
| Outfall-003 | Slip |
| Outfall-004 | Slip |
| Outfall-005 | Slip |
| Outfall-006 | Coos Bay |
| Outfall-007 | Jordan Cove |
| Outfall-008 | Slip |
| Outfall-009 | Slip |
| Outfall-010 | Slip |
| Outfall-011 | Slip |
| Outfall-012 | Jordan Cove |
| Outfall-013 | Slip |

[1] Exact location and final number of outfalls to be determined during detailed design.

### 9.5.3 Monitoring Preparation

Samples on the project site will be collected by trained sampling personnel who will be available to collect samples in accordance with the sampling schedule.

An adequate stock of monitoring supplies and equipment for sampling will be available on-site prior to a sampling event. Monitoring supplies and equipment will be stored in a cool environment that will prevent them from coming into contact with rain or direct sunlight. Supplies maintained at the facility will include, but are not limited to, the following:

- Clean, powder free nitrile gloves.
- Sample collection equipment.
- Coolers.
- Appropriate number and volume of sample containers.
- Identification labels.
- Resealable storage bags.
- Paper towels.

- Personal rain gear.
- Ice.
- Sampling field log sheets and CoC forms.

### 9.5.4 Sample Collection

Sample collection should occur during scheduled facility operating daylight hours, when sampling conditions are safe. A sample should be collected within the first 12 hours of a discharge event.

Grab samples will be collected and preserved in accordance with the example methods identified in Table 9-2. Constituents to be sampled from each outfall are to be determined during facility design. Designated personnel properly trained in water quality sampling will collect samples.

Grab samples will be collected and analyzed for pH using a portable pH meter. The pH meter will be calibrated in accordance with the manufacturer requirements. The pH analysis will be performed as soon as practicable, but no later than 15 minutes after sample collection.

Samples from different discharge locations will not be combined or composited prior to shipment to the analytical laboratory.

**Table 9-2 Example Table for Sample Collection, Preservation, and Analysis for Water Quality Samples**

| CONSTITUENT | ANALYTICAL METHOD | MIN SAMPLE VOLUME | SAMPLE CONTAINERS | SAMPLE PRESERVATION | REPORTING LIMIT | MAX HOLDING TIME |
|---|---|---|---|---|---|---|
| pH | pH Units | Field or Container | 1/2 gallon plastic (with TSS) | None | pH 1 to 12 | 15 minutes |
| Total Suspended Solids (TSS) | SM 2540-D | 1/2 gallon | 1/2 gallon plastic (with pH) | None | 1.0 mg/L | 14 days |
| Oil and Grease (O&G) | EPA 1664-A | 2 liters | Two 1 liter clear glass | HCl | 3 mg/L | 14 days |
| Iron (Fe) | EPA 200.7/ 200.8 mg/L | 250 mL | 1/2 gallon plastic with others | None | 0.015 mg/L | 14 days |
| Copper (Cu) | | | | | 0.0005 mg/L | |
| Lead (Pb) | | | | | 0.0001 mg/L | |
| Zinc (Zn) | | | | | 0.001 mg/L | |
| Cadmium (Cd) | | | | | 0.0001 mg/L | |
| Nickel (Ni) | | | | | 0.00005 mg/L | |
| Chromium (Cr) | | | | | 0.0004 mg/L | |
| Aluminum (Al) | | | | | 0.01 mg/L | |
| mg/L = milligrams per liter | | | | | | |

| CONSTITUENT | ANALYTICAL METHOD | MIN SAMPLE VOLUME | SAMPLE CONTAINERS | SAMPLE PRESERVATION | REPORTING LIMIT | MAX HOLDING TIME |
|---|---|---|---|---|---|---|
| HCl = hydrochloric acid<br>mL = milliliter | | | | | | |

### 9.5.5 Sample Analysis

Samples will be analyzed using the analytical methods identified in Table 6.2. Samples will be analyzed by the following laboratory:

| | |
|---|---|
| Laboratory Name: | Neilson Research Corporation |
| Street Address: | 245 South Grape Street |
| City, State, Zip: | Medford, OR 97501 |
| Telephone Number: | (541) 770-5678 |
| Point of Contact: | TBD |
| ORELAP Certification Number: | ELAP No. 100016 |

### 9.5.6 Data Evaluation and Reporting

A designated member of the storm water team will complete an annual evaluation of the water quality sample analytical results. The results should be included in an annual Discharge Monitoring Report. The Project will maintain all reports and analytical data for the duration of 3 years.

## 9.6 TRAINING OF SAMPLING PERSONNEL

Sampling personnel will be trained to collect, maintain, and ship samples in accordance with standard industry practices.

## 9.7 SAMPLE COLLECTION AND HANDLING

### 9.7.1 Sample Collection

Samples will be collected at the designated sampling locations determined during detailed design and listed in the preceding sections. Samples will be collected, maintained, and shipped in accordance with the requirements in the following subsections.

To maintain sample integrity and prevent cross-contamination, sample collection personnel will use the following protocols:

- Collect samples (for laboratory analysis) only in analytical laboratory-provided sample containers.
- Wear clean, powder free latex or nitrile gloves when collecting samples.
- Change gloves whenever something not known to be clean has been touched.
- Change gloves between discharge locations.

- Decontaminate equipment (e.g., bucket, tubing) prior to sample collection using a trisodium phosphate water wash, distilled water rinse, and final rinse with distilled water. (Dispose of wash and rinse water appropriately; do not discharge to storm drain or receiving water).
- Do not decontaminate laboratory-provided sample containers.
- Do not smoke during sampling events.
- Never sample near a running vehicle.
- Do not park vehicles in the immediate sample collection area (even when they are not running).
- Do not eat or drink during sample collection.
- Do not breathe, sneeze, or cough in the direction of an open sample container.

The most important aspect of grab sampling is to collect a sample that represents the entire runoff stream. Typically, samples are collected by dipping the collection container in the runoff flow paths and streams as noted.

Depending on the specific analytical test, some containers may contain preservatives. These containers should never be dipped into the stream, but filled indirectly from the collection container.

Grab samples should be collected as follows:

- For outfalls, place the bottle under the outfall flow until full.
- For small streams and flow paths, dip the bottle facing upstream until full.
- For larger streams that can be safely accessed, collect a sample in the middle of the flow stream by directly dipping the mouth of the bottle. The opening of the bottle needs to be facing upstream to avoid any contamination by the sampler.
- Avoid collecting samples from ponded, sluggish, or stagnant water.
- Do not stand upstream of the sampling point within the flow path.

### 9.7.2 Sample Handling

Field pH measurements must be conducted immediately. pH samples are not be stored for later measurement.

Immediately following sample collection, samples for laboratory analysis must be handled as follows:

1. Cap sample containers.
2. Complete sample container labels.
3. Seal containers in a resealable storage bag.
4. Place sample containers into an ice-chilled cooler.
5. Document sample information on the Sampling Field Log Sheet.
6. Complete the CoC.

Samples for laboratory analysis must be maintained between 0 to 6° C during delivery to the laboratory. Samples must be kept on ice, or refrigerated, from sample collection through delivery to the laboratory. Samples to be shipped are to be placed inside coolers with ice. The sample bottles are to be well packaged to prevent breakage and cooler lids should be secured with packaging tape.

Samples that will be analyzed at a laboratory should be shipped to the analytical laboratory right away. Hold times are measured from the time the sample is collected to the time the sample is analyzed.

### 9.7.3 Sample Documentation Procedures

Data documented on sample bottle identification labels, sampling logs, and CoCs will be recorded using waterproof ink.

Sample documentation procedures include the following:

**Sample Bottle Identification Labels:** Sampling personnel will attach an identification label to each sample bottle. Sample identification will uniquely identify each sample location.

**Sampling Field Log Sheets:** Sampling personnel will complete the Sampling Field Log Sheet for each sampling event, as appropriate.

**Chain-of-Custody:** Sampling personnel will complete the CoC for each sampling event for which samples are collected for laboratory analysis. The sampler will sign the CoC when the samples are turned over to the testing laboratory or courier.

## 9.8 QUALITY ASSURANCE AND QUALITY CONTROL

An effective quality assurance and quality control (QA/QC) program has been established for this Plan and includes the following:

- Field logs.
- Clean sampling techniques.
- CoCs.
- Data verification.

Each of these procedures is discussed in more detail in the following subsections.

### 9.8.1 Field Logs

The purpose of field logs is to record sampling information and field observations during monitoring that may explain any uncharacteristic analytical results. Sampling information to be included in the field log include the date and time of water quality sample collection, sampling personnel, sample container identification numbers, and types of samples that were collected. Field observations should be noted in the field log for any abnormalities at the sampling location (color, odor, BMPs, etc.). Field measurements for pH and turbidity should also be recorded in the field log. A Visual Observation Log is included in Attachment B.

### 9.8.2 Clean Sampling Techniques

Clean sampling techniques involve the use of certified clean containers for sample collection and clean, powder free latex or nitrile gloves during sample collection and handling. As discussed elsewhere in this Plan, adoption of a clean sampling approach will minimize the chance of field contamination and questionable data results.

### 9.8.3 Chain-of-Custody

The sample CoC is an important documentation step that tracks samples from collection through analysis to ensure the validity of the sample. Sample CoC procedures include the following:

- Proper labeling of samples.
- Use of CoC forms for samples.
- Prompt sample delivery to the analytical laboratory.

Analytical laboratories usually provide CoC forms to be filled out for sample containers.

### 9.8.4 Data Verification

After results are received from the analytical laboratory, the designated storm water team individual will verify the data to ensure that it is complete, accurate, and the appropriate QA/QC requirements were met. Data should be verified as soon as the data reports are received. Data verification will include the following:

- Check the CoC and laboratory reports.

  *Make sure requested analyses were performed and samples are accounted for in the reports.*

- Check laboratory reports to ensure hold times were met and that the reporting levels meet or are lower than the reporting levels agreed to in the contract.
- Check data for outlier values and follow up with the laboratory.

  *Occasionally typographical errors, unit reporting errors, or incomplete results are reported and should be easily detected. These errors need to be identified, clarified, and corrected quickly by the laboratory. Especially note data that is an order of magnitude or more different from similar locations, or is inconsistent with previous data from the same location.*

- Check laboratory QA/QC results.

  *EPA establishes QA/QC checks and acceptable criteria for laboratory analyses. This data is typically reported along with the sample results. Evaluate the reported QA/QC data to check for contamination (method, field, and equipment blanks), precision (laboratory matrix spike duplicates), and accuracy (matrix spikes and laboratory control samples). When QA/QC checks are outside acceptable ranges, the laboratory must flag the data and usually provides an explanation of the potential impact to the sample results.*

- Check the data set for outlier values and confirm results and reanalyze samples, where appropriate.

*Sample reanalysis should only be undertaken when it appears that some part of the QA/QC resulted in a value out of the accepted range. Sample results may not be discounted unless the analytical laboratory determines that the required QA/QC criteria were not met and confirms this finding in writing.*

Field data, including pH measurements and visual observations, should be verified as soon as the Visual Observation and Sampling Logs are received, typically at the end of the monitoring event. Field data verification will include the following:

- Check logs to make sure required measurements were completed and appropriately documented.
- Check reported values that appear out of the typical range or that are inconsistent.

  *Follow up immediately to identify potential reporting or equipment problems; if appropriate, recalibrate equipment after sampling.*

- Verify equipment calibrations.
- Review observations noted on the logs.
- Review notations of any errors and actions taken to correct the equipment or recording errors.

## 9.9 RECORDS RETENTION

Records of storm water monitoring information and copies of reports and inspections should be retained by JCEP for a period of the 3 years and made available to DEQ, agent, or local municipality upon request.

Results of visual observations, field measurements, laboratory analyses, and other documentation related to the monitoring should be maintained on-site and summarized annually in the Discharge Monitoring Report.

Records that should be retained include the following:

- A copy of the Plan and any revisions, corrective actions reports, and monthly inspection reports.
- Inspection, repair, and education activities.
- Spills or leaks of significant materials.
- The date, place, and time of inspections; sampling; visual observations; and/or measurements, including precipitation.
- The individual(s) who performed the inspections, sampling, visual observation, and/or field measurements.
- The date and approximate time of field measurements and laboratory analyses.
- The individual(s) who performed the laboratory analyses.
- Analytical laboratory reports, including the method detection limits, reporting limits, and the analytical techniques or methods used.
- Weather reports for sampled MSE.

- Calibration records.
- The records of any corrective actions and follow-up activities that resulted from analytical results, visual observations, or inspections.
- Electronic flow sensor data on outfalls.

# 10.0 Operations and Maintenance Plan

A detailed O&M plan for each structural control will be provided with the final submittal of this document prior to operations. The O&M Plan will include the name and contact information for the legally Responsible Party following the plan. JCEP will be operators of the facility from the point of substantial completion of the facility following commissioning. Temporary construction facilities leased areas will be transferred back to the owners, depending on leasing terms. The O&M Plan will also include an inspection schedule, inspection checklists, and maintenance actions, including manufacturer's recommendations and a schedule to complete those items.

# 11.0 Conclusion

The BMPs and controls described in this Plan are designed to achieve pollutant removal to the "maximum extent practicable." To ensure storm water quality, nonstructural and structural BMPs and controls are included to prevent and remove pollutants prior to off-site discharge of storm water runoff. The storm water system, oily waste system, and containment areas are designed handle storm volumes without backing up and causing damage to buildings or equipment. Preventive maintenance is a key component to BMPs. BMPs will be monitored by routine inspections and employees who are trained to ensure a high level of storm water management.

This initial Plan provides the framework from which the final design of the facility will be developed. Specifics of the analysis and design will be added to this Plan as design progresses.

# 12.0 References

1. National Weather Service of the U.S. Department of Commerce, Technical Paper No. 40, Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years, May 1961.
2. National Oceanic and Atmospheric Association, Atlas 2, Precipitation Frequency Atlas of the Western United States, Volume X – Oregon.
3. Oregon Department of Environmental Quality, Industrial Stormwater Best Management Practices Manual, February 2013.
4. Oregon Department of Environmental Quality, Water Quality Assessment Database: Oregon's 2012 Integrated Report, Website: http://www.deq.state.or.us/wq/assessment/rpt2012/results.asp.
5. Oregon Department of Environmental Quality, Fact Sheet - Reducing Copper in Industrial Stormwater, December 2014.
6. Oregon Department of Transportation, *Hydraulics Design Manual*, April 2014.

7. Oregon Department of Environmental Quality, Section 401 Water Quality Certification – Post-Construction Stormwater Management Plan Submission Guidelines, March 2018.

8. City of Eugene, Oregon, *Stormwater Management Manual*, 2014.

9. United States Department of Agriculture, TR-55, Urban Hydrology for Small Watersheds, June 1986.

10. Oregon Department of Environmental Quality, Oregon Drinking Water Protection Program, Drinking Water Source Areas and Potential Contaminants Sources, Online map viewer available at: http://hdcgcx2.deq.state.or.us/HVR291/index.html?viewer=drinkingwater. Accessed on September 7, 2017.

11. Oregon Department of Transportation, Qualified Products List, July 2018.

12. U.S. Geological Survey, U.S. Geological Survey Open-File Report 90-563, Groundwater Availability from a Dune-Sand Aquifer Near Coos Bay and North Bend, Oregon, 1992.

13. Flood Insurance Study (Coos County), FEMA, March 2014

# Attachment A. Figures and Drawings

1. FIGURE 1 – PROJECT LOCATION MAP
2. FIGURE 2 – LNG TERMINAL SITE AREAS
3. J1-000-TEC-PLT-KBJ-51000-01 OVERALL PLOT PLAN
4. J1-000-TEC-PLT-KBJ-51001-01 LIQUEFACTION PLOT PLAN
5. J1-000-TEC-PLT-KBJ-51002-01 SOUTH DUNES PLOT PLAN
6. J1-000-CIV-KEY-KBJ-04000-01 STORM WATER MANAGEMENT PLAN-PLAN-KEY PLAN, GENERAL NOTES AND LEGEND
7. J1-150-CIV-GRD-KBJ-04001-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 1
8. J1-150-CIV-GRD-KBJ-04002-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 2
9. J1-150-CIV-GRD-KBJ-04003-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 3
10. J1-150-CIV-GRD-KBJ-04004-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 4
11. J1-150-CIV-GRD-KBJ-04005-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 5
12. J1-150-CIV-GRD-KBJ-04006-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 6
13. J1-150-CIV-GRD-KBJ-04007-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 7
14. J1-150-CIV-GRD-KBJ-04008-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 8
15. J1-150-CIV-GRD-KBJ-04009-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 9
16. J1-150-CIV-GRD-KBJ-04010-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 10
17. J1-150-CIV-GRD-KBJ-04011-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 11
18. J1-150-CIV-GRD-KBJ-04012-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 12
19. J1-150-CIV-GRD-KBJ-04013-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 13
20. J1-150-CIV-GRD-KBJ-04014-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 14
21. J1-150-CIV-GRD-KBJ-04015-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 15
22. J1-150-CIV-GRD-KBJ-04016-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 16
23. J1-150-CIV-GRD-KBJ-04017-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 17
24. J1-150-CIV-GRD-KBJ-04018-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 18
25. J1-150-CIV-GRD-KBJ-04019-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 19
26. J1-150-CIV-GRD-KBJ-04020-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 20
27. J1-150-CIV-GRD-KBJ-04021-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 21
28. J1-150-CIV-GRD-KBJ-04022-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 22
29. J1-150-CIV-GRD-KBJ-04023-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 23
30. J1-150-CIV-GRD-KBJ-04024-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 24
31. J1-150-CIV-GRD-KBJ-04025-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 25
32. J1-150-CIV-GRD-KBJ-04026-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 26
33. J1-150-CIV-GRD-KBJ-04027-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 27
34. J1-150-CIV-GRD-KBJ-04028-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 28
35. J1-150-CIV-GRD-KBJ-04029-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 29
36. J1-150-CIV-GRD-KBJ-04030-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 30
37. J1-150-CIV-GRD-KBJ-04031-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 31
38. J1-150-CIV-GRD-KBJ-04032-01 STORM WATER MANAGEMENT PLAN-PLAN-AREA 32
39. J1-150-CIV-GRD-KBJ-04051-01 STORM WATER MANAGEMENT PLAN-APCO 1 (EAST)
40. J1-150-CIV-GRD-KBJ-04052-01 STORM WATER MANAGEMENT PLAN- PORT LAYDOWN SITE
41. J1-150-CIV-GRD-KBJ-04053-01 STORM WATER MANAGEMENT PLAN- MYRTLEWOOD OFFSITE PARK & RIDE

42. J1-150-CIV-GRD-KBJ-04054-01 STORM WATER MANAGEMENT PLAN- METEOROLOGICAL TOWER SITE
43. J1-150-CIV-SCT-KBJ-04950-01 STORM WATER MANAGEMENT PLAN-STORM WATER INFILTRATION CONTROLS-SECTIONS
44. J1-150-CIV-SCT-KBJ-04951-01 STORM WATER MANAGEMENT PLAN-STORM WATER INFILTRATION CONTROLS-SECTIONS
45. J1-000-CIV-KEY-KBJ-51360-01 STORM WATER MANAGEMENT PLAN-CONTOURS-KEY PLAN, GENERAL NOTES AND LEGEND
46. J1-000-CIV-KEY-KBJ-51303-01 STORM WATER MANAGEMENT PLAN-CONTOURS-AREA 1
47. J1-000-CIV-GRD-KBJ-51303-02 STORM WATER MANAGEMENT PLAN-CONTOURS-AREA 2
48. J1-000-CIV-GRD-KBJ-51303-03 STORM WATER MANAGEMENT PLAN-CONTOURS-AREA 3
49. J1-000-CIV-GRD-KBJ-51303-04 STORM WATER MANAGEMENT PLAN-CONTOURS-AREA 4
50. J1-000-CIV-GRD-KBJ-51303-05 STORM WATER MANAGEMENT PLAN-CONTOURS-AREA 5
51. J1-000-CIV-GRD-KBJ-51303-06 STORM WATER MANAGEMENT PLAN-CONTOURS-AREA 6
52. J1-000-CIV-GRD-KBJ-51303-07 STORM WATER MANAGEMENT PLAN-CONTOURS-AREA 7
53. J1-000-CIV-GRD-KBJ-51303-08 STORM WATER MANAGEMENT PLAN-CONTOURS-AREA 8
54. J1-000-CIV-GRD-KBJ-51303-09 STORM WATER MANAGEMENT PLAN-CONTOURS-AREA 9

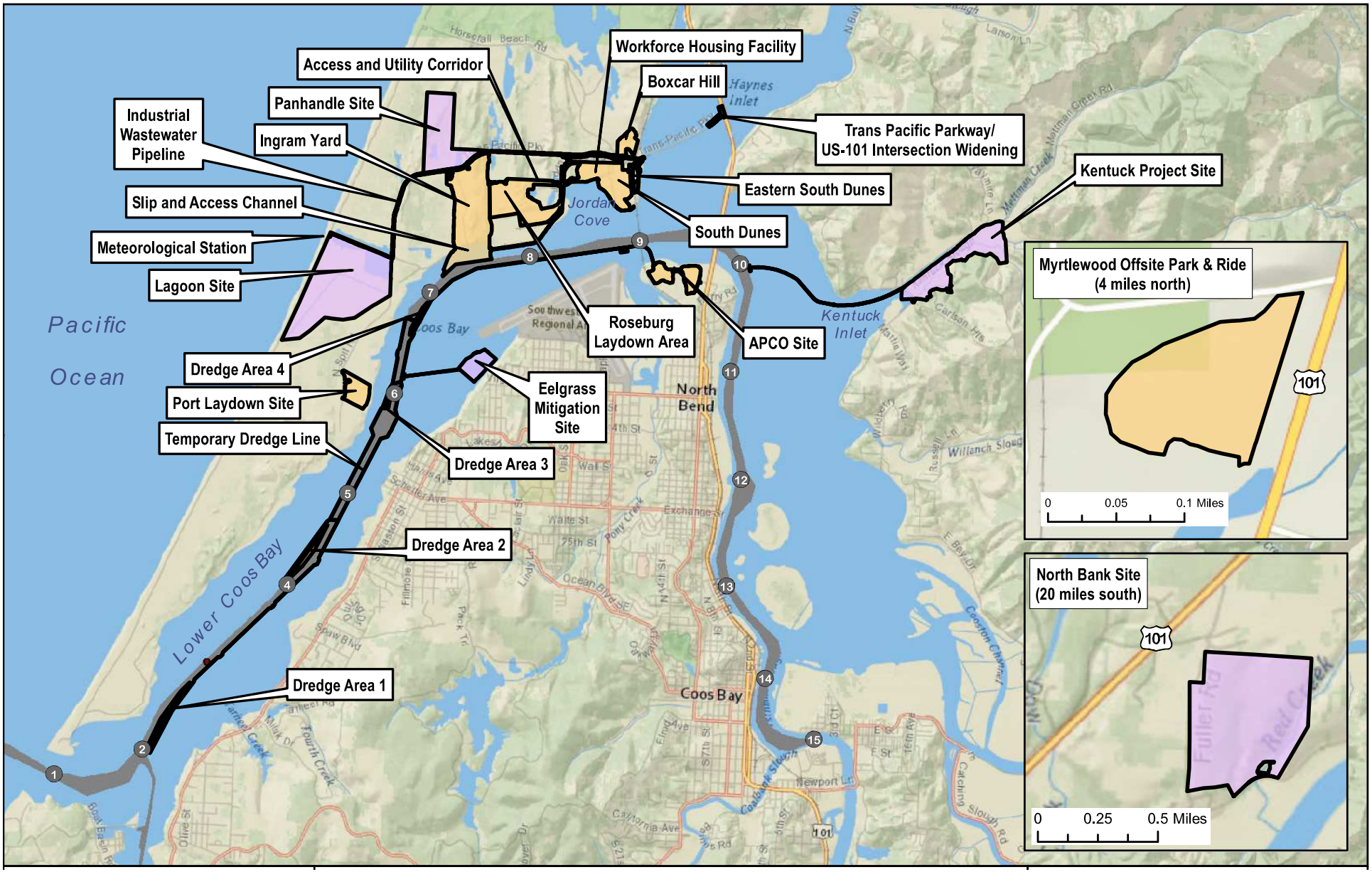



**FIGURE 1**
**PROJECT LOCATION MAP**

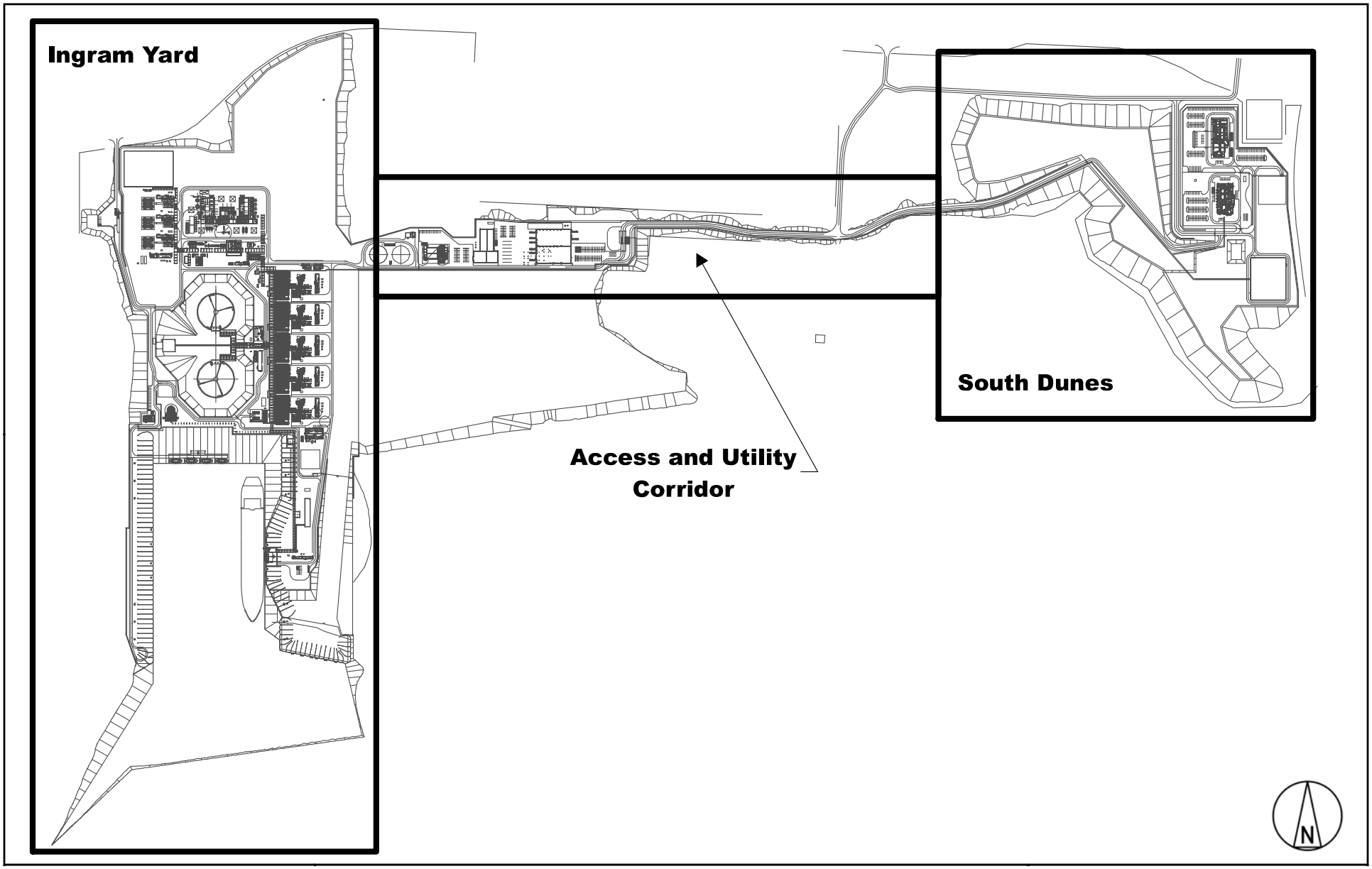
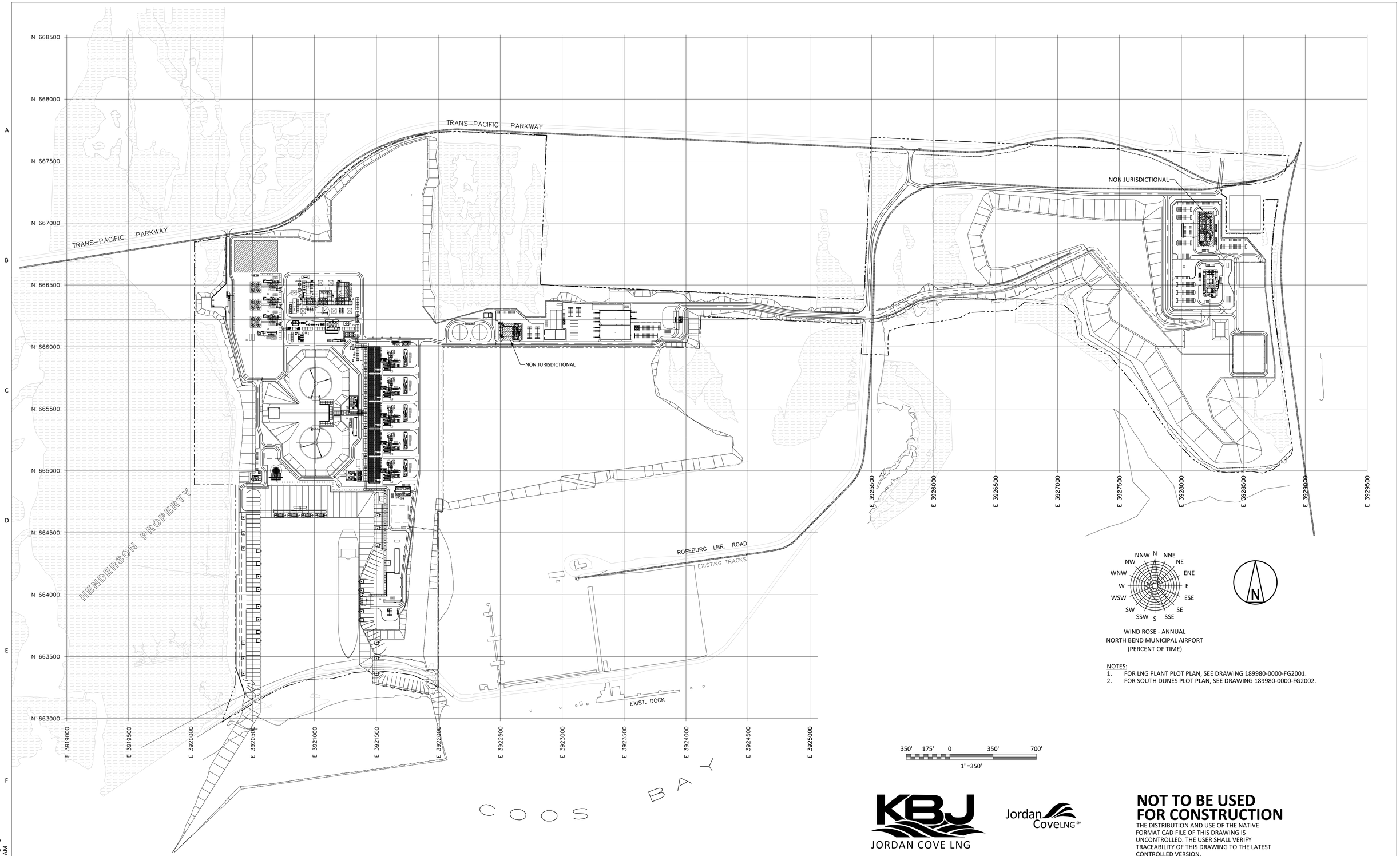



**FIGURE 2**
**LNG TERMINAL SITE AREAS**







WIND ROSE - ANNUAL
NORTH BEND MUNICIPAL AIRPORT
(PERCENT OF TIME)

NOTES:
1. FOR LNG PLANT PLOT PLAN, SEE DRAWING 189980-0000-FG2001.
2. FOR SOUTH DUNES PLOT PLAN, SEE DRAWING 189980-0000-FG2002.

JORDAN COVE LNG

Jordan Cove LNG SM

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

MicroStation v8.11.9.578
1 = 1
spe14103
ANSI D 34x22
8/30/2017 11:54:12 AM

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| | | | HHS | HHS | | JME | JCWR |
| 1 | 30/AUG/17 | ISSUED FOR FERC FILING | HHS | HHS | - | JME | JCWR |
| 0 | 03/APR/17 | ISSUED FOR FERC DRAFT FILING | HHS | HHS | - | EAH | SPH |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| | | | HHS | HHS | | JME | JCWR |
| 1 | 30/AUG/17 | ISSUED FOR FERC FILING | HHS | HHS | - | JME | JCWR |
| 0 | 03/APR/17 | ISSUED FOR FERC DRAFT FILING | HHS | HHS | - | EAH | SPH |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF

SIGNED

DATE REG NO.

HHS | DRAWN ECB
CHECKED | DATE 04/MAY/16

JORDAN COVE LNG PROJECT

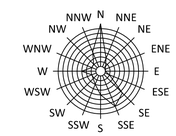
OVERALL PLOT PLAN

PROJECT / DRAWING NUMBER: 189980-0000-FG2000 — REV 1

JCLNG NUMBER: J1-000-TEC-PLT-KBJ-51000-01 — REV 1

| ITEM | FACILITIES LEGEND |
|---|---|
| 1 | FEED GAS HEADER |
| 2 | GAS CONDITIONING TRAIN |
| 3 | PROPERTY BOUNDARY |
| 4 | LNG LIQUEFACTION TRAIN #1 THROUGH #5 |
| 5 | LNG EXPANDER (WITH SHELTER) |
| 6 | LNG FLASH DRUM |
| 7 | LNG RUNDOWN PUMPS (WITH SHELTER) |
| 8 | LNG STORAGE TANK |
| 9 | LNG TANK PUMPS |
| 10 | LNG LOADING PLATFORM |
| 11 | REFRIGERANT MAKE-UP |
| 12 | LP/HP BOG COMPRESSORS (WITH SHELTER) |
| 13 | COLD FLARE KO DRUM |
| 14 | MULTI POINT GROUND FLARE KO DRUM |
| 15 | NOT USED |
| 16 | MULTI POINT GROUND FLARE |
| 17 | ENCLOSED GROUND FLARE - MARINE |
| 18 | BOP AUXILIARY POWER STG |
| 19 | BOP AUXILIARY POWER STG CONTROL ENCLOSURE |
| 20 | AUXILIARY BOILER |
| 21 | DEAERATOR / BFW PUMPS |
| 22 | NOT USED |
| 23 | PLANT / INSTRUMENT AIR PACKAGES |
| 24 | NITROGEN GENERATION PACKAGE |
| 25 | LIQUID N2 STORAGE / VAPORIZATION |
| 26 | AMMONIA STORAGE TANKS AND PUMPS |
| 27 | AMINE STORAGE |
| 28 | LNG DRAINAGE CHANNEL |
| 29 | PROCESS AREA LNG IMPOUND BASIN |
| 30 | MARINE AREA LNG IMPOUND BASIN |
| 31 | FREE FIELD SEISMOMETER SHELTER |
| 32 | TRANSFORMERS |
| 33 | CONSTRUCTION LAYDOWN AREA |
| 34 | DIESEL STORAGE |
| 35 | FIREWATER STORAGE TANKS |
| 36 | LNG TANK ACCESS ROAD |
| 37 | PLANT SECURITY FENCE |
| 38 | RETAINING WALL |
| 39 | BACKUP GENERATOR |
| 40 | PIPERACK |
| 41 | IMPERMEABLE VAPOR BARRIER |
| 42 | RO PRODUCT TANK |
| 43 | CONST. MARINE OFF-LOADING FACILITIES AREA (CONST. MOF) |
| 44 | DEMIN WATER STORAGE TANK |
| 45 | WASTEWATER TREATMENT PACKAGE PLANT |
| 46 | LAYDOWN AREA |
| 47 | DUMP CONDENSER |
| 48 | BURIED STORM WATER INFILTRATION CHAMBER |
| 49 | BOG VFD ENCLOSURE |
| 50 | PERMEABLE VAPOR BARRIER |
| 51 | TSUNAMI WALL (ELEVATION VARIES TO SUIT THE DESIGN TSUNAMI) |
| 52 | METEORLOGICAL MAST LOCATED WEST OF THE SITE NEAR INDUSTRIAL WASTEWATER LAGOON |

| ITEM | FACILITIES LEGEND |
|---|---|
| A | MAIN GUARD HOUSE / SECURITY BUILDING |
| B | TUG FACILITY BUILDING |
| C | PLANT WAREHOUSE |
| D | MAINTENANCE BUILDING |
| E | OPERATIONS BUILDING (INCLUDES CONTROL ROOM) |
| F | WATER TREATMENT BUILDING |
| G | FACILITY FIREWATER PUMPS WITH BUILDING |
| H | LUBE OIL, PAINT AND COMPRESSED GAS STORAGE |
| J | FACILITY AUX POWERHOUSE ENCLOSURE |
| K | POWERHOUSE ENCLOSURE |
| L | FIREWATER VALVE HOUSE |
| M | SECONDARY ENTRANCE SECURITY GATE/TERMINAL GUARD BUILDING |
| N | MARINE POWERHOUSE ENCLOSURE |
| P | FIRE DEPARTMENT |
| Q | GC TRAIN 1 POWERHOUSE ENCLOSURE |
| R | CEMS BUILDING (HRSG PKG) |
| S | INSPECTION STATION SHELTER |
| T | MARINE AREA GUARD HOUSE |
| U | TUG BOAT BERTH |




WIND ROSE - ANNUAL
NORTH BEND MUNICIPAL AIRPORT
(PERCENT OF TIME)

NOTES:

1. ELEVATIONS NOTED ARE NAVD88.

LEGEND:

- SECURITY FENCE
- DEMARCATION FENCE
- PROPERTY BOUNDARY
- ASPHALT PAVED ROADS AND PARKING
- GRAVEL ROADS AND PARKING
- IMPERMEABLE VAPOR BARRIER WITH SECURITY
- PERMEABLE VAPOR BARRIER

300' 150' 0 300' 600'
1"=300'

JORDAN COVE LNG

Jordan Cove LNG SM

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 1 | 30/AUG/17 | ISSUED FOR FERC FILING | HHS | HHS | - | JME | SPH |
| 0 | 03/APR/17 | ISSUED FOR FERC DRAFT FILING | HHS | HHS | - | EAH | SPH |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 1 | 30/AUG/17 | ISSUED FOR FERC FILING | HHS | HHS | - | JME | SPH |
| 0 | 03/APR/17 | ISSUED FOR FERC DRAFT FILING | HHS | HHS | - | EAH | SPH |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF
SIGNED
DATE REG NO.

DESIGNER HHS | DRAWN ECB
CHECKED | DATE 03/FEB/16

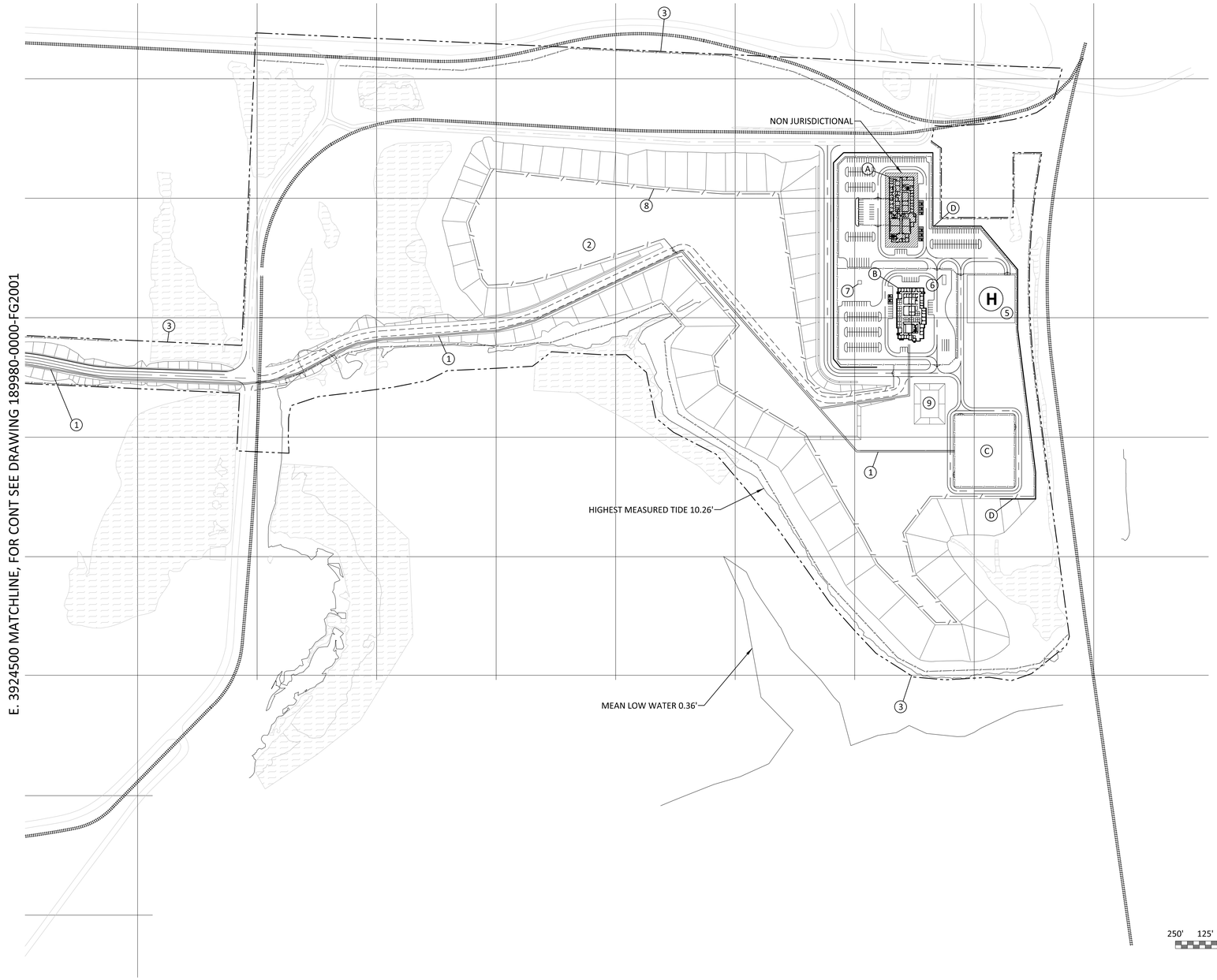
JORDAN COVE LNG PROJECT

LIQUEFACTION PLOT PLAN

PROJECT / DRAWING NUMBER: 189980-0000-FG2001 — REV 1

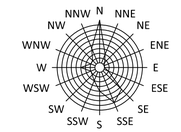
JCLNG NUMBER: J1-000-TEC-PLT-KBJ-51001-01 — REV 1

MicroStation v8.11.9.578
1 = 1
8/29/2017 1:15:14 PM
spe14103
ANSI D 24x22




| ITEM | FACILITIES LEGEND |
|---|---|
| A | SORSC BUILDING |
| B | ADMINISTRATION BUILDING |
| C | GAS METERING STATION |
| D | RETAINING WALL |

| ITEM | FACILITIES LEGEND |
|---|---|
| 1 | ACCESS AND UTILITY CORIDOR (SEE NOTE 3) |
| 2 | TEMPORARY CONSTRUCTION FACILITIES |
| 3 | PROPERTY BOUNDARY |
| 4 | PG&E SWITCHYARD EASEMENT |
| 5 | HELI-PAD |
| 6 | WASTEWATER TREATMENT PACKAGE PLANT |
| 7 | COMMUNICATIONS TOWER |
| 8 | PLANT SECURITY FENCE |
| 9 | VEGETATED INFILTRATION BASIN |




WIND ROSE - ANNUAL
NORTH BEND MUNICIPAL AIRPORT
(PERCENT OF TIME)

NOTES:

1. ELEVATIONS NOTED ARE NAVD88.
2. FOR OVERALL PLOT PLAN, SEE DRAWING 189980-0000-FG2000.
3. THE ACCESS AND UTILITY CORRIDOR CONTAINS THE FOLLOWING BURIED LINES. CORRIDOR WILL BE ROUTED ON JCLNG LAND.
   * FEED GAS LINE
   * FIRE WATER SUPPLY TO ADMIN AND SORSC BUILDINGS
   * POWER TO ADMIN BUILDING
   * IT AND SECURITY TO ADMIN AND SORSC BUILDINGS
   * CONTROL CABLING FROM METERING STATION

LEGEND:

SECURITY FENCE

DEMARCATION FENCE

ASPHALT PAVED ROADS AND PARKING

GRAVEL ROADS AND PARKING

250' 125' 0 250' 500'

1"=250'

JORDAN COVE LNG

Jordan Cove LNG SM

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP | NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | HHS | HHS | - | JME | SPH | | | | HHS | HHS | - | JME | SPH |
| 1 | 30/AUG/17 | ISSUED FOR FERC FILING | HHS | HHS | - | JME | SPH | 1 | 30/AUG/17 | ISSUED FOR FERC FILING | HHS | HHS | - | JME | SPH |
| 0 | 03/MAR/17 | ISSUED FOR FERC DRAFT FILING | HHS | HHS | - | EAH | SPH | 0 | 03/APR/17 | ISSUED FOR FERC DRAFT FILING | HHS | HHS | - | EAH | SPH |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF

SIGNED

DATE REG NO.

DRAWN HHS ECB

CHECKED DATE 04/MAY/16

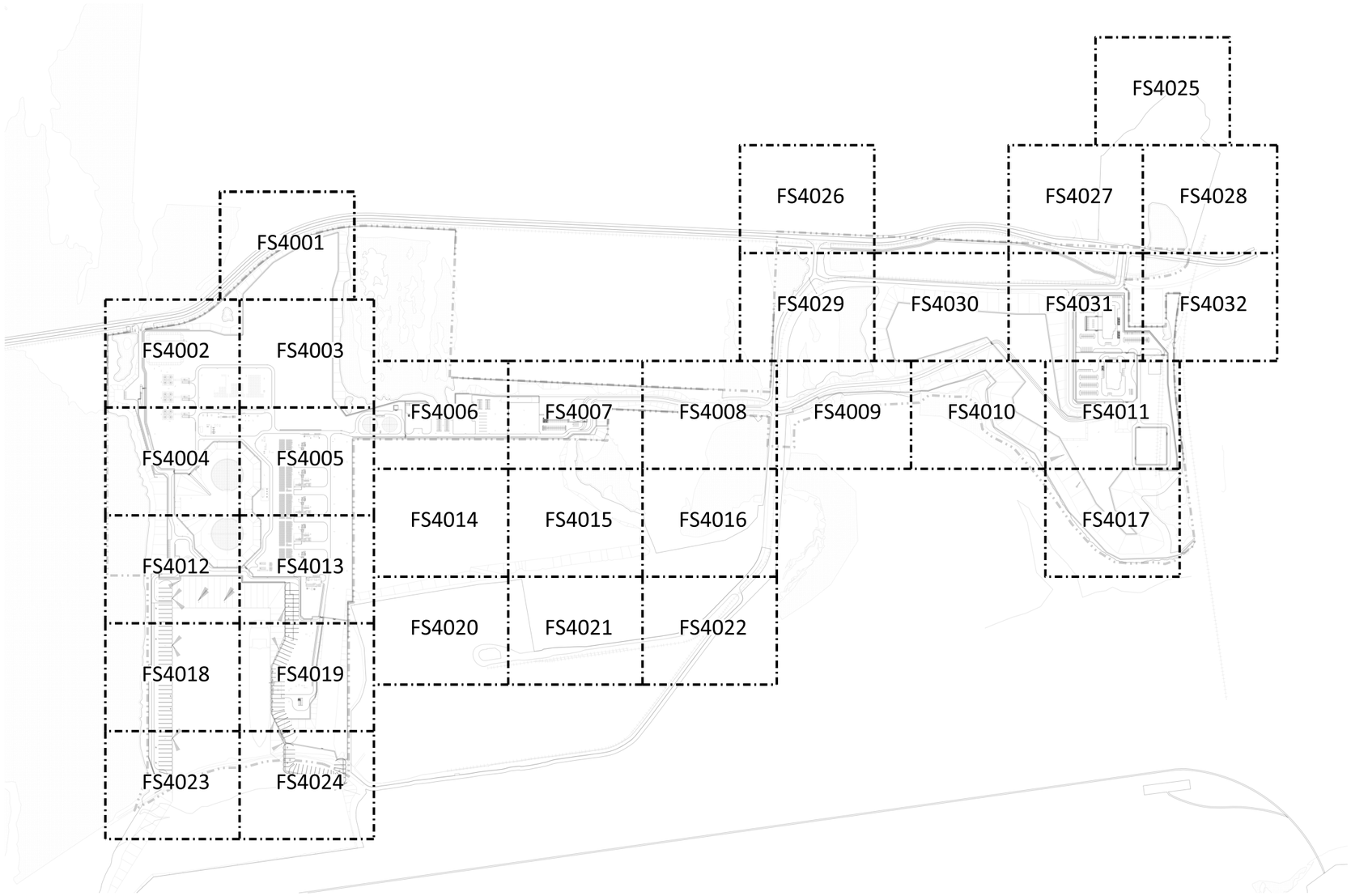
JORDAN COVE LNG PROJECT

SOUTH DUNES PLOT PLAN

PROJECT DRAWING NUMBER 189980-0000-FG2002 REV 1

JCLNG NUMBER J1-000-TEC-PLT-KBJ-51002-01 REV 1

MicroStation v8.11.9.578
1 = 1
spe14103
ANSI D 34x22
8/29/2017 2:45:37 PM




## GENERAL NOTES

1. GENERAL NOTES APPLICABLE TO ALL FS4000 SERIES DRAWINGS.
2. COORDINATES ARE BASED ON THE OREGON STATE PLANE SYSTEM, SOUTH ZONE 3602, NAD 83 INTERNATIONAL FEET. ALL COORDINATES, BEARINGS, AND DISTANCES SHOWN ARE GRID.
3. ELEVATIONS ARE BASED ON THE NAVD 88 DATUM.
4. FINISHED GRADE SHALL SLOPE UNIFORMLY BETWEEN FINISH SPOT ELEVATIONS AND CONTOURS SHOWN ON THE PLANS.
5. A SMOOTH VERTICAL TRANSITION SHALL BE PROVIDED AT ROAD INTERSECTIONS.
6. SLOPES SHALL BE 3(H):1(V) OR FLATTER, UNLESS NOTED OTHERWISE.
7. SLOPE GRADE TO DRAIN IN DIRECTION OF FLOW ARROWS.
8. THE FINISHED GRADE SHALL BE SET 6 INCHES BELOW TOP OF CONCRETE UNLESS NOTED OTHERWISE. FINISHED GRADE SHALL SLOPE AWAY FROM THE STRUCTURE AT A MINIMUM SLOPE OF 1%.

## LEGEND APPLICABLE TO ALL FS4000 DRAWINGS

- PROPERTY BOUNDARY
- R/W — LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- 46 — NEW CONTOUR
- 46 — EXISTING CONTOUR
- 46.00 + — SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- 1 / S3000 — SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER
- SC- SPILL CONTROL MANHOLE
- CF- CARTRIDGE FILTER
- CU- STORM WATER CURB INLET
- MH- STORM WATER MANHOLE
- OI- OILY WASTE INLET
- OMH- OILY WASTE MANHOLE
- I- STORM WATER INLET
- BUILDINGS
- LNG / REFRIG CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- CHEMICAL CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- WETLANDS
- CONNECTION TO IWWP

## ABBREVIATIONS APPLICABLE TO ALL FS4000 DRAWINGS

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A | - | ARC LENGTH | EGP | - | EDGE OF PAVEMENT | LS | - | LIFT STATION | RD | - | ROOF DRAIN |
| AGG | - | AGGREGATE | EGS | - | EDGE OF SHOULDER | LTR | - | LATER | RED | - | REDUCER |
| APPROX | - | APPROXIMATE | EHH | - | ELECTRICAL HANDHOLE | MATL | - | MATERIAL | REQD | - | REQUIRED |
| ASPH | - | ASPHALT | EL | - | ELEVATION | MH | - | MANHOLE | REV | - | REVISION |
| AVG | - | AVERAGE | EOP | - | END OF PIPE | MSL | - | MEAN SEA LEVEL | R/W | - | RIGHT-OF-WAY |
| BLDG | - | BUILDING | EJ | - | EXPANSION JOINT | MW | - | MONITORING WELL | S | - | SOUTH |
| B/MH | - | BOTTOM OF MANHOLE ELEVATION | EW | - | EACH WAY | N | - | NORTH | SE | - | SUPERELEVATION |
| BOD | - | BOTTOM OF ELECTRICAL DUCT BANK | EXP | - | EXPANSION | NG | - | NATURAL GRADE | SIM | - | SIMILAR |
| BOP | - | BOTTOM OF PIPE | FD | - | FLOOR DRAIN | NO. | - | NUMBER | STA | - | STATION |
| BU | - | BELL-UP | FDN | - | FOUNDATION | NTS | - | NOT TO SCALE | T | - | TANGENT LENGTH |
| CHDPE | - | CORRUGATED HIGH DENSITY POLYETHYLENE PIPE | FF | - | FINISHED FLOOR | OD | - | OUTSIDE DIAMETER | TMH | - | TOP OF MANHOLE |
| CJ | - | CONTRACTION JOINT | FG | - | FINISHED GRADE | OWS | - | OIL/WATER SEPARATOR | TOC | - | TOP OF CONCRETE |
| CL | - | CENTERLINE | FRP | - | FIBER REINFORCED PIPE | PC | - | POINT OF CURVATURE | TOG | - | TOP OF GRATING |
| CMP | - | CORRUGATED METAL PIPE | FT | - | FOOT | PE | - | PLAIN END | TOP | - | TOP OF PAVEMENT |
| CO | - | CLEAN OUT | HC | - | HANDICAPPED | PI | - | POINT OF INTERSECTION | TYP | - | TYPICAL |
| D | - | DEGREE OF CURVE | HDPE | - | HIGH DENSITY POLYETHYLENE | PL | - | PROPERTY LINE | UNO | - | UNLESS NOTED OTHERWISE |
| Δ | - | DELTA ANGLE OF HORIZONTAL CURVE | HVCM | - | HORIZ & VERT CONTROL MONUMENT | PLCS | - | PLACES | DS | - | DESIGN SPEED |
| DI | - | DUCTILE IRON | HP | - | HIGH POINT | PRC | - | POINT OF REVERSE CURVE | VERT | - | VERTICAL |
| DIA | - | DIAMETER | I | - | INLET | PT | - | POINT OF TANGENT | W | - | WEST |
| DIM | - | DIMENSION | ID | - | INSIDE DIAMETER | PVC | - | POINT OF VERTICAL CURVE | W/ | - | WITH |
| DWG | - | DRAWING | IN | - | INCH | PVI | - | POINT OF VERTICAL INTERSECTION | W/O | - | WITHOUT |
| E | - | EAST | INV | - | INVERT | PVT | - | POINT OF VERTICAL TANGENT | WP | - | WORK POINT |
| EA | - | EACH | L | - | LENGTH | R | - | RADIUS | | | |
| EF | - | EACH FACE | LC | - | LENGTH OF VERTICAL CURVE | RCP | - | REINFORCED CONCRETE PIPE | | | |

N

500' 250' 0 500' 1000'
1"=500'

KBJ
JORDAN COVE LNG

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP | NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR | 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF OREGON

SIGNED _____

DATE _____ REG NO. _____

DESIGNER CAF | DRAWN NJO

CHECKED | DATE

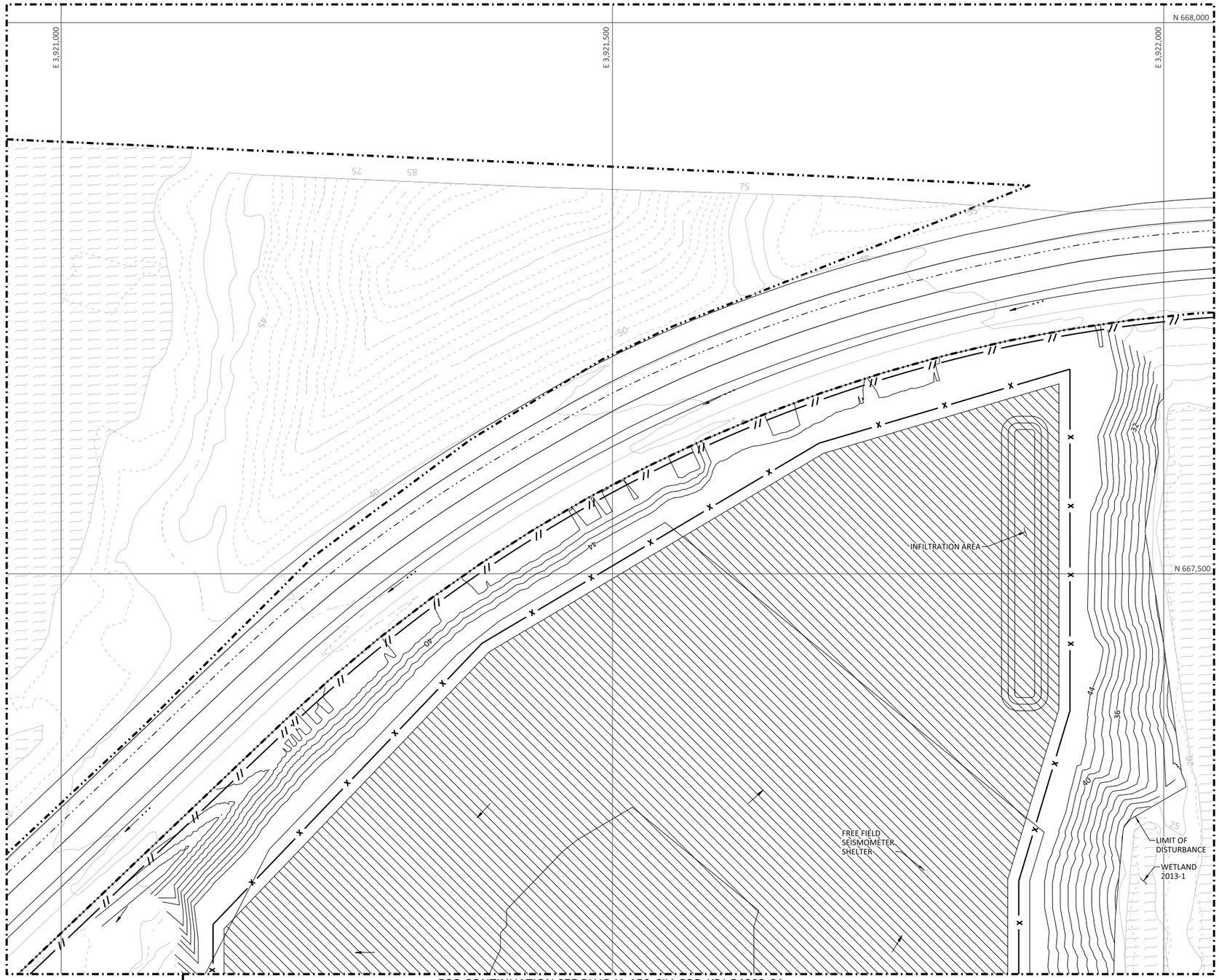
JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
PLAN - KEY PLAN, GENERAL NOTES AND LEGEND

PROJECT / DRAWING NUMBER: 189980-0000-FS4000 — REV 0

JCLNG NUMBER: J1-150-CIV-KEY-KBJ-54000-01 — REV 0

MicroStation v8.11.9.578
1 = 1
fn50857
ANSI D 34x22
3/26/2019 12:49:45 PM



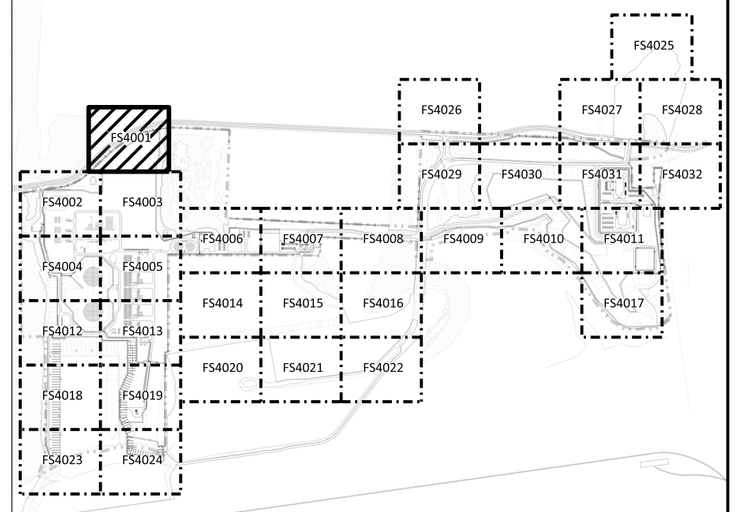

50' 25' 0 50' 100'
1"=50'

KBJ
JORDAN COVE LNG

## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER
- SC- SPILL CONTROL MANHOLE
- CF- CARTRIDGE FILTER
- CU- STORM WATER CURB INLET
- MH- STORM WATER MANHOLE
- OI- OILY WASTE INLET
- OMH- OILY WASTE MANHOLE
- I- STORM WATER INLET
- BUILDINGS
- CHEMICAL CONTAINMENT AREAS
- LNG / REFRIG CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF
SIGNED
DATE REG NO.

DESIGNER CAF | DRAWN NJO
CHECKED | DATE

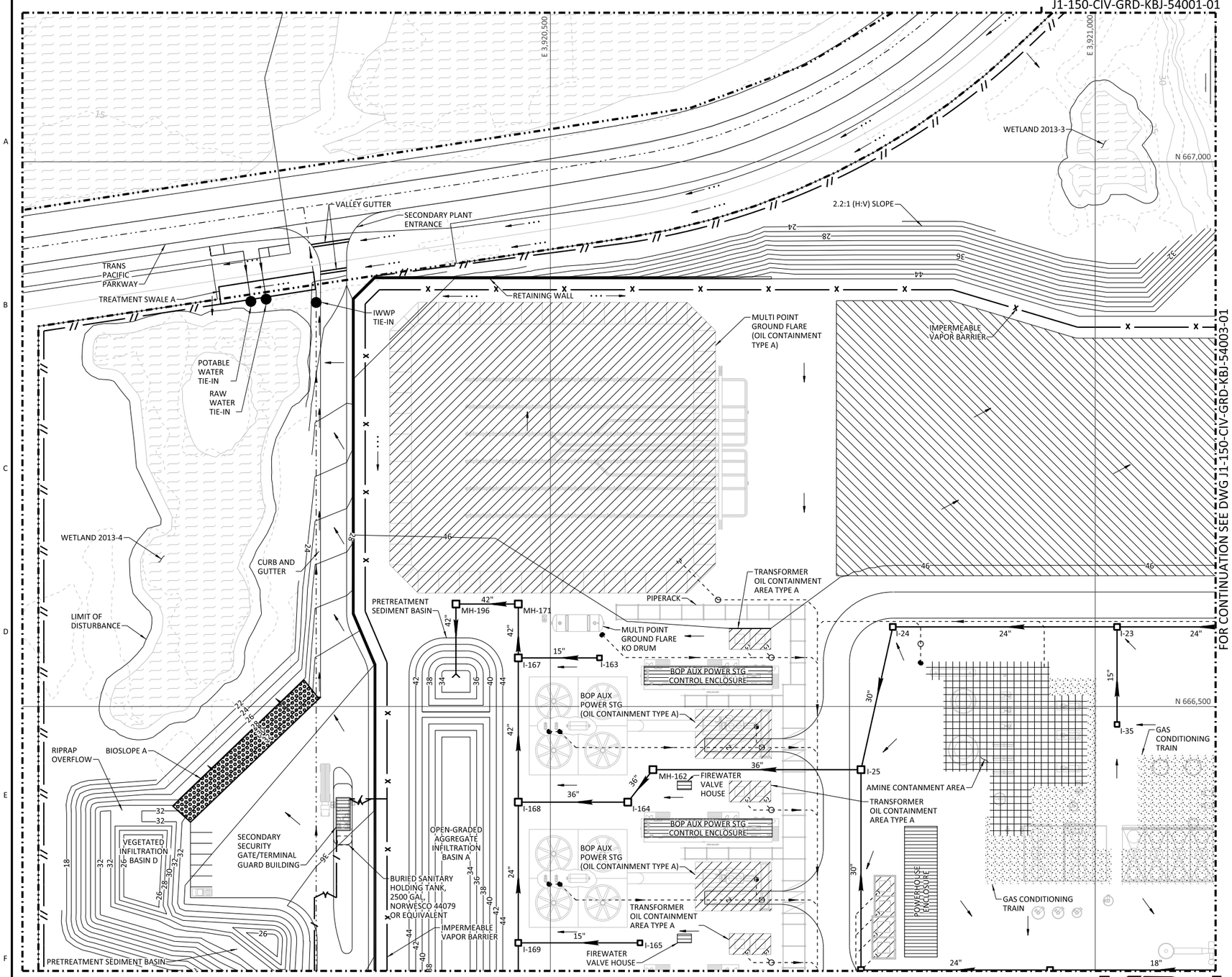
JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
PLAN - AREA 1

PROJECT / DRAWING NUMBER: 189980-0000-FS4001 | REV 0
JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54001-01 | REV 0

MicroStation v8.11.9.578
1 = 1
fin50857
ANSI D 24x22
3/26/2019 1:04:31 PM

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54001-01




FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54004-01

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54003-01

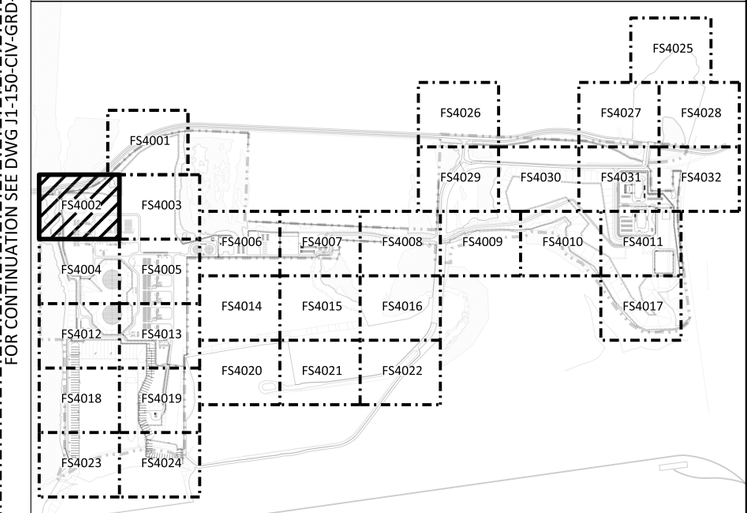
50' 25' 0 50' 100'
1"=50'

KBJ
JORDAN COVE LNG

## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER
- SC- SPILL CONTROL MANHOLE
- CF- CARTRIDGE FILTER
- CU- STORM WATER CURB INLET
- MH- STORM WATER MANHOLE
- OI- OILY WASTE INLET
- OMH- OILY WASTE MANHOLE
- I- STORM WATER INLET
- BUILDINGS
- LNG / REFRIG CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- CHEMICAL CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

Jordan Cove LNG℠ A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF

SIGNED

DATE REG NO.

DESIGNER CAF | DRAWN NJO | CHECKED | DATE

JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
PLAN - AREA 2

PROJECT / DRAWING NUMBER: 189980-0000-FS4002 — REV 0

JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54002-01 — REV 0

MicroStation v8.11.9.578
1 = 1
fin50857
ANSI D 34x22
3/26/2019 12:23:43 PM

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54001-01

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54005-01

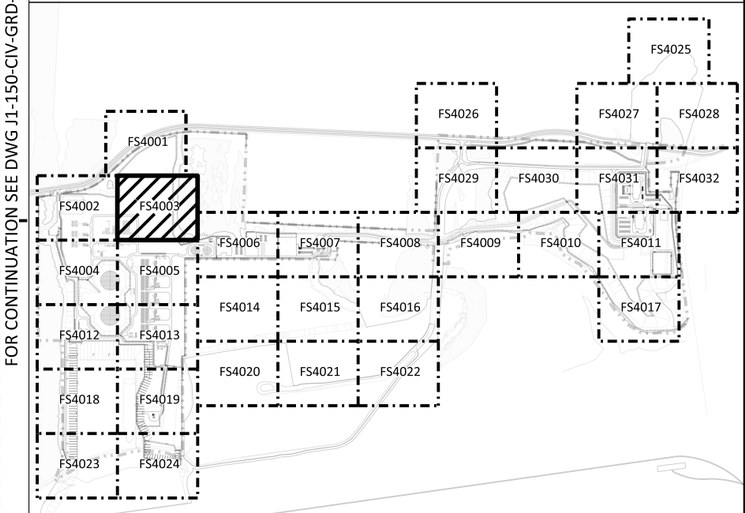
FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54006-01

50' 25' 0 50' 100'
1"=50'

## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER
- DRAWING DESIGNATION NUMBER
- SC- SPILL CONTROL MANHOLE
- CF- CARTRIDGE FILTER
- CU- STORM WATER CURB INLET
- MH- STORM WATER MANHOLE
- OI- OILY WASTE INLET
- OMH- OILY WASTE MANHOLE
- I- STORM WATER INLET
- BUILDINGS
- CHEMICAL CONTAINMENT AREAS
- LNG / REFRIG CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

KBJ
JORDAN COVE LNG

Jordan Cove LNG℠
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF

SIGNED _____

DATE _____ REG NO. _____

DESIGNER CAF | DRAWN NJO | CHECKED | DATE

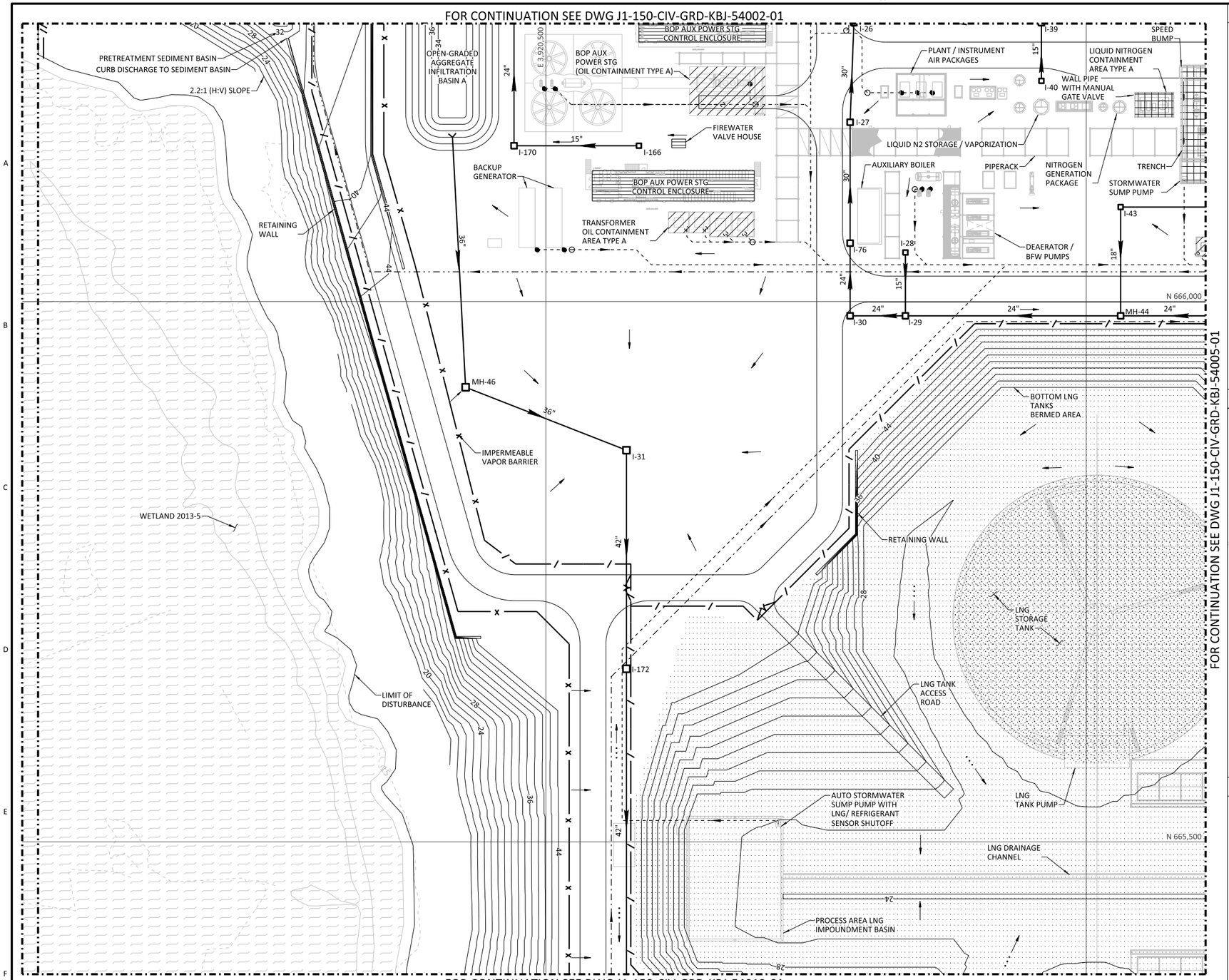
JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
PLAN - AREA 3

PROJECT / DRAWING NUMBER: 189980-0000-FS4003 — REV 0

JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54003-01 — REV 0

MicroStation v8.11.9.578
1 = 1
fn50857
ANSI D 34x22
3/26/2019 12:23:44 PM



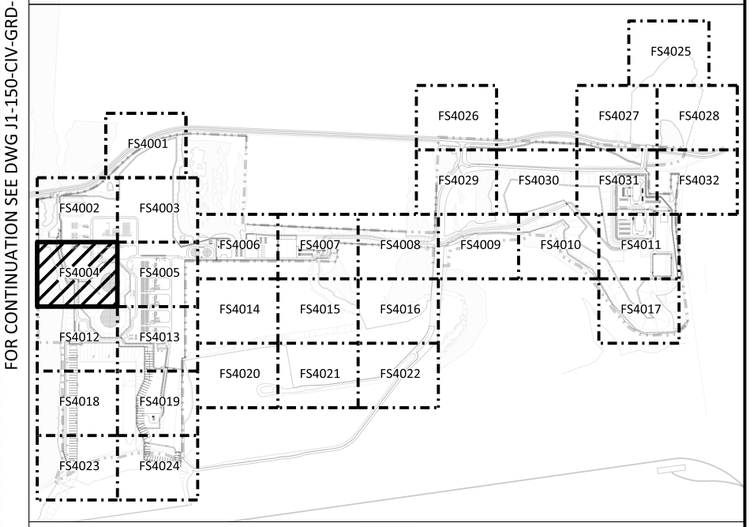

50' 25' 0 50' 100'
1"=50'

KBJ
JORDAN COVE LNG

## LEGEND

| | |
|---|---|
| | PROPERTY BOUNDARY |
| R/W | LIMIT OF RIGHT-OF-WAY |
| | SURVEY CONTROL MONUMENT |
| 46 | NEW CONTOUR |
| 46 | EXISTING CONTOUR |
| 46.00 + | SPOT ELEVATION |
| | SURFACE FLOW DIRECTION |
| | SWALE FLOW DIRECTION |
| | BOUNDARY FENCE |
| | CHAIN LINK SECURITY FENCE |
| | PERMEABLE VAPOR BARRIER FENCE |
| | VAPOR BARRIER WALL - WITH SECURITY |
| | OILY WASTE SYSTEM |
| | OILY WASTE FLOOR DRAIN |
| | OILY WASTE DRAIN CUP (BELL-UP) |
| | CULVERT |
| | STORM WATER SYSTEM |
| | PROCESS WASTEWATER |
| | SANITARY SEWER |
| 1 / S3000 | SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER |
| SC- | SPILL CONTROL MANHOLE |
| CF- | CARTRIDGE FILTER |
| CU- | STORM WATER CURB INLET |
| MH- | STORM WATER MANHOLE |
| OI- | OILY WASTE INLET |
| OMH- | OILY WASTE MANHOLE |
| I- | STORM WATER INLET |
| | BUILDINGS |
| | LNG / REFRIG CONTAINMENT AREAS |
| | SELF-CONTAINED STORMWATER AREAS |
| | CHEMICAL CONTAINMENT AREAS |
| | OILY CONTAINMENT AREAS |
| | WETLANDS |
| | CONNECTION TO IWWP |

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

Jordan Cove LNG℠ A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF

SIGNED

DATE REG NO.

DESIGNER CAF | DRAWN NJO | CHECKED | DATE

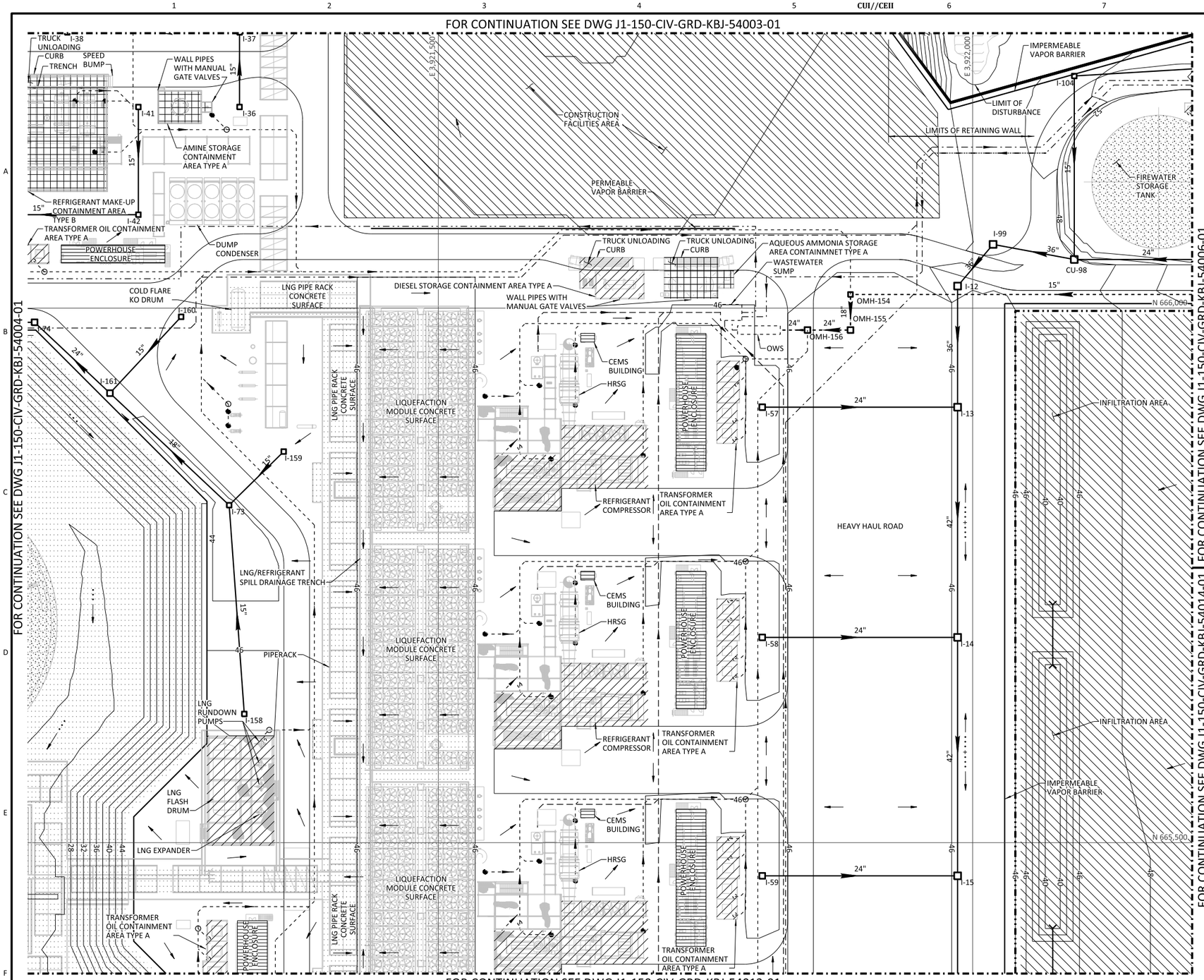
JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
PLAN - AREA 4

PROJECT / DRAWING NUMBER: 189980-0000-FS4004 — REV 0

JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54004-01 — REV 0

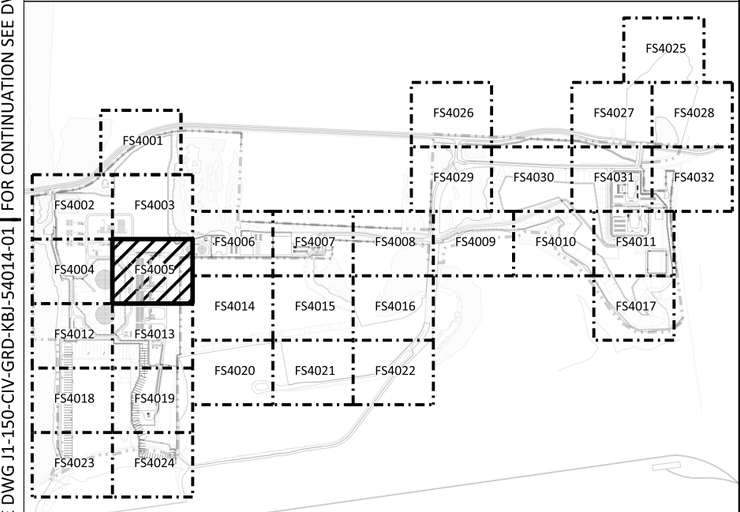
MicroStation v8.11.9.578
1 = 1
fin50857
ANSI D 34x22
3/26/2019 12:50:20 PM




## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER
- SC- SPILL CONTROL MANHOLE
- CF- CARTRIDGE FILTER
- CU- STORM WATER CURB INLET
- MH- STORM WATER MANHOLE
- OI- OILY WASTE INLET
- OMH- OILY WASTE MANHOLE
- I- STORM WATER INLET
- BUILDINGS
- LNG / REFRIG CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- CHEMICAL CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

KBJ
JORDAN COVE LNG

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF

SIGNED _____

DATE _____ REG NO. _____

DESIGNER CAF | DRAWN NJO

CHECKED | DATE

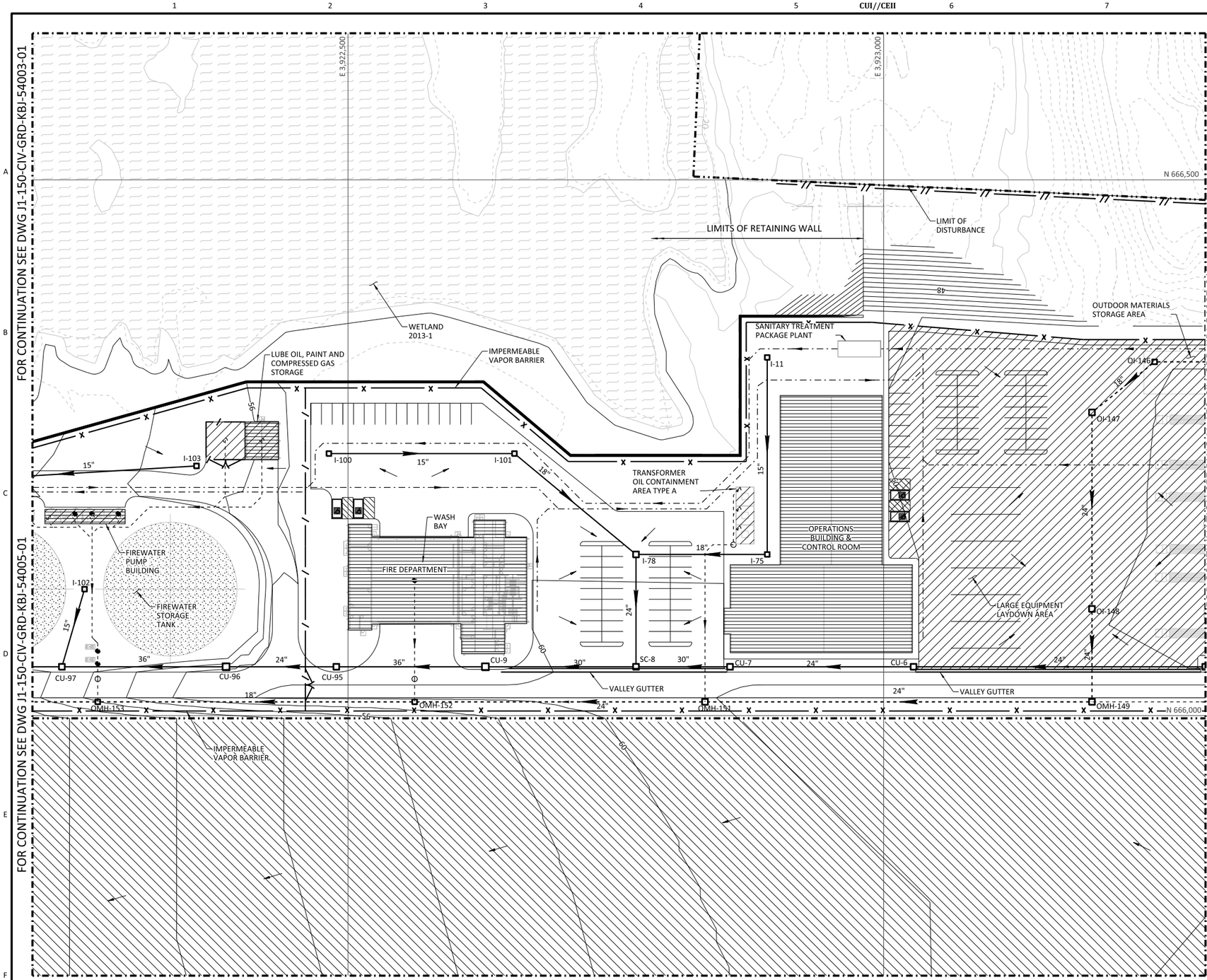
JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
PLAN - AREA 5

PROJECT DRAWING NUMBER: 189980-0000-FS4005 — REV 0

JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54005-01 — REV 0

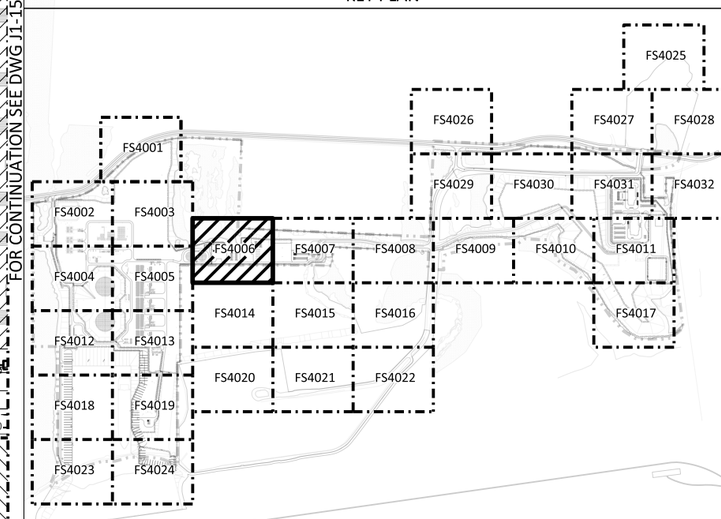
MicroStation v8.11.9.578
1 = 1
fin50857
ANSI D 24x22
3/26/2019 12:23:46 PM




## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER
- SC- SPILL CONTROL MANHOLE
- CF- CARTRIDGE FILTER
- CU- STORM WATER CURB INLET
- MH- STORM WATER MANHOLE
- OI- OILY WASTE INLET
- OMH- OILY WASTE MANHOLE
- I- STORM WATER INLET
- BUILDINGS
- CHEMICAL CONTAINMENT AREAS
- LNG / REFRIG CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

50' 25' 0 50' 100'
1"=50'

KBJ
JORDAN COVE LNG

Jordan Cove LNG℠
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF

SIGNED _____

DATE _____ REG NO. _____

DESIGNER CAF | DRAWN NJO
CHECKED | DATE

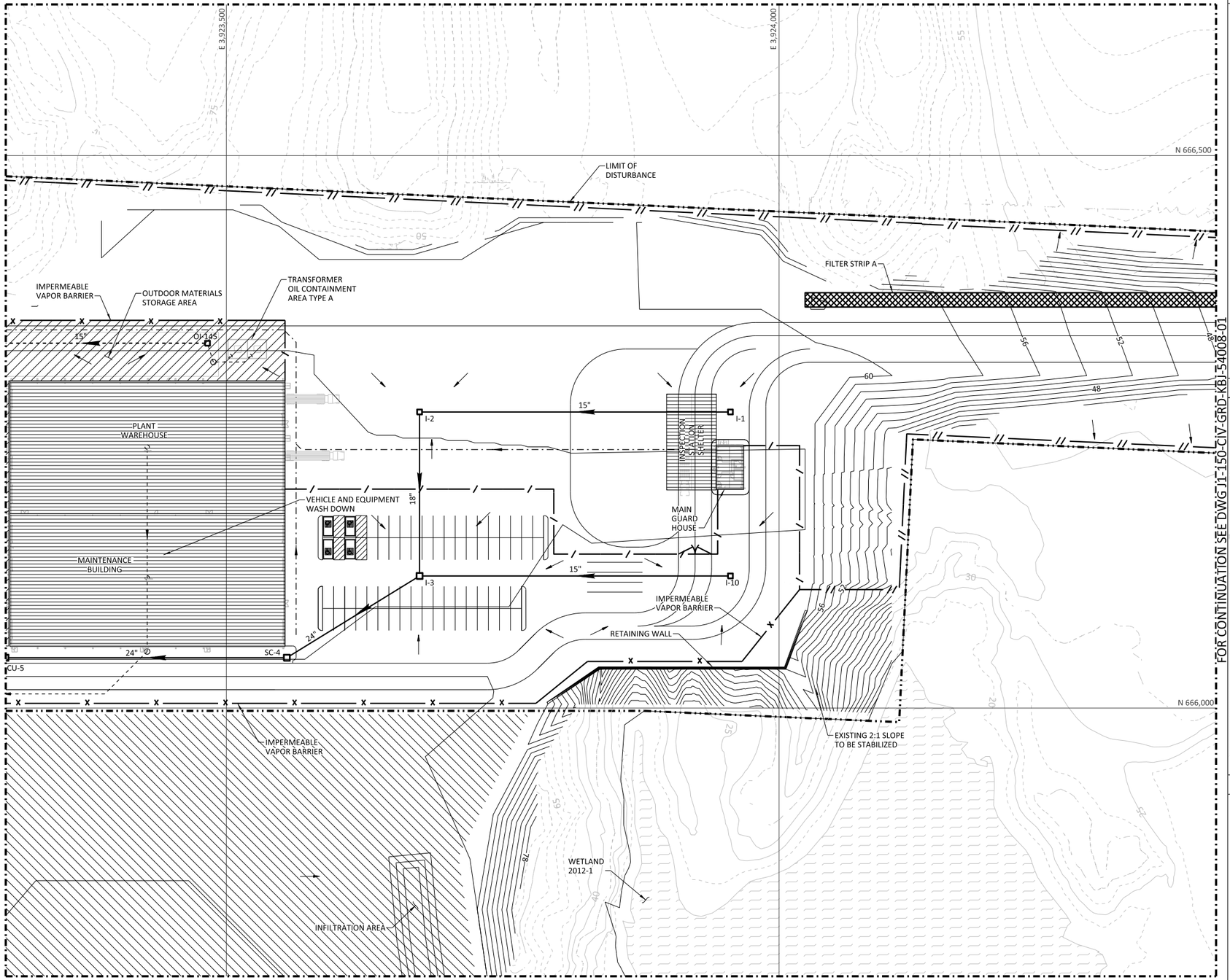
JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
PLAN - AREA 6

PROJECT / DRAWING NUMBER: 189980-0000-FS4006 — REV 0

JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54006-01 — REV 0

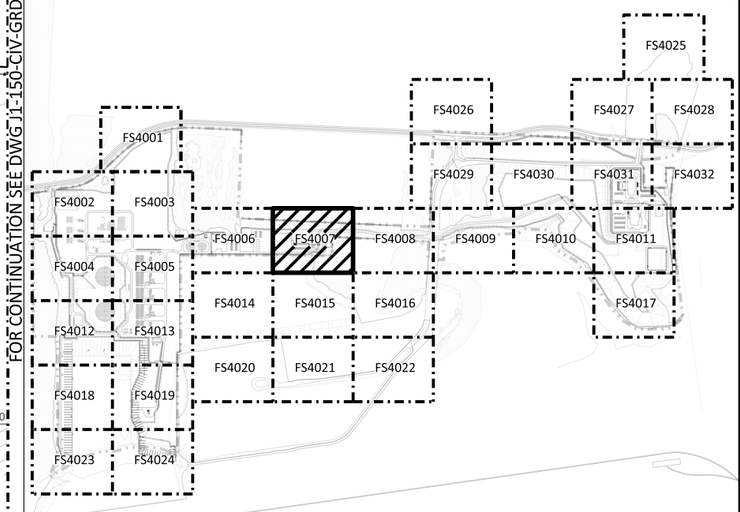
MicroStation v8.11.9.578
1 = 1
fin50857
ANSI D 34x22
3/26/2019 12:50:38 PM




## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER
- SC- SPILL CONTROL MANHOLE
- CF- CARTRIDGE FILTER
- CU- STORM WATER CURB INLET
- MH- STORM WATER MANHOLE
- OI- OILY WASTE INLET
- OMH- OILY WASTE MANHOLE
- I- STORM WATER INLET
- BUILDINGS
- CHEMICAL CONTAINMENT AREAS
- LNG / REFRIG CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

50' 25' 0 50' 100'
1"=50'

KBJ
JORDAN COVE LNG

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF

SIGNED _____

DATE _____ REG NO. _____

DESIGNER CAF | DRAWN NJO | CHECKED | DATE

JORDAN COVE LNG PROJECT

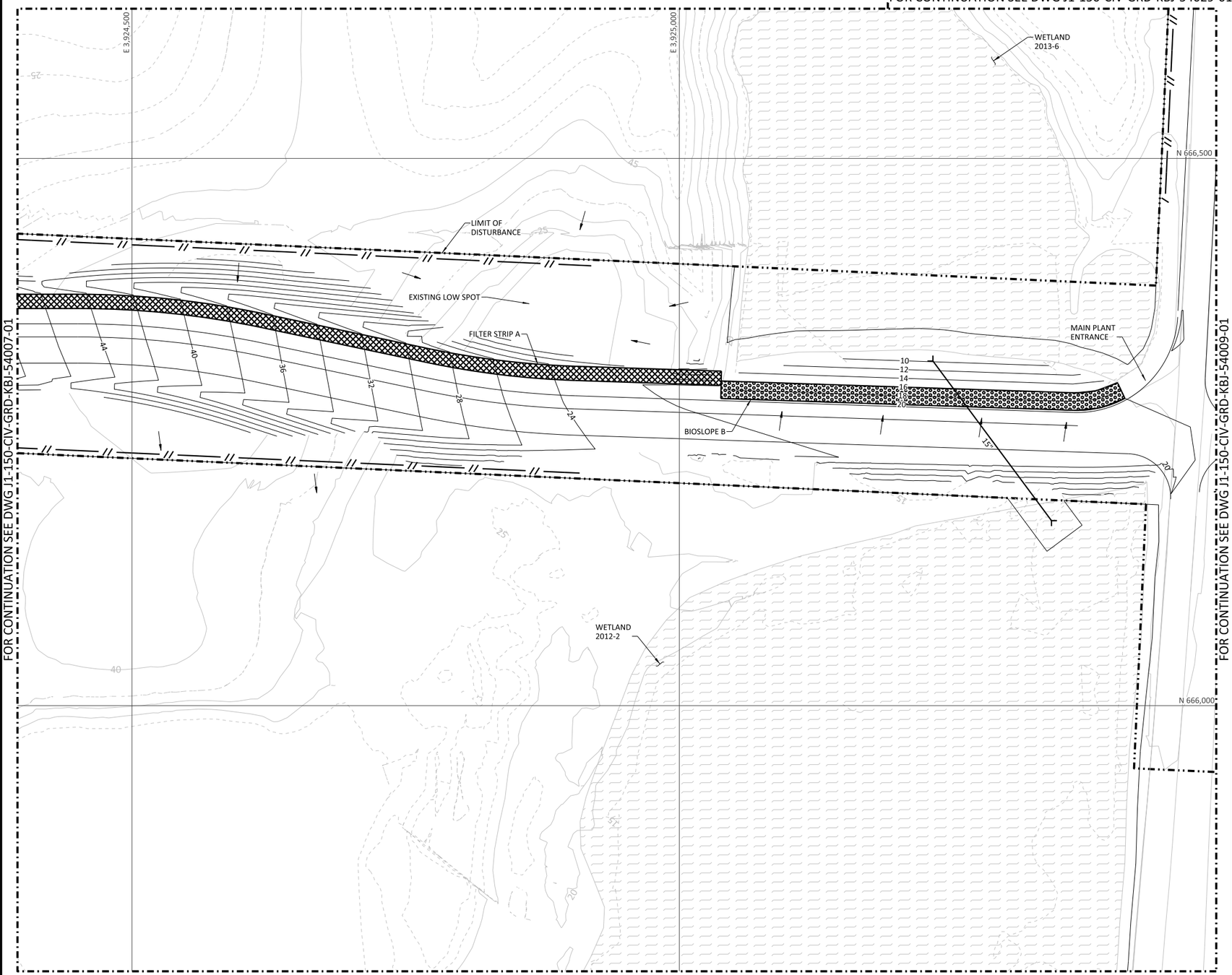
STORM WATER MANAGEMENT PLAN
PLAN - AREA 7

PROJECT / DRAWING NUMBER: 189980-0000-FS4007 — REV 0

JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54007-01 — REV 0

MicroStation v8.11.9.578
1 = 1
3/26/2019 12:23:48 PM
fin50857
ANSI D 34x22

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54029-01




FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54007-01

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54009-01

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54016-01

50' 25' 0 50' 100'

1"=50'

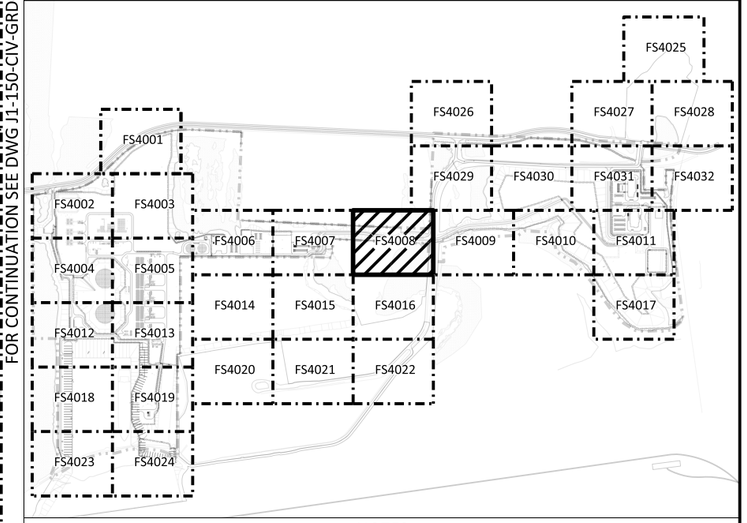
KBJ

JORDAN COVE LNG

## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER
- SC- SPILL CONTROL MANHOLE
- CF- CARTRIDGE FILTER
- CU- STORM WATER CURB INLET
- MH- STORM WATER MANHOLE
- OI- OILY WASTE INLET
- OMH- OILY WASTE MANHOLE
- I- STORM WATER INLET
- BUILDINGS
- CHEMICAL CONTAINMENT AREAS
- LNG / REFRIG CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

Jordan Cove LNG℠ A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF

SIGNED

DATE REG NO.

DESIGNER CAF | DRAWN NJO

CHECKED | DATE

JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
PLAN - AREA 8

PROJECT / DRAWING NUMBER: 189980-0000-FS4008 — REV 0

JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54008-01 — REV 0

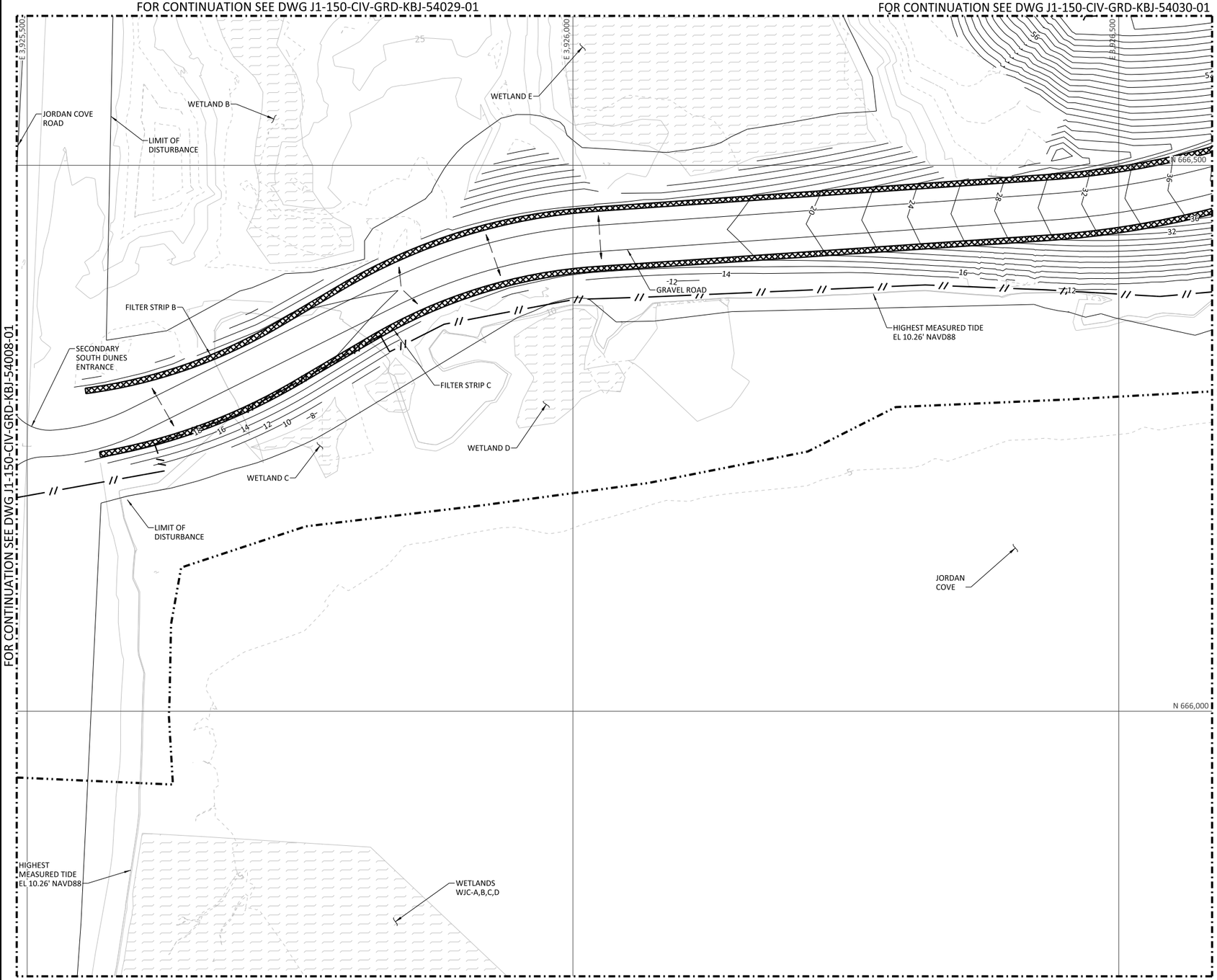
MicroStation v8.11.9.578
1 = 1
fin50857
ANSI D 34x22
3/26/2019 12:50:55 PM

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54029-01

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54030-01

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54008-01

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54010-01




50' 25' 0 50' 100'

1"=50'

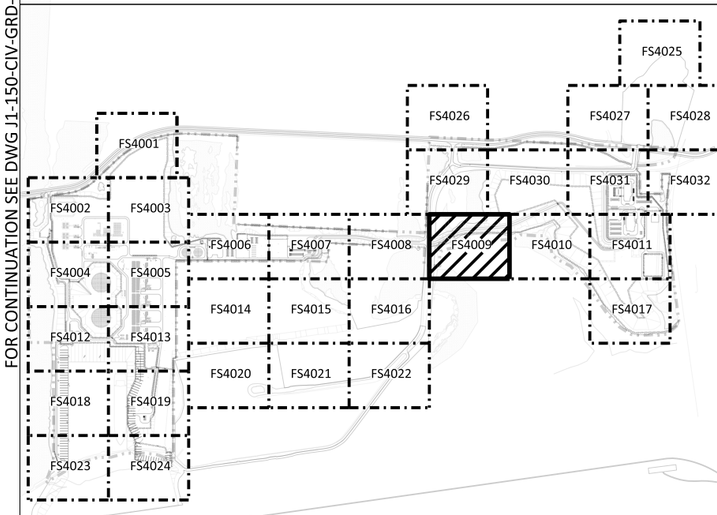
KBJ

JORDAN COVE LNG

## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER
- DRAWING DESIGNATION NUMBER
- SC- SPILL CONTROL MANHOLE
- CF- CARTRIDGE FILTER
- CU- STORM WATER CURB INLET
- MH- STORM WATER MANHOLE
- OI- OILY WASTE INLET
- OMH- OILY WASTE MANHOLE
- I- STORM WATER INLET
- BUILDINGS
- CHEMICAL CONTAINMENT AREAS
- LNG / REFRIG CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

Jordan Cove LNG℠ A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF

SIGNED _____

DATE _____ REG NO. _____

DESIGNER CAF | DRAWN NJO | CHECKED | DATE

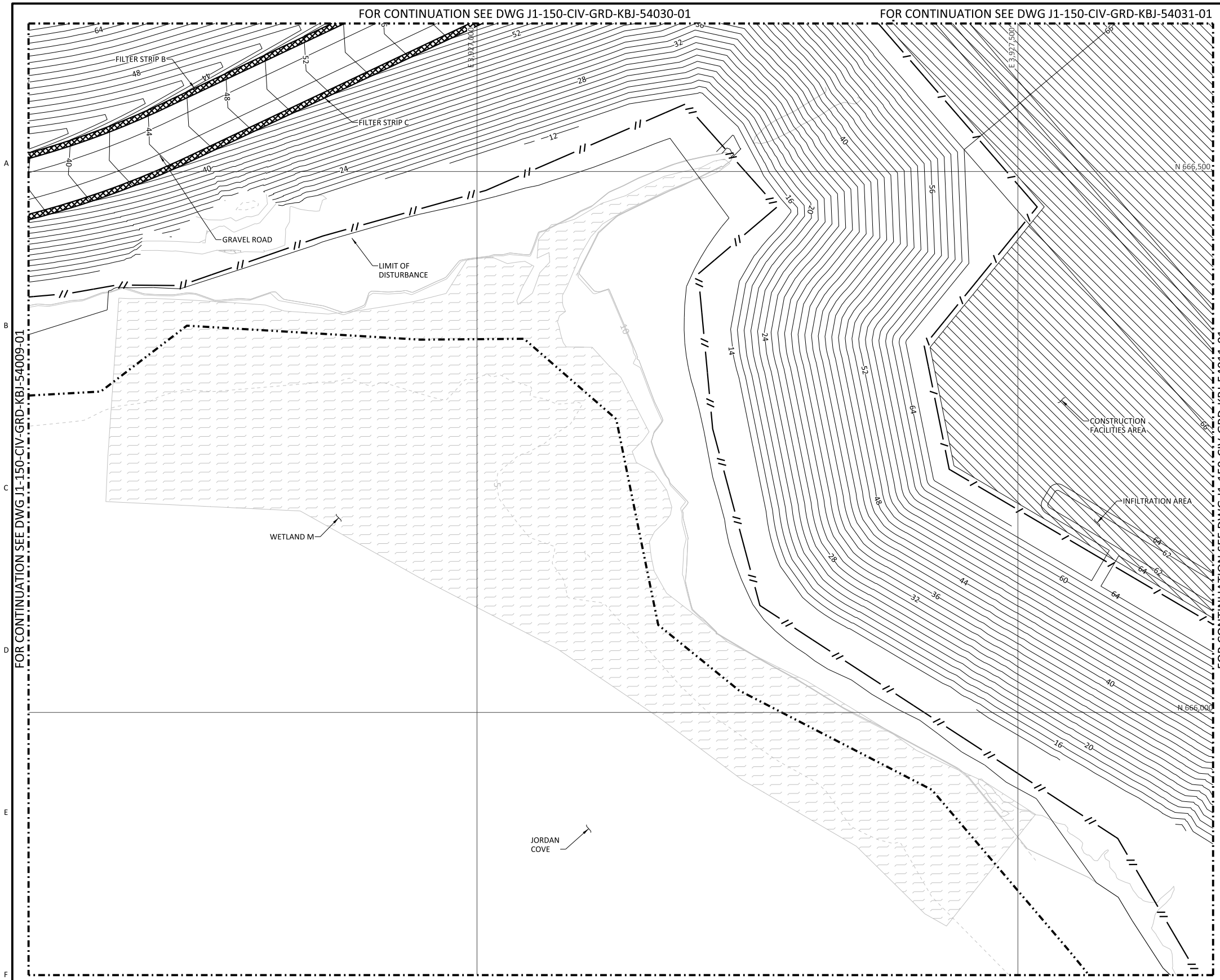
JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
PLAN - AREA 9

PROJECT DRAWING NUMBER: 189980-0000-FS4009 — REV 0

JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54009-01 — REV 0

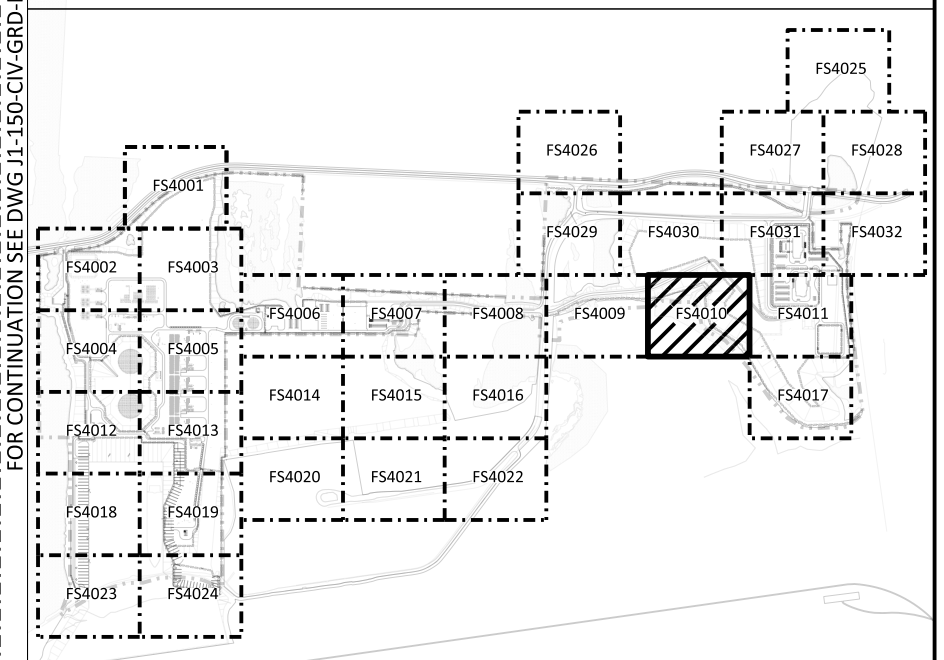
MicroStation v8.11.9.578
1 = 1
3/26/2019 12:51:03 PM
fn50857
ANSI D 34x22




## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER
- SPILL CONTROL MANHOLE
- CARTRIDGE FILTER
- STORM WATER CURB INLET
- STORM WATER MANHOLE
- OILY WASTE INLET
- OILY WASTE MANHOLE
- STORM WATER INLET
- BUILDINGS
- CHEMICAL CONTAINMENT AREAS
- LNG / REFRIG CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

50' 25' 0 50' 100'
1"=50'

KBJ
JORDAN COVE LNG

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF

SIGNED _____

DATE _____ REG NO. _____

DESIGNER CAF | DRAWN NJO

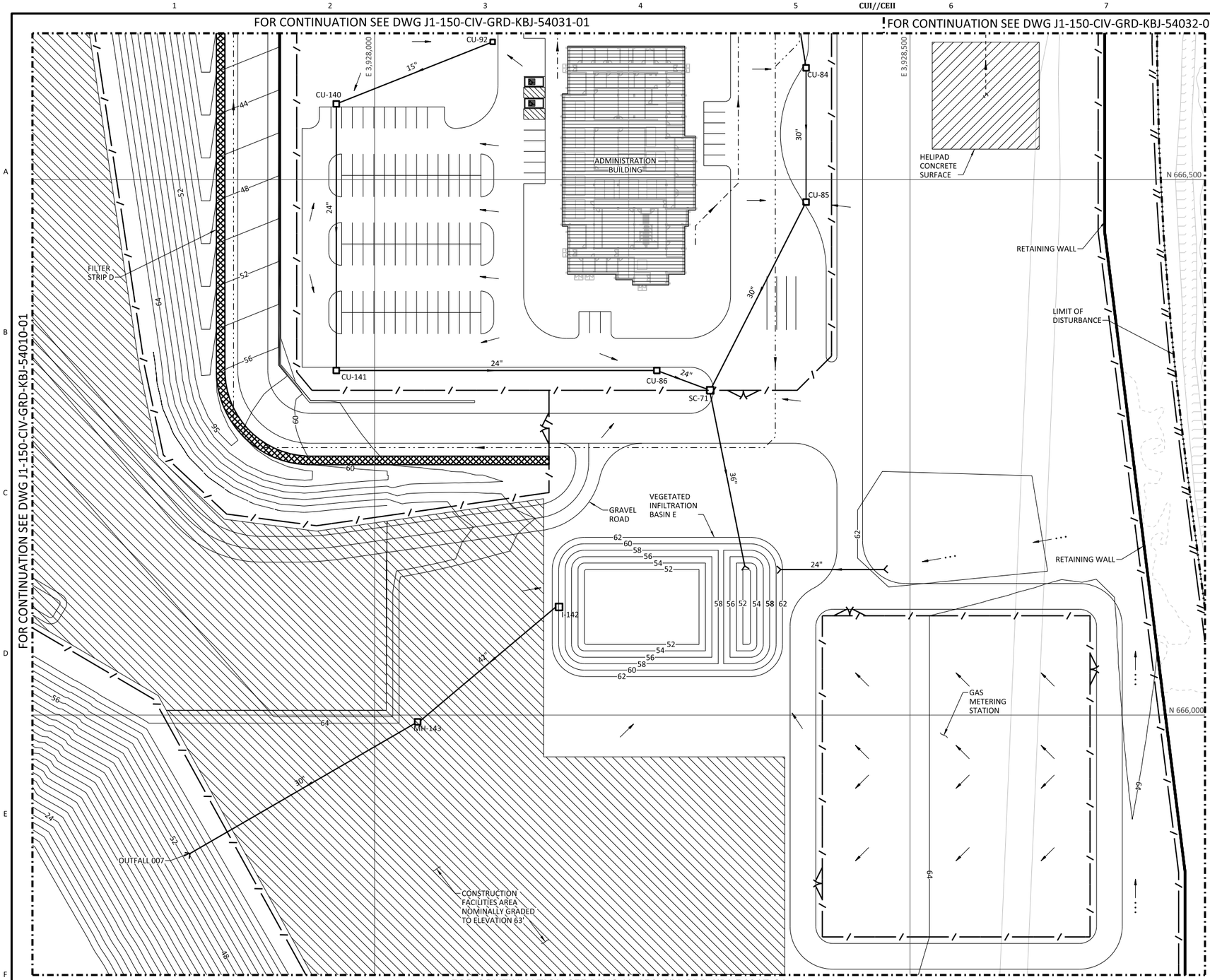
CHECKED | DATE

JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
PLAN - AREA 10

| PROJECT DRAWING NUMBER | REV |
|---|---|
| 189980-0000-FS4010 | 0 |
| JCLNG NUMBER | REV |
| J1-150-CIV-GRD-KBJ-54010-01 | 0 |

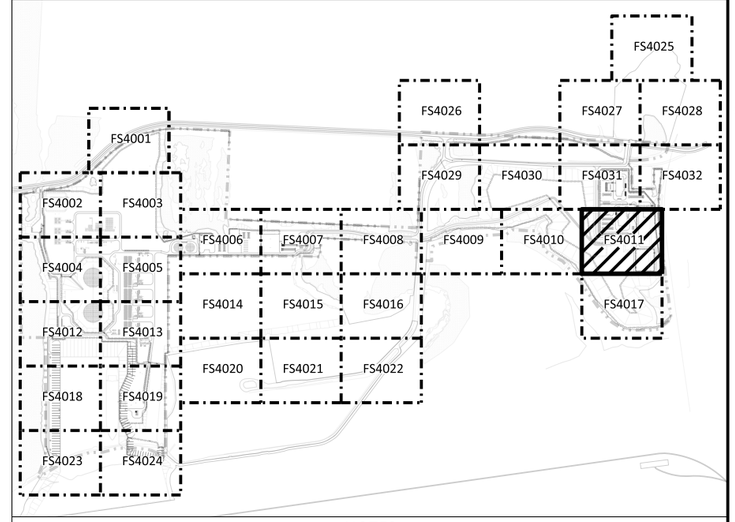
MicroStation v8.11.9.578
1 = 1
fin50857
ANSI D 34x22
3/26/2019 12:23:50 PM




## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER
- SC- SPILL CONTROL MANHOLE
- CF- CARTRIDGE FILTER
- CU- STORM WATER CURB INLET
- MH- STORM WATER MANHOLE
- OI- OILY WASTE INLET
- OMH- OILY WASTE MANHOLE
- I- STORM WATER INLET
- BUILDINGS
- LNG / REFRIG CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- CHEMICAL CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

KBJ
JORDAN COVE LNG

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF

SIGNED _____

DATE _____ REG NO. _____

DESIGNER CAF | DRAWN NJO | CHECKED | DATE

JORDAN COVE LNG PROJECT

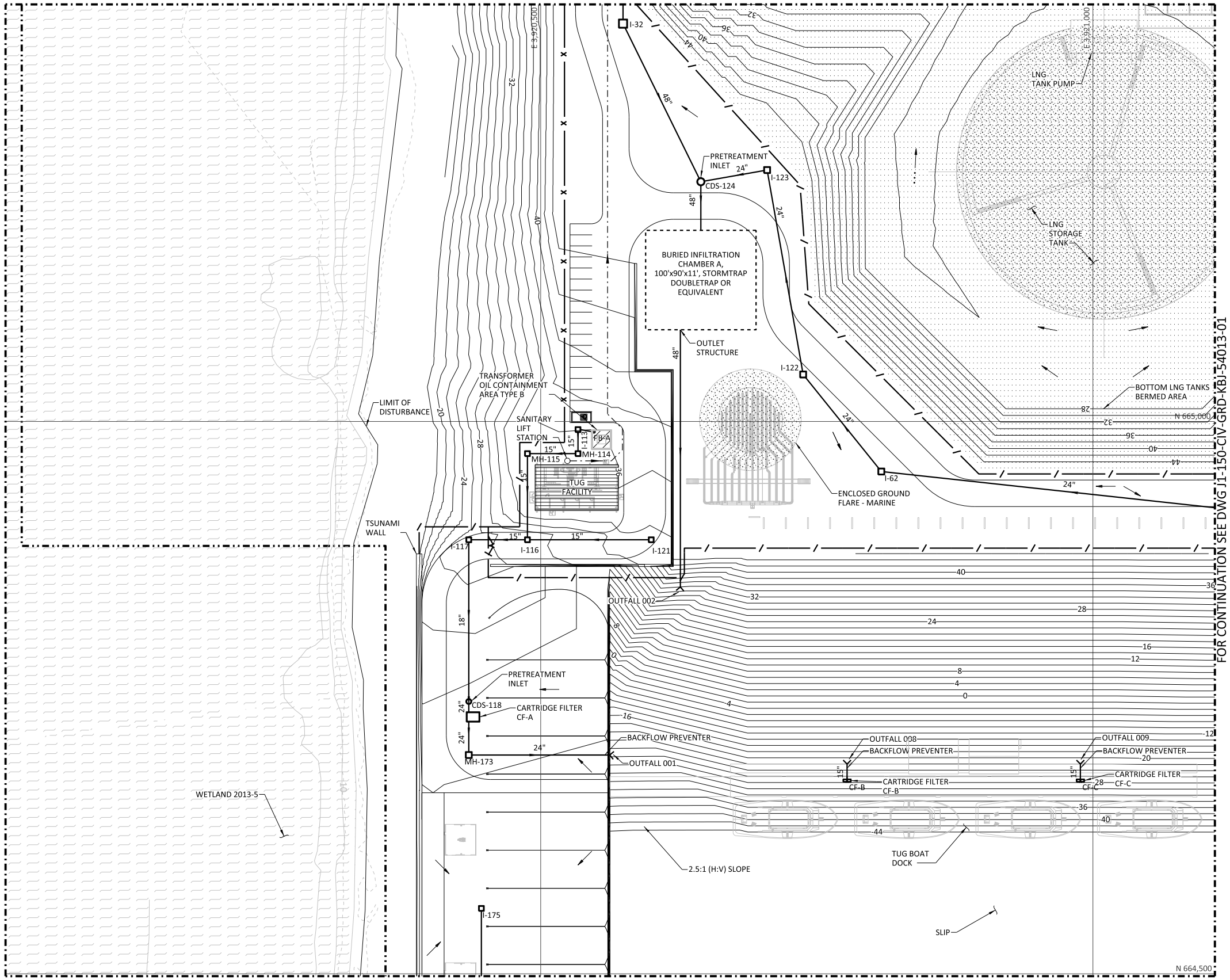
STORM WATER MANAGEMENT PLAN
PLAN - AREA 11

PROJECT / DRAWING NUMBER: 189980-0000-FS4011 — REV 0

JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54011-01 — REV 0

MicroStation v8.11.9.578
1 = 1
3/26/2019 12:23:51 PM
fin50857
ANSI D 34x22

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54004-01




FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54013-01

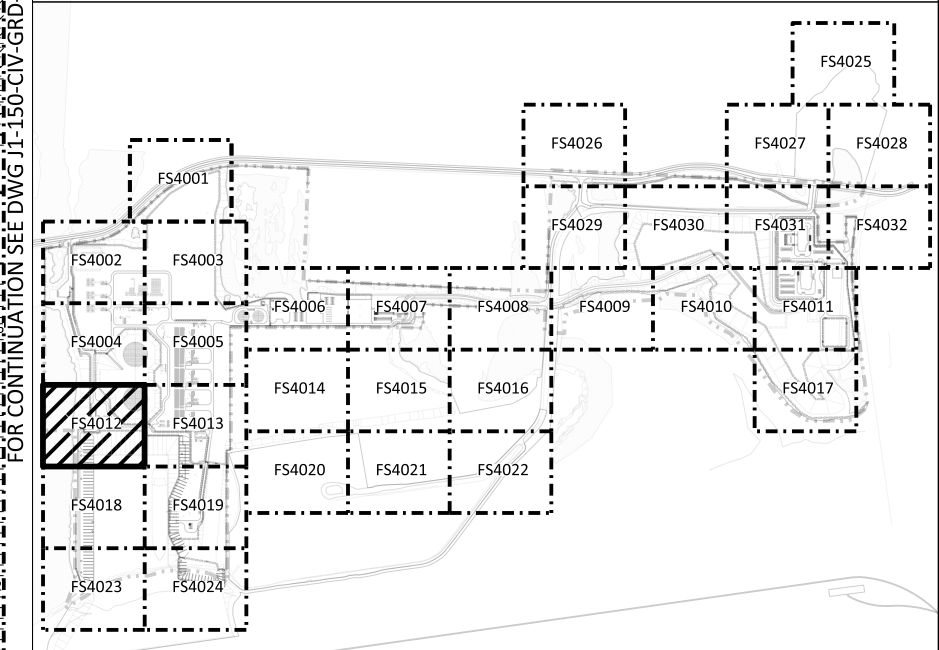
FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54018-01

50' 25' 0 50' 100'
1"=50'

## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER
- SPILL CONTROL MANHOLE
- CARTRIDGE FILTER
- STORM WATER CURB INLET
- STORM WATER MANHOLE
- OILY WASTE INLET
- OILY WASTE MANHOLE
- STORM WATER INLET
- BUILDINGS
- CHEMICAL CONTAINMENT AREAS
- LNG / REFRIG CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

KBJ
JORDAN COVE LNG

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF
SIGNED
DATE REG NO.

DESIGNER CAF | DRAWN NJO
CHECKED | DATE

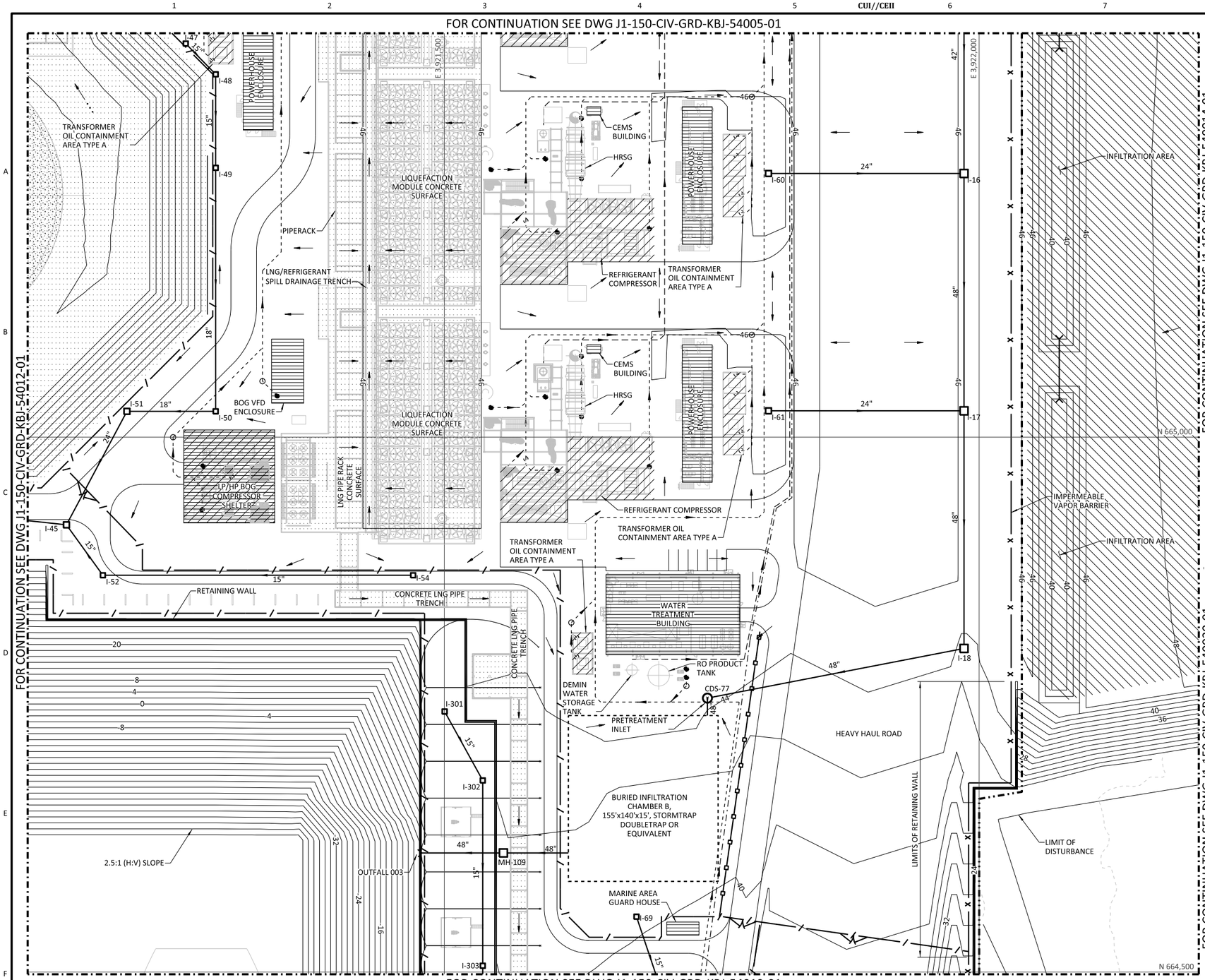
JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
PLAN - AREA 12

PROJECT / DRAWING NUMBER: 189980-0000-FS4012 — REV 0

JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54012-01 — REV 0

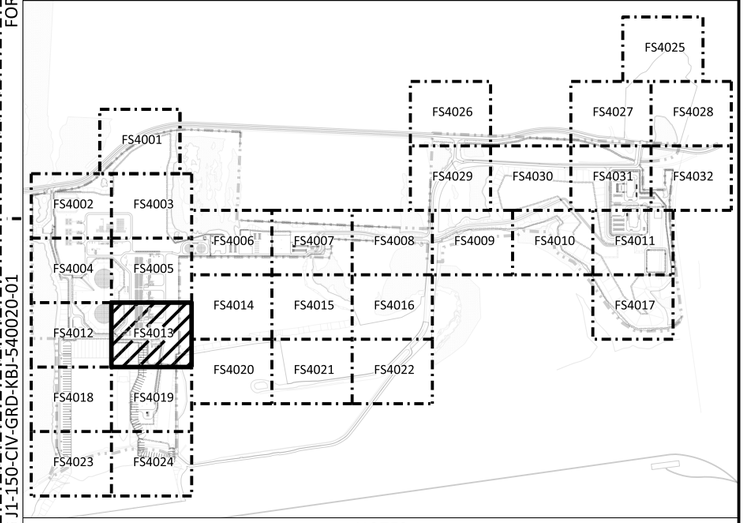
MicroStation v8.11.9.578
1 = 1
fin50857
ANSI D 34x22
3/26/2019 12:51:27 PM




## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER
- SPILL CONTROL MANHOLE
- CARTRIDGE FILTER
- STORM WATER CURB INLET
- STORM WATER MANHOLE
- OILY WASTE INLET
- OILY WASTE MANHOLE
- STORM WATER INLET
- BUILDINGS
- LNG / REFRIG CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- CHEMICAL CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

50' 25' 0 50' 100'
1"=50'

KBJ
JORDAN COVE LNG

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF

SIGNED _____

DATE _____ REG NO. _____

DESIGNER CAF | DRAWN NJO | CHECKED | DATE

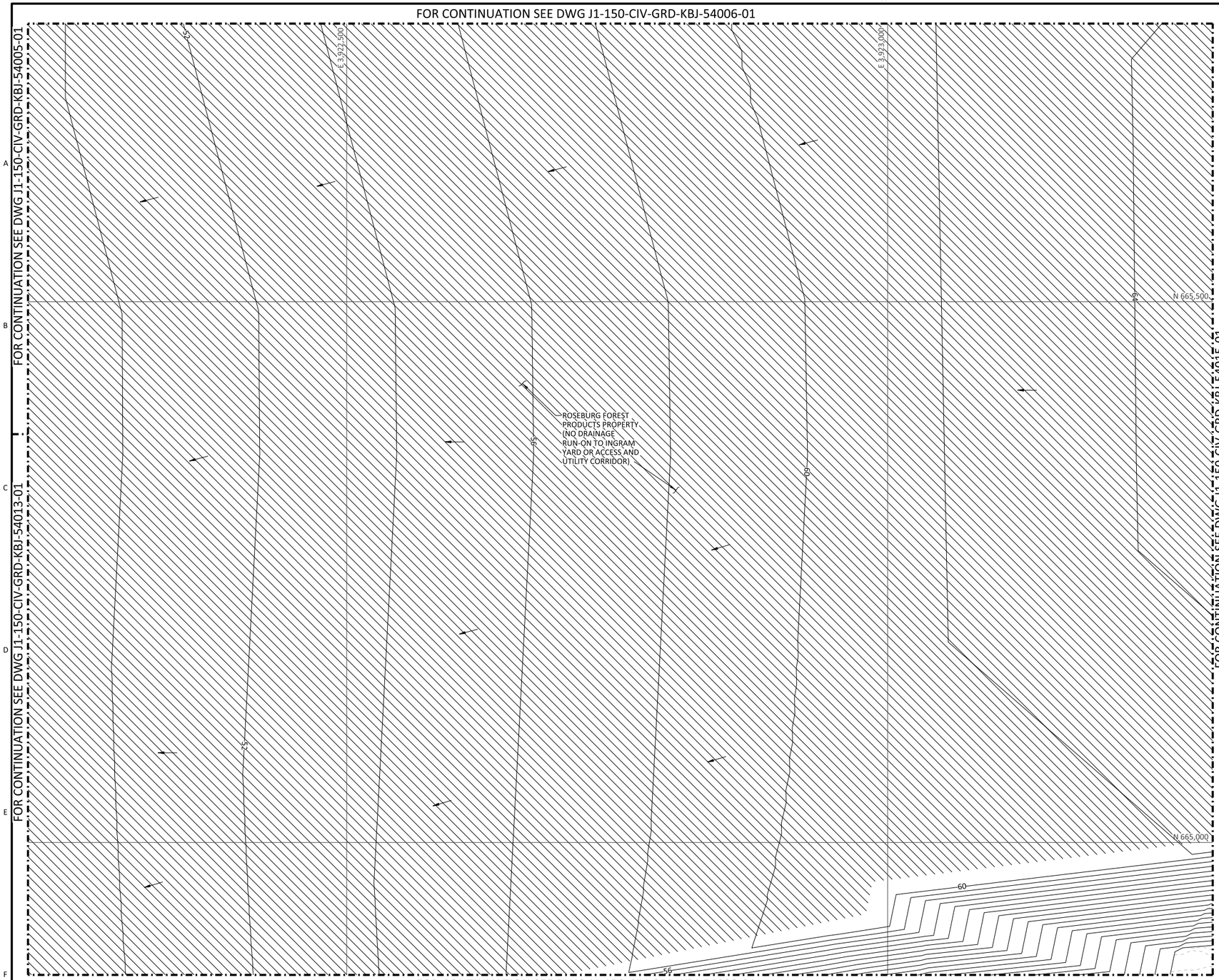
JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
PLAN - AREA 13

PROJECT / DRAWING NUMBER: 189980-0000-FS4013 — REV 0

JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54013-01 — REV 0

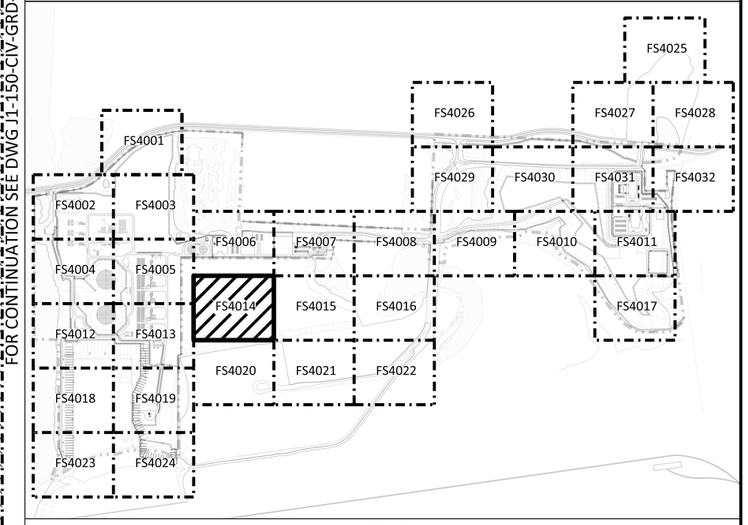
MicroStation v8.11.9.578
1 = 1
3/26/2019 12:23:53 PM
fin50857
ANSI D 34x22




## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER
- SC- SPILL CONTROL MANHOLE
- CF- CARTRIDGE FILTER
- CU- STORM WATER CURB INLET
- MH- STORM WATER MANHOLE
- OI- OILY WASTE INLET
- OMH- OILY WASTE MANHOLE
- I- STORM WATER INLET
- BUILDINGS
- CHEMICAL CONTAINMENT AREAS
- LNG / REFRIG CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

50' 25' 0 50' 100'
1"=50'

KBJ
JORDAN COVE LNG

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF
SIGNED
DATE REG NO.

DESIGNER CAF | DRAWN NJO
CHECKED | DATE

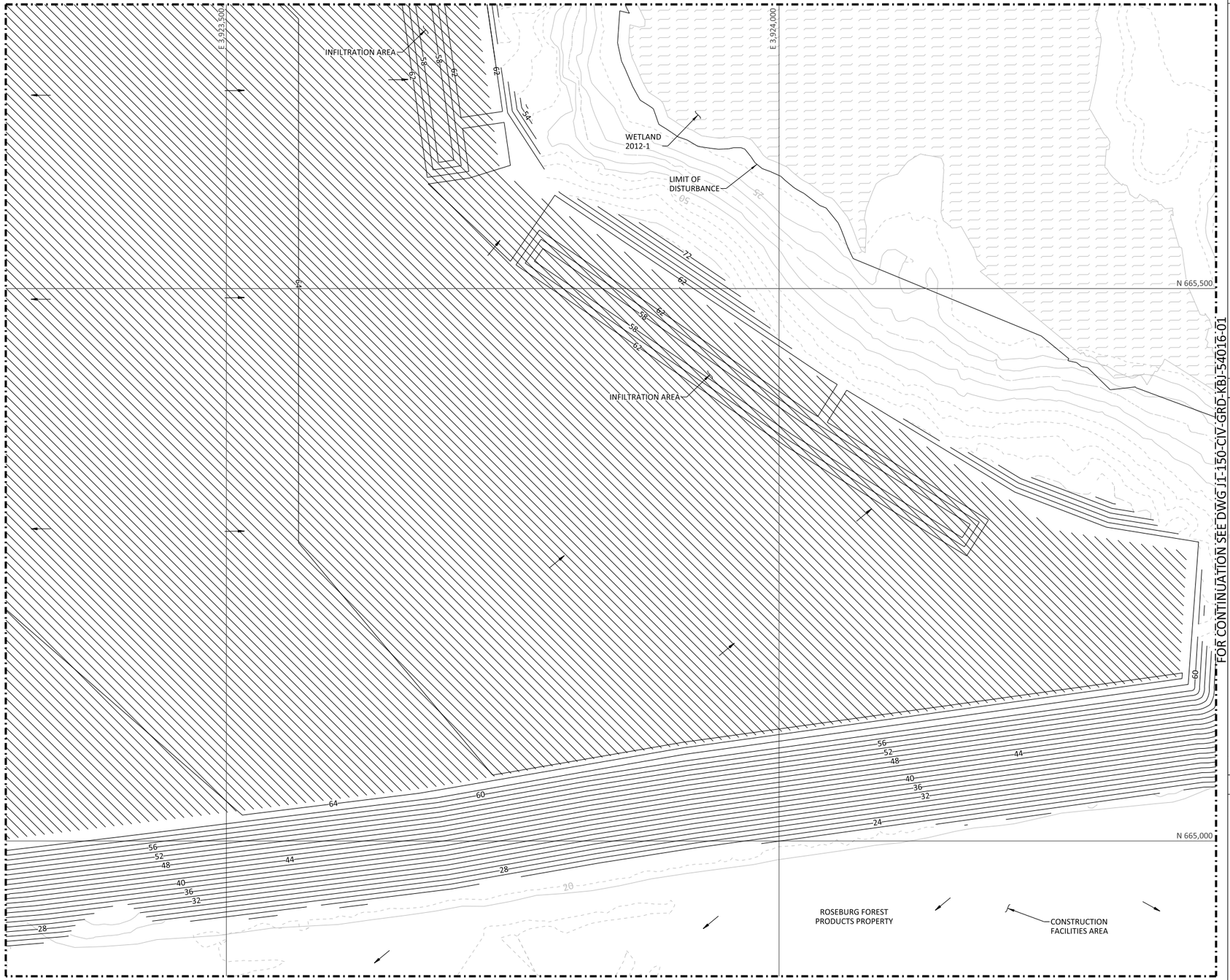
JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
PLAN - AREA 14

PROJECT / DRAWING NUMBER: 189980-0000-FS4014 — REV 0
JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54014-01 — REV 0

MicroStation v8.11.9.578
1 = 1
3/26/2019 12:51:44 PM
fin50857
ANSI D 24x22

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54007-01




FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54014-01

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54016-01

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54021-01

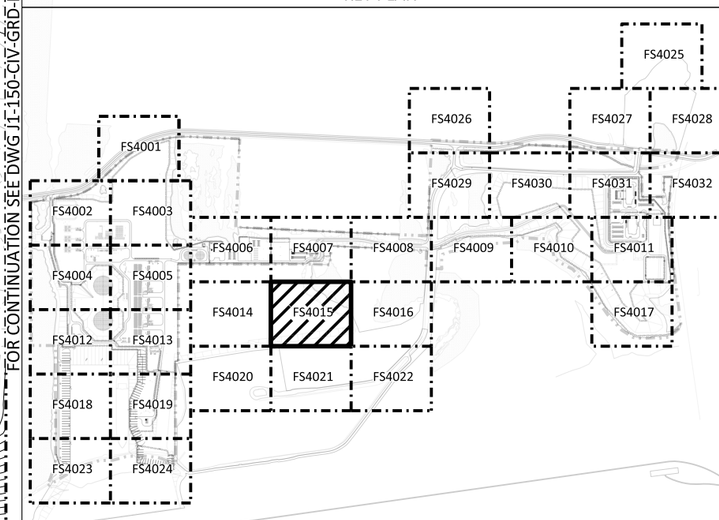
50' 25' 0 50' 100'
1"=50'

KBJ
JORDAN COVE LNG

## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER
- SPILL CONTROL MANHOLE
- CARTRIDGE FILTER
- STORM WATER CURB INLET
- STORM WATER MANHOLE
- OILY WASTE INLET
- OILY WASTE MANHOLE
- STORM WATER INLET
- BUILDINGS
- CHEMICAL CONTAINMENT AREAS
- LNG / REFRIG CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF
SIGNED
DATE REG NO.

DESIGNER CAF | DRAWN NJO
CHECKED | DATE

JORDAN COVE LNG PROJECT

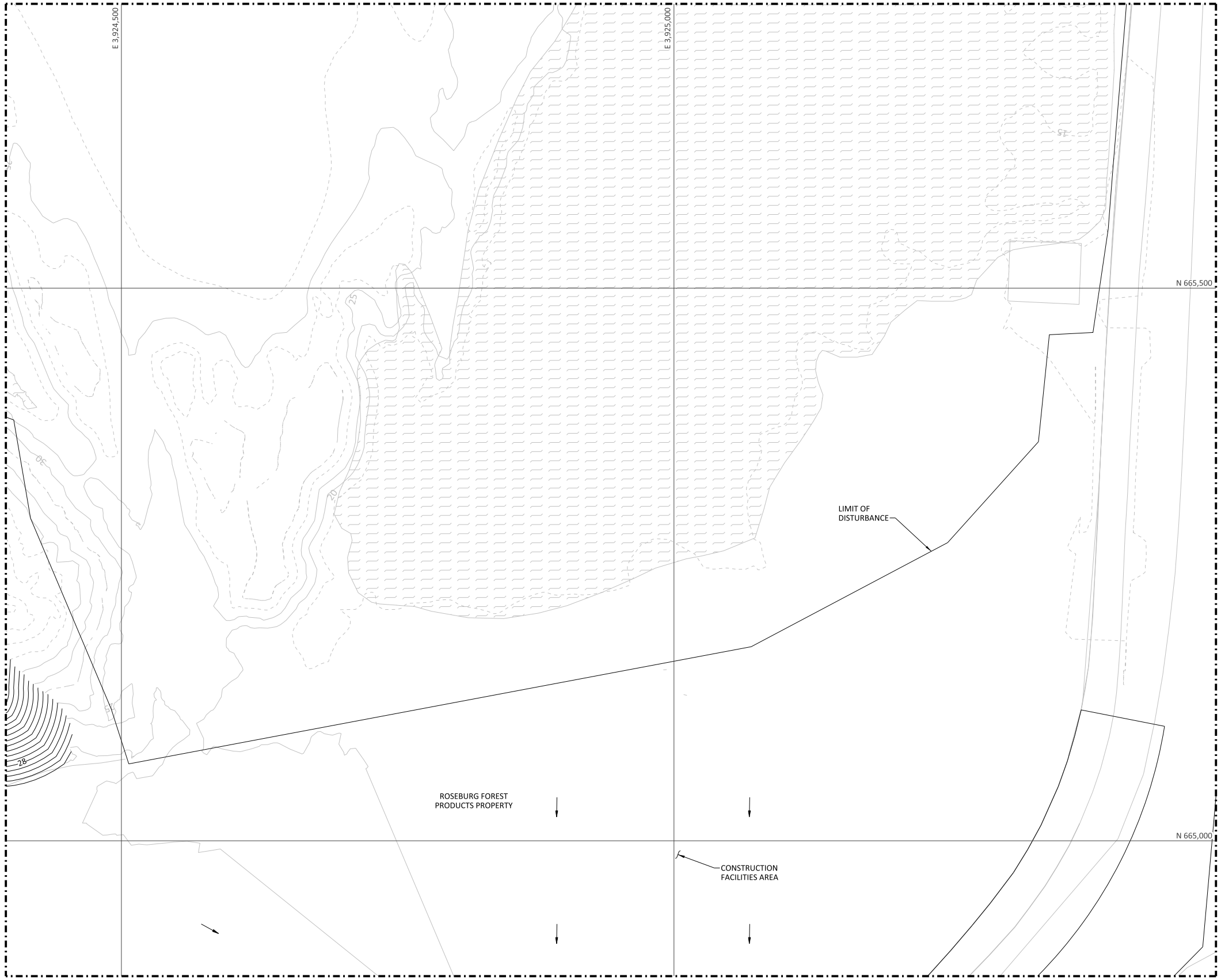
STORM WATER MANAGEMENT PLAN
PLAN - AREA 15

PROJECT / DRAWING NUMBER: 189980-0000-FS4015 — REV 0

JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54015-01 — REV 0

MicroStation v8.11.9.578
1 = 1
fin50857
ANSI D 34x22
3/26/2019 12:23:55 PM

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54008-01




FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54015-01

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54022-01

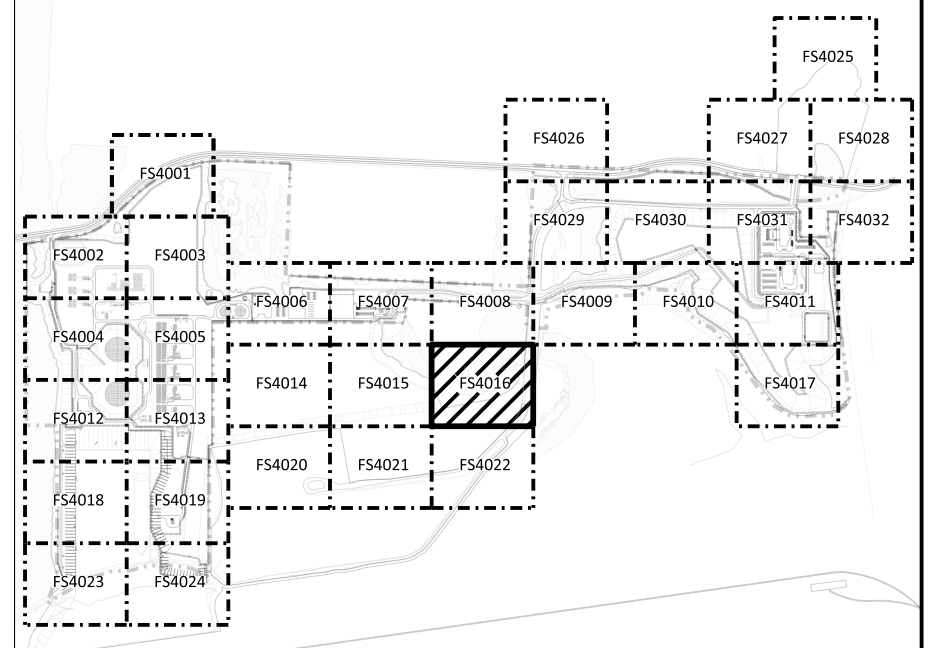
50' 25' 0 50' 100'
1"=50'

KBJ
JORDAN COVE LNG

## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER
- SC- SPILL CONTROL MANHOLE
- CF- CARTRIDGE FILTER
- CU- STORM WATER CURB INLET
- MH- STORM WATER MANHOLE
- OI- OILY WASTE INLET
- OMH- OILY WASTE MANHOLE
- I- STORM WATER INLET
- BUILDINGS
- CHEMICAL CONTAINMENT AREAS
- LNG / REFRIG CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

Jordan Cove LNG LLC
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF
SIGNED
DATE REG NO.

DESIGNER CAF | DRAWN NJO
CHECKED | DATE

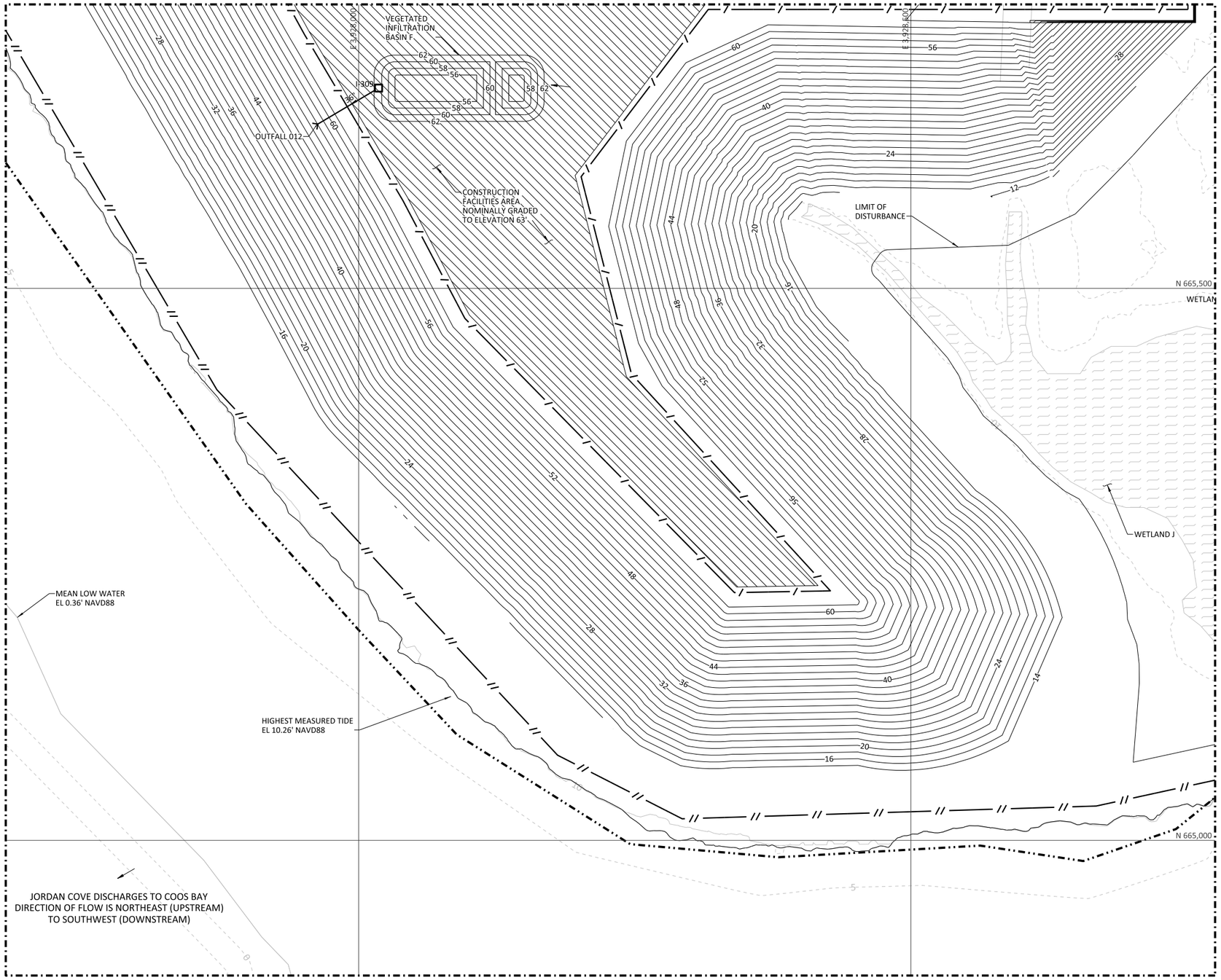
JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
PLAN - AREA 16

PROJECT / DRAWING NUMBER: 189980-0000-FS4016 — REV 0
JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54016-01 — REV 0

MicroStation v8.11.9.578
1 = 1
3/26/2019 12:23:56 PM
fin50857
ANSI D 34x22

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54011-01



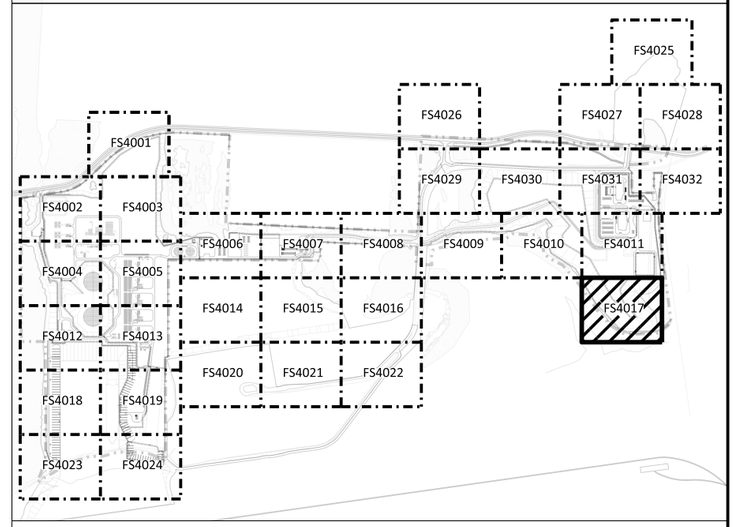

50' 25' 0 50' 100'
1"=50'

KBJ
JORDAN COVE LNG

## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER
- SC- SPILL CONTROL MANHOLE
- CF- CARTRIDGE FILTER
- CU- STORM WATER CURB INLET
- MH- STORM WATER MANHOLE
- OI- OILY WASTE INLET
- OMH- OILY WASTE MANHOLE
- I- STORM WATER INLET
- BUILDINGS
- CHEMICAL CONTAINMENT AREAS
- LNG / REFRIG CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

Jordan Cove LNG℠ A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF
SIGNED
DATE REG NO.

DESIGNER CAF | DRAWN NJO
CHECKED | DATE

JORDAN COVE LNG PROJECT

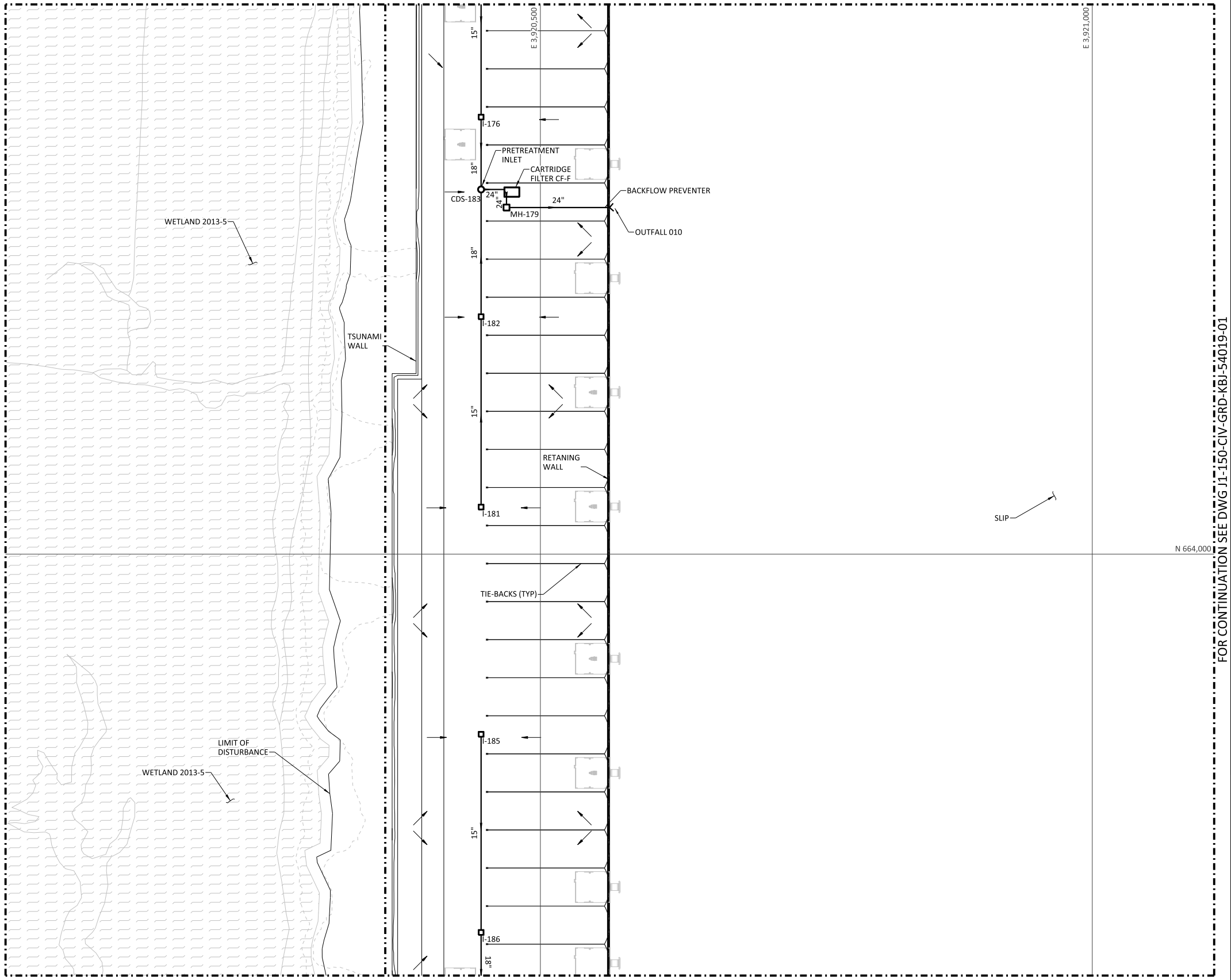
STORM WATER MANAGEMENT PLAN
PLAN - AREA 17

PROJECT / DRAWING NUMBER: 189980-0000-FS4017 — REV 0

JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54017-01 — REV 0

MicroStation v8.11.9.578
1 = 1
fin50857
ANSI D 34x22
3/26/2019 12:52:07 PM

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54012-01



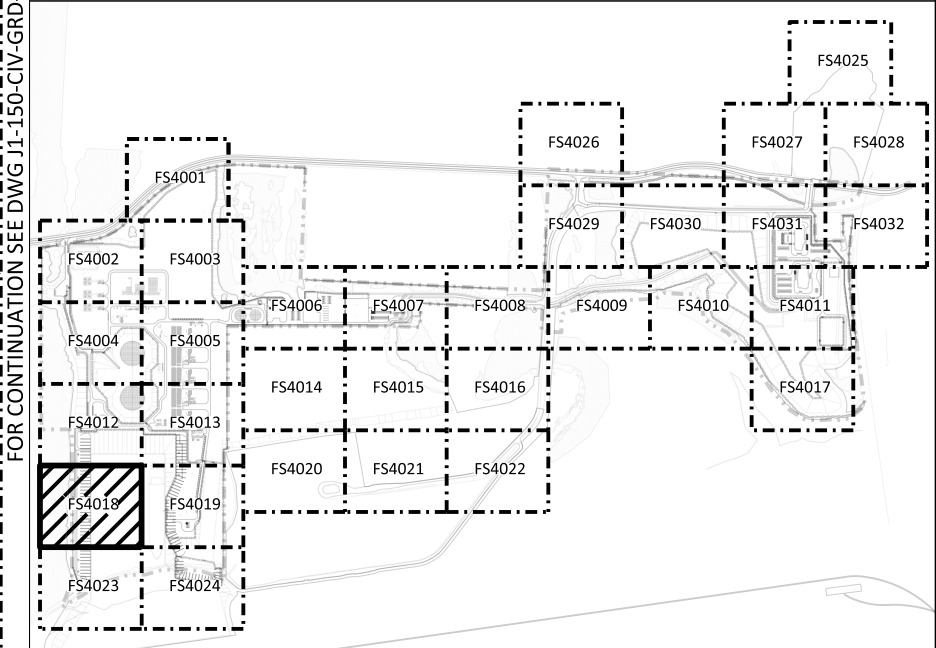

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54023-01

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54019-01

## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER
- DRAWING DESIGNATION NUMBER
- SC- SPILL CONTROL MANHOLE
- CF- CARTRIDGE FILTER
- CU- STORM WATER CURB INLET
- MH- STORM WATER MANHOLE
- OI- OILY WASTE INLET
- OMH- OILY WASTE MANHOLE
- I- STORM WATER INLET
- BUILDINGS
- CHEMICAL CONTAINMENT AREAS
- LNG / REFRIG CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

50' 25' 0 50' 100'
1"=50'

KBJ
JORDAN COVE LNG

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF
SIGNED
DATE REG NO.

DESIGNER CAF | DRAWN NJO
CHECKED | DATE

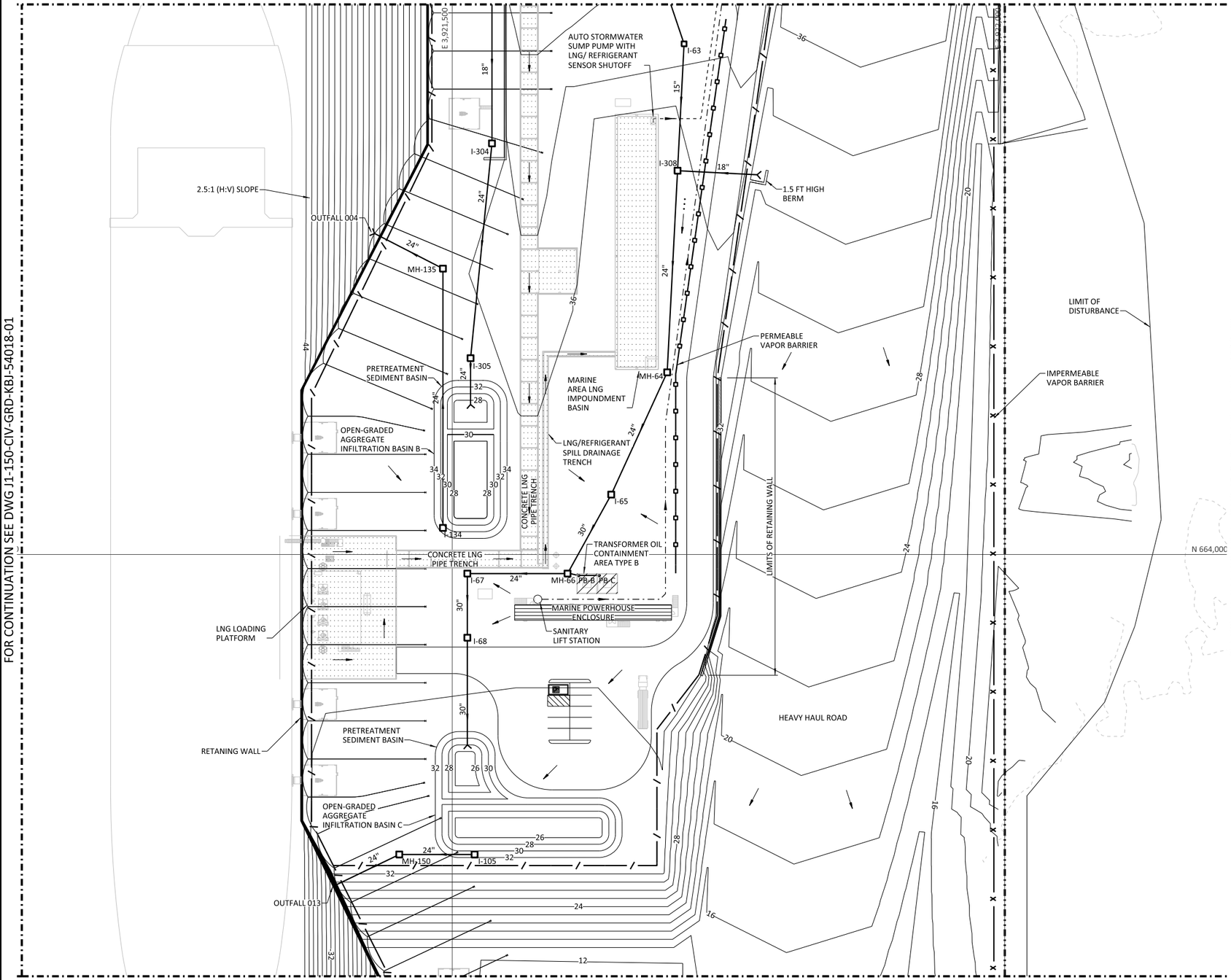
JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
PLAN - AREA 18

PROJECT / DRAWING NUMBER: 189980-0000-FS4018 | REV 0
JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54018-01 | REV 0

MicroStation v8.11.9.578
1 = 1
fin50857
ANSI D 24x22
3/27/2019 10:56:54 AM

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54013-01




FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54018-01

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54020-01

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54024-01

50' 25' 0 50' 100'

1"=50'

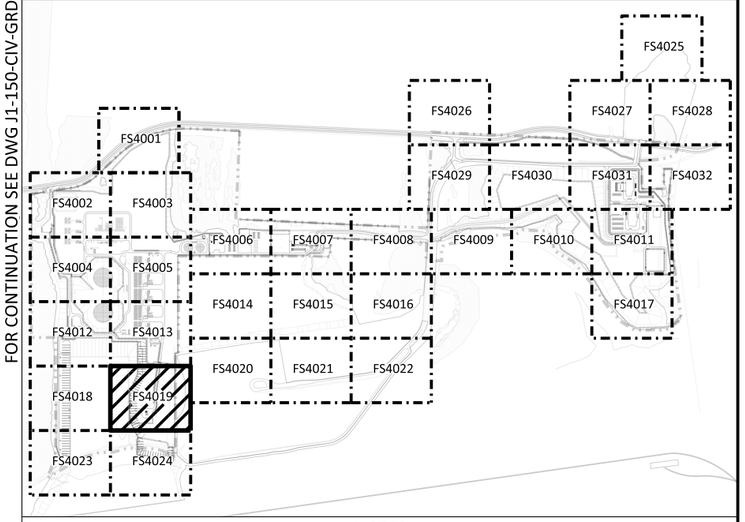
KBJ

JORDAN COVE LNG

## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER
- SC- SPILL CONTROL MANHOLE
- CF- CARTRIDGE FILTER
- CU- STORM WATER CURB INLET
- MH- STORM WATER MANHOLE
- OI- OILY WASTE INLET
- OMH- OILY WASTE MANHOLE
- I- STORM WATER INLET
- BUILDINGS
- LNG / REFRIG CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- CHEMICAL CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF

SIGNED

DATE REG NO.

DESIGNER CAF | DRAWN NJO

CHECKED | DATE

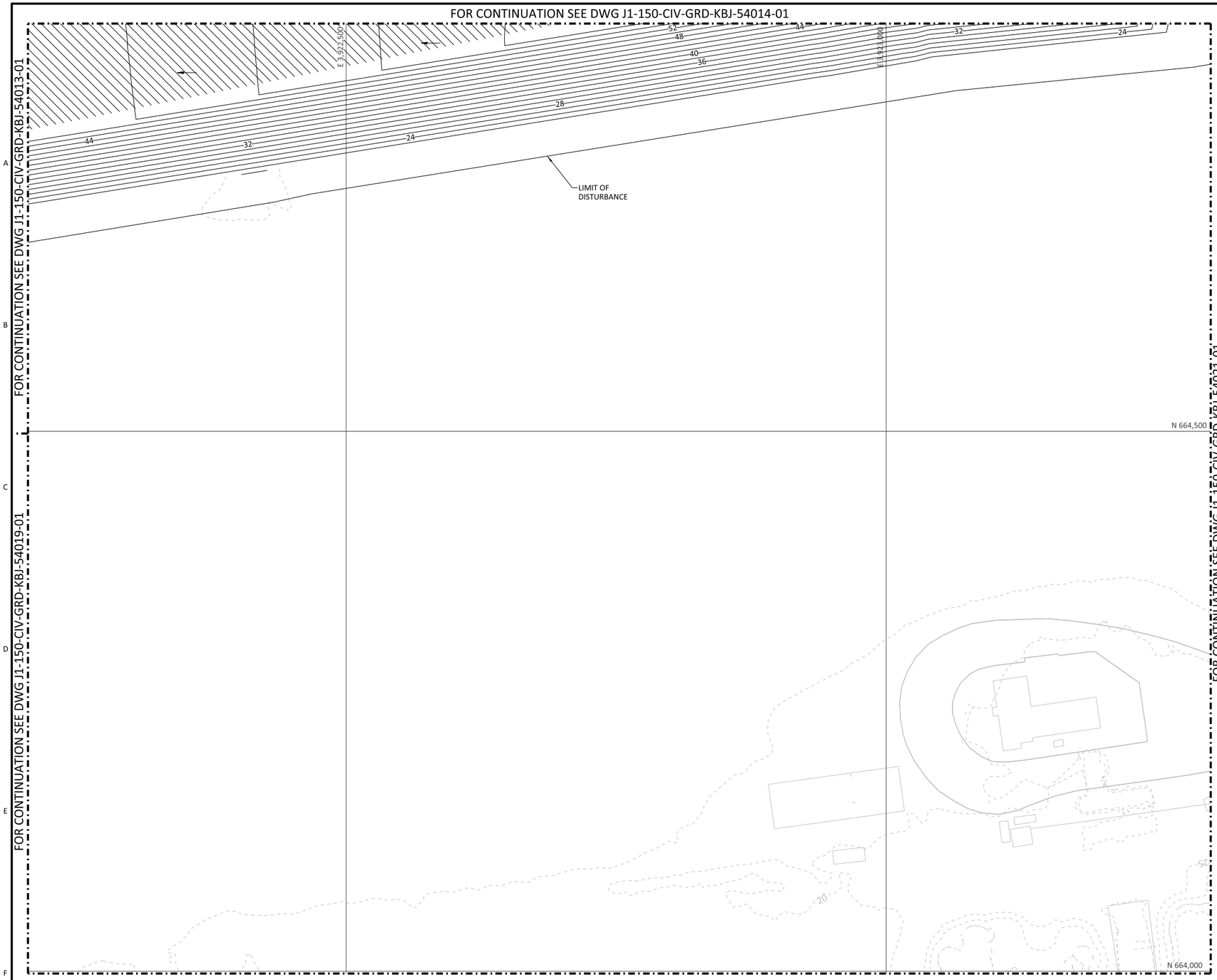
JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
PLAN - AREA 19

PROJECT / DRAWING NUMBER: 189980-0000-FS4019 — REV 0

JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54019-01 — REV 0

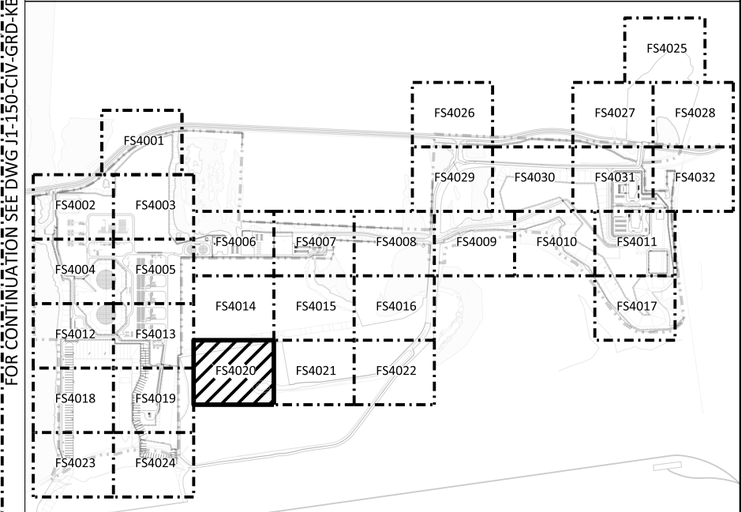
MicroStation v8.11.9.578
1 = 1
fin50857
ANSI D 24x22
3/26/2019 12:23:59 PM




## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER
- SC- SPILL CONTROL MANHOLE
- CF- CARTRIDGE FILTER
- CU- STORM WATER CURB INLET
- MH- STORM WATER MANHOLE
- OI- OILY WASTE INLET
- OMH- OILY WASTE MANHOLE
- I- STORM WATER INLET
- BUILDINGS
- CHEMICAL CONTAINMENT AREAS
- LNG / REFRIG CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

50' 25' 0 50' 100'
1"=50'

KBJ
JORDAN COVE LNG

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF
SIGNED
DATE REG NO.

DESIGNER CAF | DRAWN NJO
CHECKED | DATE

JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
PLAN - AREA 20

PROJECT / DRAWING NUMBER: 189980-0000-FS4020 — REV 0
JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54020-01 — REV 0

MicroStation v8.11.9.578
1 = 1
3/26/2019 12:24:00 PM
fin50857
ANSI D 24x22

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54015-01

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54020-01

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54022-01

50' 25' 0 50' 100'

1"=50'

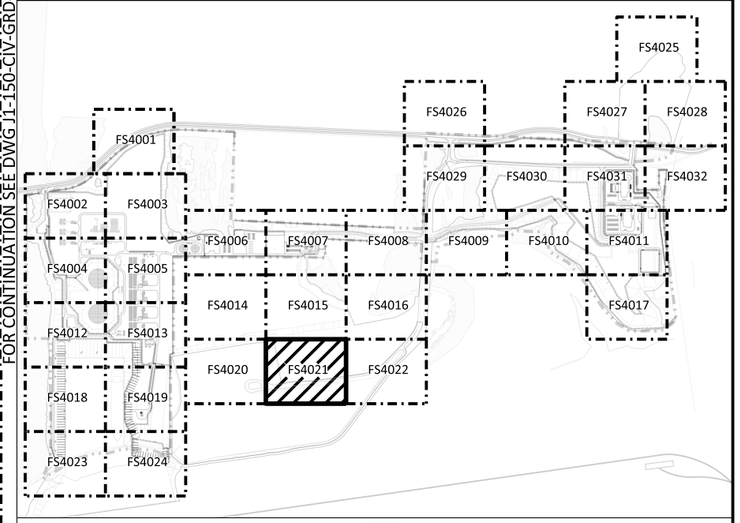
KBJ

JORDAN COVE LNG

## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER
- DRAWING DESIGNATION NUMBER
- SPILL CONTROL MANHOLE
- CARTRIDGE FILTER
- STORM WATER CURB INLET
- STORM WATER MANHOLE
- OILY WASTE INLET
- OILY WASTE MANHOLE
- STORM WATER INLET
- BUILDINGS
- CHEMICAL CONTAINMENT AREAS
- LNG / REFRIG CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

Jordan Cove LNG℠ A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF

SIGNED

DATE REG NO.

DESIGNER CAF | DRAWN NJO

CHECKED | DATE

JORDAN COVE LNG PROJECT

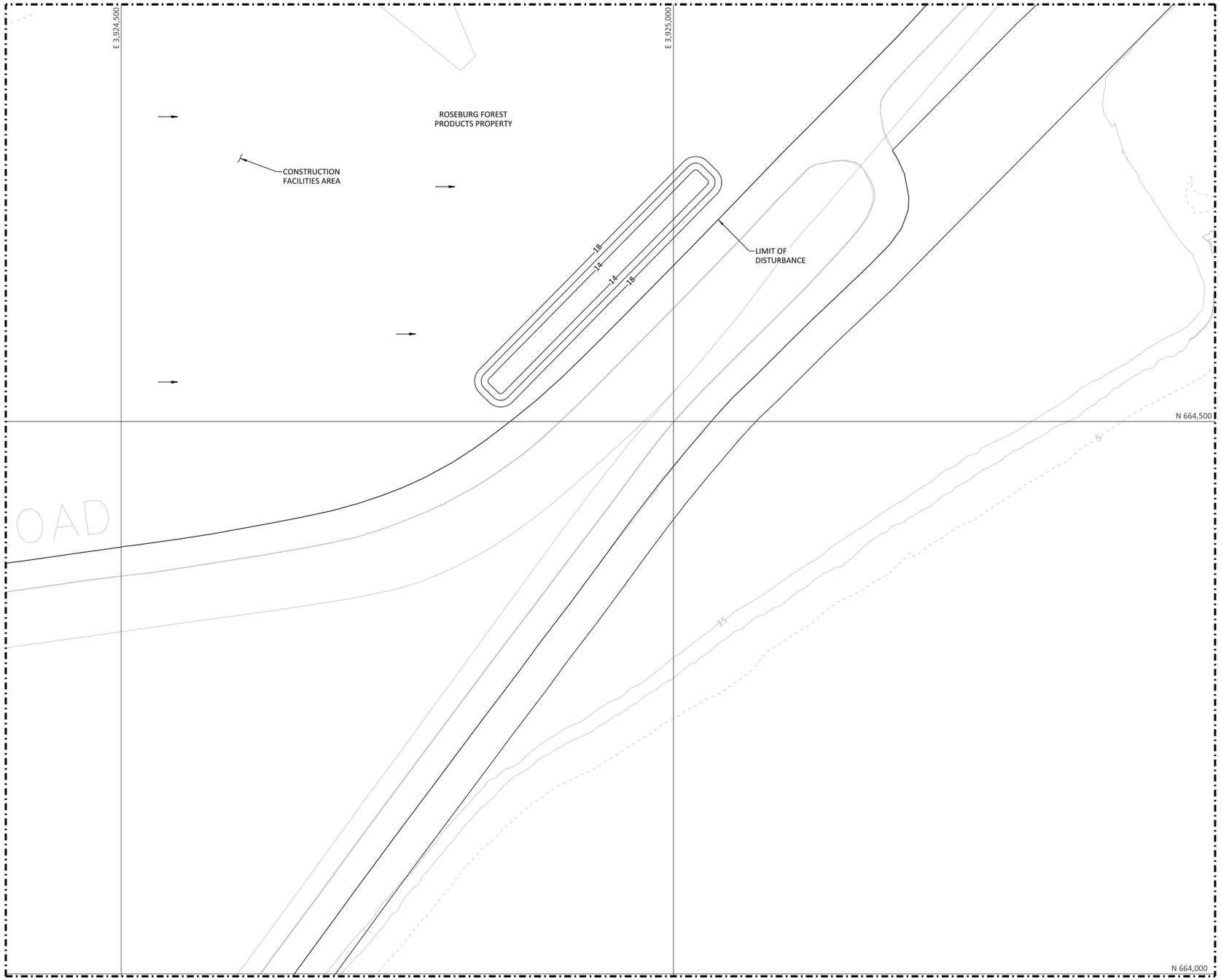
STORM WATER MANAGEMENT PLAN
PLAN - AREA 21

PROJECT / DRAWING NUMBER: 189980-0000-FS4021 — REV 0

JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54021-01 — REV 0

MicroStation v8.11.9.578
1 = 1
3/26/2019 12:24:01 PM
fin50857
ANSI D 34x22

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54016-01

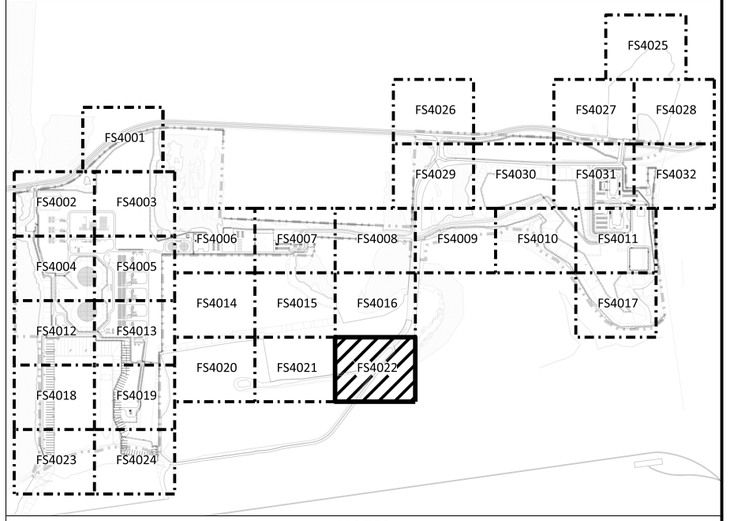



FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54021-01

## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER
- SC- SPILL CONTROL MANHOLE
- CF- CARTRIDGE FILTER
- CU- STORM WATER CURB INLET
- MH- STORM WATER MANHOLE
- OI- OILY WASTE INLET
- OMH- OILY WASTE MANHOLE
- I- STORM WATER INLET
- BUILDINGS
- CHEMICAL CONTAINMENT AREAS
- LNG / REFRIG CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

50' 25' 0 50' 100'
1"=50'

KBJ
JORDAN COVE LNG

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF

SIGNED _____

DATE _____ REG NO. _____

DESIGNER CAF | DRAWN NJO

CHECKED | DATE

JORDAN COVE LNG PROJECT

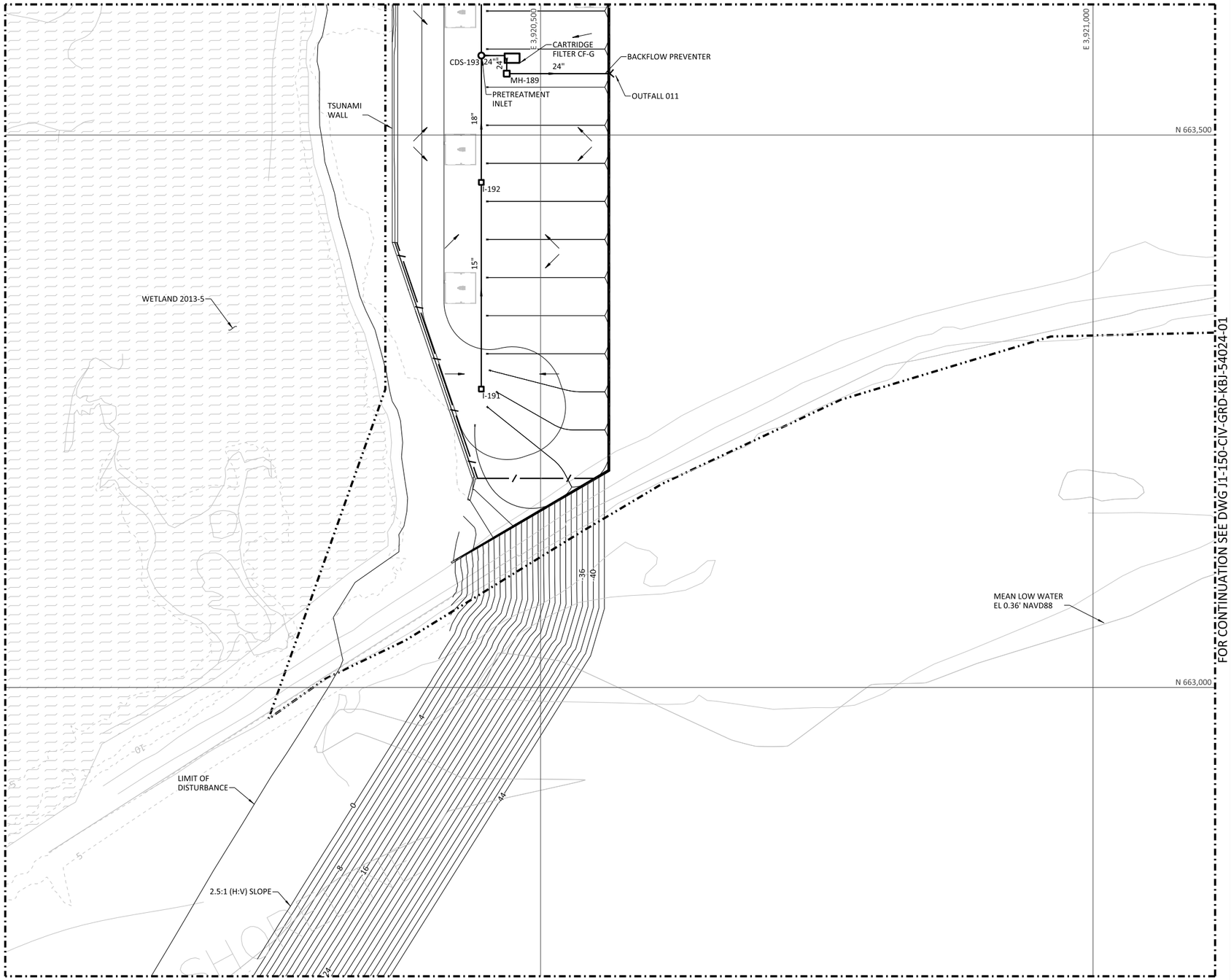
STORM WATER MANAGEMENT PLAN
PLAN - AREA 22

PROJECT / DRAWING NUMBER: 189980-0000-FS4022 — REV 0

JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54022-01 — REV 0

MicroStation v8.11.9.578
1 = 1
fn50857
ANSI D 34x22
3/26/2019 12:24:02 PM

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54018-01




FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54024-01

50' 25' 0 50' 100'

1"=50'

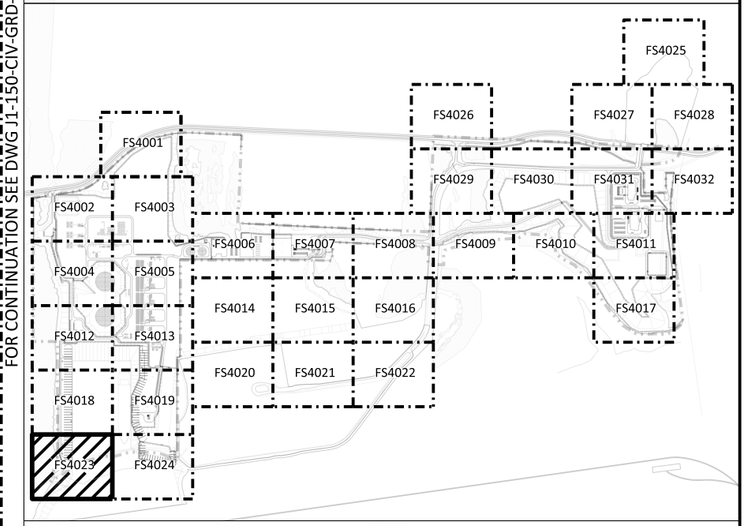
KBJ

JORDAN COVE LNG

## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER
- DRAWING DESIGNATION NUMBER
- SC- SPILL CONTROL MANHOLE
- CF- CARTRIDGE FILTER
- CU- STORM WATER CURB INLET
- MH- STORM WATER MANHOLE
- OI- OILY WASTE INLET
- OMH- OILY WASTE MANHOLE
- I- STORM WATER INLET
- BUILDINGS
- CHEMICAL CONTAINMENT AREAS
- LNG / REFRIG CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

Jordan Cove LNG℠ A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF

SIGNED

DATE REG NO.

DESIGNER CAF | DRAWN NJO

CHECKED | DATE

JORDAN COVE LNG PROJECT

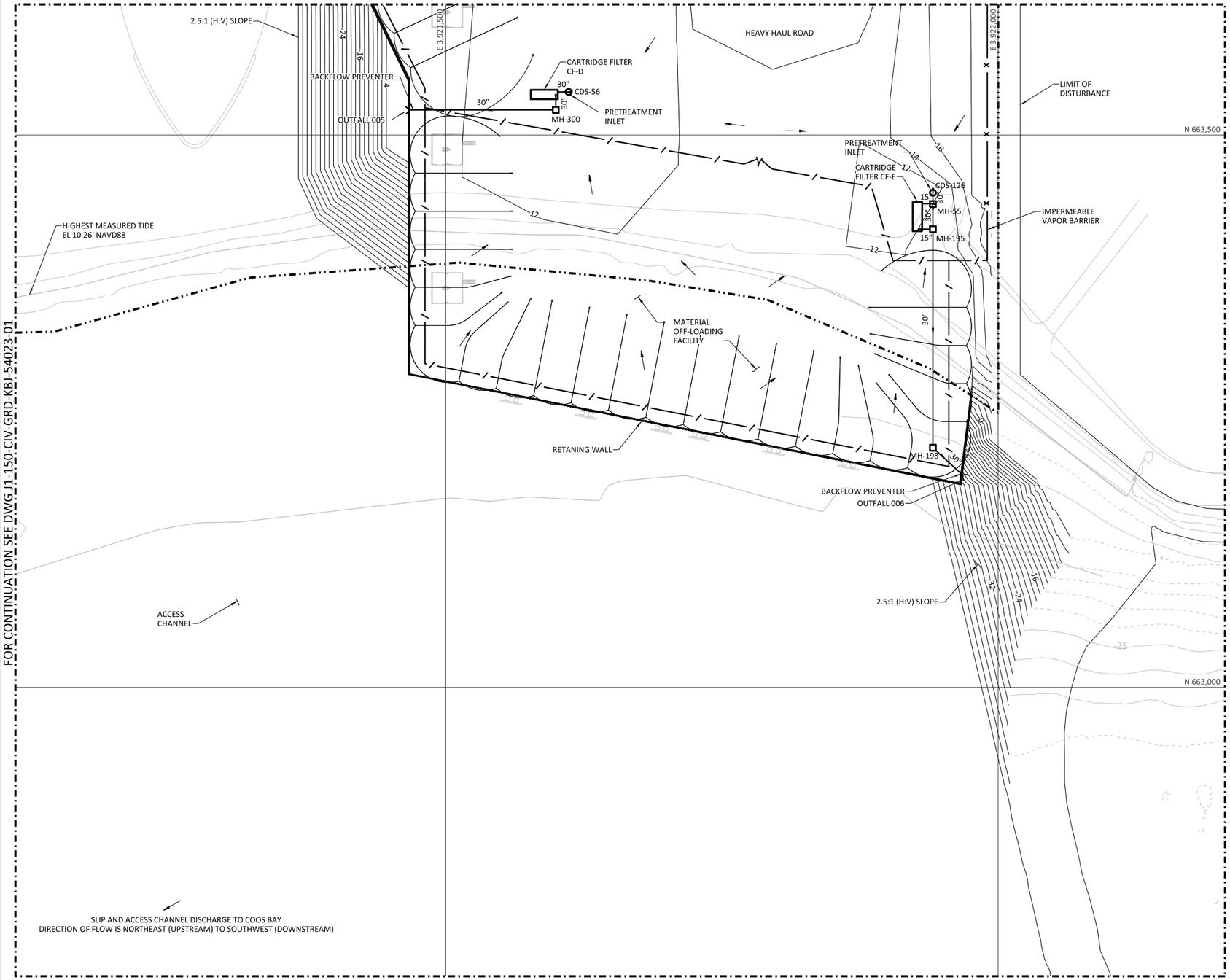
STORM WATER MANAGEMENT PLAN
PLAN - AREA 23

PROJECT / DRAWING NUMBER: 189980-0000-FS4023 — REV 0

JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54023-01 — REV 0

MicroStation v8.11.9.578
1 = 1
fin50857
ANSI D 34x22
3/26/2019 12:24:03 PM

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54019-01




FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54023-01

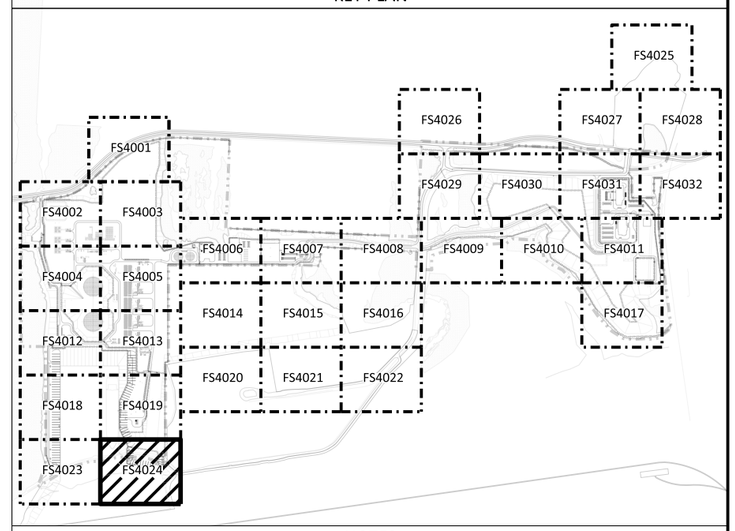
50' 25' 0 50' 100'
1"=50'

KBJ
JORDAN COVE LNG

## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER
- SPILL CONTROL MANHOLE
- CARTRIDGE FILTER
- STORM WATER CURB INLET
- STORM WATER MANHOLE
- OILY WASTE INLET
- OILY WASTE MANHOLE
- STORM WATER INLET
- BUILDINGS
- CHEMICAL CONTAINMENT AREAS
- LNG / REFRIG CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

Jordan Cove LNG℠
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF
SIGNED
DATE REG NO.

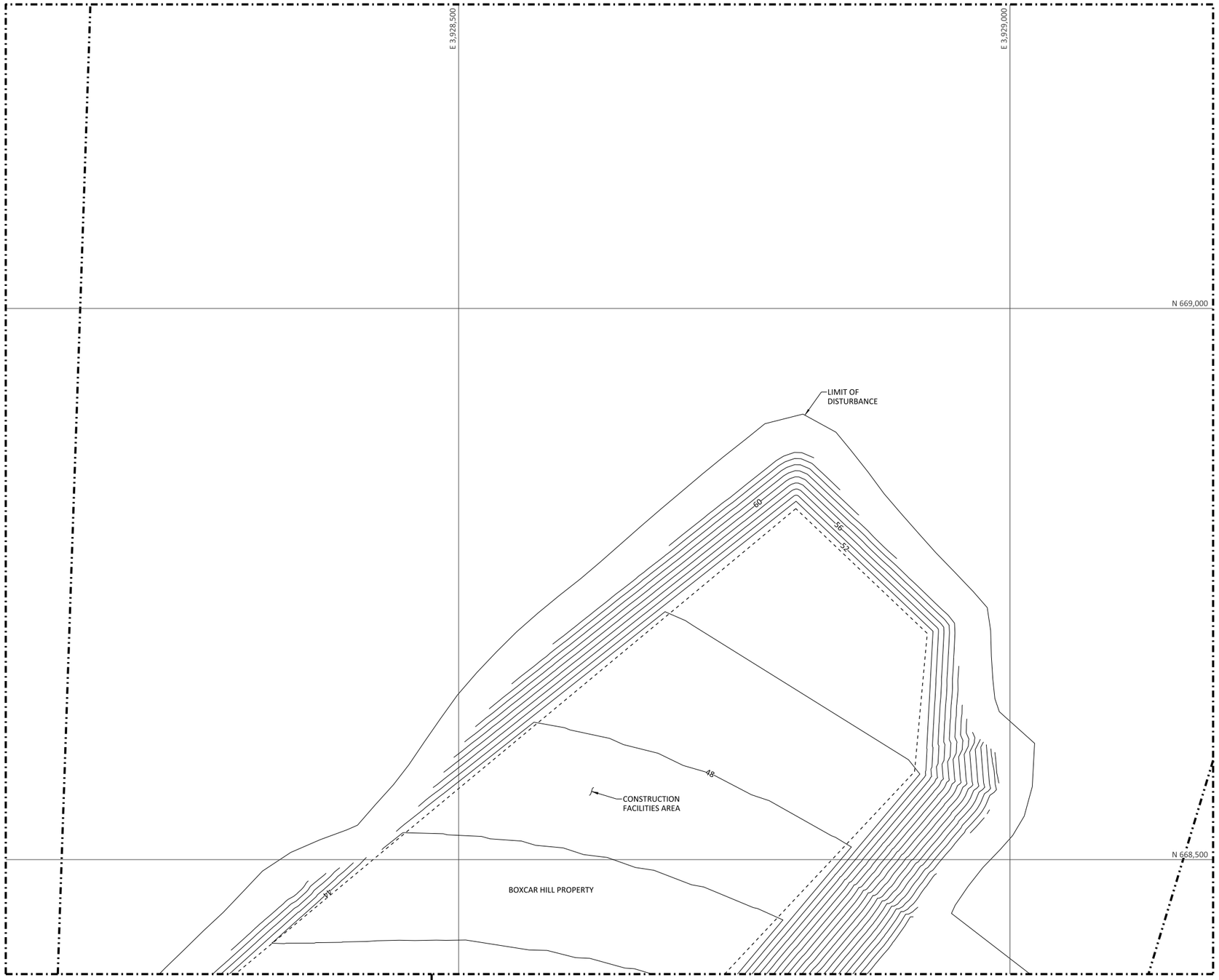
DESIGNER CAF | DRAWN NJO
CHECKED | DATE

JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
PLAN - AREA 24

PROJECT / DRAWING NUMBER: 189980-0000-FS4024 — REV 0
JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54024-01 — REV 0

MicroStation v8.11.9.578
1 = 1
3/26/2019 12:24:04 PM
fin50857
ANSI D 34x22




FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54027-01

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54028-01

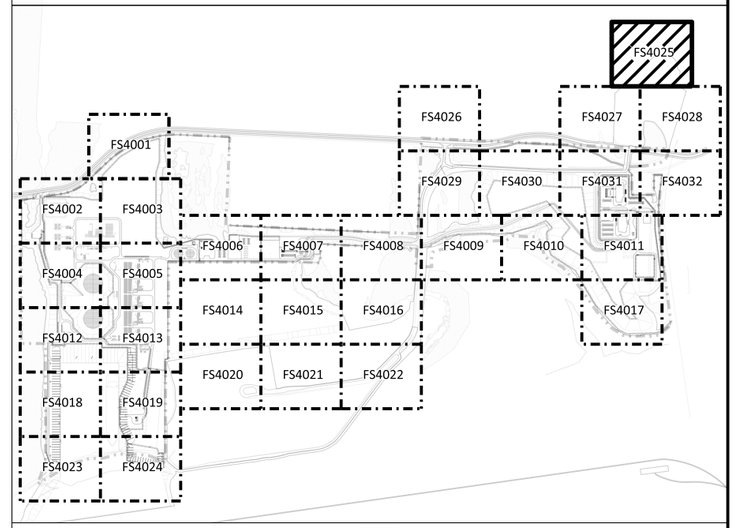
50' 25' 0 50' 100'
1"=50'

KBJ
JORDAN COVE LNG

## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER
- SC- SPILL CONTROL MANHOLE
- CF- CARTRIDGE FILTER
- CU- STORM WATER CURB INLET
- MH- STORM WATER MANHOLE
- OI- OILY WASTE INLET
- OMH- OILY WASTE MANHOLE
- I- STORM WATER INLET
- BUILDINGS
- CHEMICAL CONTAINMENT AREAS
- LNG / REFRIG CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF

SIGNED _____

DATE _____ REG NO. _____

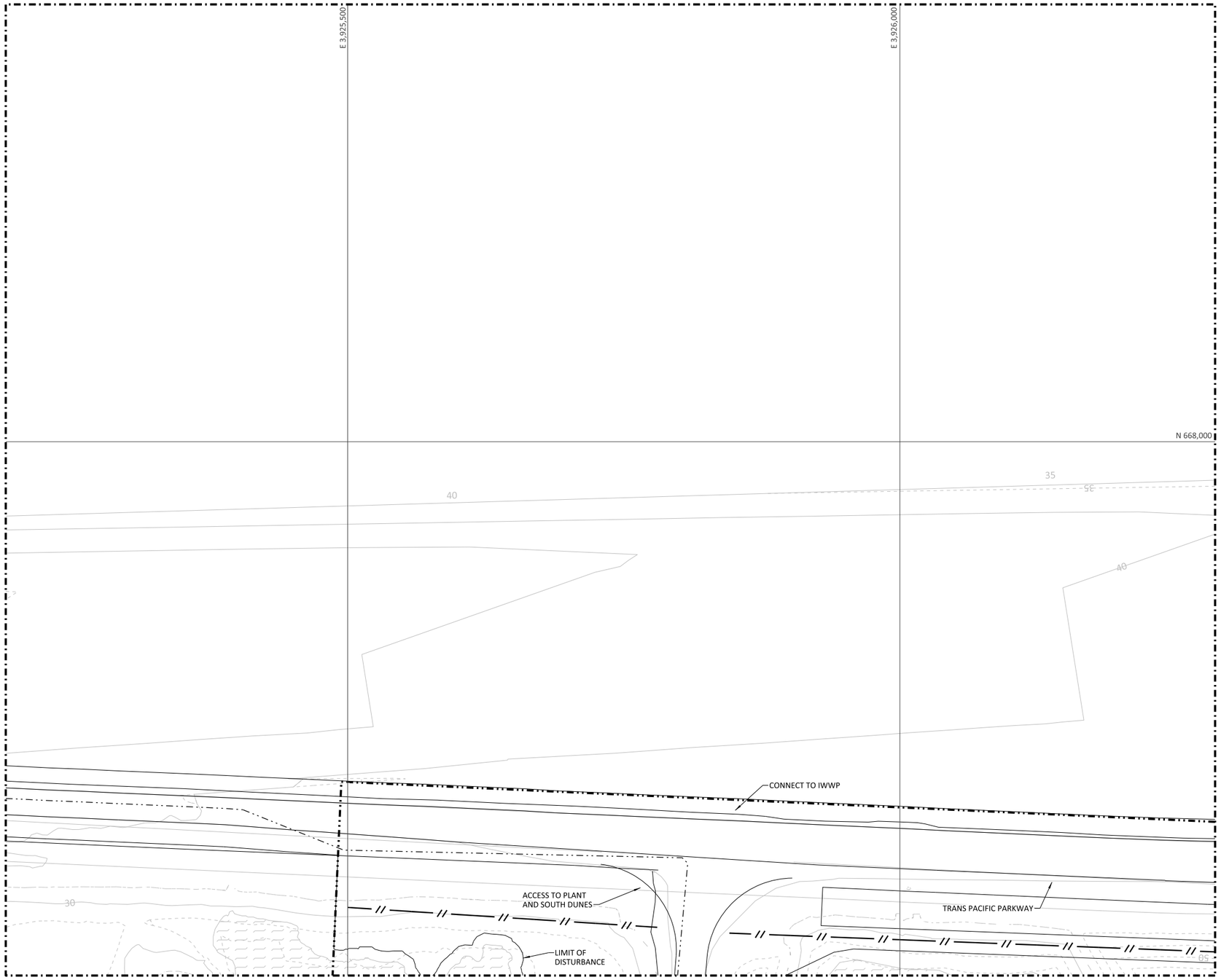
DESIGNER CAF | DRAWN NJO
CHECKED | DATE

JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
PLAN - AREA 25

| PROJECT / DRAWING NUMBER | REV |
|---|---|
| 189980-0000-FS4025 | 0 |
| JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54025-01 | 0 |

MicroStation v8.11.9.578
1 = 1
fin50857
ANSI D 34x22
3/26/2019 12:24:05 PM



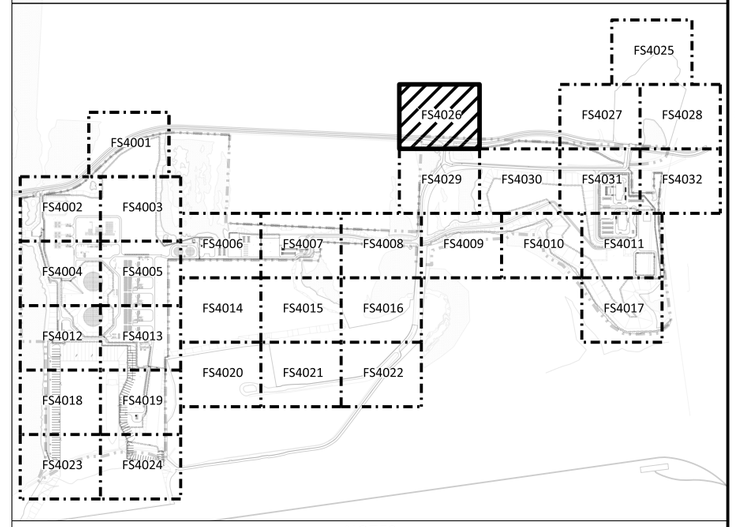

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54029-01

50' 25' 0 50' 100'
1"=50'

## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER
- DRAWING DESIGNATION NUMBER
- SC- SPILL CONTROL MANHOLE
- CF- CARTRIDGE FILTER
- CU- STORM WATER CURB INLET
- MH- STORM WATER MANHOLE
- OI- OILY WASTE INLET
- OMH- OILY WASTE MANHOLE
- I- STORM WATER INLET
- BUILDINGS
- CHEMICAL CONTAINMENT AREAS
- LNG / REFRIG CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

Jordan Cove LNG℠ A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

KBJ JORDAN COVE LNG

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF
SIGNED
DATE REG NO.

DESIGNER CAF | DRAWN NJO
CHECKED | DATE

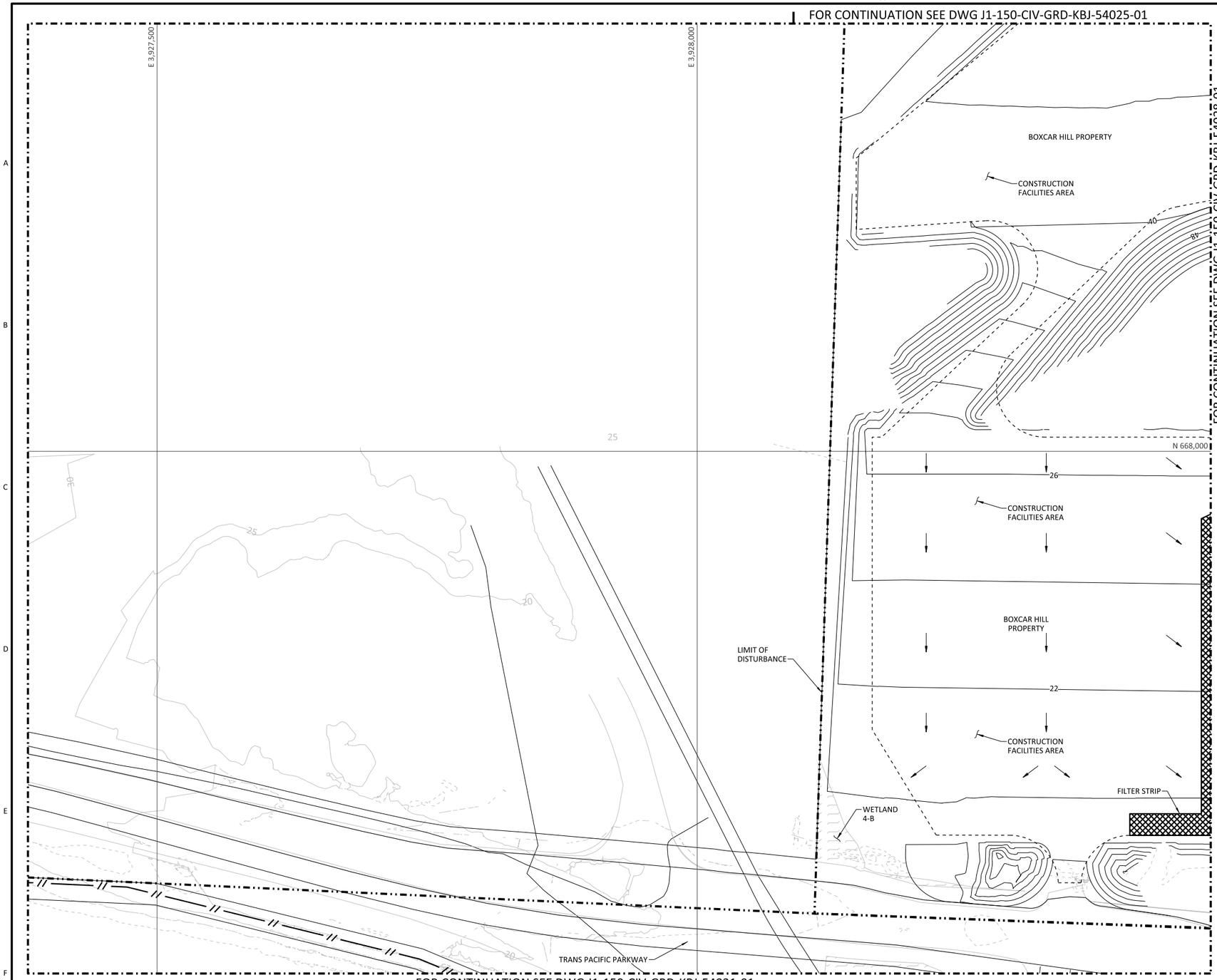
JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
PLAN - AREA 26

PROJECT / DRAWING NUMBER: 189980-0000-FS4026 — REV 0

JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54026-01 — REV 0

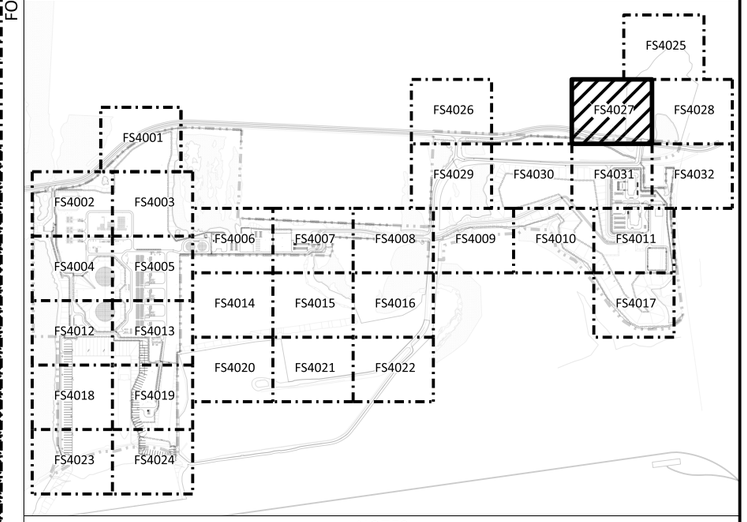
MicroStation v8.11.9.578
1 = 1
fin50857
ANSI D 34x22
3/26/2019 12:53:20 PM




## LEGEND

- PROPERTY BOundary
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER
- SPILL CONTROL MANHOLE
- CARTRIDGE FILTER
- STORM WATER CURB INLET
- STORM WATER MANHOLE
- OILY WASTE INLET
- OILY WASTE MANHOLE
- STORM WATER INLET
- BUILDINGS
- CHEMICAL CONTAINMENT AREAS
- LNG / REFRIG CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

50' 25' 0 50' 100'
1"=50'

KBJ
JORDAN COVE LNG

Jordan Cove LNG℠
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF
SIGNED
DATE REG NO.

DESIGNER CAF | DRAWN NJO
CHECKED | DATE

JORDAN COVE LNG PROJECT

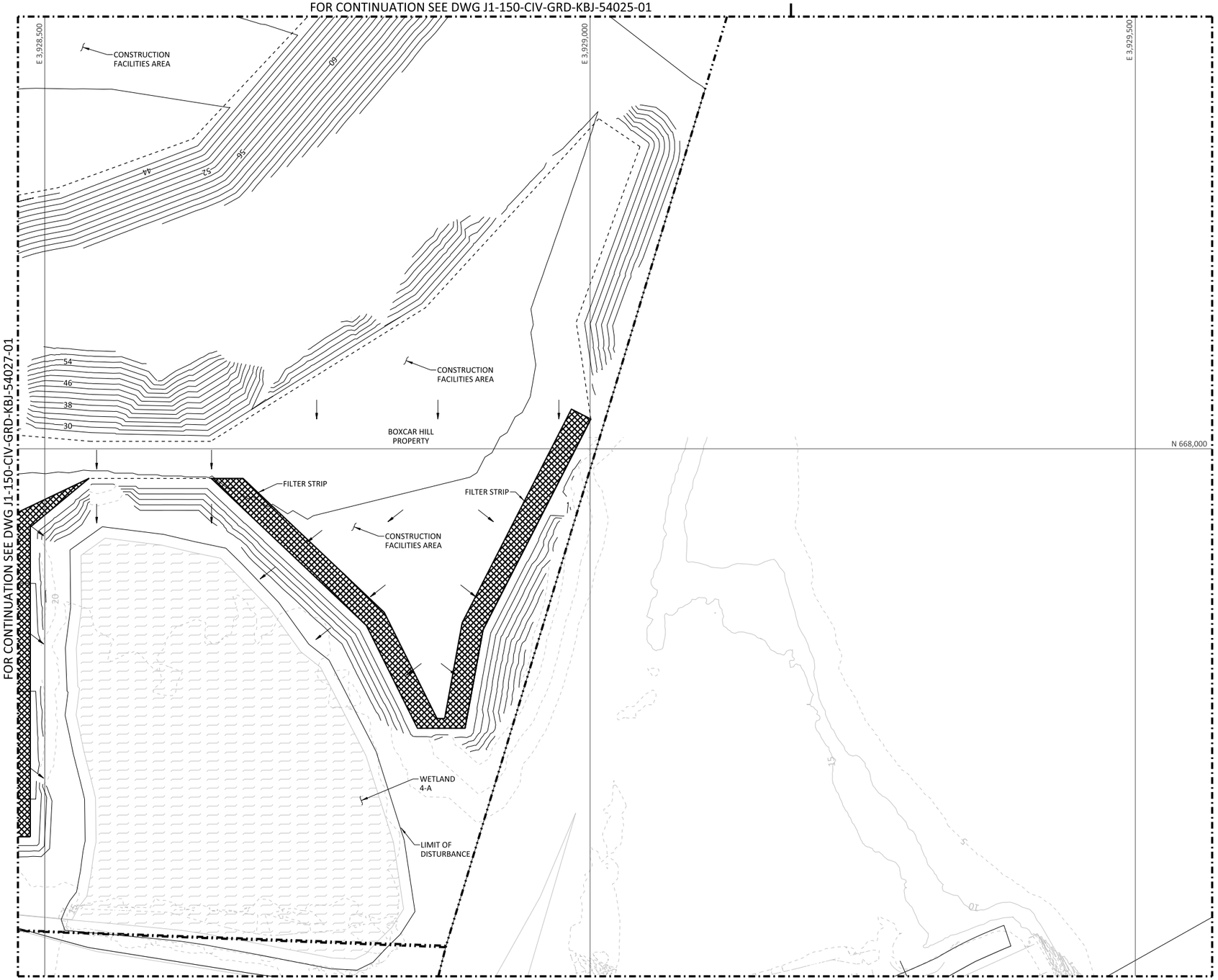
STORM WATER MANAGEMENT PLAN
PLAN - AREA 27

PROJECT / DRAWING NUMBER: 189980-0000-FS4027 — REV 0

JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54027-01 — REV 0

MicroStation v8.11.9.578
1 = 1
fin50857
ANSI D 34x22
3/26/2019 12:24:08 PM

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54025-01




FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54027-01

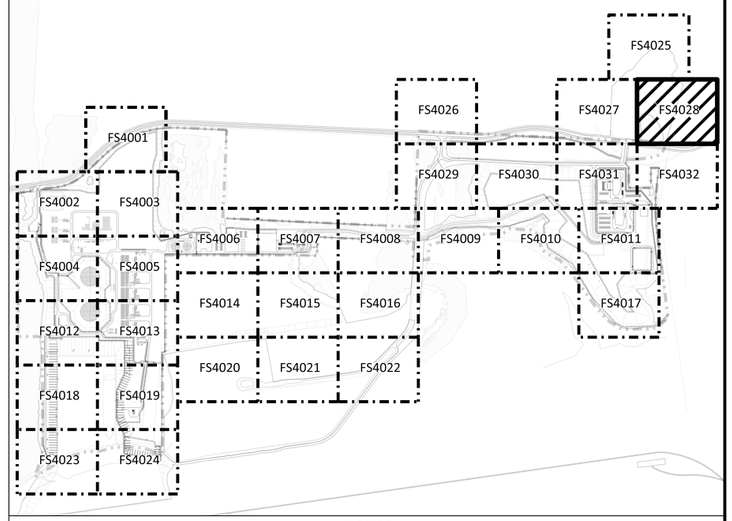
FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54032-01

50' 25' 0 50' 100'
1"=50'

## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR (46)
- EXISTING CONTOUR (46)
- SPOT ELEVATION (46.00 +)
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- 1 / S3000 — SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER
- SC- SPILL CONTROL MANHOLE
- CF- CARTRIDGE FILTER
- CU- STORM WATER CURB INLET
- MH- STORM WATER MANHOLE
- OI- OILY WASTE INLET
- OMH- OILY WASTE MANHOLE
- I- STORM WATER INLET
- BUILDINGS
- CHEMICAL CONTAINMENT AREAS
- LNG / REFRIG CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

KBJ
JORDAN COVE LNG

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF
SIGNED
DATE REG NO.

DESIGNER CAF | DRAWN NJO
CHECKED | DATE

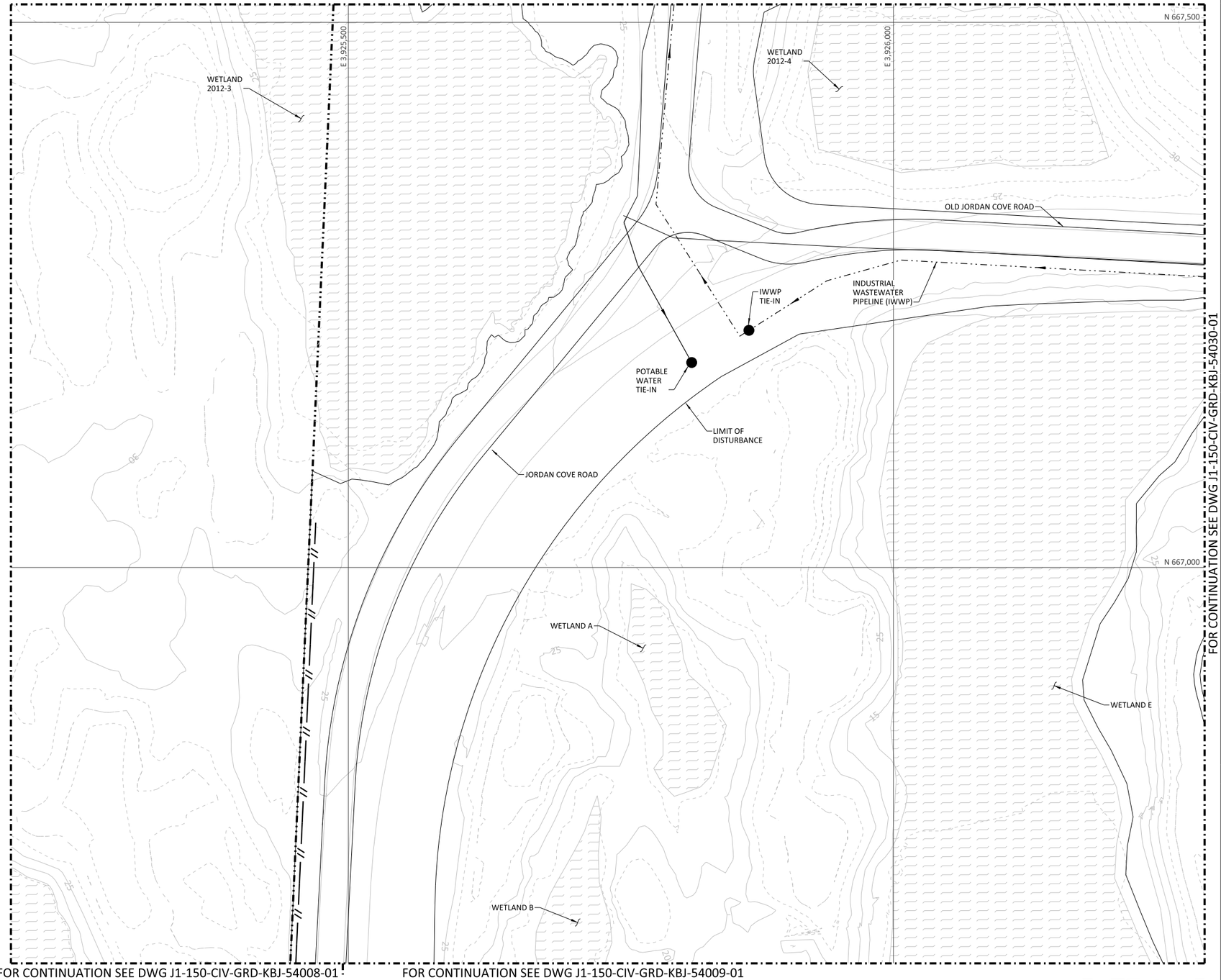
JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
PLAN - AREA 28

PROJECT / DRAWING NUMBER: 189980-0000-FS4028 — REV 0
JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54028-01 — REV 0

MicroStation v8.11.9.578
1 = 1
fin50857
ANSI D 34x22
3/26/2019 12:24:09 PM

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54029-01




FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54030-01

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54008-01

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54009-01

50' 25' 0 50' 100'

1"=50'

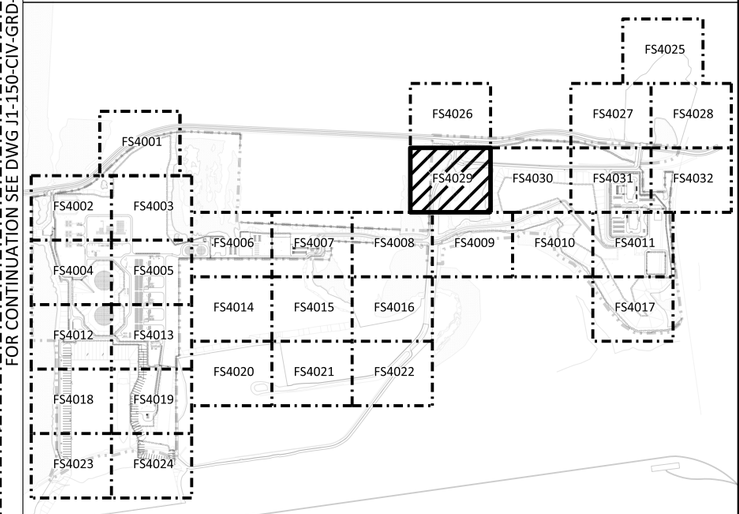
KBJ

JORDAN COVE LNG

## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER
- DRAWING DESIGNATION NUMBER
- SPILL CONTROL MANHOLE
- CARTRIDGE FILTER
- STORM WATER CURB INLET
- STORM WATER MANHOLE
- OILY WASTE INLET
- OILY WASTE MANHOLE
- STORM WATER INLET
- BUILDINGS
- CHEMICAL CONTAINMENT AREAS
- LNG / REFRIG CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

Jordan Cove LNG℠ A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF

SIGNED

DATE REG NO.

DESIGNER CAF | DRAWN NJO

CHECKED | DATE

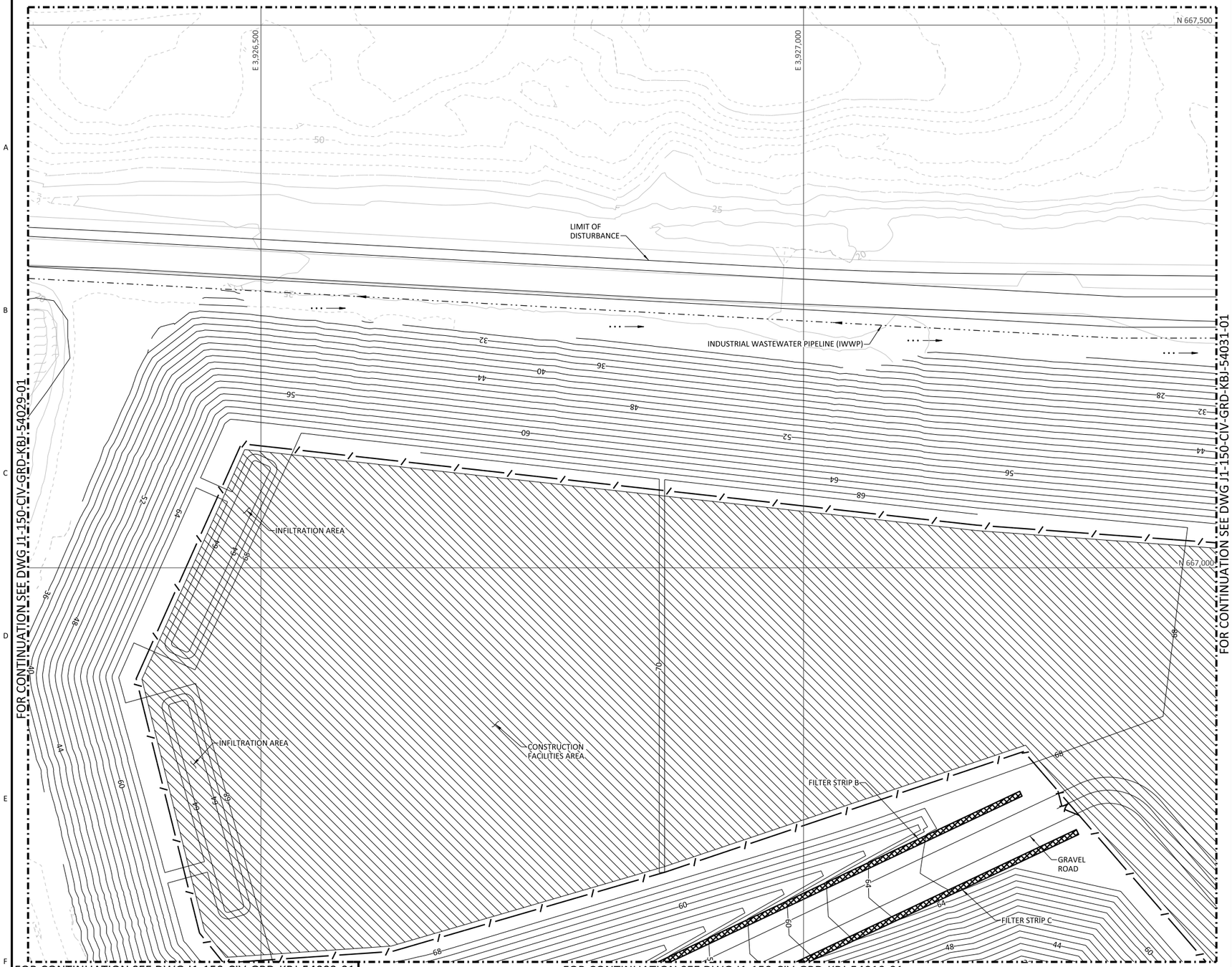
JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
PLAN - AREA 29

PROJECT DRAWING NUMBER: 189980-0000-FS4029 — REV 0

JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54029-01 — REV 0

MicroStation v8.11.9.578
1 = 1
3/26/2019 12:24:10 PM
fn50857
ANSI D 34x22



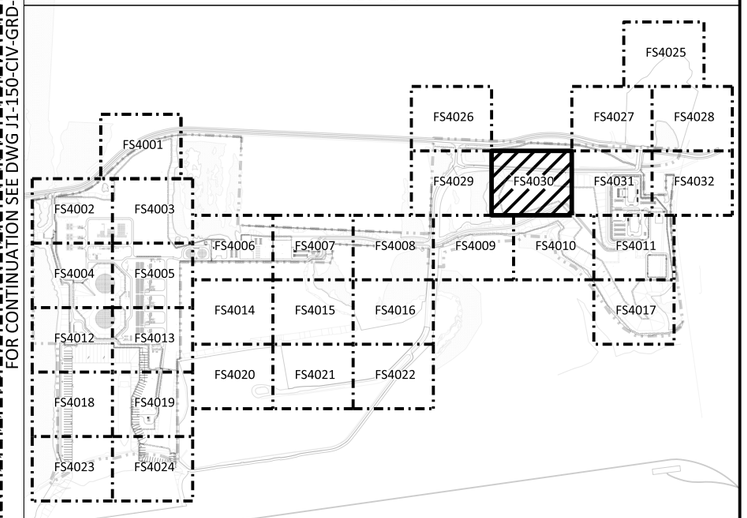

50' 25' 0 50' 100'

1"=50'

## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER
- SC- SPILL CONTROL MANHOLE
- CF- CARTRIDGE FILTER
- CU- STORM WATER CURB INLET
- MH- STORM WATER MANHOLE
- OI- OILY WASTE INLET
- OMH- OILY WASTE MANHOLE
- I- STORM WATER INLET
- BUILDINGS
- CHEMICAL CONTAINMENT AREAS
- LNG / REFRIG CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

KBJ
JORDAN COVE LNG

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF

SIGNED

DATE REG NO.

DESIGNER CAF | DRAWN NJO

CHECKED | DATE

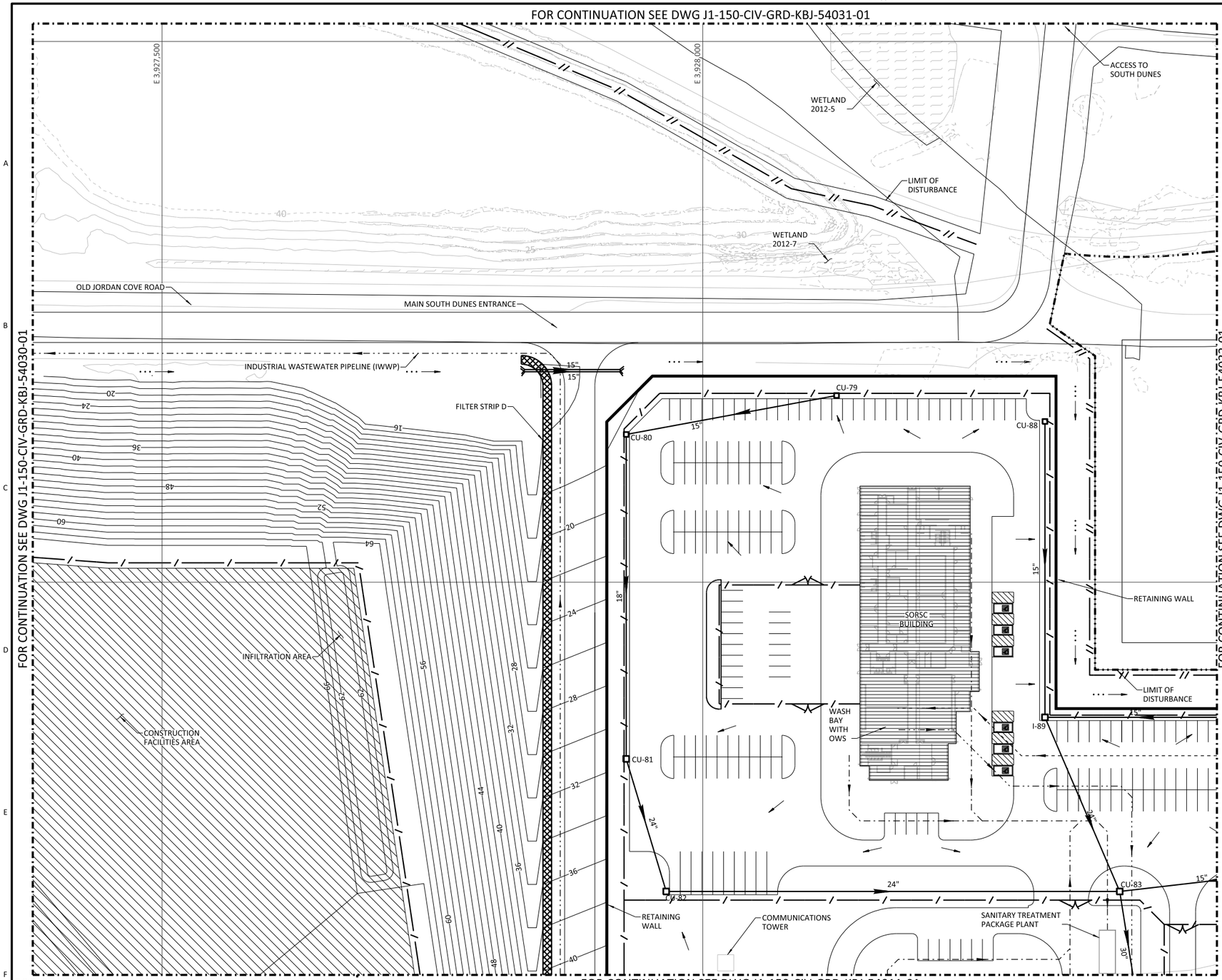
JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
PLAN - AREA 30

PROJECT / DRAWING NUMBER: 189980-0000-FS4030 — REV 0

JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54030-01 — REV 0

MicroStation v8.11.9.578
1 = 1
fin50857
ANSI D 34x22
3/26/2019 12:24:11 PM



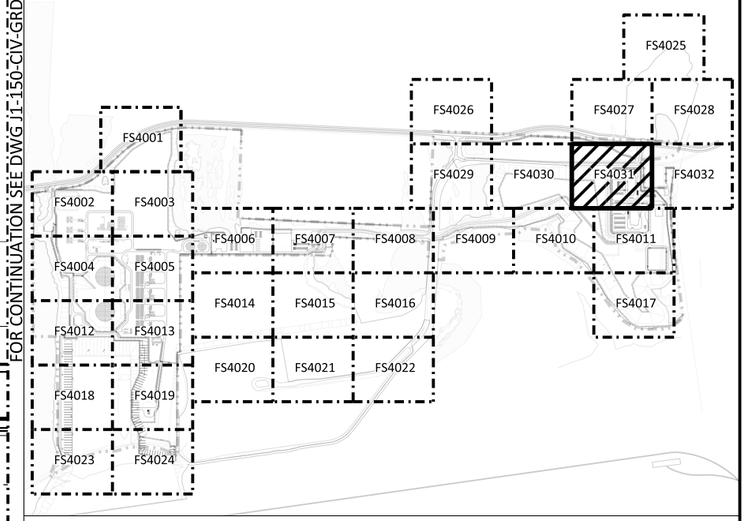

50' 25' 0 50' 100'
1"=50'

KBJ
JORDAN COVE LNG

## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER
- SC- SPILL CONTROL MANHOLE
- CF- CARTRIDGE FILTER
- CU- STORM WATER CURB INLET
- MH- STORM WATER MANHOLE
- OI- OILY WASTE INLET
- OMH- OILY WASTE MANHOLE
- I- STORM WATER INLET
- BUILDINGS
- CHEMICAL CONTAINMENT AREAS
- LNG / REFRIG CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF

SIGNED

DATE REG NO.

DESIGNER CAF | DRAWN NJO
CHECKED | DATE

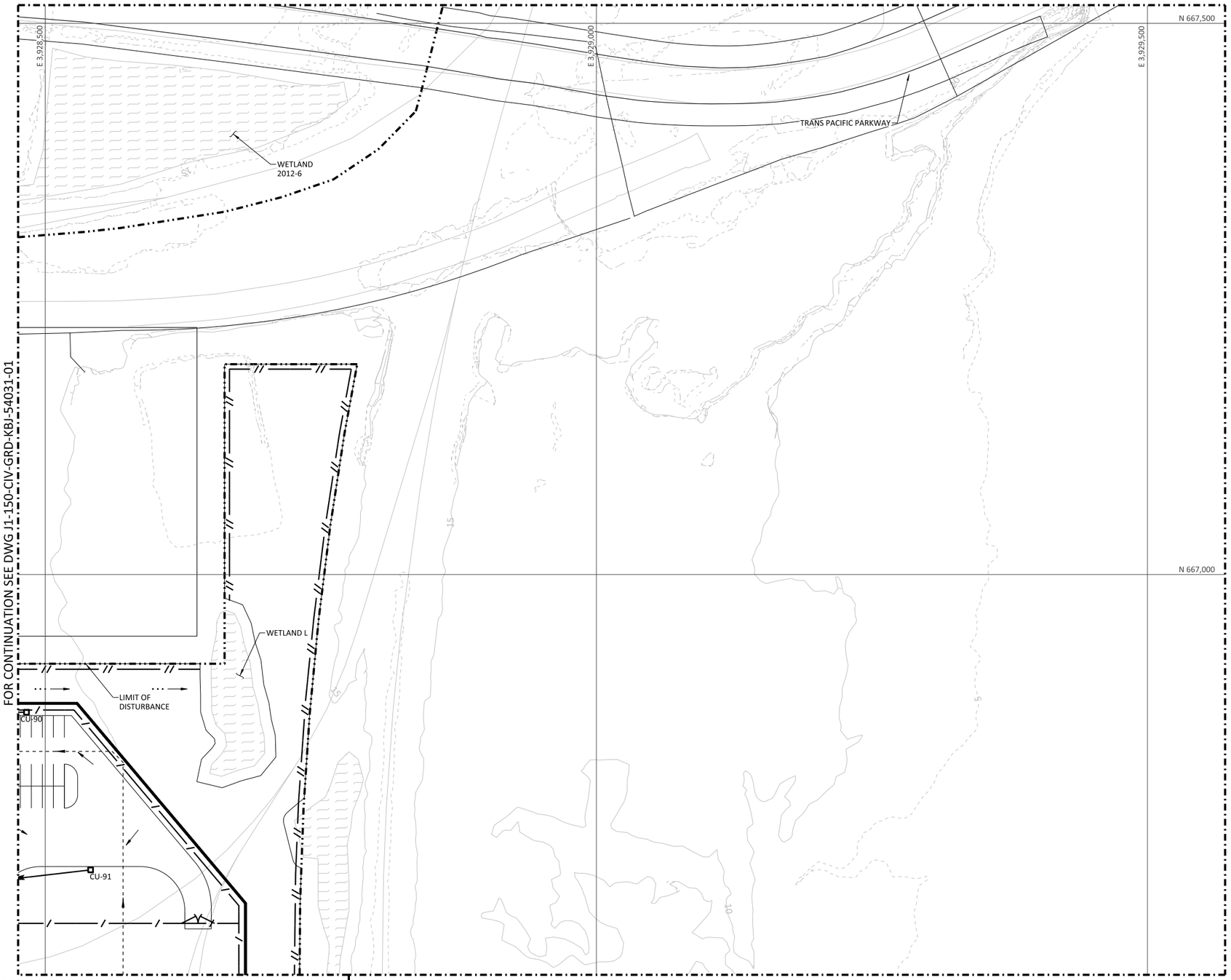
JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
PLAN - AREA 31

| PROJECT / DRAWING NUMBER | REV |
|---|---|
| 189980-0000-FS4031 | 0 |
| JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54031-01 | 0 |

MicroStation v8.11.9.578
1 = 1
fin50857
ANSI D 34x22
3/26/2019 12:24:12 PM

FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54028-01




FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54031-01

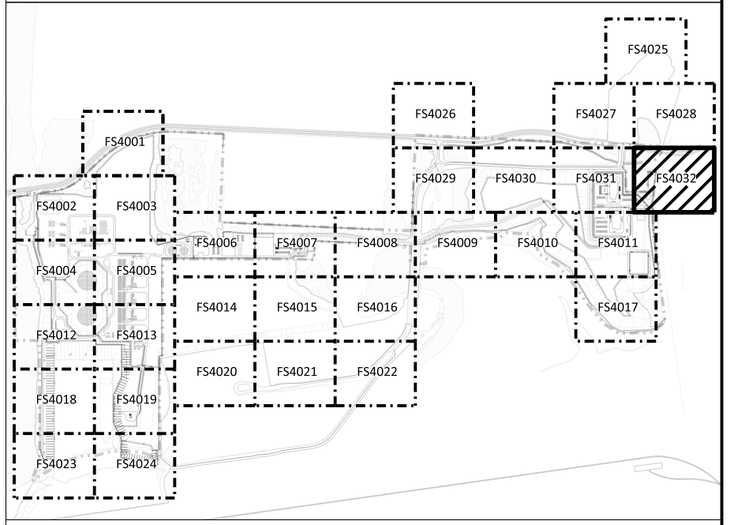
FOR CONTINUATION SEE DWG J1-150-CIV-GRD-KBJ-54011-01

50' 25' 0 50' 100'
1"=50'

## LEGEND

- PROPERTY BOUNDARY
- LIMIT OF RIGHT-OF-WAY
- SURVEY CONTROL MONUMENT
- NEW CONTOUR
- EXISTING CONTOUR
- SPOT ELEVATION
- SURFACE FLOW DIRECTION
- SWALE FLOW DIRECTION
- BOUNDARY FENCE
- CHAIN LINK SECURITY FENCE
- PERMEABLE VAPOR BARRIER FENCE
- VAPOR BARRIER WALL - WITH SECURITY
- OILY WASTE SYSTEM
- OILY WASTE FLOOR DRAIN
- OILY WASTE DRAIN CUP (BELL-UP)
- CULVERT
- STORM WATER SYSTEM
- PROCESS WASTEWATER
- SANITARY SEWER
- SECTION OR DETAIL NUMBER
- DRAWING DESIGNATION NUMBER
- SPILL CONTROL MANHOLE
- CARTRIDGE FILTER
- STORM WATER CURB INLET
- STORM WATER MANHOLE
- OILY WASTE INLET
- OILY WASTE MANHOLE
- STORM WATER INLET
- BUILDINGS
- CHEMICAL CONTAINMENT AREAS
- LNG / REFRIG CONTAINMENT AREAS
- OILY CONTAINMENT AREAS
- SELF-CONTAINED STORMWATER AREAS
- WETLANDS
- CONNECTION TO IWWP

## KEY PLAN




## NOTES

1. SEE DRAWING 0000-FS4000 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

KBJ
JORDAN COVE LNG

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF

SIGNED _____

DATE _____ REG NO. _____

DESIGNER CAF | DRAWN NJO | CHECKED | DATE

JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
PLAN - AREA 32

PROJECT / DRAWING NUMBER: 189980-0000-FS4032 — REV 0

JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54032-01 — REV 0

MicroStation v8.11.9.578
1 = 1
fn50857
ANSI D 34x22
3/26/2019 12:54:08 PM

N

100' 50' 0 100' 200'
1"=100'

JORDAN COVE LNG

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF OREGON

SIGNED _____

DATE _____ REG NO. _____

DESIGNER CAF | DRAWN NJO | CHECKED | DATE

JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
APCO 1 (EAST)

PROJECT / DRAWING NUMBER: 189980-0000-FS4051 — REV 0

JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54051-01 — REV 0

MicroStation v8.11.9.578
1 = 1
fin50857
ANSI D 24x22
3/26/2019 12:24:14 PM

KBJ
JORDAN COVE LNG

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF OREGON

SIGNED _____

DATE _____ REG NO. _____

DESIGNER CAF | DRAWN NJO

CHECKED | DATE

JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
PORT LAYDOWN SITE

PROJECT / DRAWING NUMBER: 189980-0000-FS4052 — REV 0

JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54052-01 — REV 0

MicroStation v8.11.9.578
1 = 1
3/26/2019 12:24:15 PM
fin50857
ANSI D 24x22

100' 50' 0 100' 200'
1"=100'

KBJ
JORDAN COVE LNG

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

MicroStation v8.11.9.578
1 = 1
3/27/2019 11:31:30 AM
fin50857
ANSI D 34x22

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF OREGON

SIGNED _____

DATE _____ REG NO. _____

DESIGNER CAF | DRAWN NJO
CHECKED | DATE

JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
MYRTLEWOOD OFFSITE PARK & PRIDE

PROJECT / DRAWING NUMBER: 189980-0000-FS4053 — REV 0

JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54053-01 — REV 0

N

100' 50' 0 100' 200'
1"=100'

KBJ
JORDAN COVE LNG

Jordan Cove LNG℠
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

MicroStation v8.11.9.578
1 = 1
3/26/2019 12:24:16 PM
fin50857
ANSI D 34x22

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF OREGON

SIGNED _____

DATE _____ REG NO. _____

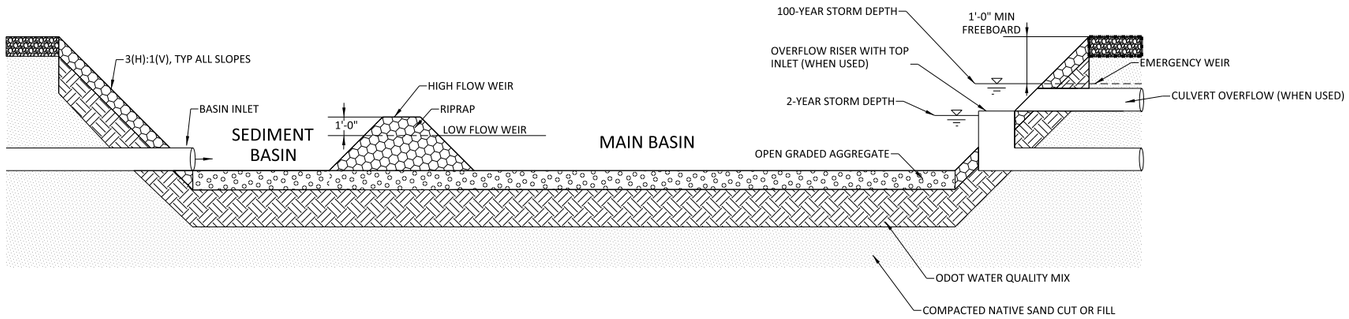
DESIGNER CAF | DRAWN NJO
CHECKED | DATE

JORDAN COVE LNG PROJECT

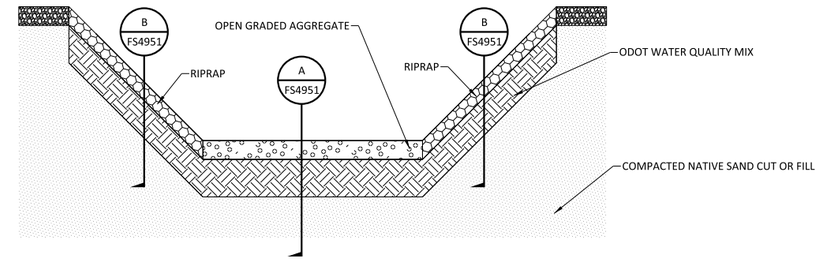
STORM WATER MANAGEMENT PLAN
METEOROLOGICAL TOWER SITE

PROJECT / DRAWING NUMBER: 189980-0000-FS4054 — REV 0

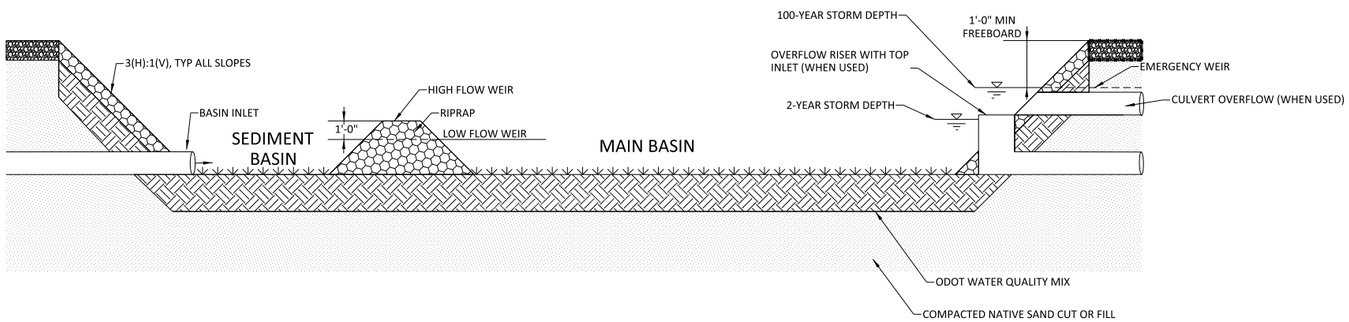
JCLNG NUMBER: J1-150-CIV-GRD-KBJ-54054-01 — REV 0



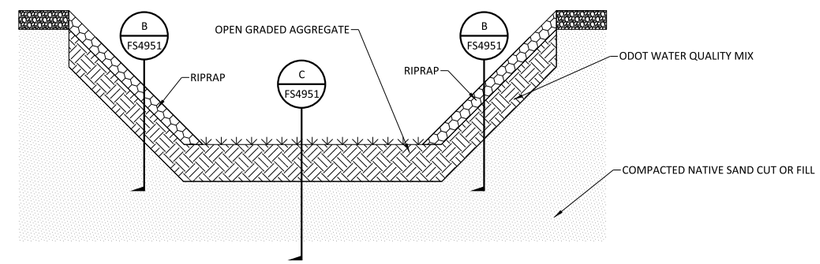

SECTION A
OPEN GRADED AGGREGATE INFILTRATION BASIN LONGITUDINAL SECTION
NO SCALE



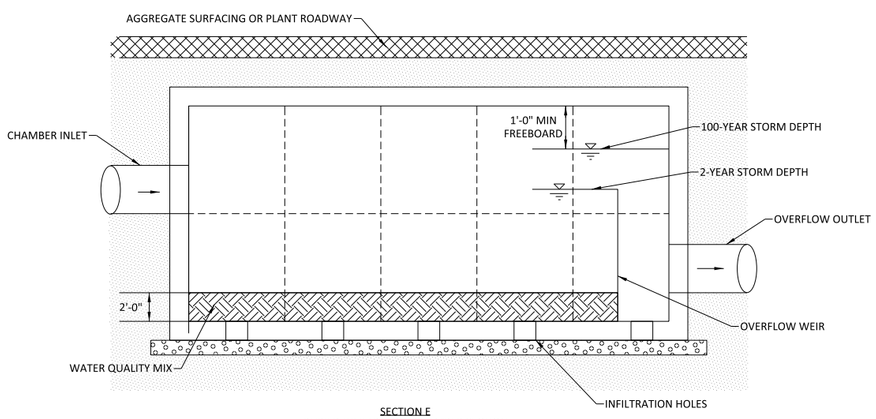

SECTION B
OPEN GRADED AGGREGATE INFILTRATION BASIN TRANSVERSE SECTION
NO SCALE




SECTION C
VEGETATED INFILTRATION BASIN LONGITUDINAL SECTION
NO SCALE




SECTION D
VEGETATED INFILTRATION BASIN TRANSVERSE SECTION
NO SCALE




SECTION E
BURIED INFILTRATION CHAMBER SECTION
NO SCALE

NOTES

JORDAN COVE LNG

Jordan Cove LNG℠
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF OREGON

SIGNED _____

DATE _____ REG NO. _____

DESIGNER CAF | DRAWN NJO

CHECKED | DATE

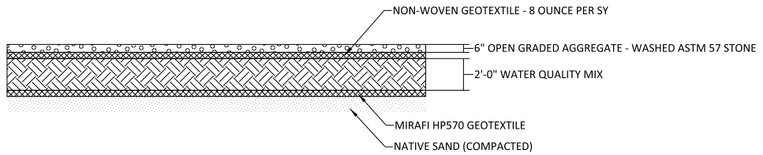
JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
STORM WATER INFILTRATION CONTROLS SECTIONS

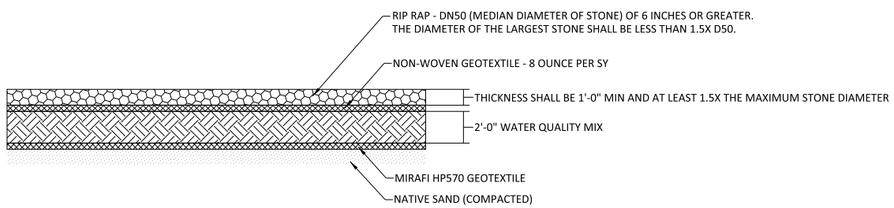
PROJECT / DRAWING NUMBER: 189980-0000-FS4950 — REV 0

JCLNG NUMBER: J1-150-CIV-SCT-KBJ-54950-01 — REV 0

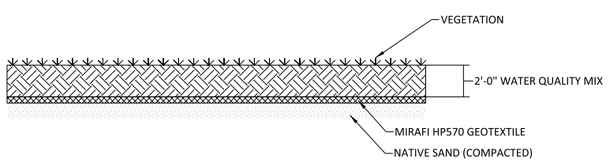
MicroStation v8.11.9.608
1 = 1
1/11/2019 12:09:02 PM
fin50857
ANSI D 34x22




SECTION A
NO SCALE
SEE DRAWING J1-150-CIV-SCT-KBJ-54950-01




SECTION B
NO SCALE
SEE DRAWING J1-150-CIV-SCT-KBJ-54950-01




SECTION C
NO SCALE
SEE DRAWING J1-150-CIV-SCT-KBJ-54950-01

NOTES

KBJ
JORDAN COVE LNG

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 0 | 26-MAR-19 | ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF OREGON

SIGNED _____

DATE _____ REG NO. _____

DESIGNER CAF | DRAWN NJO
CHECKED | DATE

JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
STORM WATER INFILTRATION CONTROLS
SECTIONS

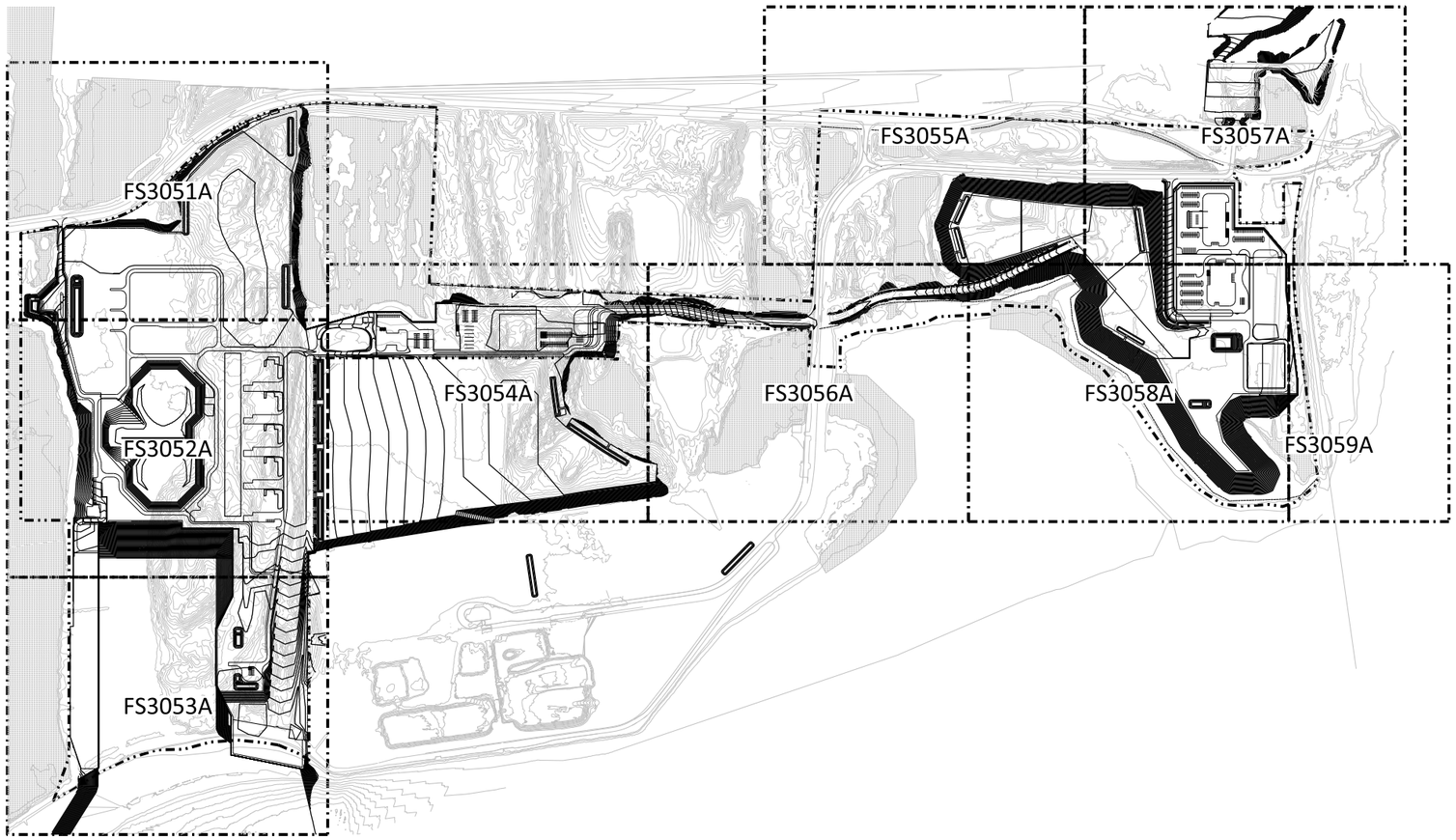
PROJECT / DRAWING NUMBER: 189980-0000-FS4951 — REV 0

JCLNG NUMBER: J1-150-CIV-SCT-KBJ-54951-01 — REV 0

MicroStation v8.11.9.578
1 = 1
fin50857
ANSI D 24x22
2/28/2019 1:04:23 AM

REVISION NOTES:

1 SEE REVISED SHEETS




## GENERAL NOTES

1. GENERAL NOTES APPLICABLE TO ALL FS3050A SERIES DRAWINGS.
2. COORDINATES ARE BASED ON THE OREGON STATE PLANE SYSTEM, SOUTH ZONE 3602, NAD 83 INTERNATIONAL FEET. ALL COORDINATES, BEARINGS, AND DISTANCES SHOWN ARE GRID.
3. ELEVATIONS ARE BASED ON THE NAVD 88 DATUM.
4. FINISHED GRADE SHALL SLOPE UNIFORMLY BETWEEN FINISH SPOT ELEVATIONS AND CONTOURS SHOWN ON THE PLANS.
5. A SMOOTH VERTICAL TRANSITION SHALL BE PROVIDED AT ROAD INTERSECTIONS.
6. SLOPE GRADE TO DRAIN IN DIRECTION OF FLOW ARROWS.
7. THE FINISHED GRADE SHALL BE SET 6 INCHES BELOW TOP OF CONCRETE UNLESS NOTED OTHERWISE. FINISHED GRADE SHALL SLOPE AWAY FROM THE STRUCTURE AT A MINIMUM SLOPE OF 1%.

## LEGEND APPLICABLE TO ALL S3050A DRAWINGS

| | |
|---|---|
| | PROPERTY LINE |
| R/W | LIMIT OF RIGHT-OF-WAY |
| 46 | EXISTING CONTOUR |
| 46 | NEW CONTOUR |
| | WETLANDS |
| 1 / S3050A | SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER |

## ABBREVIATIONS APPLICABLE TO ALL FS3050A DRAWINGS

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A | - | ARC LENGTH | EGP | - | EDGE OF PAVEMENT | LS | - | LIFT STATION | RD | - | ROOF DRAIN |
| AGG | - | AGGREGATE | EGS | - | EDGE OF SHOULDER | LTR | - | LATER | RED | - | REDUCER |
| APPROX | - | APPROXIMATE | EHH | - | ELECTRICAL HANDHOLE | MATL | - | MATERIAL | REQD | - | REQUIRED |
| ASPH | - | ASPHALT | EL | - | ELEVATION | MH | - | MANHOLE | REV | - | REVISION |
| AVG | - | AVERAGE | EOP | - | END OF PIPE | MSL | - | MEAN SEA LEVEL | R/W | - | RIGHT-OF-WAY |
| BLDG | - | BUILDING | EJ | - | EXPANSION JOINT | MW | - | MONITORING WELL | S | - | SOUTH |
| B/MH | - | BOTTOM OF MANHOLE ELEVATION | EW | - | EACH WAY | N | - | NORTH | SE | - | SUPERELEVATION |
| BOD | - | BOTTOM OF ELECTRICAL DUCT BANK | EXP | - | EXPANSION | NG | - | NATURAL GRADE | SIM | - | SIMILAR |
| BOP | - | BOTTOM OF PIPE | FD | - | FLOOR DRAIN | NO. | - | NUMBER | STA | - | STATION |
| BU | - | BELL-UP | FDN | - | FOUNDATION | NTS | - | NOT TO SCALE | T | - | TANGENT LENGTH |
| CHDPE | - | CORRUGATED HIGH DENSITY POLYETHYLENE PIPE | FF | - | FINISHED FLOOR | OD | - | OUTSIDE DIAMETER | TMH | - | TOP OF MANHOLE |
| CJ | - | CONTRACTION JOINT | FG | - | FINISHED GRADE | OWS | - | OIL/WATER SEPARATOR | TOC | - | TOP OF CONCRETE |
| CL | - | CENTERLINE | FRP | - | FIBER REINFORCED PIPE | PC | - | POINT OF CURVATURE | TOG | - | TOP OF GRATING |
| CMP | - | CORRUGATED METAL PIPE | FT | - | FOOT | PE | - | PLAIN END | TOP | - | TOP OF PAVEMENT |
| CO | - | CLEAN OUT | HC | - | HANDICAPPED | PI | - | POINT OF INTERSECTION | TYP | - | TYPICAL |
| D | - | DEGREE OF CURVE | HDPE | - | HIGH DENSITY POLYETHYLENE | PL | - | PROPERTY LINE | UNO | - | UNLESS NOTED OTHERWISE |
| Δ | - | DELTA ANGLE OF HORIZONTAL CURVE | HVCM | - | HORIZ & VERT CONTROL MONUMENT | PLCS | - | PLACES | DS | - | DESIGN SPEED |
| DI | - | DUCTILE IRON | HP | - | HIGH POINT | PRC | - | POINT OF REVERSE CURVE | VERT | - | VERTICAL |
| DIA | - | DIAMETER | I | - | INLET | PT | - | POINT OF TANGENT | W | - | WEST |
| DIM | - | DIMENSION | ID | - | INSIDE DIAMETER | PVC | - | POINT OF VERTICAL CURVE | W/ | - | WITH |
| DWG | - | DRAWING | IN | - | INCH | PVI | - | POINT OF VERTICAL INTERSECTION | W/O | - | WITHOUT |
| E | - | EAST | INV | - | INVERT | PVT | - | POINT OF VERTICAL TANGENT | WP | - | WORK POINT |
| EA | - | EACH | L | - | LENGTH | R | - | RADIUS | | | |
| EF | - | EACH FACE | LC | - | LENGTH OF VERTICAL CURVE | RCP | - | REINFORCED CONCRETE PIPE | | | |

N

500' 250' 0 500' 1000'
1"=500'

KBJ
JORDAN COVE LNG

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP | NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 26-MAR-19 | REVISED ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR | 2 | 26-MAR-19 | REVISED ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |
| 1 | 25-JUL-17 | ISSUED FOR FERC FILING | RJW | CAF | | DJN | SPH | 1 | 25-JUL-17 | ISSUED FOR FERC FILING | RJW | CAF | | DJN | SPH |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF OREGON

SIGNED _____

DATE _____ REG NO. _____

DESIGNER CAF | DRAWN RJW
CHECKED | DATE

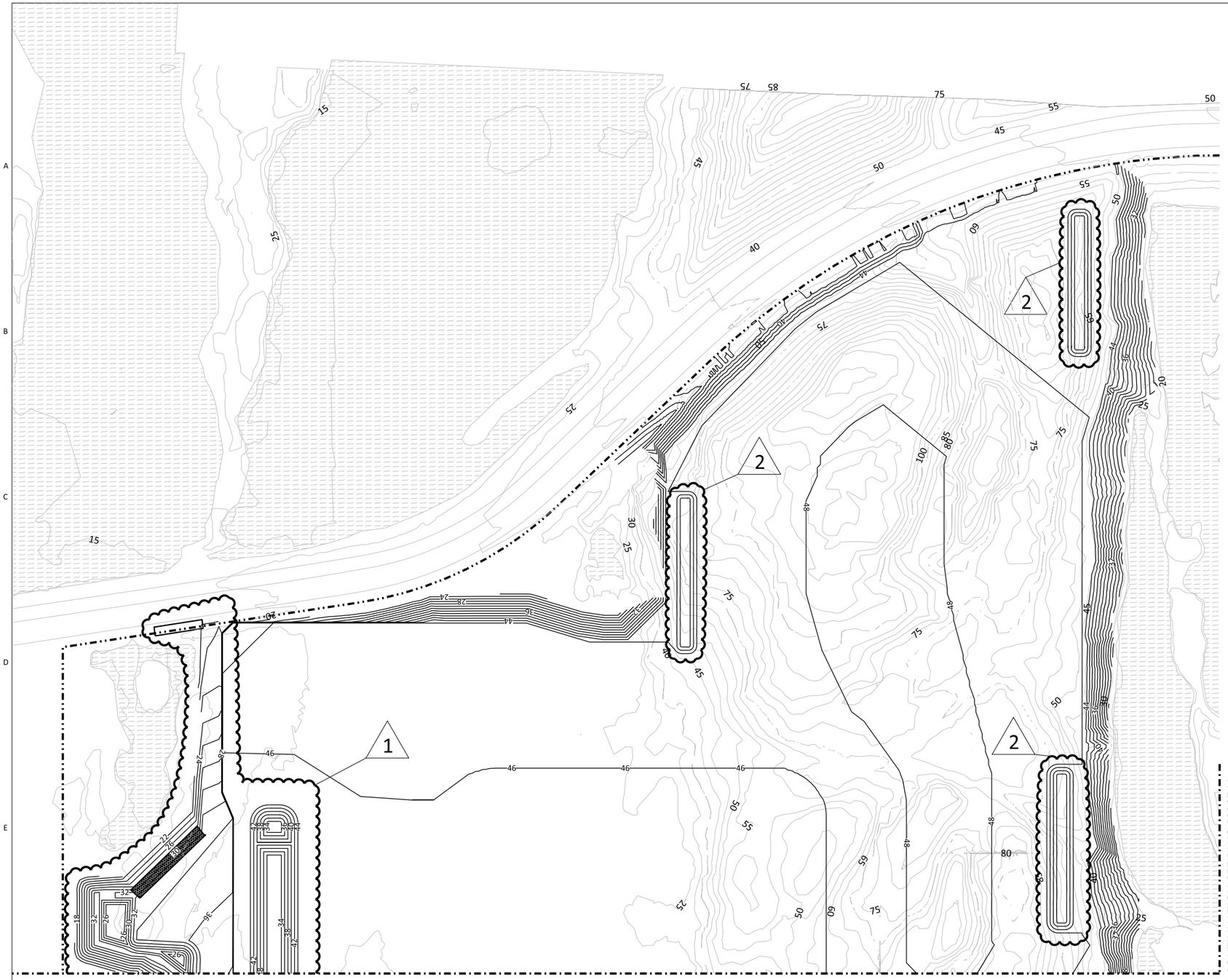
JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
CONTOURS - KEY PLAN, GENERAL NOTES AND LEGEND

PROJECT / DRAWING NUMBER: 189980-0000-FS3050A — REV 2

JCLNG NUMBER: J1-000-CIV-KEY-KBJ-51360-01 — REV 2

MicroStation v8.11.9.578
1 = 1
3/26/2019 1:56:08 PM
fin50857
ANSI D 24x22

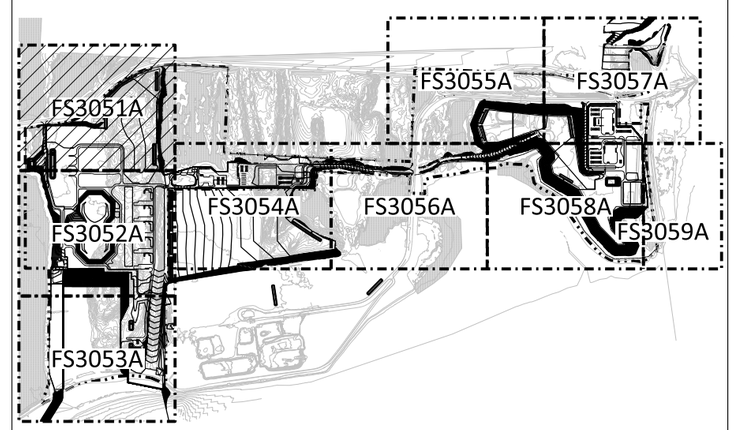



REVISION NOTES:

1. CONTOURS REVISED DUE TO FURTHER DESIGN OF INFILTRATION BASINS AND BIOSLOPE FOR STORM WATER MANAGEMENT PLAN.

2. CONTOURS REVISED DUE TO FURTHER DESIGN OF CONSTRUCTION FACILITIES INFILTRATION AREAS.

KEY PLAN




NOTES

1. SEE DRAWING 0000-FS3050A FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

N

100' 50' 0 100' 200'
1"=100'

KBJ
JORDAN COVE LNG

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP | NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 26-MAR-19 | REVISED ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR | 2 | 26-MAR-19 | REVISED ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |
| 1 | 25-JUL-17 | ISSUED FOR FERC FILING | RJW | CAF | | DJN | SPH | 1 | 25-JUL-17 | ISSUED FOR FERC FILING | RJW | CAF | | DJN | SPH |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF OREGON

SIGNED _____

DATE _____ REG NO. _____

DESIGNER CAF | DRAWN RJW | CHECKED | DATE

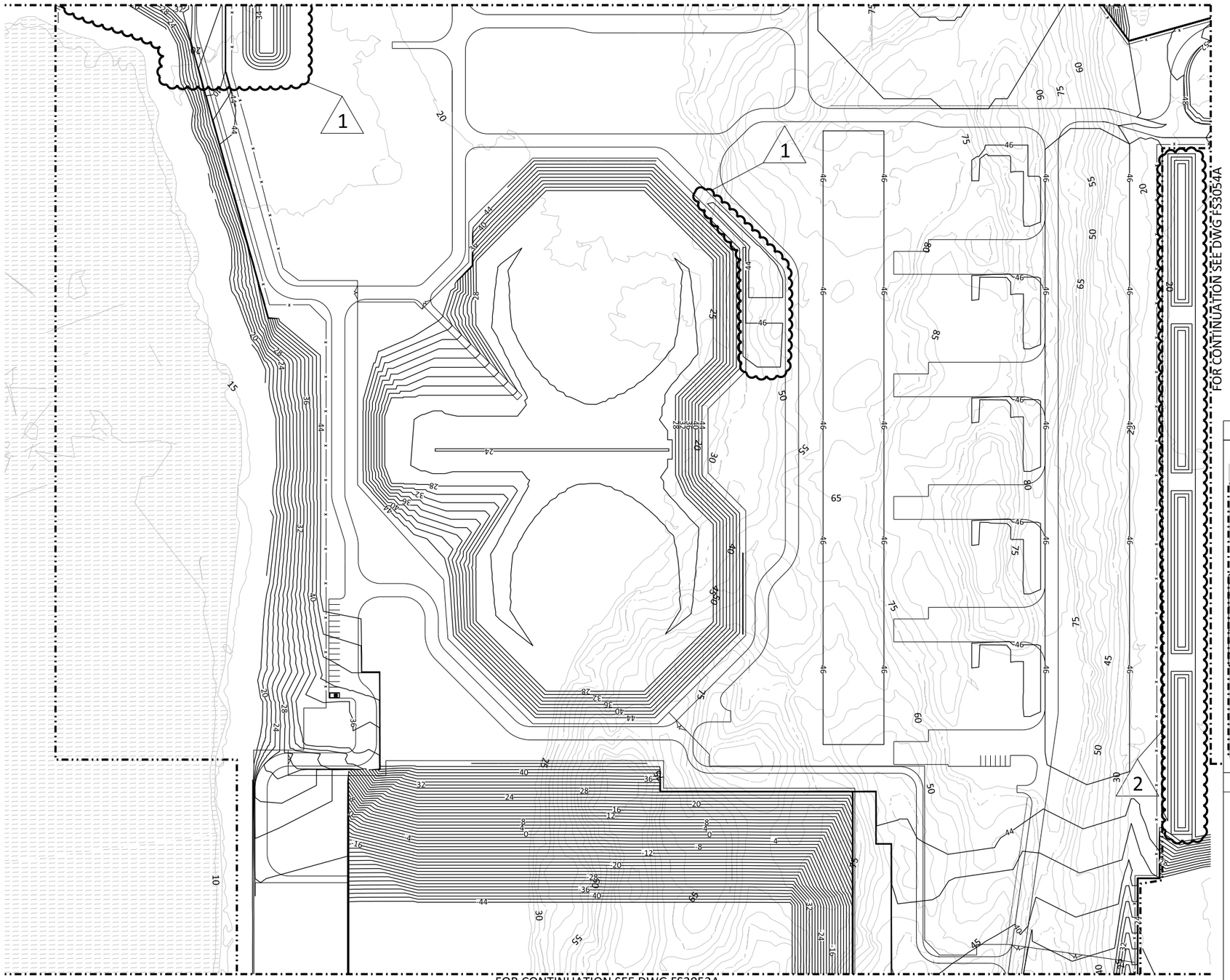
JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
CONTOURS - AREA 1

PROJECT / DRAWING NUMBER: 189980-0000-FS3051A — REV 2

JCLNG NUMBER: J1-000-CIV-GRD-KBJ-51303-01 — REV 2

MicroStation v8.11.9.578
1 = 1
3/26/2019 2:02:34 PM
ANSI D 34x22
fin50857

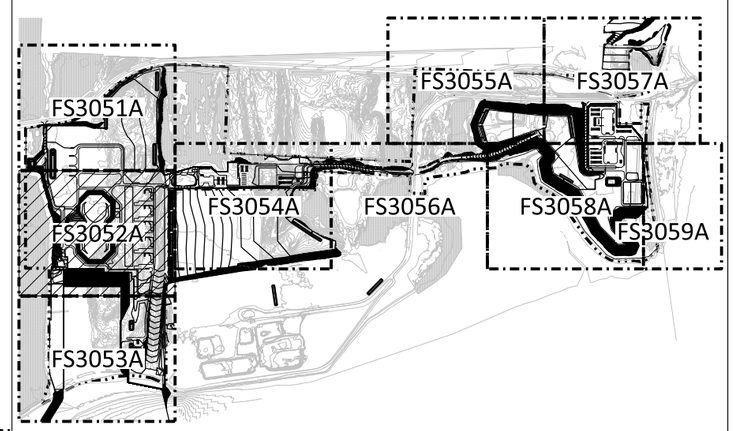



REVISION NOTES:

1. CONTOURS REVISED DUE TO FURTHER DESIGN OF INFILTRATION BASINS FOR STORM WATER MANAGEMENT PLAN.

2. CONTOURS REVISED DUE TO FURTHER DESIGN OF CONSTRUCTION FACILITIES INFILTRATION AREAS.

KEY PLAN




NOTES

1. SEE DRAWING 0000-FS3050A FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

N

100' 50' 0 100' 200'
1"=100'

KBJ
JORDAN COVE LNG

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 2 | 26-MAR-19 | REVISED ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |
| 1 | 25-JUL-17 | ISSUED FOR FERC FILING | RJW | CAF | | DJN | SPH |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 2 | 26-MAR-19 | REVISED ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |
| 1 | 25-JUL-17 | ISSUED FOR FERC FILING | RJW | CAF | | DJN | SPH |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF OREGON

SIGNED

DATE REG NO.

DESIGNER CAF | DRAWN RJW

CHECKED | DATE

JORDAN COVE LNG PROJECT

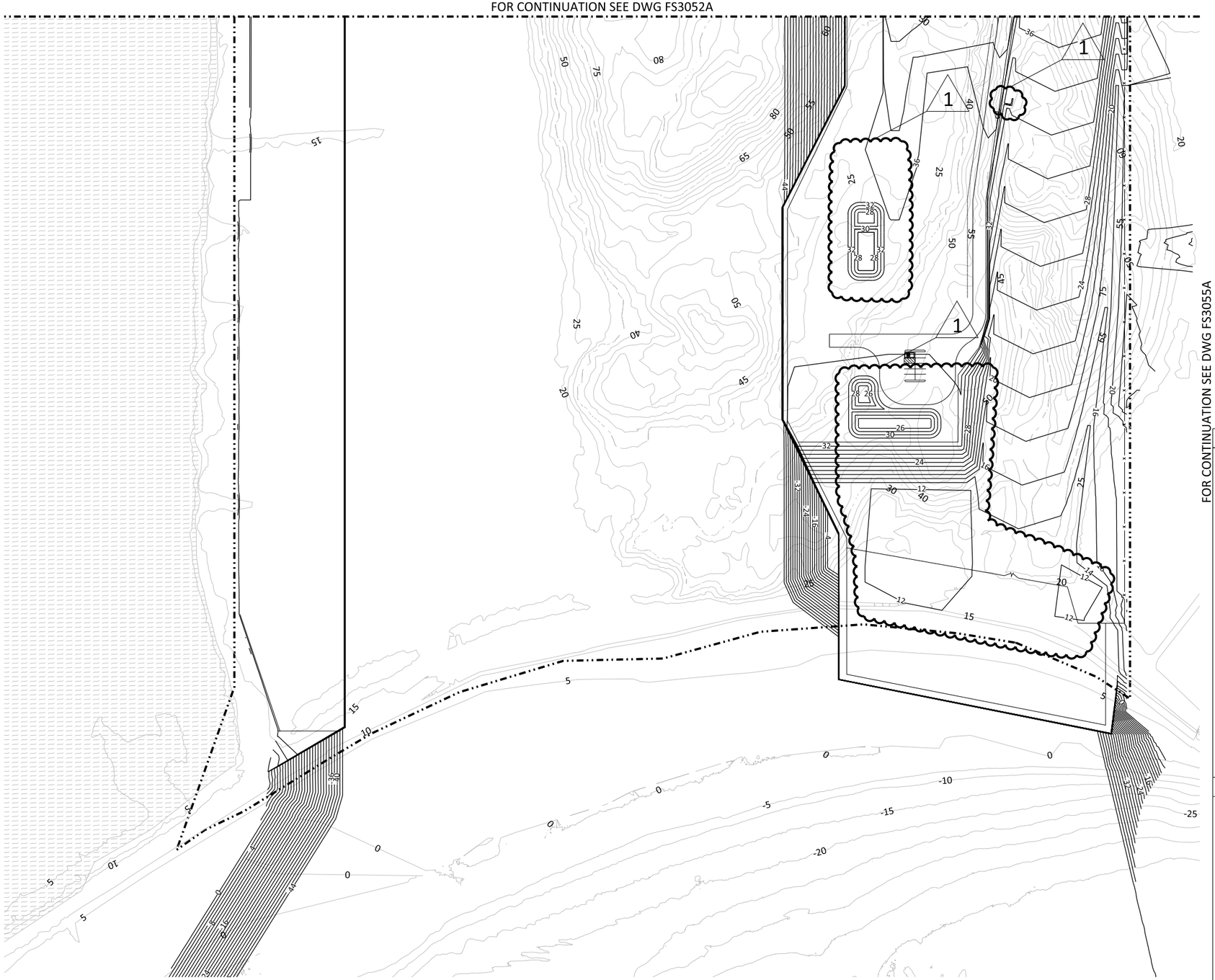
STORM WATER MANAGEMENT PLAN
CONTOURS - AREA 2

PROJECT 189980-0000-FS3052A | DRAWING NUMBER | REV 2

JCLNG NUMBER J1-000-CIV-GRD-KBJ-51303-02 | REV 2

MicroStation v8.11.9.578
1 = 1
3/26/2019 1:59:03 PM
fin50857
ANSI D 34x22

FOR CONTINUATION SEE DWG FS3052A

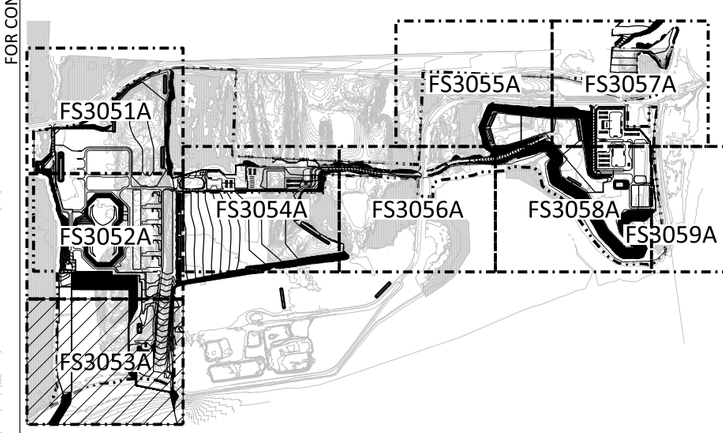


FOR CONTINUATION SEE DWG FS3055A

REVISION NOTES:

1 CONTOURS REVISED DUE TO FURTHER DESIGN OF INFILTRATION BASINS AND CARTRIGE FILTER DEVICES FOR STORM WATER MANAGEMENT PLAN.

KEY PLAN




NOTES

1. SEE DRAWING 0000-FS3050A FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

100' 50' 0 100' 200'
1"=100'

KBJ
JORDAN COVE LNG

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP | NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 26-MAR-19 | REVISED ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR | 2 | 26-MAR-19 | REVISED ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |
| 1 | 25-JUL-17 | ISSUED FOR FERC FILING | RJW | CAF | | DJN | SPH | 1 | 25-JUL-17 | ISSUED FOR FERC FILING | RJW | CAF | | DJN | SPH |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF OREGON

SIGNED _____

DATE _____ REG NO. _____

DESIGNER CAF | DRAWN RJW

CHECKED | DATE

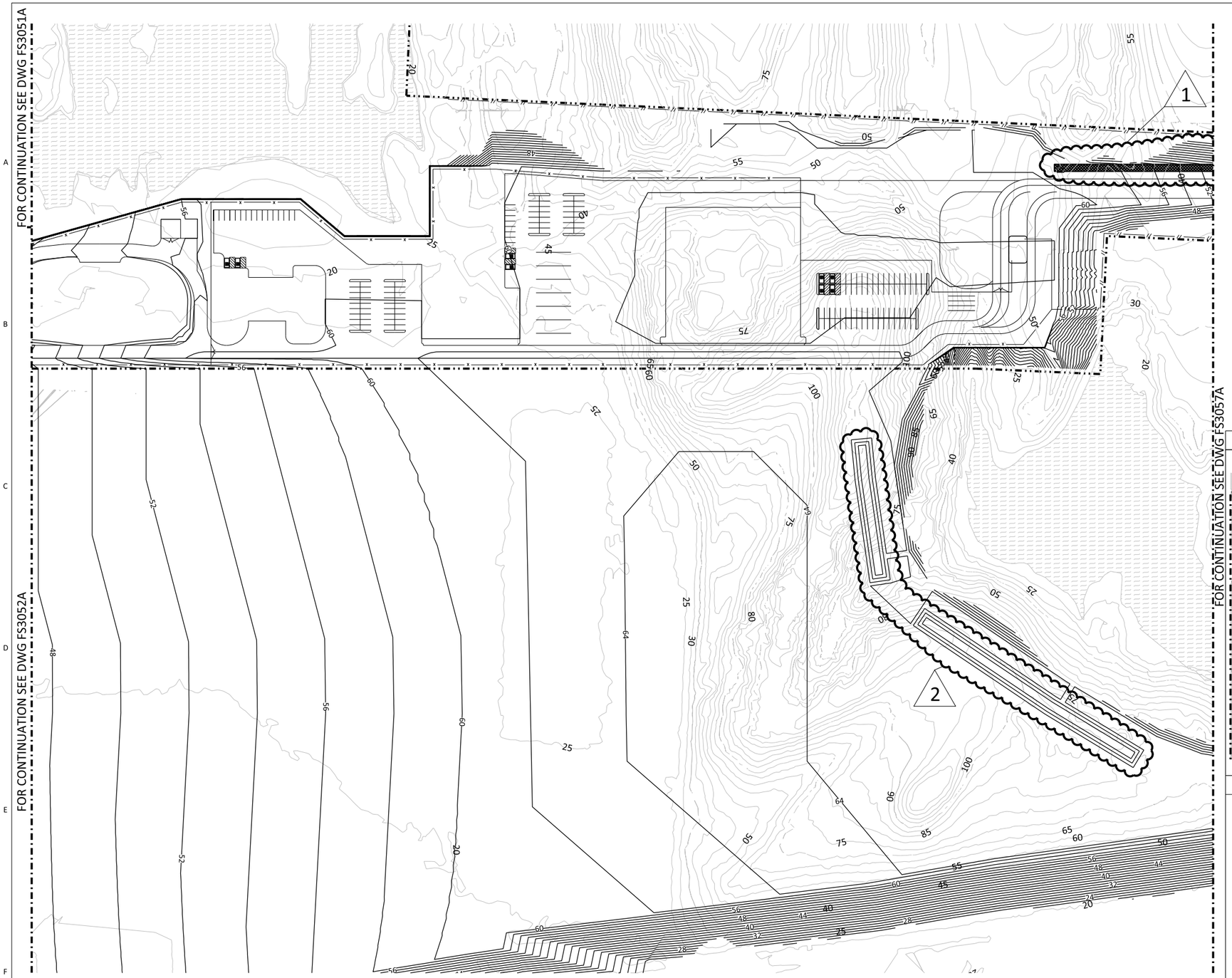
JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
CONTOURS - AREA 3

PROJECT / DRAWING NUMBER: 189980-0000-FS3053A — REV 2

JCLNG NUMBER: J1-000-CIV-GRD-KBJ-51303-03 — REV 2

MicroStation v8.11.9.578
1 = 1
fn50857
ANSI D 34x22
3/26/2019 1:56:10 PM

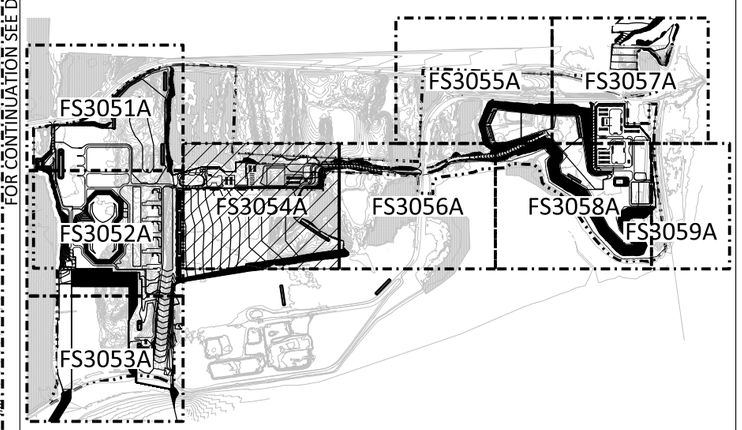



REVISION NOTES:

1. CONTOURS REVISED DUE TO FURTHER DESIGN OF FILTER STRIPS FOR STORM WATER MANAGEMENT PLAN.

2. CONTOURS REVISED DUE TO FURTHER DESIGN OF CONSTRUCTION FACILITIES INFILTRATION AREAS.

KEY PLAN




NOTES

1. SEE DRAWING 0000-FS3050A FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

N

100' 50' 0 100' 200'
1"=100'

KBJ
JORDAN COVE LNG

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 2 | 26-MAR-19 | REVISED ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |
| 1 | 25-JUL-17 | ISSUED FOR FERC FILING | RJW | CAF | | DJN | SPH |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 2 | 26-MAR-19 | REVISED ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |
| 1 | 25-JUL-17 | ISSUED FOR FERC FILING | RJW | CAF | | DJN | SPH |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF OREGON

SIGNED _____

DATE _____ REG NO. _____

DESIGNER CAF | DRAWN RJW

CHECKED | DATE

JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
CONTOURS - AREA 4

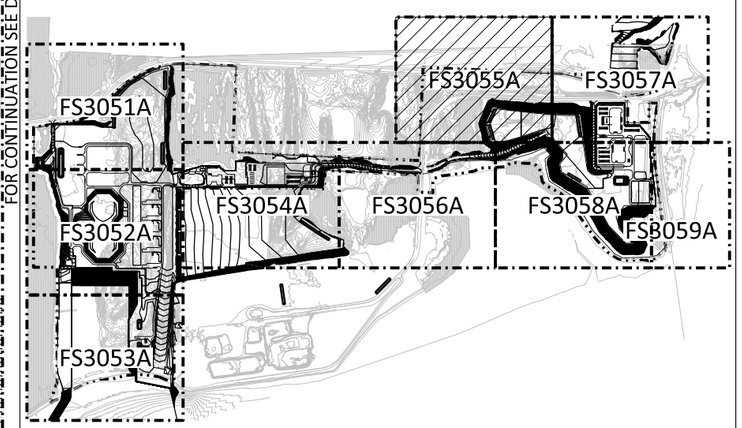
| PROJECT / DRAWING NUMBER | REV |
|---|---|
| 189980-0000-FS3054A | 2 |
| JCLNG NUMBER: J1-000-CIV-GRD-KBJ-51303-04 | 2 |

MicroStation v8.11.9.578
1 = 1
3/26/2019 1:59:16 PM
fin50857
ANSI D 34x22

REVISION NOTES:

1 CONTOURS REVISED DUE TO FURTHER DESIGN OF CONSTRUCTION FACILITIES INFILTRATION AREAS.

KEY PLAN




NOTES

1. SEE DRAWING 0000-DS3050A FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

100' 50' 0 100' 200'
1"=100'

KBJ
JORDAN COVE LNG

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP | NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 26-MAR-19 | REVISED ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR | 2 | 26-MAR-19 | REVISED ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |
| 1 | 25-JUL-17 | ISSUED FOR FERC FILING | RJW | CAF | | DJN | SPH | 1 | 25-JUL-17 | ISSUED FOR FERC FILING | RJW | CAF | | DJN | SPH |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF OREGON

SIGNED _____

DATE _____ REG NO. _____

DESIGNER CAF | DRAWN RJW | CHECKED | DATE

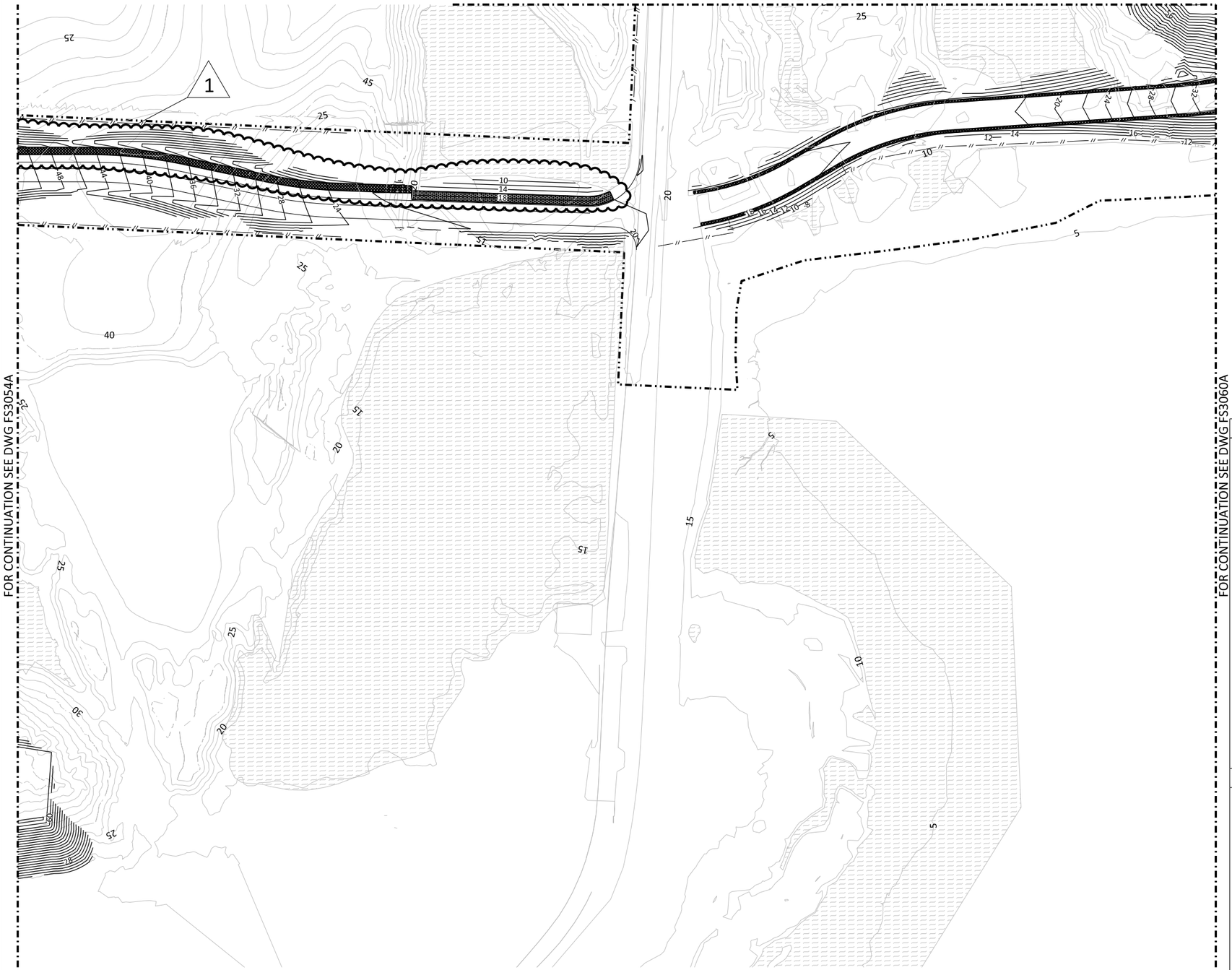
JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
CONTOURS - AREA 5

PROJECT / DRAWING NUMBER: 189980-0000-FS3055A — REV 2

JCLNG NUMBER: J1-000-CIV-GRD-KBJ-51303-05 — REV 2

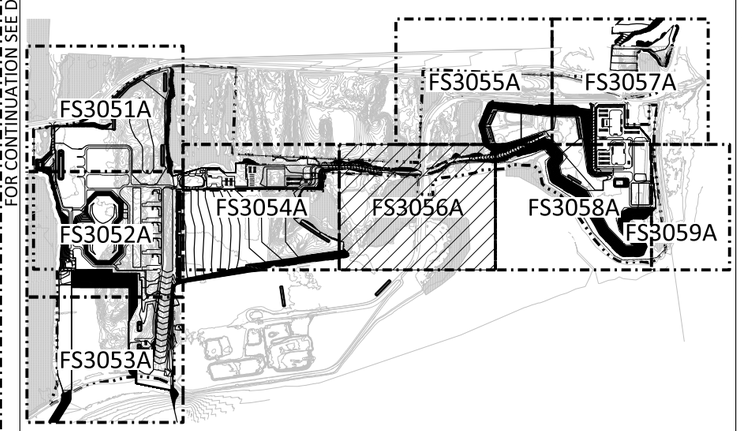
MicroStation v8.11.9.578
1 = 1
1/13/2019 4:17:32 AM
fn50857
ANSI D 34x22




REVISION NOTES:

1 CONTOURS REVISED DUE TO FURTHER DESIGN OF FILTER STRIPS AND BIOSLOPES FOR STORM WATER MANAGEMENT PLAN.

KEY PLAN




NOTES

1. SEE DRAWING 0000-FS3050A FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

100' 50' 0 100' 200'
1"=100'

KBJ
JORDAN COVE LNG

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP | NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 26-MAR-19 | REVISED ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR | 2 | 26-MAR-19 | REVISED ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |
| 1 | 25-JUL-17 | ISSUED FOR FERC FILING | RJW | CAF | | DJN | SPH | 1 | 25-JUL-17 | ISSUED FOR FERC FILING | RJW | CAF | | DJN | SPH |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF OREGON

SIGNED _____

DATE _____ REG NO. _____

DESIGNER CAF | DRAWN RJW

CHECKED | DATE

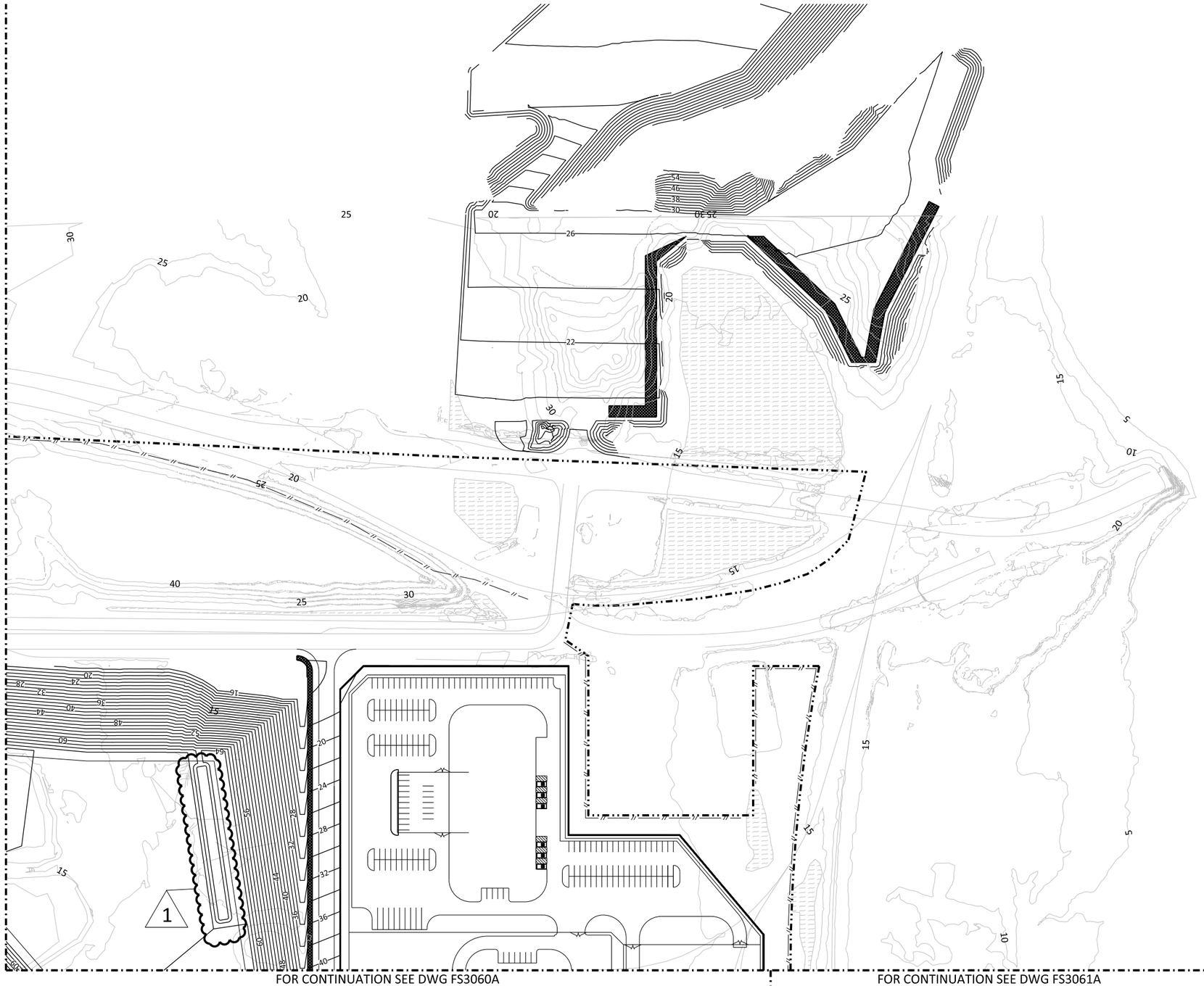
JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
CONTOURS - AREA 6

PROJECT / DRAWING NUMBER: 189980-0000-FS3056A — REV 2

JCLNG NUMBER: J1-000-CIV-GRD-KBJ-51303-06 — REV 2

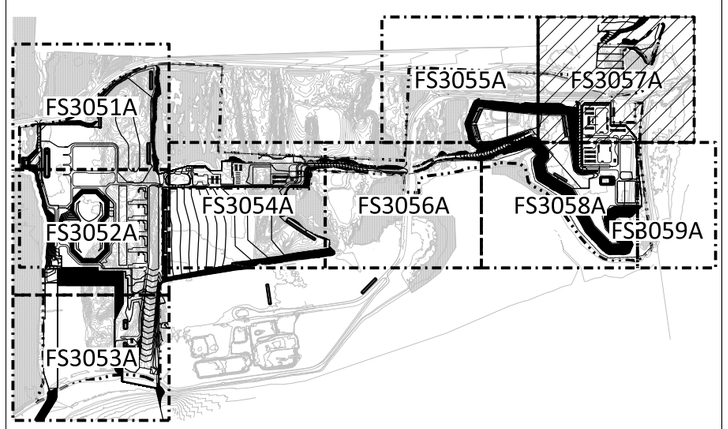
MicroStation v8.11.9.578
1 = 1
3/26/2019 1:56:11 PM
fn50857
ANSI D 34x22




REVISION NOTES:

1 CONTOURS REVISED DUE TO FURTHER DESIGN OF CONSTRUCTION FACILITIES INFILTRATION AREAS.

KEY PLAN




NOTES

1. SEE DRAWING 0000-FS3050A FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

100' 50' 0 100' 200'
1"=100'

KBJ
JORDAN COVE LNG

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 2 | 26-MAR-19 | REVISED ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |
| 1 | 25-JUL-17 | ISSUED FOR FERC FILING | RJW | CAF | | DJN | SPH |

| NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|
| 2 | 26-MAR-19 | REVISED ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |
| 1 | 25-JUL-17 | ISSUED FOR FERC FILING | RJW | CAF | | DJN | SPH |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF OREGON

SIGNED _____

DATE _____ REG NO. _____

DESIGNER CAF | DRAWN RJW | CHECKED | DATE

JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
CONTOURS - AREA 7

PROJECT / DRAWING NUMBER: 189980-0000-FS3057A — REV 2

JCLNG NUMBER: J1-000-CIV-GRD-KBJ-51303-07 — REV 2

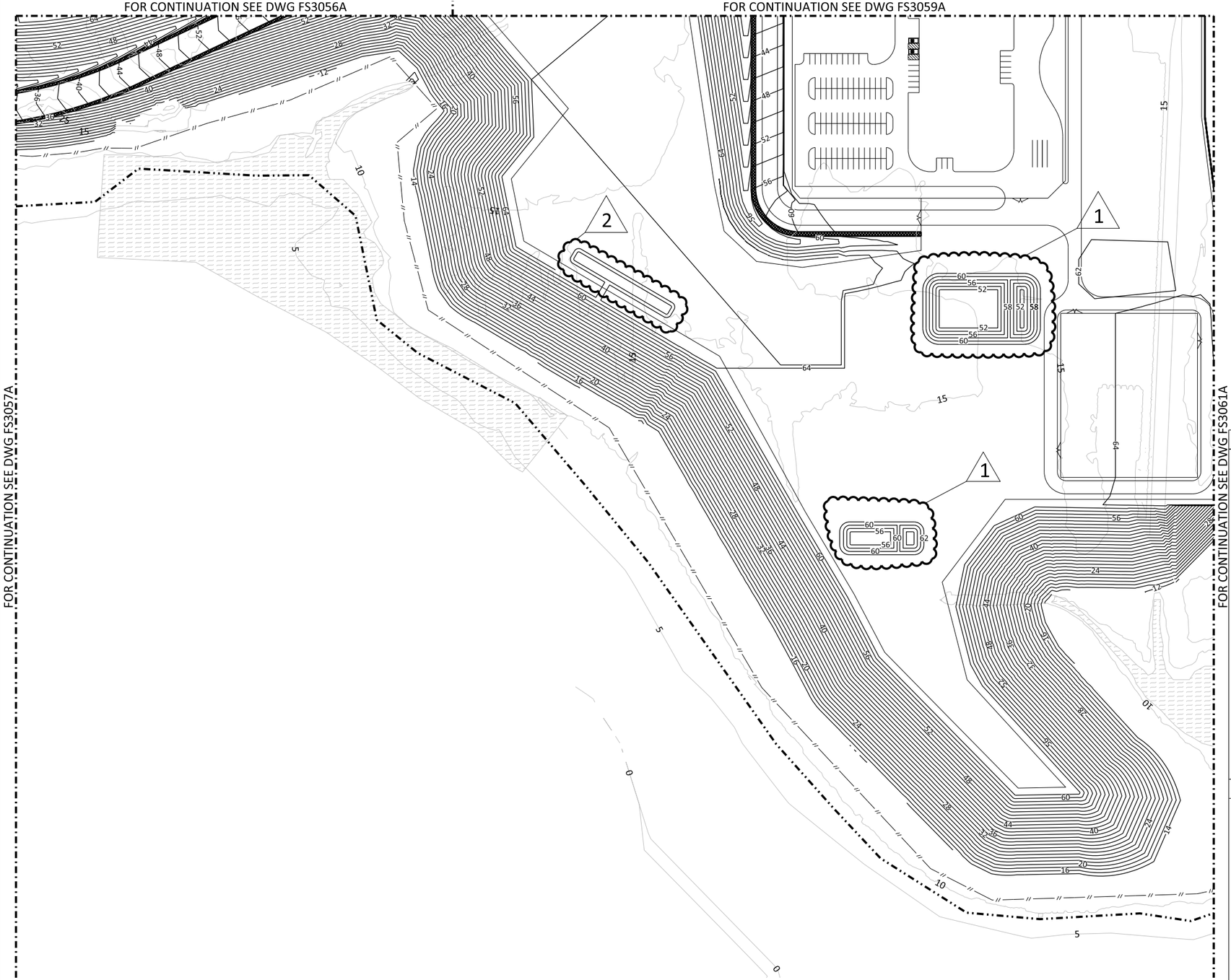
MicroStation v8.11.9.578
1 = 1
3/26/2019 1:59:29 PM
fn50857
ANSI D 34x22

FOR CONTINUATION SEE DWG FS3056A

FOR CONTINUATION SEE DWG FS3059A

FOR CONTINUATION SEE DWG FS3057A

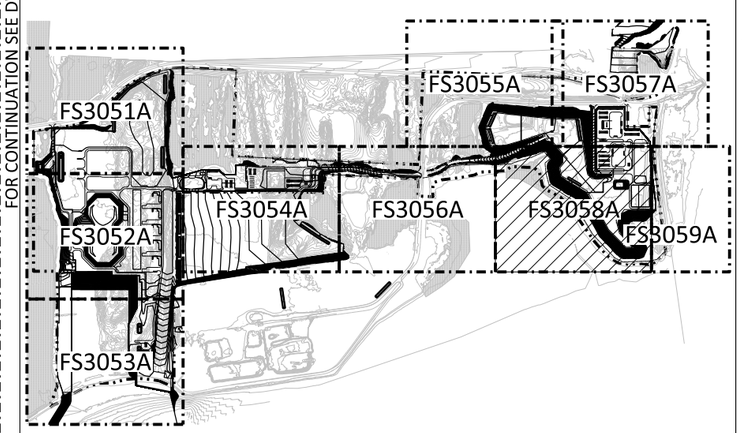
FOR CONTINUATION SEE DWG FS3061A




REVISION NOTES:

1. CONTOURS REVISED DUE TO FURTHER DESIGN OF INFILTRATION BASINS FOR STORM WATER MANAGEMENT PLAN.
2. CONTOURS REVISED DUE TO FURTHER DESIGN OF CONSTRUCTION FACILITIES INFILTRATION AREAS.

KEY PLAN




NOTES

1. SEE DRAWING 0000-FS3050A FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

KBJ
JORDAN COVE LNG

Jordan Cove LNG
A Pembina Company

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP | NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 26-MAR-19 | REVISED ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR | 2 | 26-MAR-19 | REVISED ISSUED FOR FERC FILING | NJO | CAF | | MKA | DMR |
| 1 | 25-JUL-17 | ISSUED FOR FERC FILING | RJW | CAF | | DJN | SPH | 1 | 25-JUL-17 | ISSUED FOR FERC FILING | RJW | CAF | | DJN | SPH |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF OREGON

SIGNED _____

DATE _____ REG NO. _____

DESIGNER CAF | DRAWN RJW | CHECKED | DATE

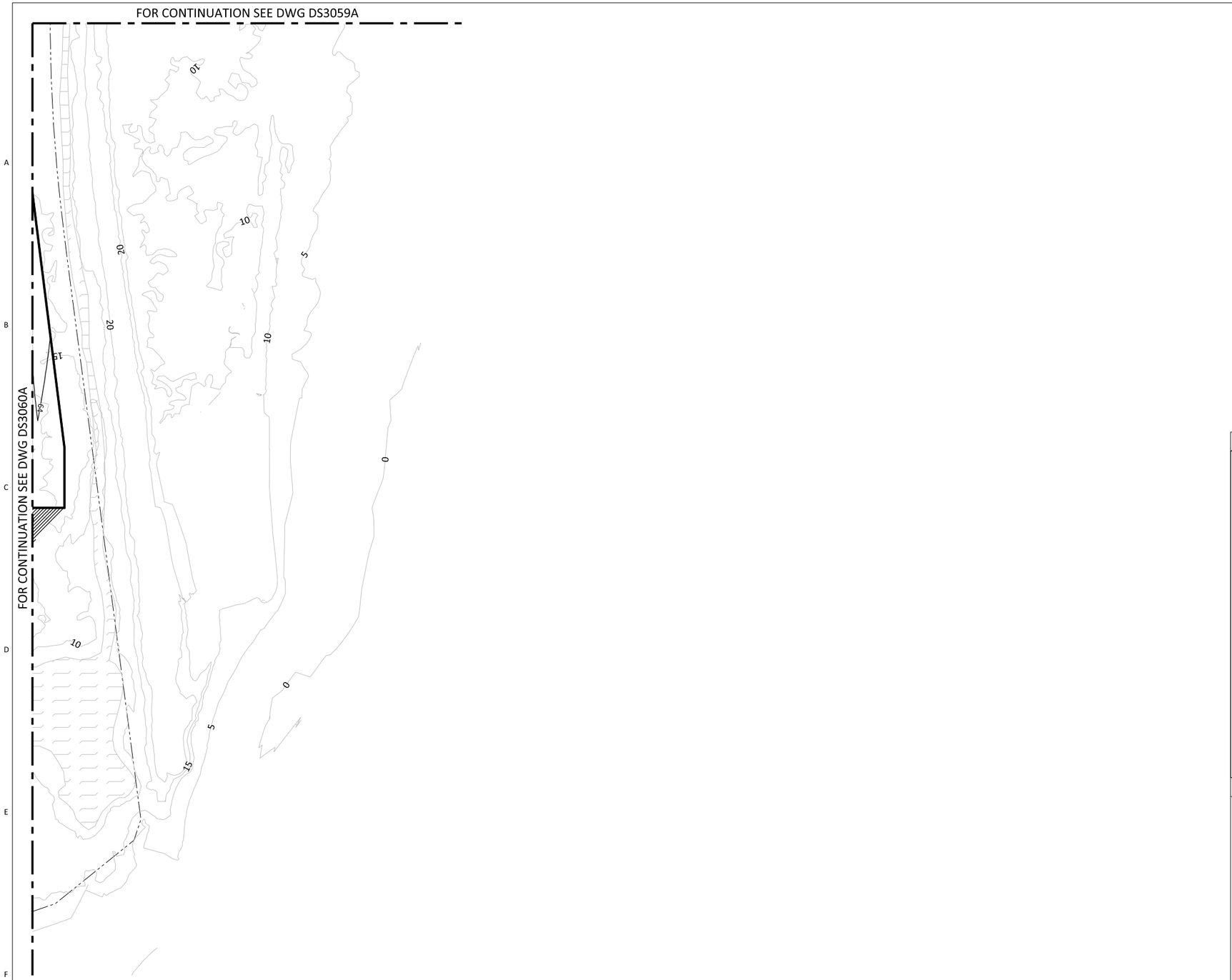
JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
CONTOURS - AREA 8

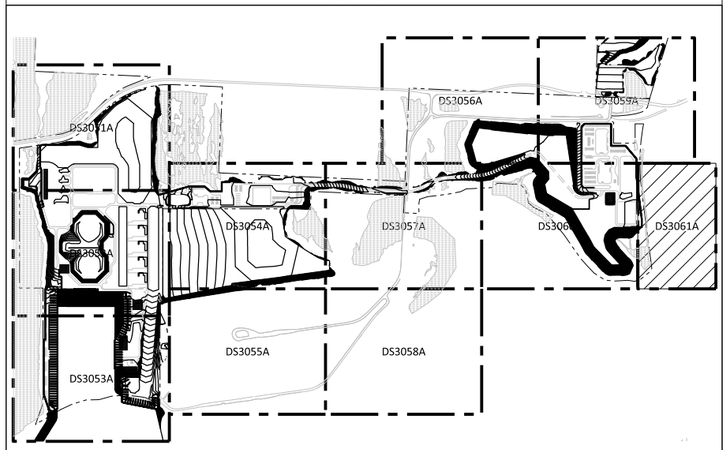
PROJECT / DRAWING NUMBER: 189980-0000-FS3058A — REV 2

JCLNG NUMBER: J1-000-CIV-GRD-KBJ-51303-08 — REV 2

MicroStation v8.11.9.578
1 = 1
3/26/2019 1:59:34 PM
fn50857
ANSI D 34x22




KEY PLAN




NOTES

1. SEE DRAWING 0000-DS3050A FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

100' 50' 0 100' 200'
1"=100'

JORDAN COVE LNG

Jordan Cove LNG SM

**NOT TO BE USED FOR CONSTRUCTION**

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

| NO | DATE | JCLNG REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP | NO | DATE | KBJ REVISIONS AND RECORD OF ISSUE | DRN | DES | CHK | PDE | APP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 25/JUL/17 | ISSUED FOR FERC FILING | RJW | CAF | | DJN | SPH | 1 | 25/JUL/17 | ISSUED FOR FERC FILING | RJW | CAF | | DJN | SPH |

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF OREGON

SIGNED _____

DATE _____ REG NO. _____

DESIGNER CAF | DRAWN RJW

CHECKED | DATE

JORDAN COVE LNG PROJECT

STORM WATER MANAGEMENT PLAN
CONTOURS - AREA 9

PROJECT / DRAWING NUMBER: 189980-0000-FS3059A — REV 1

JCLNG NUMBER: J1-000-CIV-GRD-KBJ-51303-09 — REV 1

MicroStation v8.11.9.578
1 = 1
fin50857
ANSI D 34x22
11/20/2017 12:39:24 PM

# Attachment B. Forms

# Visual Observation Log

(Complete a separate form for each outfall you assess)

Name of Facility: **Jordan Cove LNG Facility** NPDES Tracking No.

Outfall Name:

Person(s)/Title(s) collecting sample:

Person(s)/Title(s) examining sample:

Date & Time Discharge Began: Sample Collected? (Y/N): Date & Time of Sample:

Rainfall Amount (inches):

**Parameter**

Color ☐ None ☐ Other (describe):

Odor ☐ None ☐ Musty ☐ Sewage ☐ Sulfur ☐ Sour ☐ Petroleum/Gas _____
☐ Solvents ☐ Other (describe):

Clarity ☐ Clear ☐ Slightly Cloudy ☐ Cloudy ☐ Opaque ☐ Other

Floating Solids ☐ No ☐ Yes (describe):

Settled Solids ☐ No ☐ Yes (describe):

Suspended Solids ☐ No ☐ Yes (describe):

Foam (gently shake sample) ☐ No ☐ Yes (describe):

Oil Sheen ☐ None ☐ Flecks ☐ Globs ☐ Sheen ☐ Slick
☐ Other (describe):

Other Obvious Indicators of Storm water Pollution ☐ No ☐ Yes (describe):

Do the control measures provided need cleaning, replacement, maintenance, reconditioning or repair? ☐ No ☐ Yes (describe):

**Detail any concerns, additional comments, descriptions of pictures taken, and any corrective actions taken below (attach additional sheets as necessary).**

**Certification by Facility Responsible Official**

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 gathered and evaluated 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.

A. Name: B. Title:

C. Signature: D. Date Signed:

# Annual Evaluation Report

| Inspected by: | | | Title: | Inspection Date: |
|---|---|---|---|---|
| **Inspection Items** | **Yes** | **No** | **Major Observations/Comments** | **Modifications to Measures and Controls** |
| Are the members on the Pollution Prevention Team still current? | | | | |
| Is the site plan drawing and drainage map still accurate? | | | | |
| Is the inventory of exposed materials still accurate? | | | | |
| Were there any spills or leaks during the past year? | | | | |
| Did the facility conduct all quarterly visual inspections? | | | | |
| Did facility personnel conduct/document all weekly inspections? | | | | |
| Are the existing measures and controls to reduce pollutant loadings effective? | | | | |
| Are the structural BMPs maintained and operating properly? | | | | |
| Are spill prevention and response procedures being followed? | | | | |
| Has a visual inspection of spill response equipment been made? Describe adequacy. | | | | |
| Does the facility maintain good housekeeping? | | | | |
| Has annual pollution prevention training been completed and documented at least one time this year? | | | | |
| Does the facility keep adequate records of inspections, spills, and maintenance activities? | | | | |

| General Inspection Findings |
| --- |
| As part of this comprehensive site inspection, did you inspect all potential pollution sources, including areas where industrial activity may be exposed to storm water? If no, describe why not: |
| Is there any evidence that the control measures are in need of repair or replacement? |
| Is there any evidence that additional control measures are needed to reduce pollutant loading in these areas? |
| Did you inspect the storm water outfall(s) associated with the facility? If no, describe why not: |
| Is there any evidence of pollutants leaving the outfall(s) (oil sheen, solids, trash/debris, foam, color, etc.)? |

| General Inspection Findings |
| --- |
| Did this inspection identify any storm water or non-storm water related outfalls not previously identified in your SWMP? |
| Did this inspection identify any sources of storm water or non-storm water discharges not previously identified in your SWMP? |
| Describe any evidence of pollutants entering the drainage system or discharging to surface waters, and the condition of and around outfalls, including flow dissipation measures to prevent scouring: |
| Have you taken, or plan to take, any corrective actions as a result of this comprehensive site inspection? |
| Are any modifications or improvements to the SWMP required as a result of this evaluation? (Note: Revisions to SWMP must be addressed within 30 days of evaluation). |

## CERTIFICATION STATEMENT

**"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 gathered and evaluated 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."**

**Print name and title: _____**

**Signature:_____Date:_____**

# Attachment C. NPDES Permits Near the Project

# Oregon DEQ Facility Profiler 2.0

[Help] [Close Window]

## Matching Sites

View Results on Map | Home/Search Again | Edit Search

**The following DEQ facilities and sites matched your search.**

Select a site below for detailed information.

Page 1 of 1 Total Matches (max 5000): 13 Print Results

| | Distance (Mi) | Facility/Site Information | DEQ Programs | Details |
|---|---|---|---|---|
| #1 | 0.48 | LTM, INCORPORATED<br>449 HIGHWAY 101<br>NORTH BEND , 97459 | Water Discharge Permit | Go >> |
| #2 | 0.52 | OCEAN TERMINALS CO.<br>FOOT OF CALIFORNIA STREET<br>NORTH BEND , 97459 | Water Discharge Permit | Go >> |
| #3 | 1.16 | INTERNATIONAL PORT OF COOS BAY<br>MUNICIPAL AIRPORT OFF COLORADO AVE<br>NORTH BEND , 97459 | Cleanup, Haz Waste, Water Discharge Permit | Go >> |
| #4 | 1.27 | CCAD SITE PREPARATION<br>AIRPORT LANE & AVIATION CT<br>NORTH BEND , 97459 | Water Discharge Permit | Go >> |
| #5 | 1.34 | JUDITH ANN REEVES LIVING TRUST<br>66582 EAST BAY RD.<br>NORTH BEND , 97459 | Water Discharge Permit | Go >> |
| #6 | 1.40 | NORTH BAYSIDE ESTATES LLC<br>66642 E. BAY DRIVE<br>NORTH BEND , 97459 | Water Discharge Permit | Go >> |
| #7 | 1.47 | NORTH BEND, CITY OF<br>1255 AIRPORT LANE<br>NORTH BEND , 97459 | Water Discharge Permit | Go >> |
| #8 | 1.64 | WEYERHAEUSER<br>92770 TRANS PACIFIC LANE<br>NORTH BEND , 97459 | Leaking UST, Haz Waste, Water Discharge Permit | Go >> |
| #9 | 1.72 | BOXCAR HILL CAMPGROUND & RV PARK<br>92799 TRANSPACIFIC PKWY<br>NORTH BEND , 97459 | Water Discharge Permit | Go >> |
| #10 | 1.73 | TYREE OIL, INC.<br>341 NEWMARK STREET<br>NORTH BEND , 97459 | Water Discharge Permit | Go >> |
| #11 | 1.79 | SUNSET CREST ESTATES<br>ONE BLOCK SOUTH OF VIRGINIA ON MCKINLEY<br>NORTH BEND , 97459 | Water Discharge Permit | Go >> |
| #12 | 1.85 | OREGON CHIP TERMINAL INC.<br>FOOT OF TOWER STREET<br>NORTH BEND , 97459 | Leaking UST, Water Discharge Permit | Go >> |
| #13 | 1.89 | ROSEBURG FOREST PRODUCTS CO.<br>66237 JORDAN COVE RD<br>NORTH BEND , 97459 | Cleanup, Water Discharge Permit | Go >> |

Download Data File

**Selected location information.**

| | |
|---|---|
| Search Radius: | 2 Mi |
| Latitude, Longitude: | 43.4157, -124.224 |
| OR House District : | 09 |
| Congressional District : | 4 |
| Township Range Section : | 25.00S13.00W10 |

| | |
|---|---|
| 6th Field Hucs Code : | 171003040405 |
| Zip Code Area : | 97459 |
| City : | North Bend |
| County : | Coos |
| Vegetation Type : | Urban And Industrial |
| OR Senate District : | 05 |
| Watershed : | Coos |

[DEQ's Privacy Notice] [Contact DEQ] [Application Feedback]

# Attachment D. Section 401 Water Quality Certification Post-Construction Storm Water Management Plan Submission Guidelines

# Section 401 Water Quality Certification
## Post-Construction Stormwater Management Plan Submission Guidelines

March 2018

**DEQ Water Quality**
**401 Program**
700 NE Multnomah St.
Suite 600
Portland, OR 97232
Phone: 503-229-5696
800-452-4011
Fax: 503-229-5850
Contact: Amy Simpson
www.oregon.gov/DEQ

DEQ is a leader in restoring, maintaining and enhancing the quality of Oregon's air, land and water.

State of Oregon
Department of Environmental Quality

This document prepared by: Amy Simpson, P.E.
Oregon Department of Environmental Quality
700 NE Multnomah St, Ste 600, Portland, OR 97204
1-800-452-4011
www.oregon.gov/deq
Contact:
Amy Simpson
503-229-5051

Documents can be provided upon request in an alternate format for individuals with disabilities or in a language other than English for people with limited English skills. To request a document in another format or language, call DEQ in Portland at 503-229-5696, or toll-free in Oregon at 1-800-452-4011, ext. 5696; or email deqinfo@deq.state.or.us.

# Table of Contents

A. Purpose ..... 1
B. Requirements ..... 1
C. Background ..... 4
D. Acronyms ..... 5
E. Elements of a Post-Construction Stormwater Management Plan ..... 6
E.1 Determine the Water Quality Storm Event ..... 7
E.2 Evaluate Site Constraints ..... 9
E.3 Justify the Level of Infiltration ..... 11
E.4 Reduce Stormwater Runoff Volume ..... 13
E.5 Review Stormwater Runoff Water Quality Impacts ..... 15
E.6 Select Stormwater Treatment Method(s) ..... 17
E.7 Design the Structural Stormwater Control(s) ..... 19
E.8 Provide Details for Construction Practices ..... 23
E.9 Provide an Operations and Maintenance Plan ..... 24
F. Appendices ..... 26
F.1 Glossary ..... 27
F.2 Post-Construction SWMP Checklist ..... 35
F.3 Designated Beneficial Uses ..... 37
F.4 Details of Stormwater Controls (Examples Only) ..... 38
G. References ..... 48

# A. Purpose

This document provides guidelines for applicants and Department of Environmental Quality (DEQ) staff regarding when a post-construction stormwater management plan (SWMP) must be submitted to the DEQ 401 Water Quality Certification (WQC) Program and the information that must be included in the post-construction SWMP. This document does not relieve applicants from the responsibility of complying with any other local, state, or federal requirements.

# B. Requirements

See Figure 1 for a flowchart showing how to determine whether the DEQ 401 WQC Program requires a post-construction SWMP and whether review is deferred to another agency or permit authority. For any portion of a project where post-construction stormwater runoff is regulated by the following permit and/or agency, the DEQ 401 WQC Program defers post-construction SWMP review to the applicable agency and/or permit authority:

- A 1200-Z National Pollutant Discharge Elimination System (NPDES) permit and/or
- The City of Eugene, Clean Water Services, and/or the City of Portland, provided there is no nexus with DEQ Cleanup and no structural stormwater control for treating stormwater runoff is located within a water of the state.

Applicants for any project requiring a 401 WQC that adds or re-constructs any impervious surface outside of the above-listed deferred areas must submit a post-construction SWMP to the DEQ 401 WQC Program unless the applicant demonstrates to the satisfaction of the DEQ 401 WQC Program that the water quality impacts from post-construction stormwater runoff are minor. Below are examples of projects where the DEQ 401 WQC Program considers the water quality impacts from post-construction stormwater runoff to be minor:

- Utility line installation with no new impervious surface area;
- Small, localized repairs with no new impervious surface area;
- Pavement preservation that does not expose gravels, aggregate, or soil (see Figure 2);
- Exterior remodeling with no new impervious surface area; and
- Some projects with a small contributing impervious area (CIA) where post-construction stormwater runoff is routed to vegetated areas (evaluated on a case-by-case basis).

The post-construction SWMP must demonstrate post-construction stormwater runoff generated by the water quality storm event on the CIA will receive any necessary treatment prior to discharge to waters of the state unless the applicant adequately demonstrates that site constraints make this infeasible (e.g., a highway along a cliff). If infeasible, the applicant must demonstrate that post-construction stormwater runoff from an equivalent offsite area will be treated to offset the water quality impacts from the project's post-construction stormwater runoff. Within 30 days of project completion, the applicant must submit to the DEQ 401 WQC Program as-builts or red-lined construction drawings of all structural stormwater controls.

***Figure 1: Determining Whether a Post-Construction Stormwater Management Plan is Required and Whether the DEQ 401 WQC Program Defers Review***

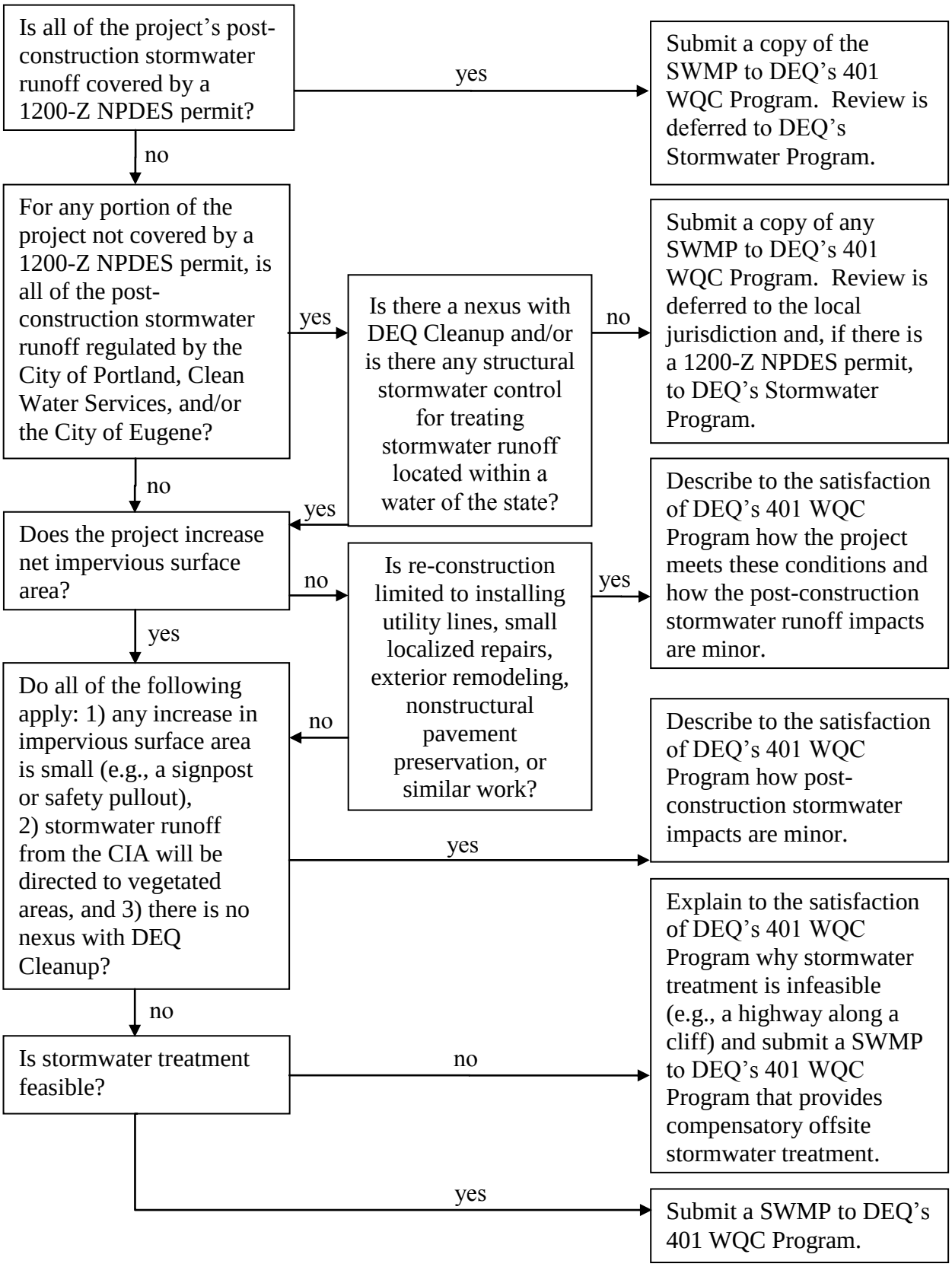
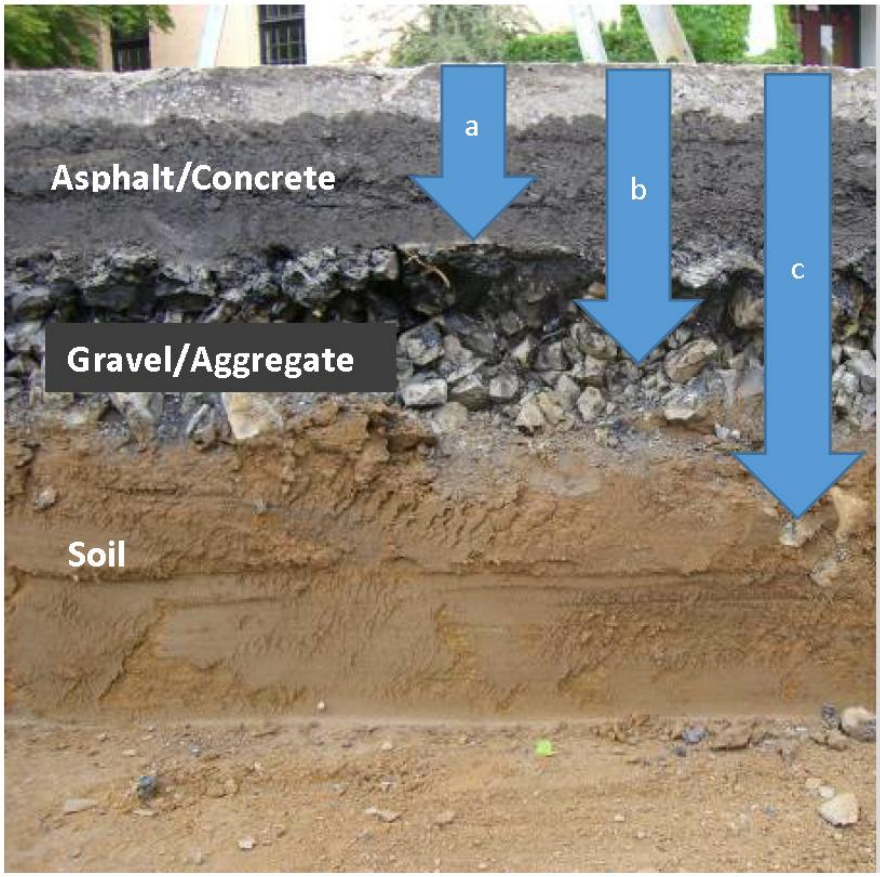


***Figure 2: Paved Impervious Cross Section – Determining Which Activities Trigger a Stormwater Review***




Development and redevelopment activities that do not reach or exceed depth "a" leave impervious surfaces in place and do not trigger stormwater requirements. Development and redevelopment activities that expose gravels, aggregates or soil (depths "b" and "c") do trigger stormwater requirements.

© City of Portland, courtesy Bureau of Environmental Services

# C. Background

Section 401 of the Federal Water Pollution Control Act (aka Clean Water Act) gives states the authority to certify, waive, or deny applications for projects requiring a federal license or permit that may result in any discharge into the waters of the United States.[1] DEQ has the authority to require modifications to and impose conditions on such projects to ensure they meet state water quality standards and other applicable water quality laws. DEQ also has the authority to deny 401 WQCs for such projects; if a 401 WQC is denied, the federal permit or license will not be issued for the project.

State water quality standards are established in Oregon Administrative Rules (OARs) Chapter 340 Division 41. DEQ requires the use of all available and reasonable methods necessary for the project to meet state water quality standards.[2] This includes protecting designated beneficial uses (see Appendix F.3), meeting narrative and numeric water quality criteria, and complying with the antidegradation policy.

Stormwater runoff that may cause or tend to cause pollution is a waste.[3] As stated in Oregon Revised Statutes (ORS) Chapter 468B, it is the public policy of the state to provide that no waste be discharged into any waters of this state without first receiving the necessary treatment or other corrective action to protect the legitimate beneficial uses of such waters and to provide for the prevention, abatement and control of new or existing water pollution.[4] State water quality standards require, in part, that the highest and best practicable treatment and/or control of wastes be provided to maintain overall water quality at the highest possible levels.[5]

Except where water quality impacts from post-construction stormwater runoff are minor, post-construction stormwater runoff from new or reconstructed impervious surfaces may cause or tend to cause pollution. The DEQ 401 WQC Program requires applicants submit a post-construction SWMP for projects where post-construction stormwater runoff may cause or tend to cause pollution. To meet the 401 WQC requirements, post-construction SWMPs must demonstrate that post-construction stormwater runoff receives the highest and best practicable treatment and/or control.

This document provides guidelines for compiling and evaluating post-construction SWMPs to ensure they demonstrate the use of available and reasonable methods to provide the highest and best practicable treatment and/or control of post-construction stormwater runoff. On a case-by-case basis, additional information may be required to ensure compliance with state water quality standards and other applicable water quality laws.

---

[1] Clean Water Act Sections 401(a)(1) and 502(7)
[2] Oregon Revised Statutes (ORS) 468B.020(2)(b)
[3] See the Glossary (Appendix F.1) for the definitions of “pollution” (from ORS 468B.005(5)) and “waste” (from Oregon Administrative Rule (OAR) 340-041-00069)
[4] ORS 468B.015(3),(4)
[5] OAR 340-041-0007

# D. Acronyms

| | |
|---|---|
| BMPs | Best Management Practices |
| CIA | Contributing Impervious Area |
| DEQ | Oregon Department of Environmental Quality |
| HUC4 | 4th field Hydrologic Unit Code |
| LA | Load Allocation |
| LID | Low Impact Development |
| NOAA | National Oceanic and Atmospheric Administration |
| NPDES | National Pollutant Discharge Elimination System |
| NRCS | Natural Resource Conservation Service |
| OAR | Oregon Administrative Rule |
| ODOT | Oregon Department of Transportation |
| ORS | Oregon Revised Statute |
| PAHs | Polycyclic Aromatic Hydrocarbons |
| SWMP | Stormwater Management Plan |
| TAPE | Technology Assessment Protocol - Ecology |
| TMDL | Total Maximum Daily Load |
| UIC | Underground Injection Control |
| USDA | United States Department of Agriculture |
| USGS | United States Geological Survey |
| WLA | Waste Load Allocation |
| WQC | Water Quality Certification |
| WRD | Water Resources Department (of Oregon) |

# E. Elements of a Post-Construction Stormwater Management Plan

Refer to Appendix F.2 for a checklist of the necessary elements of a post-construction SWMP. A complete post-construction SWMP includes the elements listed below, each of which is more fully described in steps E.1-E.9, plus any additional information requested by DEQ.

E.1. The water quality storm event;

E.2. A site map showing pre- and post-construction topography, flow patterns, buffers, and any features that could impact the siting and design of structural stormwater controls;

E.3. Documentation that post-construction stormwater runoff generated by the water quality storm event on the CIA within each of the project's drainage basins:

- Will be routed to one or more regional structural stormwater controls with sufficient capacity to accommodate this stormwater runoff without discharging to surface waters or polluting groundwater and the owner(s) accept(s) this runoff, and/or

- Will fully infiltrate (after any necessary treatment), evapotranspirate, and/or be reused onsite, and/or

- Cannot fully infiltrate, evapotranspirate, and/or be reused onsite, but will be treated *prior* to discharging to receiving waters and infiltration (after any necessary treatment), evapotranspiration, and/or reuse will be maximized;

E.4. A description of the design elements used to reduce post-construction stormwater runoff, and any related details and calculations;

E.5. A description of how the project will meet any applicable restrictions or goals from a water quality management plan for the basin, how onsite materials could impact the water quality of post-construction stormwater runoff, and how trees and shading to waters of the state will be preserved (if applicable);

E.6. A description of how post-construction stormwater runoff generated by the water quality storm event on the CIA will be managed to minimize water quality impacts, including site plans showing the structural stormwater controls and drainage basins;

E.7. Design calculations and design details of the structural stormwater controls, citing any stormwater manuals, equations, models, and/or peer-reviewed articles used;

E.8. Details for construction practices; and

E.9. An operations and maintenance plan that identifies the responsible party.

# E.1 Determine the Water Quality Storm Event

DEQ's 401 WQC Program defines the water quality storm event as the greater of 1) the storm event at which 80% of the average annual rainfall comes from storms that are equal to or smaller than that event or 2) the first flush event (assumed to be 0.7 inches of rainfall over 24 hours).[6]

## E.1.1 Determine the Water Quality Storm Event Depth

Option 1: Approximate using Statewide Datasets[6]

1) Find the site's 2-year, 24-hour precipitation. The 2-year, 24 hour precipitation can be found using the National Oceanic and Atmospheric Administration (NOAA) Atlas 2 Precipitation Frequency Estimates (http://www.nws.noaa.gov/ohd/hdsc/noaaatlas2.htm) or the Oregon Department of Transportation (ODOT) Precipitation Data Viewer (ftp://ftp.odot.state.or.us/techserv/geo-environmental/Hydraulics/Precip/ODOT_Precipitation_Data_Viewer.pdf).

2) Multiply the 2-year 24-hour precipitation by the appropriate water quality design storm factor: 0.67 for Zone 9 (Malheur County) and Zone 4 (the Northern Cascades), 0.75 for Zone 5 (the High Plateau) and 0.5 for the rest of the state. See Figure 4 for the zone map.

3) If the results are less than 0.7 inch, use 0.7 inch.

Option 2: Calculate using Local Data

Calculate the depth of a 24-hour storm event that represents at least 80% of the cumulative rainfall using at least 20 contiguous years of rainfall data, beginning in 1996 or earlier to the most recent verified data. If the results are less than 0.7 inch, use 0.7 inch.

## E.1.2 Consider Rainfall Rates

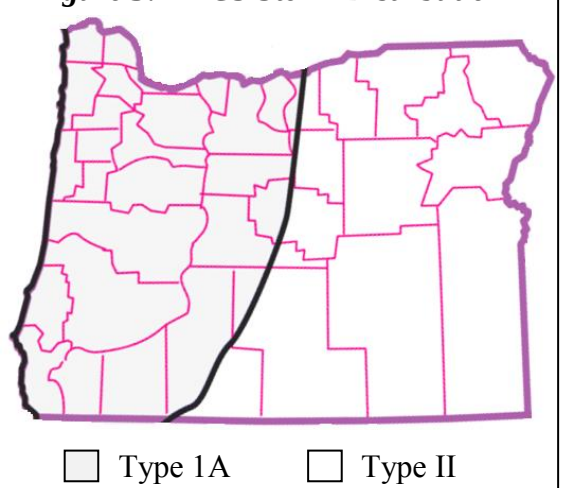
Option 1: Continuous Simulation

Use a continuous simulation program with at least 20 contiguous years of local rainfall, beginning in 1996 or earlier to the most recent verified data to demonstrate at least 80 percent of the average annual rainfall will be treated.

Option 2: Hydrograph Method

Use a single 24-hour storm hydrograph method using an appropriate design storm distribution (such as NRCS Type 1A or Type II) as shown in Figure 3 and multiple these values by the water quality storm event depth found in step E.1.1.

***Figure 3: NRCS Storm Distribution[7]***

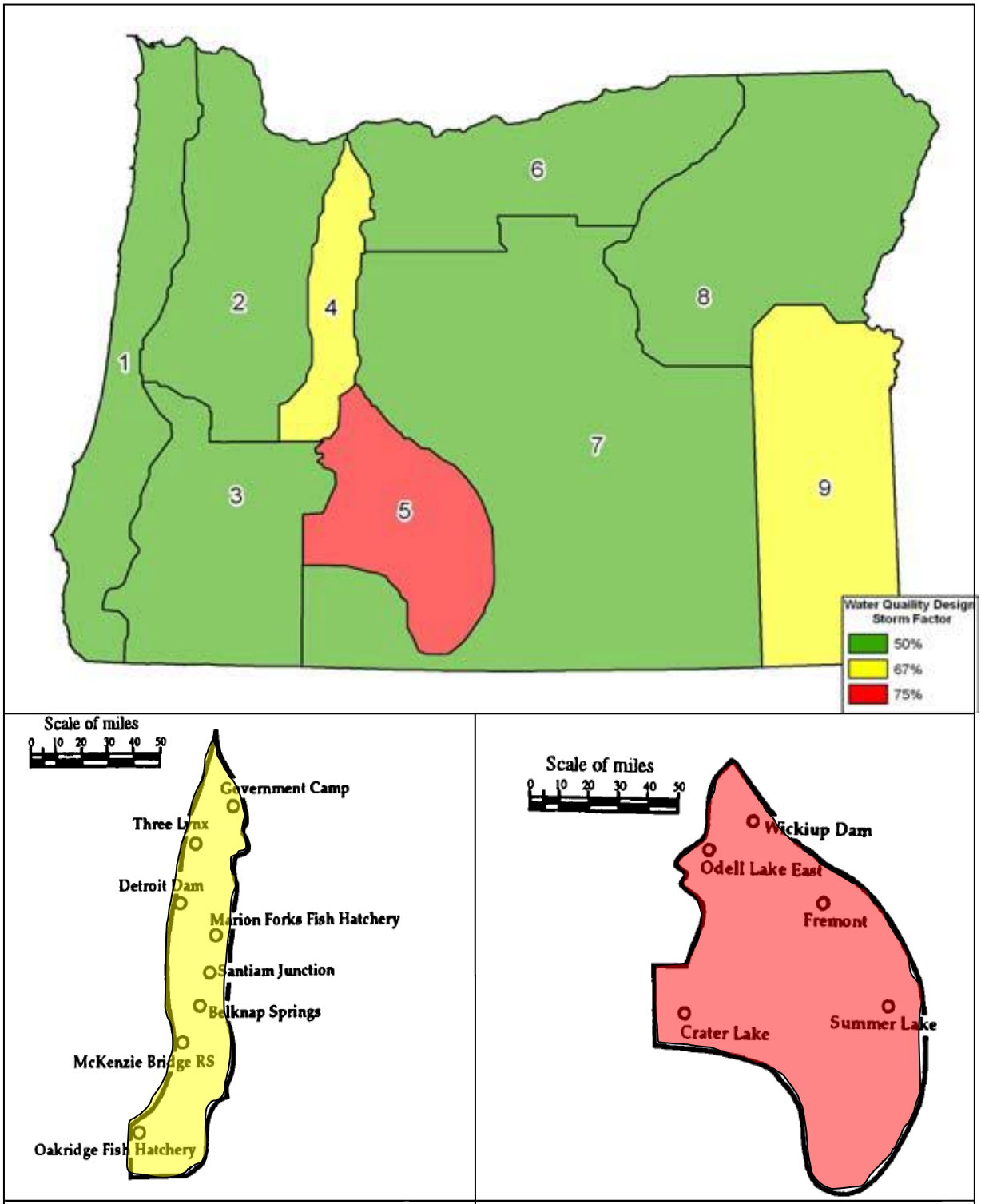



Option 3: Local Stormwater Manual's Rate

Use the local jurisdiction's water quality design rainfall intensity for the time of concentration to rate-based structural stormwater controls if this treats at least 80% of the average annual rainfall.

[6] This is from ODOT's April 9, 2008 Water Quality Design Storm Evaluation Memorandum.
[7] This figure is from the USDA's Urban Hydrology for Small Watersheds, TR-55, June 1986

*Figure 4: Oregon Climate Zone Map*[8]




| Close-up of Zone 4: the Northern Cascades | Close-up of Zone 5: the High Plateau |
|---|---|

[8] This figure is from ODOT's April 9, 2008 Water Quality Design Storm Evaluation Memorandum; the zones are the Oregon Climate Service zones, and the factors are set to approximate 85% of the cumulative annual rainfall. The close-ups are from Special Reports 916 and 917 of the Oregon State University Agricultural Experiment Station.

# E.2 Evaluate Site Constraints

Site conditions and features can influence the siting and design of structural stormwater controls. Evaluate the pre- and post- construction topography and flow patterns and identify any features that impact the siting and design of structural stormwater controls, as described below.

## E.2.1 Identify Areas Not Recommended for Siting Structural Stormwater Controls

Post-construction stormwater runoff from the water quality storm event must be treated prior to discharge to a water of the state. Structural stormwater controls for treating stormwater runoff should not be located within a waterway. Avoid siting structural stormwater controls in sensitive areas (e.g., wetlands, natural buffers, floodplains) or provide justification to the satisfaction of DEQ's 401 WQC Program why this cannot be avoided. If siting structural stormwater controls in wetlands or natural buffers is unavoidable, demonstrate that Oregon Department of State Lands' mitigation requirements will be met. If siting structural stormwater controls in floodplains is unavoidable, address how sediment will be stabilized or removed prior to flood events and how the project will conform to federal, state, and local floodplain regulations.

### E.2.1.1 Protection for Waterbodies

Preserve at least a 50-foot natural buffer around waters of the state to remain onsite, unless infeasible.

## E.2.2 Identify Areas where Excavation and/or Infiltration May be Precluded

Check for areas where infiltration and/or excavation may be precluded, including the areas listed below, and document and follow the advice of the appropriate certified professional or authority. Lined structural stormwater controls may still be permissible where infiltration is precluded.

- Areas with Steep Slopes or Landslide Risk
  Check the topography and Oregon Department of Geology and Mineral Industries' Statewide Landslide Information Database (http://www.oregongeology.org/sub/slido/index.htm). Consult with an Oregon-registered geotechnical engineer or engineering geologist in areas with steep slopes or landslide risk to see if excavation and/or infiltration should be avoided.

- Drinking Water Sources Areas
  Check the DEQ's Drinking Water Protection Interactive Map Viewer (http://www.oregon.gov/deq/wq/programs/Pages/DWP-Maps.aspx) and relevant local data. If the project is within a drinking water source area or groundwater 2-year time of travel, check with the local jurisdiction or the Oregon Health Authority to see if infiltration should be avoided or if structural spill control might be required to protect the resource.

- Areas with Soil or Groundwater Contamination
  Check historical records and DEQ's Environmental Cleanup Site Information database (http://www.oregon.gov/deq/Hazards-and-Cleanup/env-cleanup/Pages/ecsi.aspx) and Facility Profiler-Lite (http://hdcgcx1.deq.state.or.us/Html5viewer291/?viewer=FacilityProfilerLite). If the site has known or suspected contamination, check with DEQ Cleanup to see if excavation and/or infiltration should be avoided to prevent mobilizing contamination.

- Areas within any Setbacks
  Check with the local jurisdiction regarding setback requirements (e.g., property lines, domestic wells, utilities, retaining walls, berms, structures, basements). To protect infrastructure, a partially or fully lined structural stormwater control might be required.

### E.2.3 Check Depth to Groundwater

If groundwater is too shallow, it can interfere with the effective functioning of structural stormwater controls. If not considered in the design of a structural stormwater control, shallow groundwater can take up volume that was intended for stormwater retention and/or treatment. Additionally, for infiltration structural stormwater controls, shallow groundwater can reduce the infiltration rate. Any of the above can result in a structural stormwater control that is undersized. Poor design of structural stormwater controls can also impact groundwater by inadvertently draining groundwater through outlets and, if unlined, by discharging insufficiently treated stormwater runoff to groundwater. To reduce the likelihood of adverse water quality impacts, the following elevations should be considered in the design of the structural stormwater control:

- Outlets
  The invert elevation of any outlets should be above the highest anticipated seasonal groundwater to prevent draining groundwater.

- Infiltration Structural Stormwater Control Bottom
  Avoid siting infiltration structural stormwater controls in areas where shallow groundwater will prevent the structural stormwater control from draining between storm events. Generally the available storage volume within the soil pores should be sufficient to store the volume of post-construction stormwater runoff the structural stormwater control is designed to infiltrate (see step E.7.2.1).

The highest anticipated groundwater elevation can be estimated by reviewing data during the wet season from piezometers, wells, or boring logs and/or checking soil properties for conditions associated with saturation. See the United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) 2017 *Field Indicators of Hydric Soils in the United States* for field indicators of soil conditions associated with saturation (https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcs142p2_053171.pdf). See also the Oregon Water Resources Department (WRD) 2009 *How to Measure the Water Level in a Well* document for a description of well measurements (http://www.oregon.gov/owrd/gw/docs/water_level_booklet.pdf).

Unless the project is small, such as a rain garden for a residential house, a qualified professional such as a soil scientist, engineering geologist, or registered geotechnical engineer should estimate the depth to groundwater.

# E.3 Justify the Level of Infiltration

NOTE: If any of the following apply, provide documentation to DEQ's 401 WQC Program demonstrating which are applicable and then skip to step E.4:

— All of the post-construction stormwater runoff generated by the water quality storm event on the CIA will be routed to one or more regional structural stormwater controls that have a combined capacity sufficient to accommodate this stormwater runoff without discharging to surface waters or polluting groundwater and the owner(s) accept(s) this stormwater runoff.
— There is no onsite area to locate infiltration structural stormwater controls per step E.2.
— There is a high likelihood of spills and structural spill control is not feasible.

Infiltration of post-construction stormwater runoff generated by the water quality storm event on the CIA is recommended unless there is 1) both a high likelihood of spills and structural spill control is not feasible or 2) site constraints preclude infiltration. Unless one of the bullets in the box above apply, review soil data for the project site and perform infiltration testing as described below.

## E.3.1 Review Soil Data

Review existing soil maps such as USDA NRCS soil maps (https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm) and any other relevant, available information. USDA NRCS soil maps are for planning purposes and are useful to help assess where to take infiltration tests; these maps may or may not reflect actual soil conditions.

***Table 1: NRCS Soil Group Infiltration***

| NRCS Group | Suitability for Infiltration Structural Stormwater Controls |
|---|---|
| A | Likely to allow infiltration |
| B | Likely to allow infiltration |
| C | May allow some infiltration |
| D | Likely too slow to allow for infiltration |

## E.3.2 Select Sites for Infiltration Testing

Use the following steps to select onsite areas to perform infiltration testing:

1. Exclude onsite areas where site constraints as identified in step E.2 preclude infiltration structural stormwater controls.

2. Exclude onsite areas where post-construction stormwater runoff will not flow by gravity from impervious areas (i.e., exclude areas upslope of the impervious areas). Multiple onsite structural stormwater controls are encouraged, and each structural stormwater control only needs to be sited downstream of the impervious area from which it will be designed to receive stormwater runoff, not the entire site's impervious area.

3. Select areas to perform infiltration testing based on which areas have soils that are most likely to allow infiltration (e.g., preferably avoid Group D soils).

### E.3.3 Perform Infiltration Testing

Perform at least two infiltration tests on the site, with at least one infiltration test in each area being considered for an infiltration structural stormwater control. At least two business days before digging, call 811 or the One Call Center (http://callbeforeyoudig.org/oregon/index.asp). Follow Oregon Occupational Safety & Health precautions for excavations and do not leave any open excavation unsecured or unmarked. Except for small facilities such as rain gardens serving a single-family residence, an Oregon-registered professional engineer, soil scientist, geologist, or engineering geologist should perform the infiltration tests.

Infiltration tests include percolation, modified percolation, and double-ring infiltrometer tests. "In general…each test involves digging a hole at the approximate location and depth of the proposed infiltration [structural stormwater control], [pre-soaking the hole if recommended], [adding a layer of course sand or fine gravel to the bottom to protect the bottom from scour if recommended], pouring water in an open-bottomed ring or dug hole, and measuring the drop over time from the top…"[9] Pre-soaking the soil in western Oregon is generally recommended to simulate soil conditions during the wet season. Only perform the infiltration test when it is not raining, has not rained more than ½ of an inch in the past 24 hours, and the temperature is above freezing. Follow local manuals and refer to the 2011 *Infiltration Testing Fact Sheet*, by Maria Cahill, Green Girl Land Development Solutions; Derek C. Godwin and Marissa Sowles, and the Oregon Sea Grant Extension (ORESU-G-11-008) *(http://seagrant.oregonstate.edu/sites/seagrant.oregonstate.edu/files/sgpubs/onlinepubs/g11008-lid-infiltration-testing.pdf).*

Document the method and results of the infiltration tests and convert the results into inches per hour. If the tested infiltration rate is too rapid (e.g., > 9 inches/hour), pretreatment or soil amendments may be required in the structural stormwater control; if too slow, it may be impractical to infiltrate all of the post-construction stormwater runoff generated by the water quality storm event on the CIA. If the infiltration rate is less than 0.5 inch/hour, the infiltration structural stormwater control should be designed by a qualified Oregon-registered professional engineer.[10]

[9] From the 2011 *Infiltration Testing Fact Sheet,* Maria Cahill, Green Girl Land Development Solutions; Derek C. Godwin and Marissa Sowles, Oregon Sea Grant Extension.

[10] From the Template for LID Stormwater Manual for Western Oregon, Appendix C Infiltration Testing, Maria Cahill, Green Girl Land Development Solutions.

# E.4 Reduce Stormwater Runoff Volume

Consider options to reduce post-construction stormwater runoff. If the site has known or suspected contamination, check with and follow the advice of DEQ Cleanup. For each relevant item below, either i) describe how it is used, ii) explain why it is not practicable or iii) document that DEQ Cleanup's advice precludes its implementation. Evapotranspiration and/or reuse of post-construction stormwater runoff must be given highest priority wherever practicable.[11]

- Minimize impervious surface area.
    - Design narrow streets and small building footprints (e.g., build up instead of out).
    - Use porous pavement to infiltrate direct precipitation[12] in areas with neither significant windblown sediment,[13] nor a high potential for spills,[14] nor high groundwater.[15]
    - Remove abandoned pavement.
    - Install contained planters over impervious surfaces.
    - Avoid compacting the soil unless necessary.
- Avoid adding impervious surfaces over areas that could be used to infiltrate post-construction stormwater runoff where this would prevent the use of onsite infiltration structural stormwater controls.
- Reuse or infiltrate direct rainfall on roofs (see Figure 5).
    - Use ecoroofs (i.e., green roofs) and infiltrate, evapotranspirate, reuse, or treat the stormwater runoff generated by the water quality storm event on the ecoroof.[16]
    - Harvest rainwater from rooftop surfaces (e.g., using a rain barrel or cistern), directing the initial fraction of an inch of each rain event to vegetated areas.[17]
    - Disconnect roof drain downspouts to gently sloped or flat vegetated areas.
- Retain and plant trees (especially evergreens) and shrubs onsite.

---

[11] OAR 340-041-0007(3) and OAR 340-041-0002(69)
[12] Permeable pavement should be designed to only infiltrate direct precipitation.
[13] Examples of areas with significant windblown sediment include the Summer Lake area.
[14] Examples include vehicle wrecking yards, fast food parking lots, and automotive repair places (from the City of *Eugene's 2014 Stormwater Management Manual, pg 2-45*).
[15] Provide separation between the reservoir's bottom and highest anticipated groundwater per local guidelines.
[16] The load bearing capacity of the roof must be evaluated by an appropriate licensed professional.
[17] Refer to the Building Codes Division Oregon Smart Guide on Rainwater Harvesting for additional information: https://www.oregon.gov/bcd/Documents/brochures/3660.pdf.

***Figure 5: Options for Addressing Stormwater Runoff from Rooftops***[18]

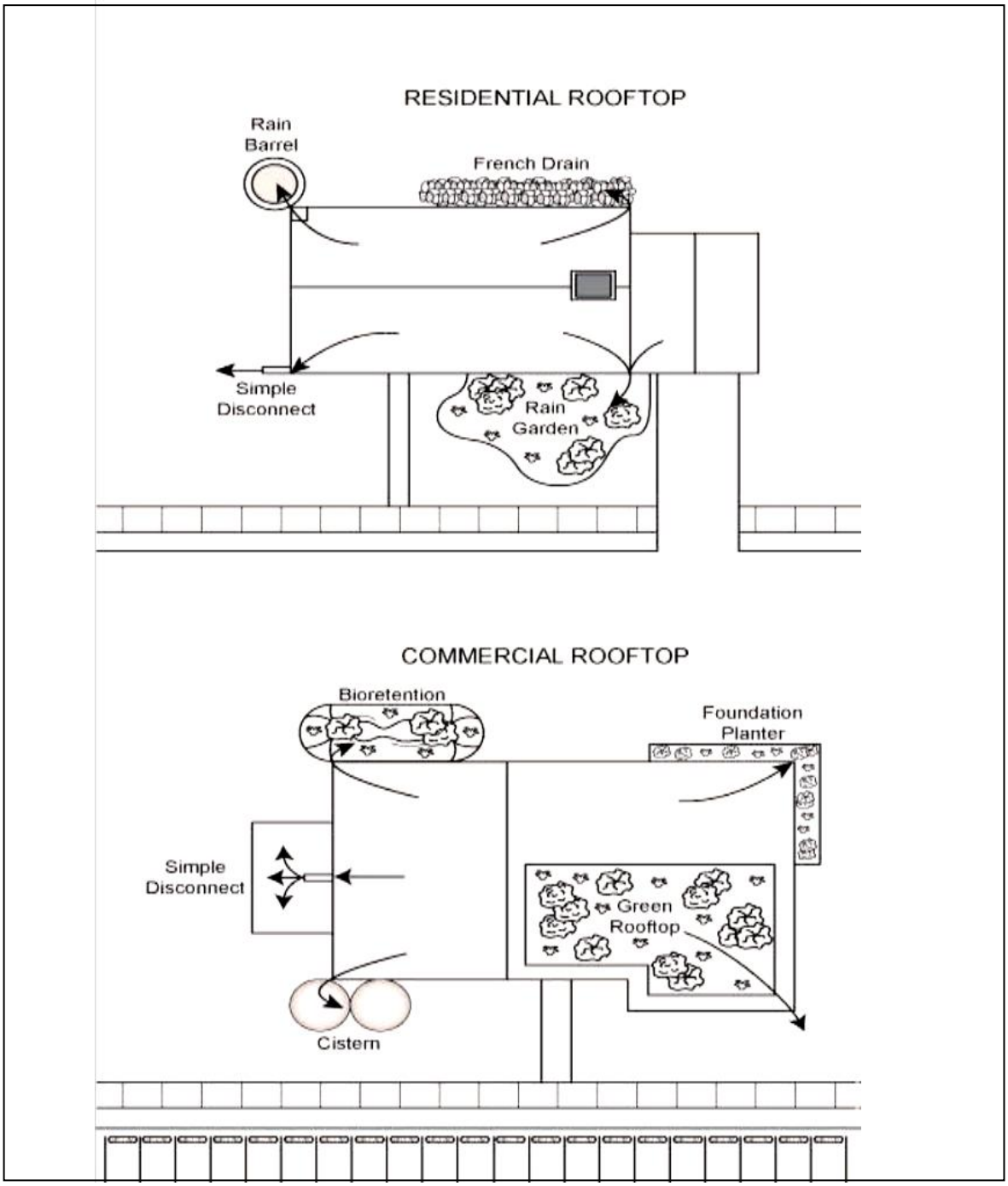



Figure 5 shows a sample residential rooftop and a sample commercial rooftop with multiple design elements to reduce the volume of stormwater runoff discharging offsite and to promote infiltration. Simple disconnection of roof drain downspouts to vegetated areas, rainwater harvesting (with rain barrels or cisterns), and green rooftops are all discussed in this section. Rain gardens, french drains, stormwater planters, and bioretention are discussed in step E.6.

[18] Figure 5 is from *Low Impact Development in Coastal South Carolina: A Planning and Design Guide 4*, page 4-121

# E.5 Review Stormwater Runoff Water Quality Impacts

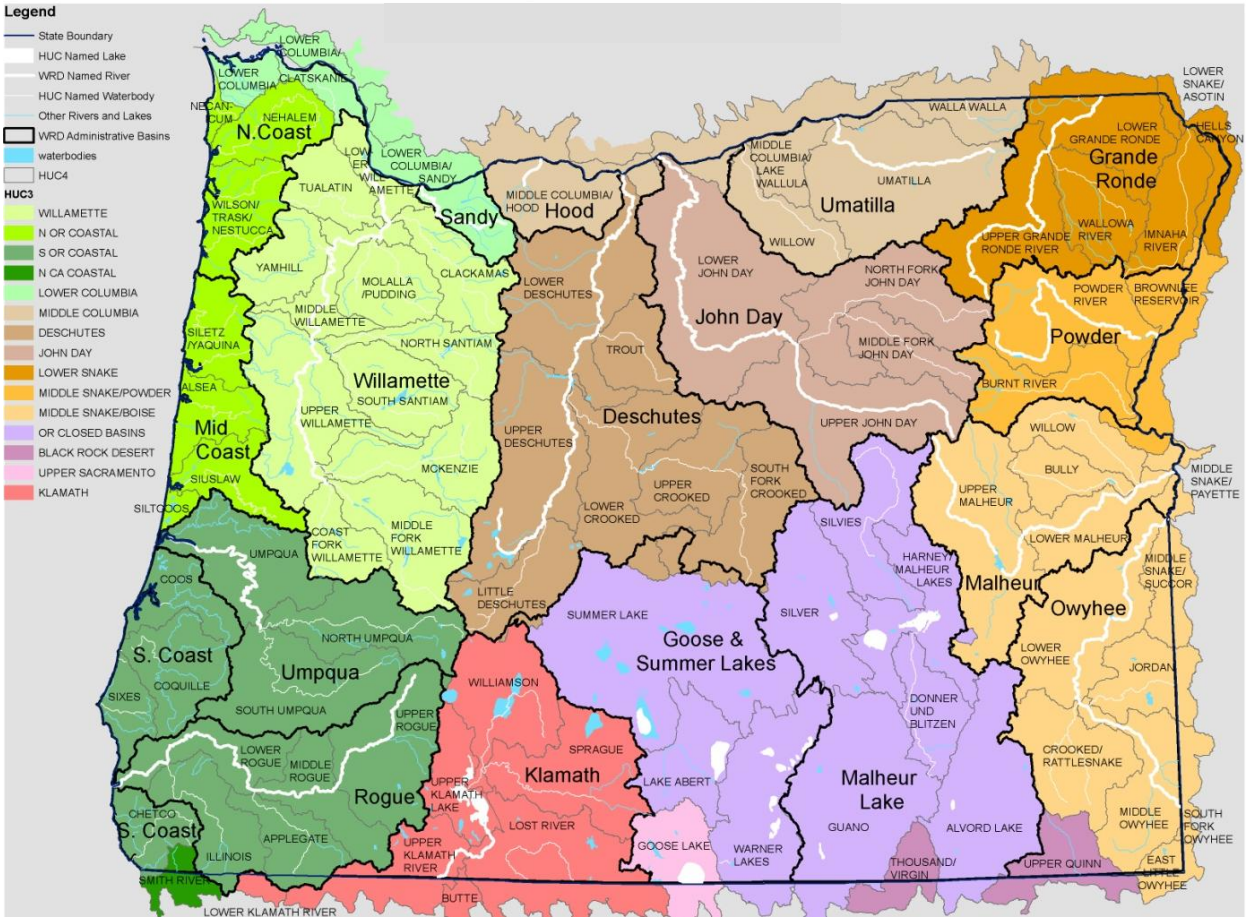
## E.5.1 Receiving Water Beneficial Uses and Water Quality Limited Pollutants

1. Identify each receiving water to which post-construction stormwater runoff discharges.

2. List each receiving water's designated beneficial uses (see Appendix F.3), which are based on the WRD Administration basins (outline in black in Figure 6), except for the Snake and Columbia Rivers, which each have their own designations.

3. List all water quality limited pollutants per the latest EPA-approved Integrated Report Assessment Database. At the time of this publication, this is the 2012 Integrated Report Assessment Database (http://www.deq.state.or.us/wq/assessment/rpt2012/search.asp). The assessment is based on the United States Geological Survey (USGS) 4th field Hydrologic Unit Code basin (HUC4 as outlined in light gray in Figure 6). If the receiving water has any total maximum daily loads (TMDLs), describe any applicable restrictions or goals from the water quality management plan and how these will be addressed (http://www.oregon.gov/deq/wq/tmdls/Pages/TMDLS-Basin-List.aspx).

***Figure 6: Oregon's Basins and Rivers***



### E.5.2 Onsite Materials that Could Impact Water Quality

Design the site to minimize water quality impacts to receiving waters from the post-construction stormwater runoff generated by the water quality storm event on the CIA. Consider the use of cool pavements to reduce thermal impacts to receiving waters. Also consider alternatives to the following materials that could detrimentally impact water quality:

- Galvanized steel (which releases zinc and lead);
- Copper (which releases copper);
- Pavement sealcoats (which release polycyclic aromatic hydrocarbons (PAHs)); and
- Treated wood (which releases copper and arsenic if chromated copper arsenate-treated, PAHs if creosote-treated, and pentachlorophenol if pentachlorophenol-treated).

Provide a map that clearly shows the site's existing impervious surface areas, proposed impervious surface areas, and the CIA and describe all of the applicable items listed below:

- The materials comprising the CIA (e.g., pavement types, roadway sealcoats, roofing materials, exposed treated wood) and their respective areas;

- The materials through which stormwater runoff will be routed prior to entering the structural stormwater control (e.g., architectural features, gutters);

- Any other onsite materials with potential water quality concerns (e.g., community garbage cans (preferably covered by a rooftop));

- Any materials proposed to be directly applied to the site (e.g., fertilizers, pesticides) that could adversely impact water quality and their proposed quantities (preferably minimizing the use of fertilizers and pesticides);

- Any materials that are likely to be left on the ground that could adversely impact water quality (e.g., pet waste in residential areas, litter along highways, lead bullets at shooting ranges) and if pickup is proposed, a description of the type and frequency of pickup;

- The anticipated and design annual average daily traffic of any roadways;

- Any toxic substances that will be transported or stored onsite and any proposed method of spill containment (e.g., structural spill control, spill response plan); and

- Any other activity that could adversely impact water quality (e.g., pressure-washing homes to strip lead paint, car washing).

### E.5.3 Shade Preservation

Avoid loss of shading to waters of the state; this is especially critical in areas that are water quality impaired due to high temperature. Shade loss can be avoided through the preservation of buffers around waters of the state.

# E.6 Select Stormwater Treatment Method(s)

Stormwater treatment should mimic natural hydrology as much as feasible. Low impact development (LID), such as preserving buffers and trees and providing smaller structural stormwater controls distributed throughout the site, is encouraged.

## E.6.1 Provide Structural Stormwater Control(s) for Each Drainage Basin

Divide the site into drainage basins, such that all post-construction stormwater runoff generated by the water quality storm event on the CIA from each drainage basin will be infiltrated and/or treated by a structural stormwater control, suited to treat the constituents of concern. If a structural stormwater control exists onsite, consider retrofitting it, if necessary. Site each structural stormwater control such that it is accessible for maintenance and post-construction stormwater runoff flows to it. Demonstrate the following steps were adhered to in the design:

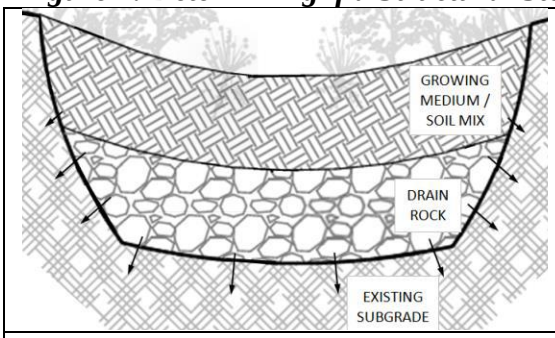
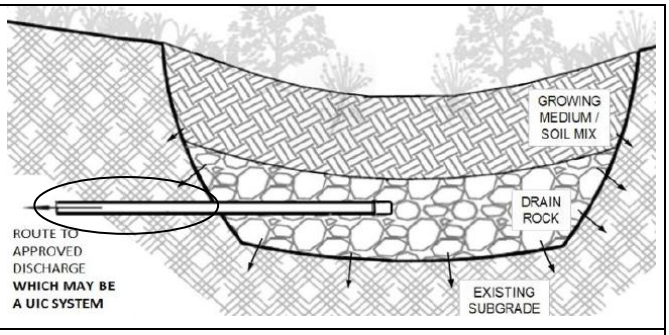
1. Infiltrate as much of the post-construction stormwater runoff generated by the water quality storm event on the CIA as feasible, unless not recommended due to site constraints or spill potential. Include treatment (e.g., filtration through filter media) unless stormwater runoff has already been treated or unlikely to have contaminants (e.g., some rooftops, pedestrian-only areas). Examples of infiltration structural stormwater controls include the following:

   - With treatment (e.g., bioretention basins, stormwater planters, rain gardens, bioslopes, and sand filters) and

   - Without treatment (e.g., soakage trenches, french drains, and drywells).

   If the structural stormwater control is deeper than its largest surface dimension, or uses piping that emplaces stormwater in subsurface soils (see Figure 7 below), the requirements of the Underground Injection Control (UIC) Program apply. UICs must be permitted in Oregon. UIC permittees are required to show that UICs are protective of groundwater. To prevent groundwater pollution, stormwater runoff directed to UICs should either 1) be from areas that are not anticipated to cause pollution or 2) be properly treated prior to discharging to the UIC. To apply for a UIC permit, contact the DEQ UIC Program.

***Figure 7: Determining if a Structural Stormwater Control is a UIC***

| | |
|---|---|
|   |   |
| This is not a UIC, since it is not deeper than it is wide and does not use piping that emplaces stormwater in subsurface soils. | If the pipe outside of the drain rock (circled above) is perforated, this is a UIC as it uses piping that emplaces stormwater in subsurface soils; otherwise this is not a UIC. |

2. For any portion of a site where post-construction stormwater runoff generated by the water quality storm event on the CIA will discharge to a receiving water via pipes and/or overland flow, use vegetated structural stormwater controls if practicable (or if the local climate precludes vegetated structural stormwater controls, use unvegetated structural stormwater controls such as sand filters) and identify both the discharge location(s) and the receiving water(s). *Note that detention ponds are not considered to be a sufficient stand-alone treatment method and should be combined with other structural stormwater controls.* Examples of structural stormwater controls include:

   - Swales and filter strips[19] (e.g., vegetated swales, grassy swales, filter strips);
   - Filters (e.g., bioretention basins, stormwater planters, bioslopes, and sand filters, all with underdrains); and
   - Ponds (e.g., wet ponds, extended wet ponds, and constructed wetlands).

3. If site constraints prevent the above structural stormwater controls (e.g., a highly urbanized area), use proprietary devices that have a general use level designation by the Department of Washington Ecology's Technology Assessment Protocol (TAPE).[20]

### E.6.2 Erosion Control

The above steps are for post-construction stormwater runoff generated by the water quality storm event on the CIA. Post-construction stormwater runoff generated by many different storm events (including those larger than the water quality storm event) on the CIA may contribute to erosion along or within the receiving water. Local jurisdictions typically require larger storm events be detained onsite and released at or below the pre-construction rate for flood control purposes; this detention may alleviate some erosion impacts, but not necessarily all erosion impacts.

On a case-by-case-basis, the DEQ 401 WQC Program may require the applicant for a 401 WQC to evaluate, and if necessary reduce or address, the erosion impacts to receiving waters caused by post-construction stormwater runoff generated by different storm events (including those larger than the water quality storm event).

[19] Swales and filter strips also can serve as alternatives to conventional curb and gutter.
[20] http://www.ecy.wa.gov/programs/wq/stormwater/newtech/technologies.html

# E.7 Design the Structural Stormwater Control(s)

Demonstrate each structural stormwater control is appropriately sized and designed to protect the receiving water's designated beneficial uses and existing water quality. Provide plans, cross-sections, and design details of each structural stormwater control and cite any studies and any stormwater manuals followed. Unless the structural stormwater control is small, such as a rain garden for a residential house, the design should be stamped by a qualified Oregon-registered professional engineer. For small rain gardens, see the 2010 Oregon Rain Garden Guide (Sea Grant, Oregon): *http://seagrant.oregonstate.edu/sgpubs/oregon-rain-garden-guide*. See Appendix F.4 for example details of some post-construction stormwater controls.

## E.7.1 Note Any Special Considerations

Design the structural stormwater control(s) for any conditions that merit special water quality considerations, including the conditions listed in Table 2, as applicable.

***Table 2: Special Considerations for Designing Structural Stormwater Controls***

| *Condition* | *Special water quality consideration* |
|---|---|
| Shallow groundwater | — Locate outlets above the highest anticipated seasonal groundwater.<br>— Size structural stormwater controls assuming groundwater is at its highest anticipated seasonal elevation.<br>— Size infiltration structural stormwater controls such that there is sufficient depth to groundwater to facilitate drainage (e.g., soil pore storage volume ≥ volume of stormwater designed to infiltrate). |
| Water quality limited for temperature | — Shade areas designed for standing water.<br>— Limit exposure of the discharge to heated surfaces such as rip rap.<br>— Preferably infiltrate, evapotranspirate, or reuse the 2-year, 24-hour summertime storm event. |
| Water quality limited for bacteria/ pathogens | — Avoid ponds and swales as the final step in the treatment train.<br>— Provide best management practices (BMPs) to limit bacteria sources (e.g., discourage waterfowl, encourage pet waste pickup). |
| Water quality limited for algae, nitrogen, phosphorus, or dissolved oxygen | — Avoid underdrains below nutrient-leaching filter media that discharge to surface waters.<br>— Consider including subsurface storage.<br>— Consider providing a longer residence time. |
| Floodplain | — Stabilize or remove accumulated sediment before flood events. |
| Wetlands | — Mitigate for any impacts to wetlands. |
| Cold climate | — Avoid ponds and swales in areas with frequent ice or snow events. |
| Saline/brackish waters | — Limit direct freshwater discharges. |
| Low hardness[21] | — Provide additional treatment, such as a longer residence time. |

[21] Note that freshwaters in coastal basins and the Cascades tend to have especially low hardness.

### E.7.2 Appropriately Size the Structural Stormwater Control(s)

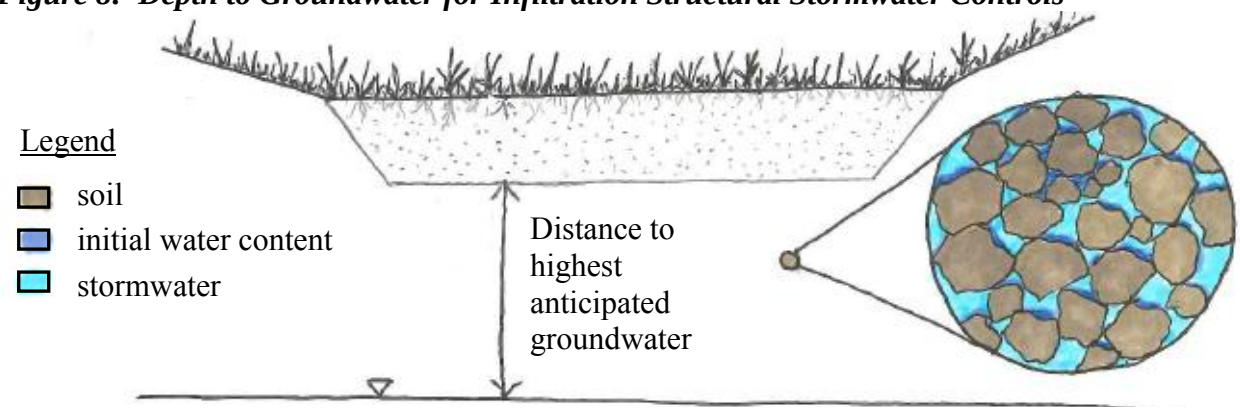
Design each structural stormwater control to ensure it:

- Protects public safety (e.g., has adequate freeboard, is fenced or avoids standing water for extended periods and has no retaining walls, has overflow for the 100-year storm event);
- Avoids creating mosquito breeding habitat (e.g., fully drains within 72 hours) if feasible or is managed to prevent mosquitoes (e.g., stocking with mosquito fish, removing cattails); and
- Treats (or for some UICs, passes) the water quality design storm event and accommodates the subsequent storm event, when groundwater is at its highest anticipated seasonal level:
    - Design *volume-based* structural stormwater controls[22] to store the post-construction stormwater runoff volume generated by the water quality storm event on the CIA;
    - Design *combination rate/volume-based* structural stormwater controls[23] using the hydrograph method or the continuous simulation method (see step E.1.2); and
    - Design *rate-based* structural stormwater controls[24] to provide the minimum residence time, and to not exceed the maximum depth and velocity per protective local guidelines.

#### E.7.2.1 Additional Sizing Requirements for Infiltration Structural Stormwater Controls

The bottom of the structural stormwater control should be sufficiently above the highest anticipated seasonal groundwater to facilitate drainage. Generally, the volume of post-construction stormwater runoff the structural stormwater control is designed to infiltrate should not exceed the storage volume within the soil pores of the subgrade (see Figure 8 below).[25]

***Figure 8: Depth to Groundwater for Infiltration Structural Stormwater Controls***




[22] Examples include constructed wetlands, wet ponds, and extended wet ponds.
[23] Examples include planters, filtration basins, infiltration basins, rain gardens, and sand filters.
[24] Examples include swales, filter strips, and bioslopes.
[25] The storage volume within the soil pores is the volume available for stormwater between the soil particles from the bottom of the structural stormwater control to highest anticipated groundwater and can be calculated as follows: [(soil porosity) – (initial water content (by volume))] * (distance between the bottom of the structural stormwater control and highest anticipated groundwater) * (bottom area of the structural stormwater control).

### E.7.3 Design the Components of the Structural Stormwater Control

Do not use toxic substances in the design of the structural stormwater control (e.g., do not include chemically treated railroad ties and lumber, recycled crushed asphalt, copper, or galvanized metals). Design to local requirements and the plumbing code, where applicable.

#### E.7.3.1 Route and Possibly Pre-treat Stormwater Runoff into the Structural Stormwater Control

Route post-construction stormwater runoff from the CIA to the structural stormwater control(s):

- Consider swales or filter strips, in lieu of "curb and gutter" systems.
- Consider installing a gross pollutant trap to collect sediment, trash and debris.
- Consider providing a settling basin to remove coarse sediment and debris.
- Consider bypassing large flows to minimize erosion and wash-out of contaminants.
- Design any inlet to ensure stormwater runoff enters the structural stormwater control.
- Either grade to ensure sheet flow to the structural stormwater control (required for filter strips), distribute the inflow[26] or provide energy dissipation[27] for erosion control.

#### E.7.3.2 Select the Vegetation (for vegetated structural stormwater controls)

Develop a planting plan for the entire structural stormwater control; vegetation should:

- Not be dormant in the wet season.
- Preferably target the constituents of concern.
- Be consistent with local low-height requirements for visibility and safety.
- Not be invasive.
- Be suitable for the post-construction environment, including the wet and dry zones of the structural stormwater control (based on the bottom of any outlets or the top of any check dams) such that minimal maintenance is required and long-term irrigation is not required.

#### E.7.3.3 Design Filter Media (for structural stormwater controls that include filtration)

Add the appropriate thickness of a filter media (e.g., growing media). Onsite soils may be used if suitable; otherwise import soils or amend soils in place (e.g., tilling in compost or sand). This filter media should:

- Be capable of supporting plant growth (for vegetated structural stormwater controls).
- Preferably target the constituents of concern.
- Not be over-fertilized (test prior to applying fertilizer or compost).
- Have sufficient long-term infiltration capacity to accommodate the design capacity.

#### E.7.3.4 Determine the Type and Thickness of Any Drainage Layer

Except for some structural stormwater controls in well-drained soils and filter strips, generally include a drainage layer (e.g. drain rock) for structural stormwater controls that include filtration, to prevent ponding in flow rate-based structural stormwater controls with shallow slopes and/or to provide subsurface storage. If a drainage layer is used, a separation layer (e.g., aggregate) should divide the filter media from the drainage layer.

[26] Examples of flow distribution include a level spreader, filter strip, or grading.
[27] Examples of erosion control include rock, a concrete splash pad, or a riprap stilling basin.

#### E.7.3.5 Determine Whether Underdrains and Drain Pipe are Needed

Determine if a drain pipe is necessary within the drainage layer and if it needs to serve as an underdrain (i.e., connect to a system that discharges offsite). Underdrains below nutrient-leaching filter media should not discharge to waters impaired for nutrients.

- Choose an appropriate diameter pipe to accommodate the flow.
- Include observation well(s)/cleanout(s).
- Consider installing a valve on the drain pipe near the downgradient end so that water may be retained during the dry season for vegetation and drained as needed.

#### E.7.3.6 Determine the Type of Liner, if Needed

Provide a liner only if lined structural stormwater controls are required or recommended.

#### E.7.3.7 Consider Stormwater Runoff Routing and Containment

Consider how post-construction stormwater runoff within the structural stormwater control will be contained and routed. Consider check dams or baffles to slow the flow of stormwater runoff.

- Check local manuals to ensure adequate freeboard.
- Generally design for shallow side slopes (except for stormwater planters).
- Check dams should be integrated into the grading, installed perpendicular to the flow path and generally include an orifice for low flows and to minimize long-term ponding.

#### E.7.3.8 Outflow

Provide an outlet unless the structural stormwater control is designed to infiltrate all of the post-construction stormwater runoff that can enter through the inlet (including any storms larger than the water quality storm event up to the 10-year, 24-hour storm event, if these can enter through the inlet). Consider the following:

- Provide conveyance for the 100-year storm event, considering public safety.
- Either distribute the outflow or provide energy dissipation.[28]
- Provide a screen (e.g., trash rack) on outfalls.
- Set the invert elevation of the outlet such that the post-construction stormwater runoff generated by the water quality storm event on the CIA in the drainage basin either does not discharge through it or discharges only after receiving adequate treatment.
- Size the outflow pipe to ensure an adequate residence time, if applicable.

#### E.7.3.9 Access

Design the site to ensure there is maintenance access to the structural stormwater control. For underground detention, provide access to the upstream side of any outlets from underground detention. To prevent public access and protect public safety, fencing may be needed (e.g., if there are retaining walls, steep slopes, and/or standing water for more than 24 hours). Any fencing near a wildlife corridor should be wildlife-friendly.

[28] Examples of energy dissipation include riprap, energy dissipaters, or orienting the discharge pipe to prevent erosion on the opposite bank (when discharging to a channel).

# E.8 Provide Details for Construction Practices

Construction methods can impact the long-term functioning of structural stormwater controls. Clearly explain how each structural stormwater control will be constructed, including the type of equipment and fuel to be used and provide the following construction practice details, as appropriate, both in the application and in the construction specifications and drawings.

### E.8.1 Provide Construction Quality Assurance

Before construction, test any filter media (e.g., growing media) to ensure it meets the specifications and, for infiltration structural stormwater controls, test the subbase to ensure it meets the design rate. After construction, check structural stormwater control elevations (including the inlets and outlets and the bottom of the structural stormwater controls), and the dimensions and slopes. For infiltration structural stormwater controls, also check the infiltration rate after construction.

### E.8.2 Protect Structural Stormwater Controls and Trees

Describe how areas proposed to be structural stormwater controls will be clearly marked off (e.g., with orange constructing fencing or a covering) before site work begins to prevent compaction. Do not allow staging areas or vehicles (except those specifically authorized to construct the structural stormwater control) within 10 feet of areas proposed to be infiltration structural stormwater controls. Describe how trees to be preserved will be protected.

### E.8.3 Prevent Sediment Inundation within the Structural Stormwater Control

Prevent structural stormwater controls from being inundated with sediment from construction. Remove any construction-related sediment from all structural stormwater controls.

### E.8.4 Prevent Erosion into and within the Structural Stormwater Control

Protect any exposed areas of structural stormwater controls (e.g., with jute matting, tackified mulches (in low velocity areas), biodegradable blankets or nets, or turf reinforcement mats) until plants have become fully established. Plants must be established prior to routing concentrated flows to the structural stormwater control.

### E.8.5 Establish Plants for Long-Term Success

- Salvage onsite plants for later planting, as appropriate.
- Prepare the site prior to planting:
  - For constructed wetlands, after excavation, keep the excavation flooded until planting, and then drain the excavation just before planting.
  - For infiltration structural stormwater controls, scarify native soil within 24-hours before planting and after all machinery work and debris removal, when rain is not forecasted.
- Schedule planting during the growth season and time seeding to avoid rain wash-off.
- Install an irrigation system only if necessary to establish plants and remove any irrigation system after plants are established.

# E.9 Provide an Operations and Maintenance Plan

Provide an operations and maintenance plan that includes the items described below:

## E.9.1 Best Management Practices (BMPs) at the Site

Describe BMPs used to reduce pollution at the source (e.g., pet waste pickup, roof-covered community garbage cans, a street sweeping schedule).

## E.9.2 Structural Stormwater Control Upkeep

Provide an inspection schedule that includes an annual inspection in the spring, fall and after large storm events. The plan should describe the following items, as appropriate.

### E.9.2.1 Debris and Sediment Removal

Remove sediment build-up (e.g., clogged inlets/outlets, pretreatment areas, splash pads) and remove trash, leaf litter, and other debris. Consider sending clippings to a composting facility.

### E.9.2.2 Vegetation Maintenance (for vegetated structural stormwater controls)

Remove invasive plants (e.g., Himalayan blackberry). Weed the structural stormwater control, minimizing pesticides and herbicides. Reseed bare areas and replace dead plants semi-annually. If mowing is required, consider requiring a retractable-arm mower to avoid compaction.

### E.9.2.3 Replace Filter Media (if used)

Periodically check for standing water after storms to determine if the filter media is clogged. Conduct infiltration tests and replace the top 1-2 inches of the filter media, as needed.

### E.9.2.4 Check for Operational Problems and Damages

Repair damaged surfaces (e.g. damaged by erosion, rodents, tree roots), correct operational problems (e.g., rill formation), and, if there are embankments, check for embankment stability issues (e.g., cracking, leaking).

### E.9.2.5 Other

Clean and flush risers, as needed. Provide mosquito control (e.g., restock mosquitofish, remove cattails) as needed if the structural stormwater control has standing water for four or more days.

## E.9.3 Identify Prohibited Activities

Prohibit heavy equipment and stockpiling materials in infiltration structural stormwater controls. Prohibit applying sealcoats to, stockpiling materials in, and routing stormwater runoff to porous pavement. Prohibit applying sand to porous pavement (except porous concrete during the first year, where it must be swept and vacuumed after each application of sand).

## E.9.4 Identify Maintenance Responsibility

Operation and maintenance responsibility must be assigned to an existing person or entity. Provide the name and contact information and the process for transferring maintenance responsibility in the future (e.g., delegated to homeowners associations, or contracted out to management entities). The applicant is responsible for maintenance unless documentation is provided to DEQ that demonstrates another entity has agreed to be the responsible party.

# F. Appendices

# F.1 Glossary

The following definitions apply for the purposes of this document.

**2-year, 24-hour precipitation:** The amount of rainfall over a 24-hour period that has a 50% probability of occurring in a given year. The 2-year, 24 hour precipitation can be found using the NOAA Atlas 2 Precipitation Frequency Estimates (http://www.nws.noaa.gov/ohd/hdsc/noaaatlas2.htm) or the ODOT Precipitation Data Viewer (ftp://ftp.odot.state.or.us/techserv/geo-environmental/Hydraulics/Precip/ODOT_Precipitation_Data_Viewer.pdf).

**10-year, 24-hour storm event:** The amount of rainfall over a 24-hour period that has a 10% probability of occurring in a given year.

**401 Water Quality Certification (WQC):** A determination made by DEQ that a dredge and fill activity, private hydropower facility, or other federally licensed or permitted activity that may result in a discharge to waters of the state has adequate terms and conditions to meet state water quality standards and other applicable water quality laws. The federal permit in question may not be issued without this state determination in accordance with the Federal Clean Water Act, section 401 (33 USC 1341).[29]

**Amend:** The process of adding material to the soil or growing media to improve its characteristics for plant growth, water quality treatment, or infiltration purposes.

**Amendment:** The material added to the soil or growing media to improve its characteristics for plant growth, water quality treatment, or infiltration purposes.

**Baffle:** A structure designed to slow and/or redirect flow within a structural stormwater control.

**Best Management Practices (BMPs):** Schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of "waters of the United States." BMPs also include treatment requirements, operating procedures, and practices to control [project] site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.[30]

**Bioretention Basin:** A structural stormwater control that is comprised of a shallow, landscaped depression with growing media and vegetation that allows stormwater runoff to pond in a designated area, then filter through the filter media (e.g., growing media) and vegetation and possibly infiltrate to groundwater. Small-scale bioretention basins are also known as rain gardens.[31] See Appendix F.4 for example details of bioretention basins.

**Bioslope:** A structural stormwater control that is comprised of a trench filled with aggregate at the top, filter media in the middle, and a drain layer at the bottom. Bioslopes are typically

[29] From the Clean Water Act Section 401 and OAR 340-041-0002(1)
[30] 40 Code of Federal Regulations 122.2.
[31] From EPA's website https://www.epa.gov/greeningepa/stormwater-management-practices-epa-facilities

preceded by filter strips that provide pretreatment. See Appendix F.4 for a design detail of a bioslope.

**Check Dam:** A small dam or weir located across an open channel within a structural stormwater control to slow down the flow.

**Cistern:** A container to which stormwater runoff is directed and stored for later use. Cisterns are generally for larger applications than rain barrels. See also the definition for "Rain Barrel".

**Cleanout:** A pipe fitting that allows access to a pipe for maintenance purposes (e.g., inspecting and clearing clogs).

**Combination rate/volume-based structural stormwater control:** A structural stormwater control where there is a combination of ponding and flow-through (e.g., filtering through media). Examples include stormwater planters, bioretention basins, rain gardens, and sand filters.

**Compost:** A substance derived primarily or entirely from the decomposition of vegetative or animal organic material that is distributed for the purpose of promoting or stimulating plant growth and to which no fertilizer, agricultural amendment, agricultural mineral or lime product is added other than to promote decomposition.[32]

**Concentrated Flow:** Stormwater runoff that has converged and accumulated.

**Constructed Wetlands:** A structural stormwater control designed to mimic natural wetlands, with growing media and vegetation that provides for standing water or saturated conditions within a foot of the ground surface.

**Contained Planter:** A vegetated container placed over impervious surface.

**Contributing Impervious Area (CIA):** All impervious surface areas within the project boundaries plus impervious surface areas owned or managed by the same entity from which stormwater runs overland or via discrete conveyance (e.g., piped) to an area within the project boundaries. The area outside of the project boundaries that is considered to be part of the CIA may be negotiated for public works projects if necessary to make the project economically feasible.

**Designated Beneficial Use:** The purpose or benefit to be derived from a water body as designated by the Water Resources Department or the Water Resources Commission.[33] See Appendix F.3 for a list of designated beneficial uses.

**Detention Pond:** A structural stormwater control that is comprised of a depression that stores and slowly releases stormwater runoff.

[32] ORS 633.311(5)
[33] OAR 340-041-0002(17)

**Drainage Basin:** All of the area that contributes post-construction stormwater runoff to the structural stormwater control.

**Drywell:** A structural stormwater control that is comprised of a deep, vertical underground structure with perforations that stores stormwater runoff until it can infiltrate out the sides.[34]

**Ecoroof:** A type of rooftop that includes vegetated growing media over a drainage layer all overlying a waterproof membrane to protect the roof.

**Energy Dissipation:** A design feature to prevent erosion from stormwater runoff.

**Erosion:** The movement of soil particles or rock fragments by water or wind.

**Evapotranspirate:** Evaporation from surfaces (e.g., soils, water surfaces, and vegetative surfaces) plus transpiration through vegetative surfaces (e.g., leaves).

**Extended Wet Pond:** A structural stormwater control that is comprised of a depression that provides a permanent pool of water with growing media and vegetation and an outlet. Extended wet ponds are wet ponds that have additional storage above the permanent pool of water to meet flow control requirements for storm events larger than the water quality storm event.

**Feasible:** Technologically possible and economically practicable and achievable in light of best industry practices.

**Filter Strip:** A structural stormwater control that is comprised of gently sloping dense vegetation that receives sheet flow from impervious surfaces. See Appendix F.4 for an example detail of a filter strip.

**Filtration:** The physical straining of suspended particles (and pollutants that adhere to these particles) in stormwater runoff through filter media (e.g., growing media). The size of the voids in the filter media and the rate of flow impact the size and shape of the particles that will be filtered.

**First Flush Event:** The initial stormwater runoff with a higher pollutant concentration than stormwater runoff later in the storm event. For purposes of determining the water quality event, the "first flush" event is assumed to be 0.7 inches over a 24-hour period.

**Floodplain:** An area along a waterway subject to flooding when the stream overflows its banks.

**Foundation Planter:** See the definition for "Stormwater Planter".

**Freeboard:** The vertical distance between the highest point of the structural stormwater control that is capable of fully storing water and the highest design water elevation.

---

[34] DEQ 2015 Fact Sheet Identifying an Underground Injection Control http://www.oregon.gov/deq/FilterDocs/IDswInjSysFS.pdf

**French Drain:** A structural stormwater control that is comprised of a trench filled with aggregate and a perforated pipe.

**Green Roof/Green Rooftop:** See the definition for "Ecoroof".

**Gross Pollutant Trap:** A structure that physically separates out of stormwater runoff, large pollutants (e.g., litter, debris, coarse sediment) and/or pollutants less dense than water (e.g., oils, floatables). Examples include water quality manholes (with a sump) and catch basin inserts.

**Groundwater:** Water beneath the land surface where the soil is fully saturated.

**Growing Media:** A soil or other base that supports vegetation.

**Highest Anticipated Seasonal Groundwater:** The highest elevation that groundwater is anticipated to typically reach annually.

**Impervious Surface:** Any surface resulting from development activities that prevents the infiltration of water or results in more stormwater runoff than in the undeveloped condition. Common impervious surfaces include building roofs; traditional concrete or asphalt paving on walkways, driveways, and parking lots; gravel lots and roads; and packed earthen materials.

**Infiltration:** Flow of rainfall or stormwater runoff into the soil through soil pores.

**Infiltration Rate:** The velocity at which stormwater runoff flows into the soil through soil pores.

**Infiltration Structural Stormwater Control:** A structural stormwater control designed to infiltrate stormwater into the soil beneath the structural stormwater control.

**Level Spreader:** A design feature to evenly distribute stormwater runoff.

**Low Impact Development (LID):** A land development approach that mimics natural hydrology by preserving natural resources and infiltrating stormwater runoff close to where it falls.

**Minimize:** Reduce and/or eliminate, or both, to the extent achievable using control measures (including best management practices) that are technologically available and economically practicable and achievable in light of best industry practice.

**Natural Buffer:** An area of undisturbed natural cover surrounding surface waters within which construction activities are restricted. Natural cover includes the natural vegetation, exposed rock, and barren ground that existed prior to commencement of earth-disturbing activities.

**Nutrients:** Substances necessary for the growth and maintenance of life; notably nitrogen and phosphorus.

**Observation Well:** A well (e.g., pipe) that allows subsurface drainage to be monitored.

**Pollution:** Such alteration of the physical, chemical or biological properties of any waters of the state, including change in temperature, taste, color, turbidity, silt or odor of the waters, or such discharge of any liquid, gaseous, solid, radioactive or other substance into any waters of the state, which will or tends to, either by itself or in connection with any other substance, create a public nuisance or which will or tends to render such waters harmful, detrimental or injurious to public health, safety or welfare, or to domestic, commercial, industrial, agricultural, recreational or other legitimate beneficial uses or to livestock, wildlife, fish or other aquatic life or the habitat thereof.[35]

**Porous Pavement:** Also known as permeable pavement. This is a special type of pavement that allows rainwater and snowmelt to pass through it, thereby reducing the stormwater runoff from a site. In addition, porous pavement filters some pollutants from the infiltrated rainwater and snowmelt. Porous pavement includes porous asphalt and pervious concrete.[36]

**Pretreatment:** Initial stormwater treatment prior to entering the main part of the structural stormwater control; this typically involves settling or screening stormwater runoff to remove coarse sediment, debris, and/or trash, thereby minimizing maintenance requirements and extending the life of the structural stormwater control.

**Rain Barrel:** A barrel to which stormwater runoff is directed and stored for later use. Rain barrels are typically for smaller applications than cisterns. See also the definition for "Cistern".

**Rain Garden:** A "sunken garden bed" with gentle side slopes and vegetation that collects and ponds stormwater runoff and passes it through filter media (e.g., growing media). Rain gardens are small-scale bioretention areas. See Appendix F.4 for an example detail of a rain garden.

**Rainfall Intensity:** The rate at which rain falls over a given period of time. In a given storm event, the rainfall intensity will vary, as there may be short bursts of heavy rainfall.

**Rainwater Harvesting:** Collecting, storing, and using rainwater or stormwater runoff.

**Rate-Based Structural Stormwater Control:** A structural stormwater control where stormwater runoff is not ponded, but instead flows through the control. Examples include filter strips, bioslopes, and some swales (swales can also be designed as combination rate/volume based structural stormwater controls, with check dams ponding stormwater runoff).

**Receiving Water:** The waterbody into which stormwater runoff discharges.

**Residence Time:** The average time it takes for stormwater runoff to travel though the structural stormwater control.

**Rill:** A shallow channel formed by concentrated flow.

---

[35] ORS 468B.005(5)

[36] EPA Stormwater Technology Fact Sheet- Porous Pavement, EPA 832-F-99-023

**Riser:** A vertical structure within a structural stormwater control with one or more openings that allow treated stormwater runoff to flow to the outlet pipe for discharge.

**Sand Filter:** A structural stormwater control that is comprised of a depression that temporarily stores water with sand or sand and gravel as the filter media. Vegetation is optional in a sand filter. See Appendix F.4 for an example detail of a sand filter.

**Scarify:** Loosen and make less dense near the surface.

**Settling Basin:** A structural stormwater control that is comprised of a depression to collect stormwater runoff and slow it down sufficiently to provide the time for suspended particles in the stormwater runoff to fall through the water column by gravity and accumulate at the bottom.

**Sheet Flow:** Stormwater runoff over the surface as a uniform film of water, before it has converged into concentrated flow.

**Soakage Trench:** An excavated trench filled with aggregate that receives stormwater runoff and stores it until it infiltrates.

**Soil Pore:** Open space (i.e., voids) between soil particles.

**Soil Porosity:** The ratio of the volume of the voids in the soil (i.e., soil pore volume) to the total volume of the soil.

**Stormwater:** Water from precipitation or snowmelt that collects on or runs off outdoor surfaces such as buildings, roads, paved surfaces and unpaved land surfaces.[37]

**Stormwater Planter:** A structural stormwater control with vertical side slopes and a flat bottom that includes growing media and vegetation. Stormwater planters pond stormwater runoff and provide filtration through the filter media (e.g., growing media). See Appendix F.4 for example details of stormwater planters.

**Structural Spill Control:** A structure that contains spills so that they can be effectively cleaned up. Examples include spill control manholes and secondary containment.

**Structural Stormwater Control:** A physical feature to which stormwater runoff is directed and that is designed to infiltrate or slow down stormwater runoff. Unless all of the stormwater runoff directed to the structural stormwater control is from an area unlikely to introduce contaminants (e.g., some rooftops) the structural stormwater control should provide treatment through a combination of settling, flotation, screening, filtration, adsorption, photodegradation, microbial degradation and/or biological uptake.

**Swale:** A structural stormwater control that is comprised of a vegetated channel with a shallow slope or check dams to provide a low velocity through the channel. Grassy swales are planted

[37] OAR 340-044-0005(41)

with grasses; vegetated swales are planted with other vegetation. See Appendix F.4 for example details of vegetated swales.

**Time of Concentration:** The travel time from the hydraulically most distant point in the drainage basin (or the CIA) to the point of interest (i.e., the time it takes for stormwater runoff from all parts of the drainage area to contribute to flow at the point of interest). In designing structural stormwater controls, the point of interest is the inlet to the structural stormwater control.

**Total Maximum Daily Load (TMDL):** The sum of the individual waste load allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and background. If [the] receiving water has only one point source discharger, the TMDL is the sum of that point source WLA plus the LAs for any nonpoint sources of pollution and natural background sources, tributaries, or adjacent segments. TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure. If Best Management Practices (BMPs) or other nonpoint source pollution controls make more stringent load allocations practicable, then wasteload allocations can be made less stringent. Thus, the TMDL process provides for nonpoint source control tradeoffs.[38]

**Toxic Substance:** Those pollutants or combinations of pollutants, including disease-causing agents, that after introduction to waters of the state and upon exposure, ingestion, inhalation or assimilation either directly from the environment or indirectly by ingestion through food chains will cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions (including malfunctions in reproduction), or physical deformations in any organism or its offspring.[39]

**Underdrain:** A portion of a structural stormwater control filled with aggregate and a perforated pipe that discharges stormwater runoff to a point outside of the footprint of the structural stormwater control. Underdrains are located beneath any vegetation and growing media.

**Underground Injection Control (UIC):** A structural stormwater control that is deeper than its largest surface dimension or uses piping that emplaces stormwater in subsurface soils.

**Unvegetated Structural Stormwater Control:** A structural stormwater control that does not rely on vegetation as part of the treatment process.

**Vegetated Structural Stormwater Control:** A structural stormwater control that relies on vegetation as part of the treatment process.

**Volume-Based Structural Stormwater Control:** A structural stormwater control that is sized to store and treat a specific volume of stormwater runoff. Examples include wet ponds, extended wet ponds, and constructed wetlands.

[38] OAR 340-041-0002(65)
[39] OAR 340-041-0002 (66)

**Waste:** Sewage, industrial wastes, and all other liquid, gaseous, solid, radioactive, or other substances that may cause or tend to cause pollution of any water of the state.[40]

**Water Content (by Volume):** The ratio of the volume of the water in the soil to the total volume of the soil.

**Water Quality Storm Event:** The design storm event used to size structural stormwater controls. The DEQ 401 WQC Program defines this as the rainfall depth or flow rate that corresponds to eighty percent of the annual average rainfall, or the "first flush" event, whichever is greater. See step E.1 for instructions regarding how to determine the water quality storm event.

**Waters of the State:** Lakes, bays, ponds, impounding reservoirs, springs, wells, rivers, streams, creeks, estuaries, marshes, inlets, canals, the Pacific Ocean within the territorial limits of the State of Oregon, and all other bodies of surface or underground waters, natural or artificial, inland or coastal, fresh or salt, public or private (except those private waters that do not combine or effect a junction with natural surface or underground waters) that are located wholly or partially within or bordering the state or within its jurisdiction.[41] Structural stormwater controls are not waters of the state provided they neither were originally created in waters of the state nor resulted from the impoundment of waters of the state.[42]

**Well:** A bored, drilled, driven or dug hole whose depth is greater than its largest surface dimension, an improved sinkhole, a sewage drain hole, or a subsurface fluid distribution system.[43]

**Wetlands:** Areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.[44]

**Wet Pond:** A structural stormwater control that is comprised of a depression that provides a permanent pool of water with growing media and vegetation and an outlet. Wet ponds with extra storage above the permanent pool of water to provide flow control for storm events larger than the water quality storm event are called 'extended wet ponds'.

[40] OAR 340-041-0002 (69)
[41] OAR 340-041-0002(72)
[42] Adapted from 40 Code of Federal Regulations 122.2
[43] OAR 340-044-0005(51)
[44] From USACE and EPA definitions

## F.2 Post-Construction SWMP Checklist

Provide, at a minimum, the following plus any information specifically requested by DEQ.

- ☐ A cover page, including:
  - ☐ Date
  - ☐ Project name and number (e.g., U.S. Army Corps of Engineers number, if applicable)
  - ☐ Plan preparer's name and contact information
  - ☐ An Oregon-registered engineer's stamp and signature *(unless the structural stormwater control is small, such as a rain garden for a single family residence)*

- ☐ Site plans showing the following:
  - ☐ Reference information (e.g., title, north arrow, scale bar, legend, and date)
  - ☐ The pre- and post-construction topography
  - ☐ Any features that impact the siting and design of structural stormwater controls
  - ☐ Buffers for waters of the state to remain onsite (50-ft minimum unless infeasible)
  - ☐ Existing, new, removed, and contributing impervious surface areas
  - ☐ The locations of any infiltration tests
  - ☐ The drainage basin for each structural stormwater control
  - ☐ The stormwater conveyance system
  - ☐ Structural stormwater controls
  - ☐ The discharge point(s) from the structural stormwater controls
  - ☐ The route stormwater flows from the structural stormwater control to the receiving waters
  - ☐ The name(s) and flow direction(s) of the receiving waters

- ☐ A description of how post-construction stormwater runoff generated by the water quality storm event on the CIA from each drainage basin will be managed to minimize impacts to water quality, and avoid sensitive areas (or provide justification why this is infeasible, along with the necessary mitigation) including documentation that this stormwater runoff either be:

  - ☐ Routed to one or more regional structural stormwater controls with a combined capacity sufficient to accommodate this runoff without discharging to surface waters or polluting groundwater (provide documentation that the owner(s) accept(s) this runoff) and/or

  - ☐ Infiltrated (after any necessary treatment), evapotranspirated, and/or reused onsite (if infiltrated, include results of infiltration tests) and/or

  - ☐ Treated prior to discharge to receiving waters as there is either insufficient or no onsite area to locate infiltration structural stormwater controls or there is both a high likelihood of spills and structural spill control is not feasible (provide justification, including a description of site constraints and the results of any infiltration tests).

- ☐ A description of the design elements to reduce stormwater runoff, including:
  - ☐ How impervious surface area is minimized
  - ☐ How rainfall on roofs is managed (if applicable)
  - ☐ How trees and shrubs are retained and/or planted onsite or why this is infeasible

- A description of the water quality impacts of the site and receiving water status:
  - Receiving waters' beneficial uses and water quality limited pollutants
  - Materials that could impact water quality (including materials comprising the CIA)
  - How any applicable water quality mangement plan goals and/or restrictions will be met
  - How shading is preserved

- A description of and design details of each structural stormwater control, including:
  - An identification of any UICs
  - A description of any pretreatment
  - Cross section(s) showing relevant features including
    - Dimensions and slopes
    - Elevation of the bottom of the structural stormwater control
    - Inlet and outlet sizes and invert elevations
    - Thickness of any filter/growing media, drain layer, and separation layer
  - Plan view(s) showing relevant features (including dimensions)
  - The plantings (including species, locations, and density)
  - Filter/growing media specifications (including composition and infiltration rate)
  - Drain layer specifications (including the size of any drain rock and any pipes)
  - Description of any other relevant features (e.g., liners, energy dissipation)
  - How maintenance access will be provided

- Design calculations and printouts, including the following:
  - The stormwater management manual used
  - The models, equations, and/or any studies used and any associated limitations
  - The water quality storm event
  - The elevation of the highest anticipated seasonal groundwater
  - The minimum residence time (if applicable)
  - The maximum velocity (if applicable)
  - Any special conditions (e.g., cold climate, low hardness receiving waters)
  - *For infiltration structural stormwater controls,* the soil pore storage volume

- Construction details, including the following, as appropriate:
  - The type of equipment and fuel to be used
  - Quality control/quality assurance to be implemented for structural stormwater controls
  - How the structural stormwater control(s) and trees will be protected from compaction
  - How the structural stormwater control(s) will be protected from inundation with sediment
  - How the structural stormwater control(s) will be protected from erosion
  - A planting plan to establish plants for long-term success

- An operations and maintenance plan, including the following:
  - A description of best management practices
  - An inspection schedule and list
  - A description of any prohibited activities
  - An identification of the responsible party

# F.3 Designated Beneficial Uses

| Basins | Waters | Beneficial Uses | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Public Domestic Water Supply[1] | Private Domestic Water Supply[1] | Industrial Water Supply | Irrigation | Livestock Watering | Fish & Aquatic Life[2] | Wildlife & Hunting | Fishing[3] | Boating | Water Contact Recreation[3] | Aesthetic Quality | Hydro Power | Commercial Navigation & Transportation |
| Columbia River | Columbia River Mouth to RM 86 | x | x | x | x | x | x | x | x | x | x | x | | x |
| | Columbia River RM 86 to 309 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| Deschutes | Deschutes River Main Stem from Pelton Regulating Dam | x | x | x | x | x | x | x | x | x | x | x | x | |
| | Crooked River Main Stem | x | x | x | x | x | x | x | x | x | x | x | x | |
| | All Other Basin Waters | x | x | x | x | x | x | x | x | x | x | x | | |
| Goose and Summer Lakes | Goose Lake | | | | | x | x | x | x | x | x | x | | |
| | Highly Alkaline & Saline Lakes | | | x | | | x | x | x | x | x | x | | |
| | All Other Basin Waters | x | x | x | x | x | x | x | x | x | x | x | | |
| Grand Ronde | All Basin Waters | x | x | x | x | x | x | x | x | x | x | x | x | |
| Hood | All Basin Waters | x | x | x | x | x | x | x | x | x | x | x | x | |
| John Day | All Basin Waters | x | x | x | x | x | x | x | x | x | x | x | | |
| Klamath | Klamath River from Klamath Lake to Keno Dam (RM 255 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| | All Other Basin Waters | x | x | x | x | x | x | x | x | x | x | x | | |
| Malheur Lake | Natural Lakes | | | | x | x | x | x | x | x | x | x | | |
| | All Other Basin Waters | x | x | x | x | x | x | x | x | x | x | x | | |
| Malheur | All Basin Waters | x | x | x | x | x | x | x | x | x | x | x | | |
| Mid-coast | Estuaries & Adjacent Marine Waters | | | x | | | x | x | x | x | x | x | | x |
| | All Other Basin Waters | x | x | x | x | x | x | x | x | x | x | x | x | |
| North-coast | Estuaries & Adjacent Marine Waters | | | x | | | x | x | x | x | x | x | | x |
| | All Other Basin Waters | x | x | x | x | x | x | x | x | x | x | x | | |
| Owyhee | Designated Scenic Waterway[4] | x | x | | | x | x | x | x | x | x | x | | |
| | All Other Basin Waters | x | x | x | x | x | x | x | x | x | x | x | | |
| Powder | All Basin Waters | x | x | x | x | x | x | x | x | x | x | x | | |
| Rogue | Rogue River Estuary & Adjacent Marine Waters | | | x | | | x | x | x | x | x | x | | x |
| | Rogue River Main Stem from Estuary to Lost Creek Dam | x | x | x | x | x | x | x | x | x | x | x | | x |
| | Bear Creek Main Stem | | | x | x | x | x | x | x | x | x | x | | |
| | All Other Basin Waters | x | x | x | x | x | x | x | x | x | x | x | x | |
| Sandy | Streams Forming Waterfalls Near Columbia River | | | | | | x | x | x | | x | x | | |
| | Bull Run River and all Tributaries | x | | | | | x | | | | | x | x | |
| | All Other Basin Waters | x | x | x | x | x | x | x | x | x | x | x | x | |
| Snake River | Snake River RM 176 to 409 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| South Coast | Estuaries & Adjacent Marine Waters | | | x | | | x | x | x | x | x | x | | x |
| | All Other Basin Waters | x | x | x | x | x | x | x | x | x | x | x | x | |
| Umatilla | Walla Walla River Main Stem from confluence of N. & S. | x | x | x | x | x | x | x | x | x | x | x | | |
| | All Other Walla Walla Subbasin Waters | x | x | | x | x | x | x | x | x | x | x | x | |
| | All Other Basin Waters[5] | x | x | x | x | x | x | x | x | x | x | x | x | |
| Umpqua | Umpqua R. Estuary to Head of Tidewater & Adjacent | | | x | | | x | x | x | x | x | x | | x |
| | Umpqua R. Main from head of tidewater to confluence of | x | x | x | x | x | x | x | x | x | x | x | | |
| | All Other Basin Waters | x | x | x | x | x | x | x | x | x | x | x | x | |
| Willamette | Willamette River Tributaries | x | x | x | x | x | x | x | x | x | x | x | x | |
| | Main Stem Willamette River Mouth to Willamette Falls[6], | x | x | x | x | x | x | x | x | x | x | x | x | x |
| | Main Stem Willamette River Willamette Falls to Newberg | x | x | x | x | x | x | x | x | x | x | x | x | x |
| | Main Stem Willamette River Newberg to Salem | x | x | x | x | x | x | x | x | x | x | x | | x |
| | Main Stem Willamette River Salem to Coast Fork | x | x | x | x | x | x | x | x | x | x | x | | |

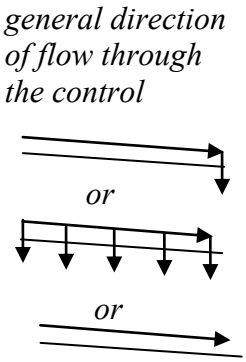
[1] With adequate pretreatment (filtration and disinfection) and natural quality to meet drinking water standards.
[2] See also fish use designations (http://www.oregon.gov/deq/Regulations/Pages/OARDiv41.aspx).
[3] For coastal water contact recreation and shellfish harvesting, see also Figures 220C-H, 230C-H, 300C, D and 320C from 340 OAR Div. 41.
[4] The mainstem of the S. F. of the Owyhee River from the Oregon-Idaho river border to Three Forks (the confluence of the N., M. and S. Forks Owyhee River) and the mainstem Owyhee River form Crooked Creek (RM 22) to the mouth of Birch Creek (RM 76).
[5] For the Willow Creek Subbasin, boating applies at the mouth of Willow Creek.
[6] In the Main Stem Willamette River Mouth to Willamette Falls, this is not to conflict with commercial activities in Portland Harbor.

# F.4 Details of Stormwater Controls (Examples Only)

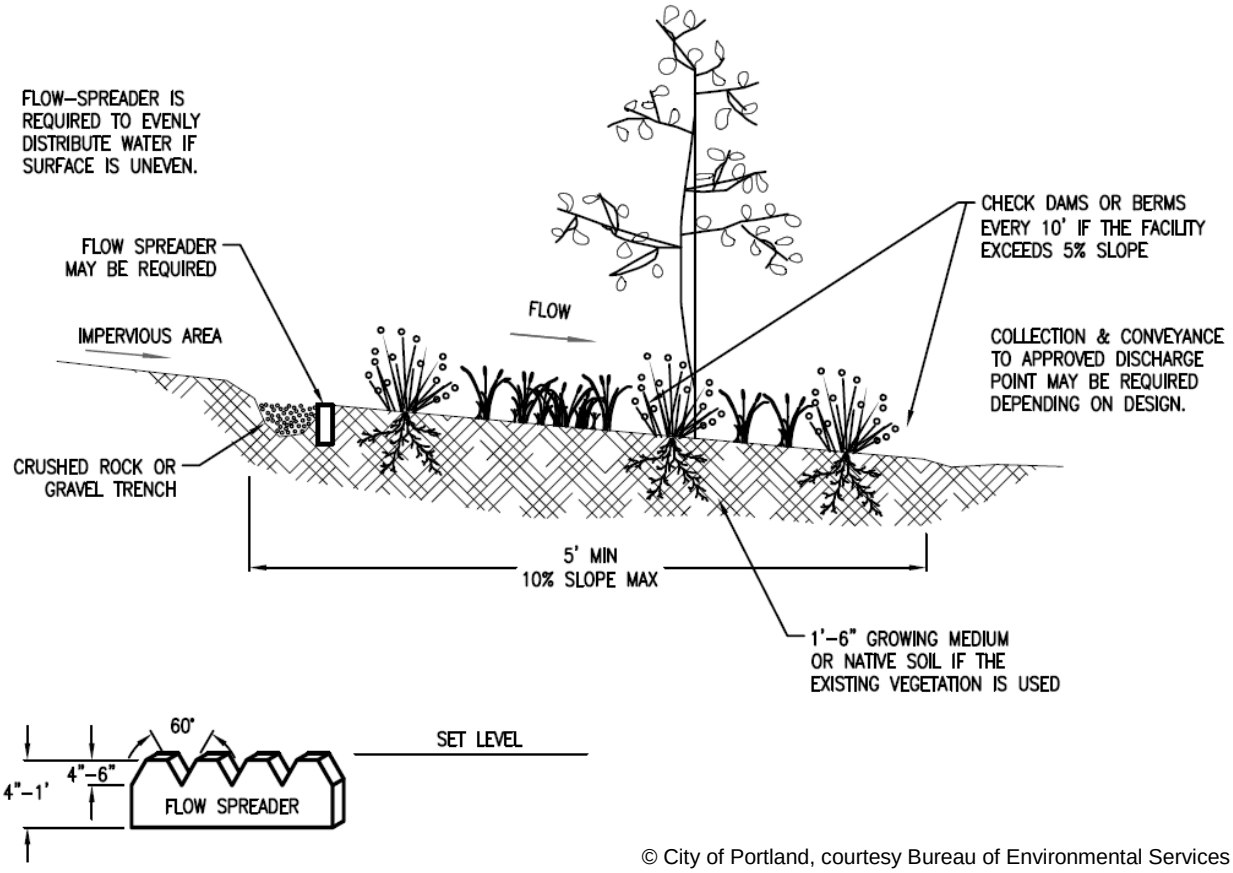
The following are details of post-construction stormwater controls to serve as illustrative examples only. The bioslope details are from the April 2014 ODOT Hydraulics Manual; the volume-based controls are from the 2016 King County Surface Water Design Manual and all of the other details are from the City of Portland's 2016 Stormwater Management Manual. Note that these details come with specifications that are not included here and that minimum requirements may vary.

## F.4.1 FLOW-RATE BASED CONTROLS

Swales, filter strips, and bioslopes are designed for stormwater runoff to flow over a sloped surface. Swales and filter strips are both fully vegetated; swales have a limited width with a long flow path within a depression while filter strips have an unlimited width, with a (usually much shorter) flow path that is not within a depression. Bioslopes are designed to have stormwater runoff flow over a filter strip and then over aggregate, which allows the water quality storm event to filter through filter media.

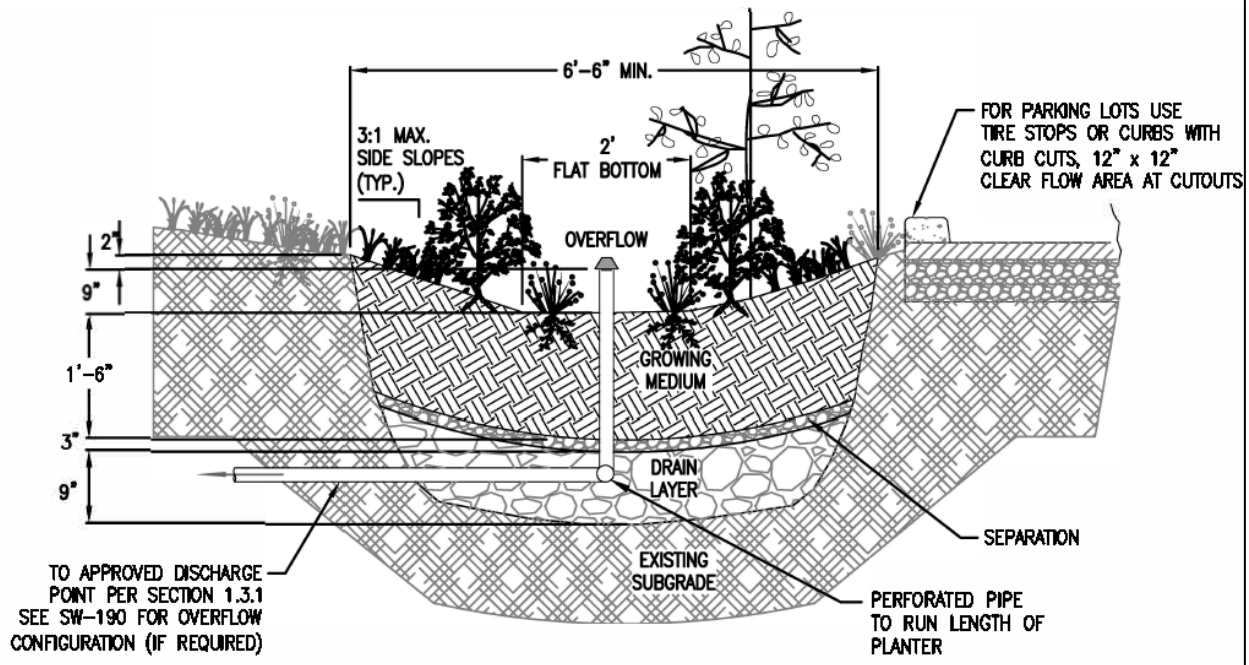



**FILTER STRIP PROFILE**



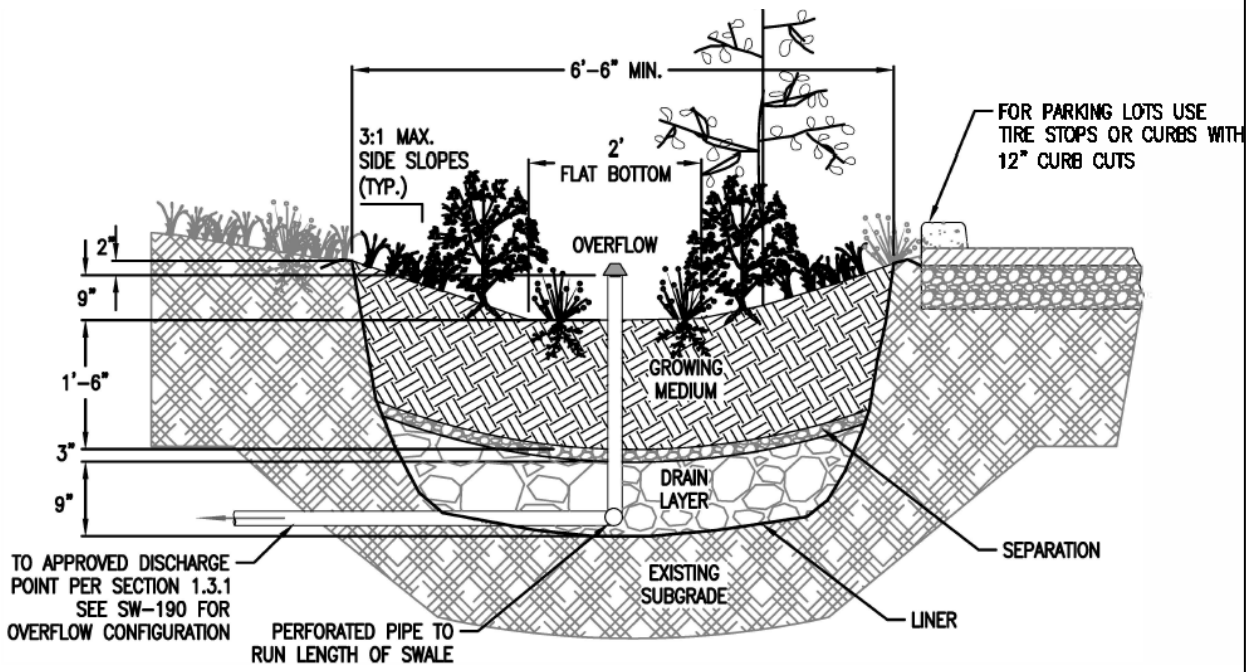

© City of Portland, courtesy Bureau of Environmental Services

## UNLINED VEGETATED SWALE CROSS SECTION[45]




© City of Portland, courtesy Bureau of Environmental Services

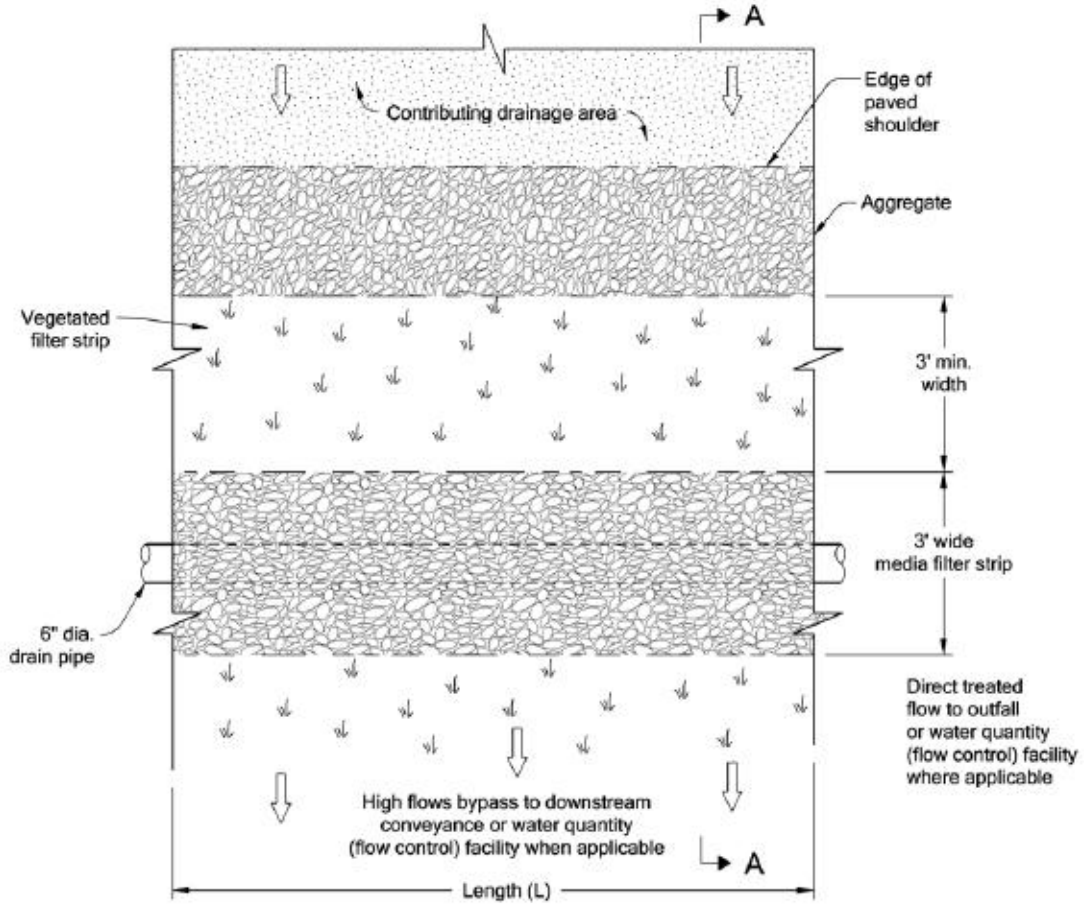
## LINED VEGETATED SWALE CROSS SECTION



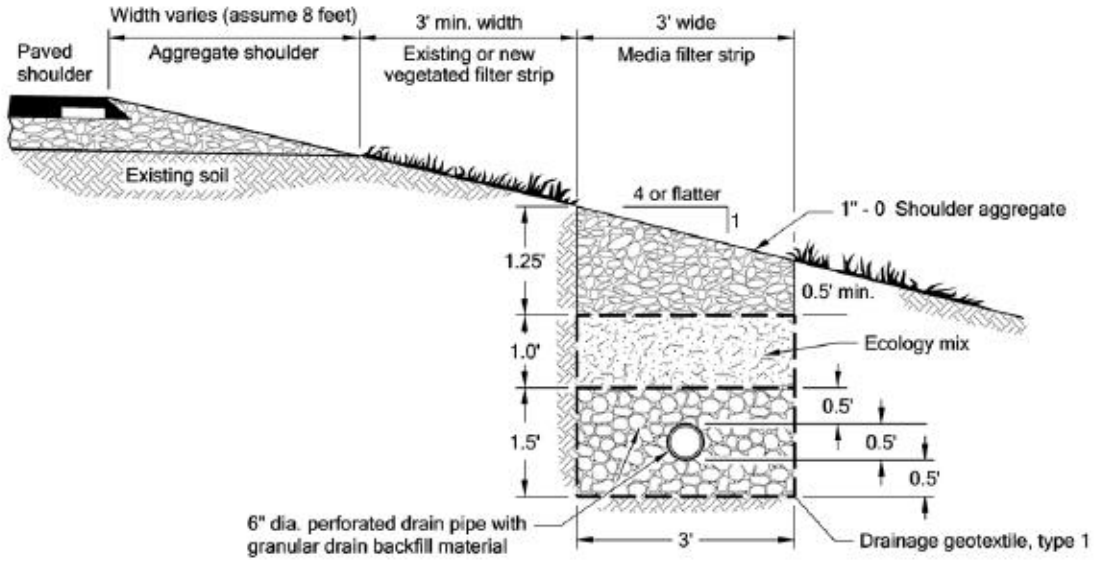

© City of Portland, courtesy Bureau of Environmental Services

[45] Swales can also be sized as combination volume/rate based controls

# BIOSLOPE




PLAN VIEW
NTS



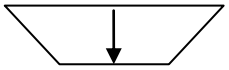

SECTION A-A
NTS

© Oregon Department of Transportation

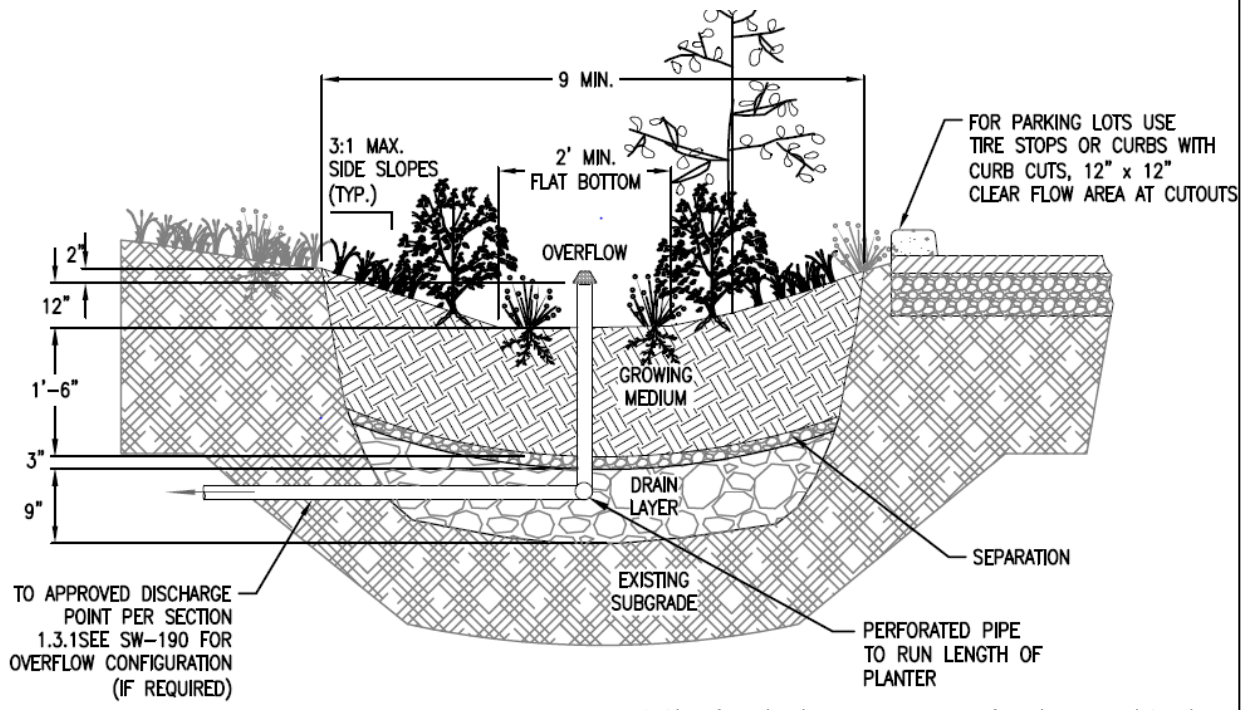
## F.4.2 COMBINATION VOLUME and RATE BASED CONTROLS

Filters are designed for stormwater runoff to pond and then filter through filter media such as a growing media or sand. Some filters allow full infiltration, some partial, and some are lined to prevent infiltration.

*general direction of flow through the control*

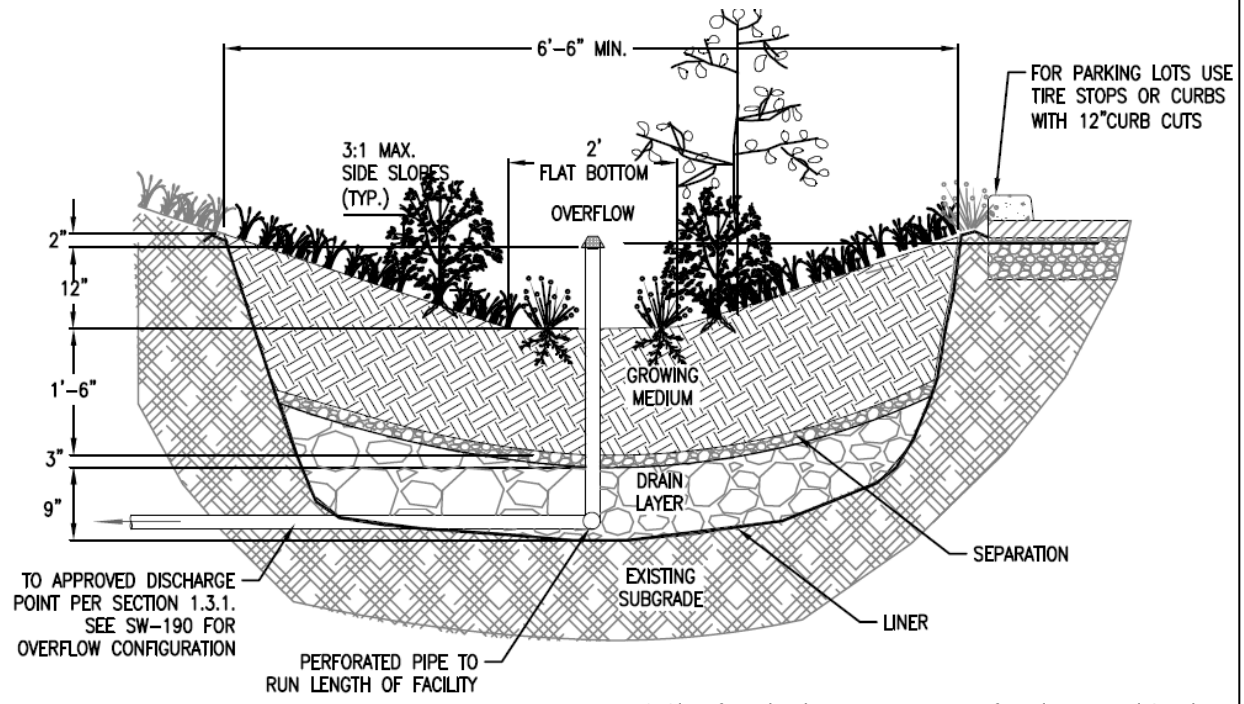


**UNLINED BIORETENTION BASIN CROSS SECTION**



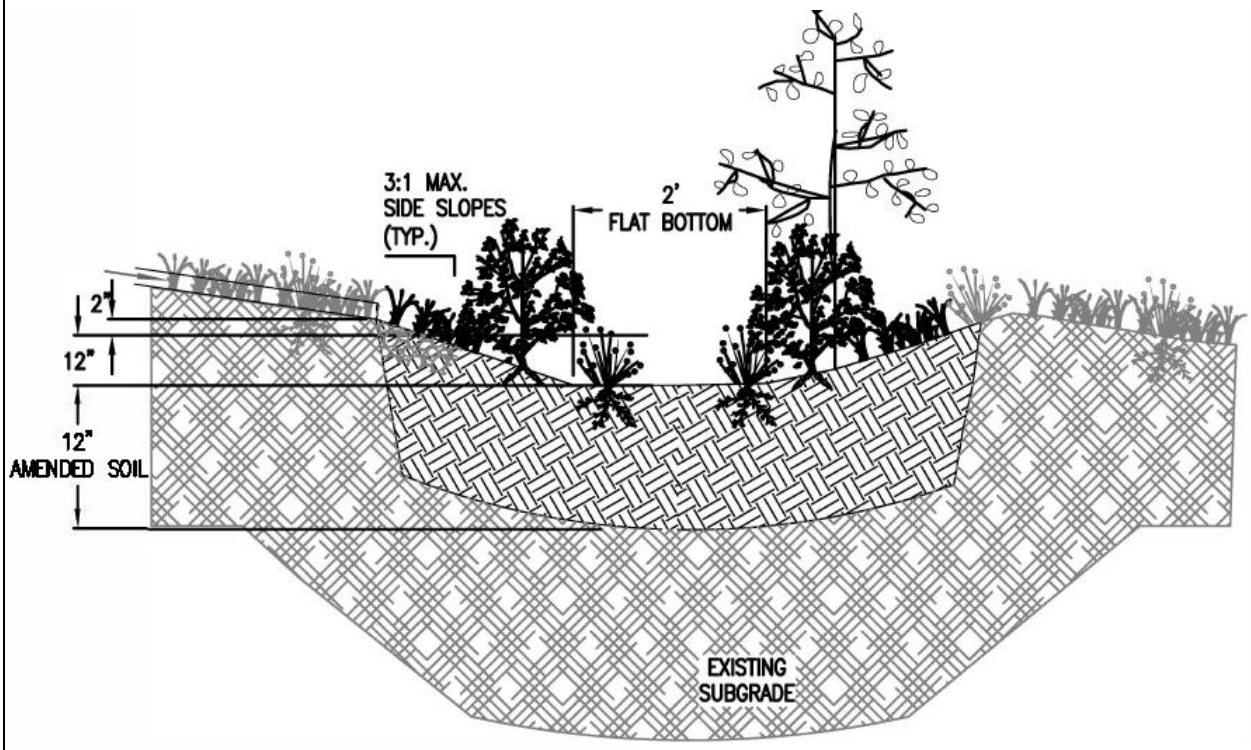

© City of Portland, courtesy Bureau of Environmental Services

**LINED BIORETENTION BASIN CROSS SECTION**



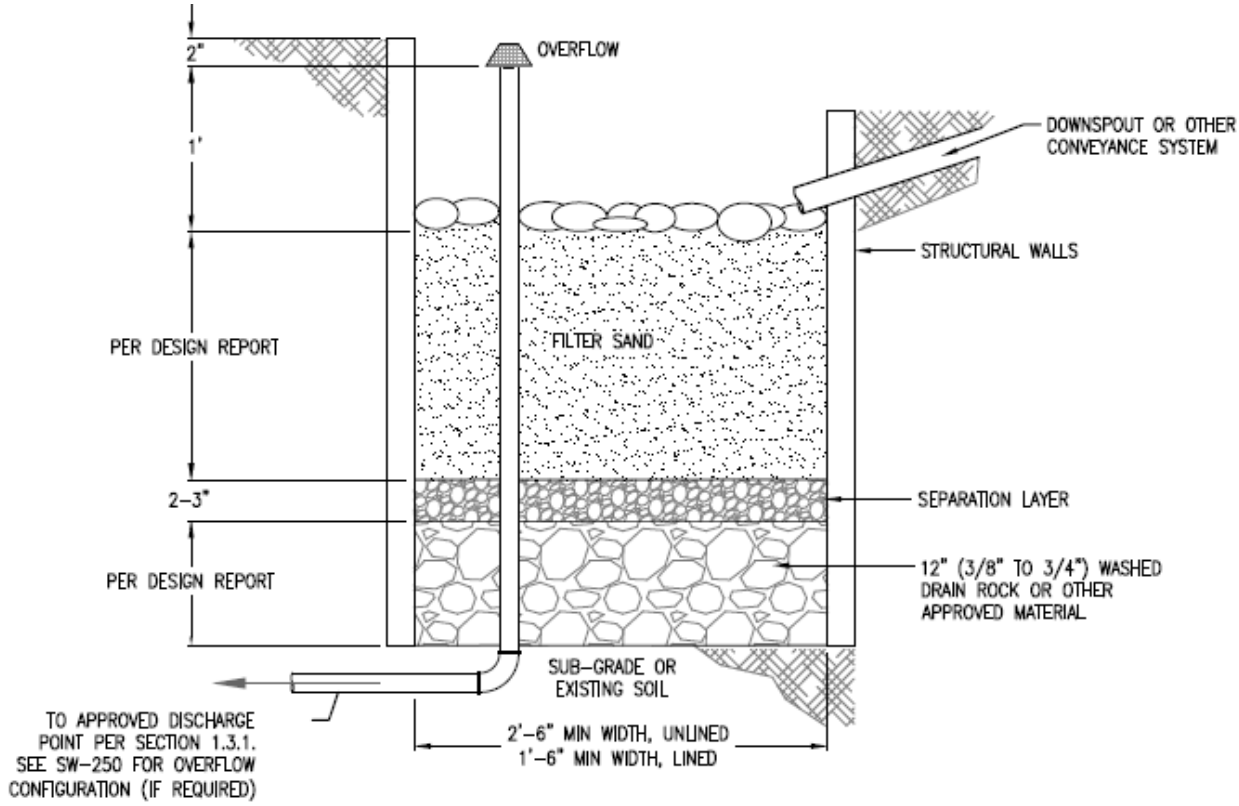

© City of Portland, courtesy Bureau of Environmental Services

## RAIN GARDEN CROSS SECTION



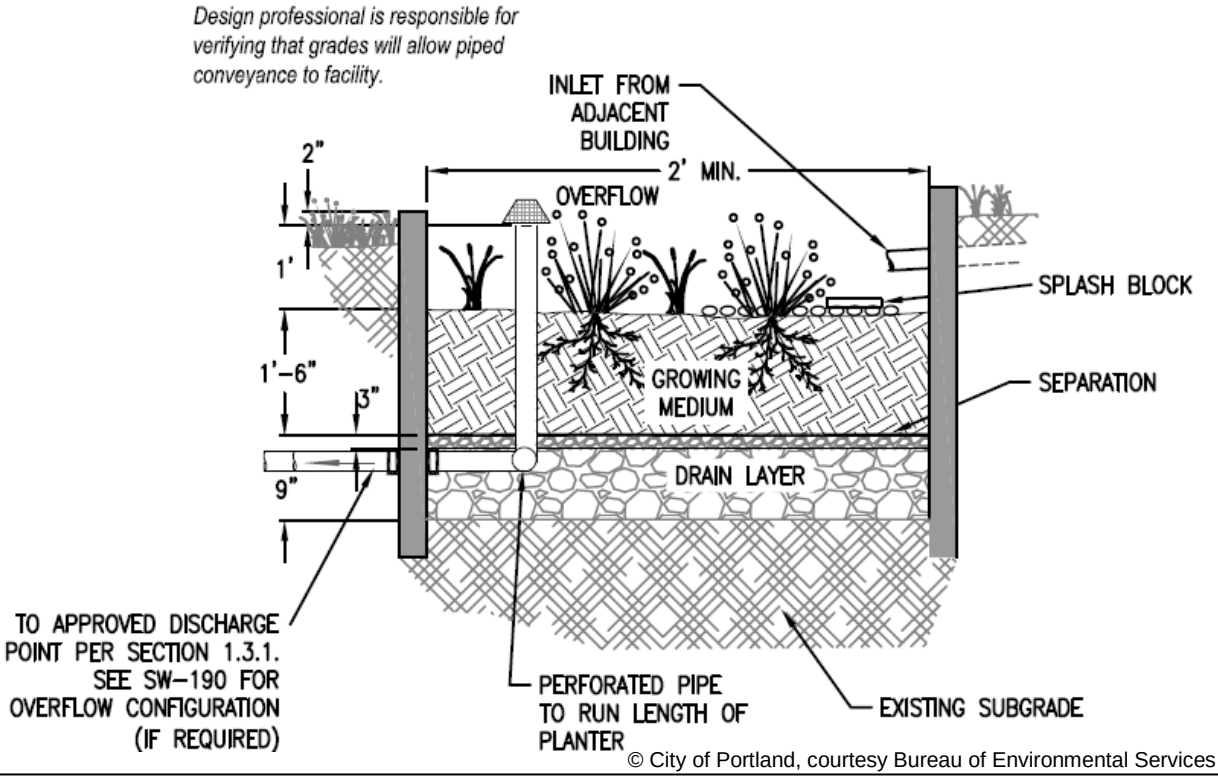

© City of Portland, courtesy Bureau of Environmental Services

## SAND FILTER CROSS SECTION



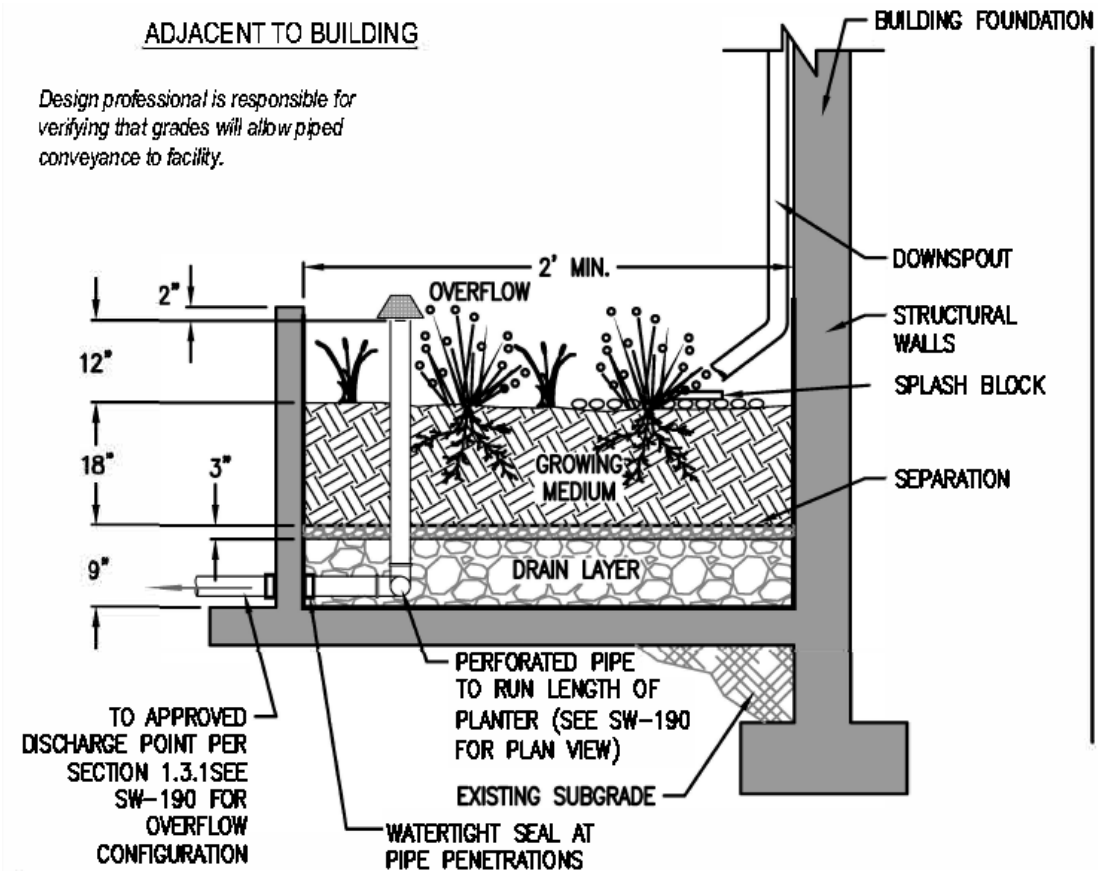

© City of Portland, courtesy Bureau of Environmental Services

## UNLINED STORMWATER PLANTER CROSS SECTION




© City of Portland, courtesy Bureau of Environmental Services

## LINED STORMWATER PLANTER CROSS SECTION

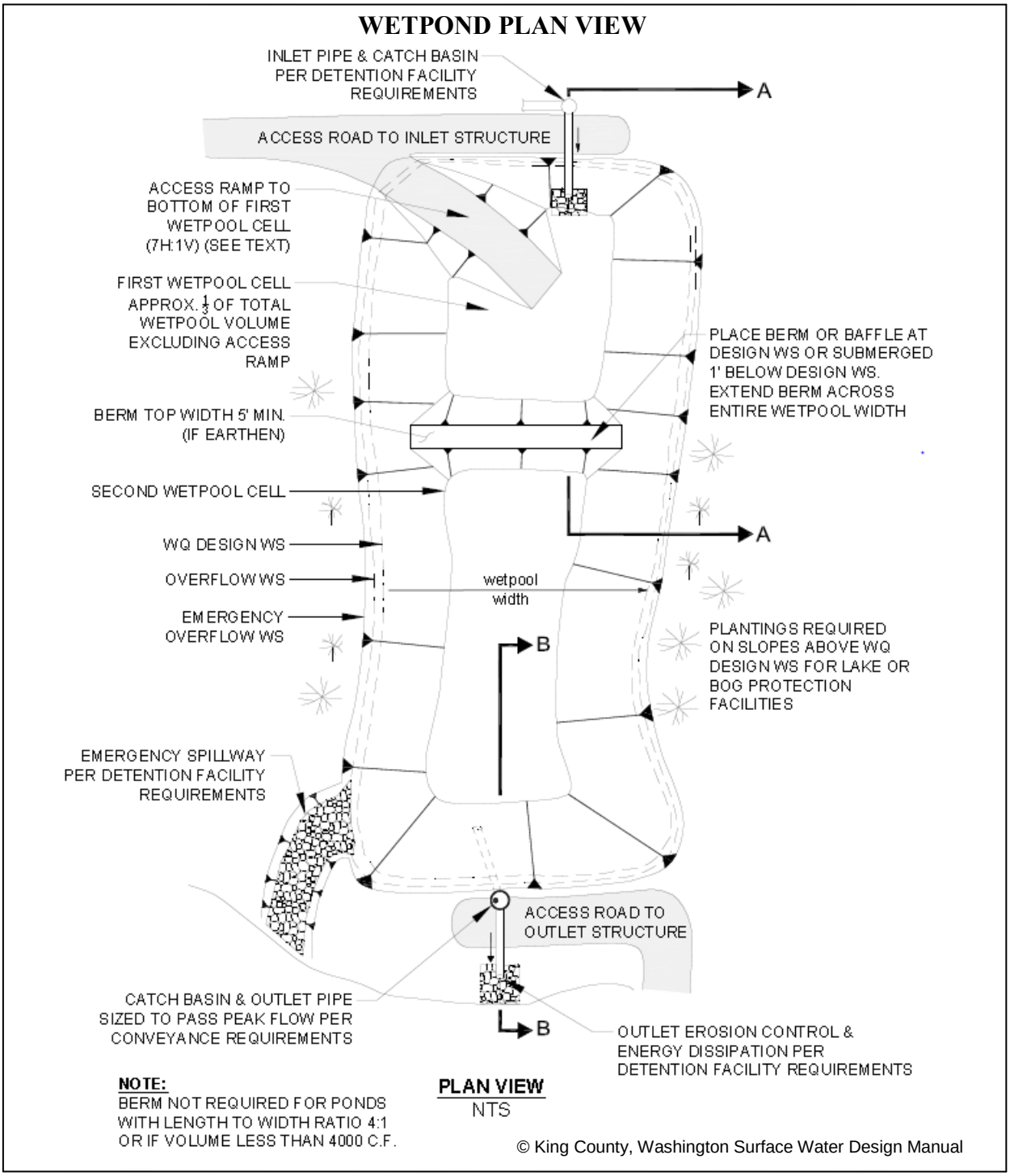



© City of Portland, courtesy Bureau of Environmental Services

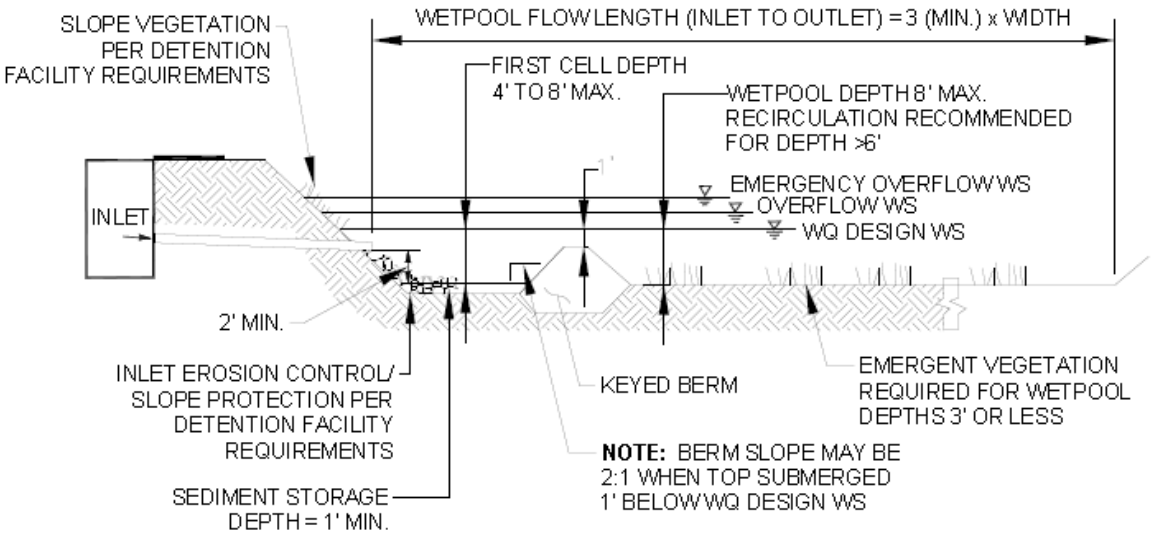
## F.4.1 VOLUME-BASED CONTROLS

*general direction of flow through the control*

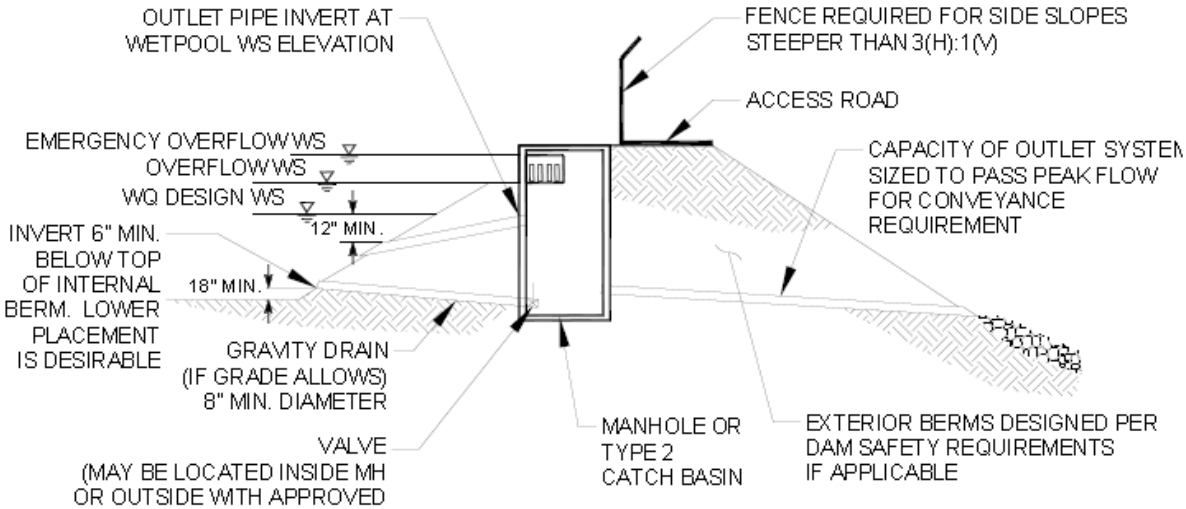
Wetponds, extended wetponds, and wetlands are designed to store a pool of water (the water quality design storm volume) that gets displaced during storm events.



# WETPOND CROSS SECTION




**SECTION A-A**
NTS

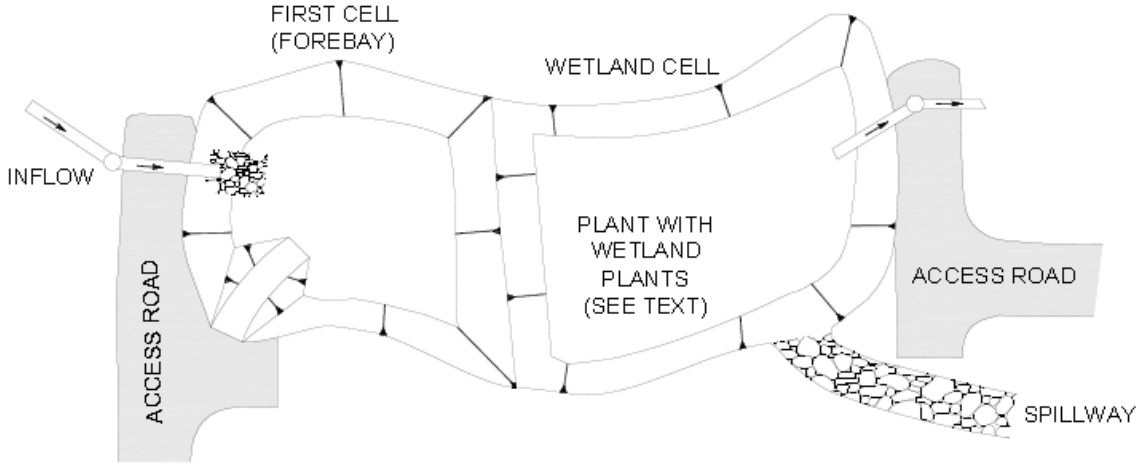



**SECTION B-B**
NTS

**NOTE:**
SEE DETENTION FACILITY REQUIREMENTS FOR LOCATION AND SETBACK REQUIREMENTS.

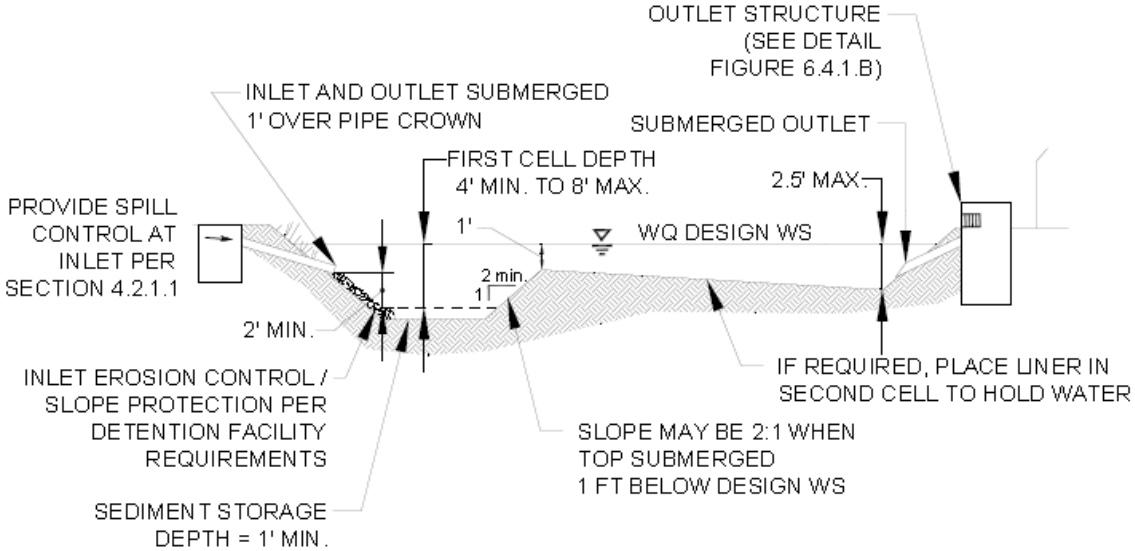
© King County, Washington Surface Water Design Manual

# CONSTRUCTED WETLAND




**PLAN VIEW Option A**
NTS

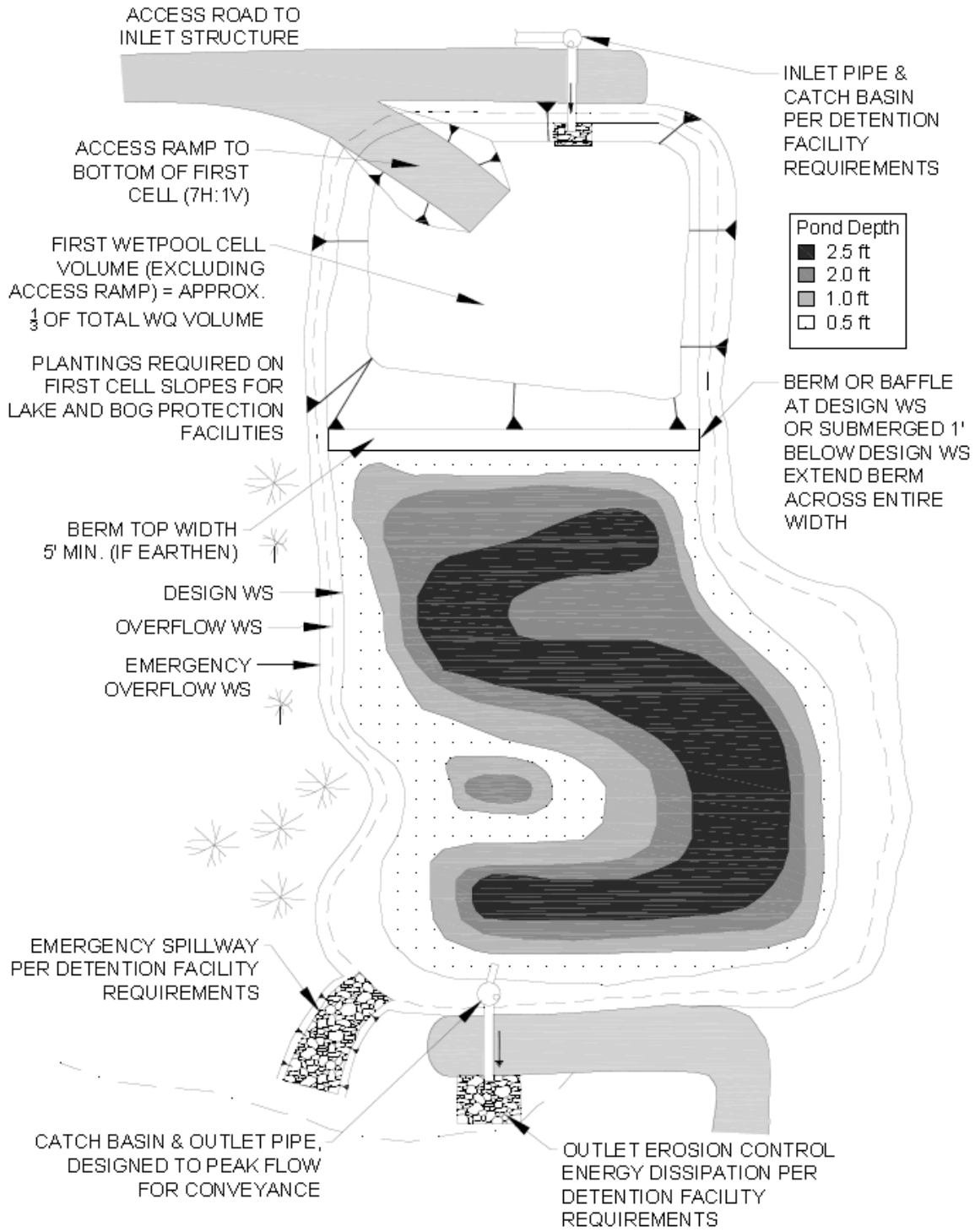
**NOTE:**
SEE DETENTION FACILITY REQUIREMENTS FOR
LOCATION AND SETBACK REQUIREMENTS.




**SECTION VIEW Option A**
NTS

© King County, Washington Surface Water Design Manual

## CONSTRUCTED WETLAND




**PLAN VIEW Option B**

NTS

© King County, Washington Surface Water Design Manual

# G. References

*Ballard Roadside Raingardens, Phase 1 – Lessons Learned,* Shanti Colwell, Tracy Tackett, Green Stormwater Infrastructure Program, Seattle Public Utilities
https://www.epa.gov/sites/production/files/2015-10/documents/gi_ballardproject.pdf

*Biofilters (Bioswales, Vegetative Buffers, & Constructed Wetlands) for Storm Water Discharge Pollution Removal*, DEQ NWR, Dennis Jurries (2003)
http://www.deq.state.or.us/wq/stormwater/docs/nwr/biofilters.pdf

*Construction Depot Safety and Health Newsletter for the Oregon Construction Industry, Oregon* OSHA (September 16, 2014)
http://osha.oregon.gov/OSHAConstructionDepot/2014/09/call-before-you-dig.html

*Design & Construction Standards*, Clean Water Services (2017)
http://cleanwaterservices.org/media/2103/ro17-05exceptdetails.pdf

*Design of Infiltrating Basin*, Dr. James Guo
*http://www.ucdenver.edu/faculty-staff/jguo/Documents/papers/(SW6)InfiltrationBasinDesign.pdf*

*Don't Lose Your LID – Learn These Lessons for Effective Stormwater Drainage*, Steven D. Trinkaus, PE, Informed Infrastructure (2016)
https://informedinfrastructure.com/23002/dont-lose-your-lid-learn-these-lessons-for-effective-stormwater-drainage/

*Emerging Best Management Practices in Stormwater: Addressing Galvanized Roofing*, Pacific Northwest Pollution Prevention Resource Center (2014)
*http://pprc.org/wp-content/uploads/2014/09/Emerging-BMPs_Galvanized-Roofs_2014.pdf*

*Fact Sheet Identifying an Underground Injection Control*, DEQ (2015)
http://www.oregon.gov/deq/FilterDocs/IDswInjSysFS.pdf

*Federal-aid Highway Program Programmatic User's Guide*, ODOT (2016)
http://www.oregon.gov/odot/geoenvironmental/pages/index.aspx

*Green Infrastructure Design and Implementation,* Environmental Protection Agency *(*EPA)
https://www.epa.gov/green-infrastructure/green-infrastructure-design-and-implementation

*Indicator Bacteria Removal in Storm-water Best Management Practices in Charlotte, North Caroline,* J. M. Hathaway; W. F. Hunt; and S. Jadlocki, Journal of Environmental Engineering American Society of Civil Engineers (2009)

*Infiltration Testing Fact Sheet,* Maria Cahill, Green Girl Land Development Solutions; Derek C. Godwin and Marissa Sowles, Oregon Sea Grant Extension (2011)

*International Stormwater BMP Database,* Water Environment Reuse Foundation, Environmental & Water Resources Institute/ASCE, EPA, U.S. Department of Transportation, American Public Works Association, Wright Water Engineers, Inc., Geosyntec consultants
http://www.bmpdatabase.org/help.html

*Large Volume Storms and Low Impact Development,* EPA
https://www.epa.gov/sites/production/files/2017-10/documents/lid_fs10_rainfall_epa_508.pdf

*Low Impact Development Construction Guide*, Version 1.0, Credit Valley Conservation (2012)
http://www.creditvalleyca.ca/wp-content/uploads/2013/03/CVC-LID-Construction-Guide-Book.pdf

*Low Impact Development Handbook*, Clean Water Services (2016)
http://cleanwaterservices.org/media/1468/lida-handbook.pdf

*Low Impact Development in Coastal South Carolina: A Planning and Design Guide*. Ellis, K., C. Berg, D. Caraco, S. Drescher, G. Hoffmann, B. Keppler, M. LaRocco, and A.Turner. ACE Basin and North Inlet – Winyah Bay National Estuarine Research Reserves, 462 pp. (2014)
http://www.scseagrant.org/pdf_files/LID-in-Coastal-SC-low-res.pdf

*Minnesota Stormwater Manual Design criteria for infiltration,* Minnesota Pollution Control Agency
https://stormwater.pca.state.mn.us/index.php?title=Design_criteria_for_infiltration

*National Engineering Handbook Part 630 Hydrology, Chapter 7 Hydrologic Soil Groups,* USDA NRCS (2007)
https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba

*ODOT Hydraulics Manual*, ODOT (2011)
ftp://ftp.odot.state.or.us/techserv/geo-environmental/Hydraulics/Hydraulics%20Manual/Table_of_Contents_rev_Nav.pdf

*Oregon Smart Guide on Rainwater Harvesting, Department of Consumer & Business Service*, Building Codes Division
https://www.oregon.gov/bcd/Documents/brochures/3660.pdf

*PAH Chemical Action Plan*, Washington Department of Ecology, pub no. 12-07-048 (2012)
https://fortress.wa.gov/ecy/publications/documents/1207048.pdf

*Porous Pavement and Groundwater Quality Technical Bulletin*, The University of Rhode Island Cooperative Extension in partnership with the Rhode Island Department of Health Source Water Protection Program
http://cels.uri.edu/rinemo/publications/PP.GWQuality.pdf

*Roofing Materials' Contributions to Stormwater Pollution*, Shirley E. Clark, P.E. D.WRE, M.ASCE; Kelly A. Steele, A.M.ASCE; Julia Spicher, A.M.ASCE; Christina Y. S. Siu; Melinda M. Lalor; Robert Pitt, P.E. D.WRE, M.ASCE; and Jason T. Kirby, A.M.ASCE, Journal of Irrigation and Drainage Engineering, ASCE (September/October 2008)
http://chesapeakestormwater.net/wp-content/uploads/downloads/2012/01/j20id20roofing2020081.pdf

*Stormwater Facility Fact Sheets*, Fairfax County
https://www.fairfaxcounty.gov/publicworks/stormwater/facility-fact-sheets

*Stormwater Management Manual*, City of Eugene (2014)
https://www.eugene-or.gov/477/Stormwater-Management-Manual

*Stormwater Management Manual*, City of Portland (2016)
https://www.portlandoregon.gov/bes/64040

*Stormwater Management Manual for Western Washington*, Washington Department of Ecology (2014)
https://fortress.wa.gov/ecy/madcap/wq/2014SWMMWWinteractive/2014%20SWMMWW.htm

*Stormwater Management and Vector Breeding Habitats*, United States Department of Health and Human Services, Centers for Disease Control and Prevention
https://www.cdc.gov/nceh/ehs/docs/factsheets/stormwater-factsheet.pdf

*Stormwater Monitoring Two Ecoroofs in Portland, Oregon, USA, City of Portland Bureau of Environmental Services*, Doug Hutchinson, Peter Abrams, Ryan Retzlaff, Tom Liptan
https://www.portlandoregon.gov/bes/article/63098

*Stormwater Phase II Final Rule Post-Construction Runoff Control Minimum Control Measure*, EPA, EPA 833-F-00-009 (revised 2005)
https://www3.epa.gov/npdes/pubs/fact2-7.pdf

*Stormwater Technology Fact Sheet Porous Pavement*, EPA, EPA 832-F-99-023 (1999)
https://nepis.epa.gov/Exe/ZyNET.exe/91018M1N.TXT?ZyActionD=ZyDocument&Client=EPA&Index=1995+Thru+1999&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5Czyfiles%5CIndex%20Data%5C95thru99%5CTxt%5C00000032%5C91018M1N.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL

*Stormwater Treatment Technologies Approved through TAPE and CTAPE,* Washington Department of Ecology website
http://www.ecy.wa.gov/programs/wq/stormwater/newtech/technologies.html

*Surface Water Design Manual*, King County, Washington (2016)
https://www.kingcounty.gov/services/environment/water-and-land/stormwater/documents/surface-water-design-manual.aspx

*Template for LID Stormwater Manual for Western Oregon: A Practical Guide for Watershed Health*, Maria Cahill, Green Girl Land Development Solutions LLC (2016)

*The Climate of Oregon Climate Zone 4 Northern Cascades, Special Report 916,* Oregon State University Agricultural Experiment Station (May 1993)

*The Climate of Oregon Climate Zone 5 High Plateau, Special Report 917,* Oregon State University Agricultural Experiment Station (May 1993)

*The Effects of Water Quality Characteristics on Pollutant Releases from Drainage Materials*, Olga N. Ogburn, Robert E. Pitt and Shirley E. Clark
http://rpitt.eng.ua.edu/Publications/4_Stormwater_Characteristics_Pollutant_Sources_and_Land_Development_Characteristics/Stormwater_pollutant_sources/metal%20leaching%20CHI%20monograph_Ogburn%20James_2012.pdf

*The Myth of Native Plant Superiority*, Linda Chalker-Scott, Ph.D., Puyallup Research and Extension Center, Washington State University (2015)
https://s3.wp.wsu.edu/uploads/sites/403/2015/03/native-plants.pdf

*The Myth of Soil Amendments Parts 1-IV*, Linda Chalker-Scott, Ph.D., Puyallup Research and Extension Center, Washington State University (2015)
https://s3.wp.wsu.edu/uploads/sites/403/2015/03/soil-amendments.pdf
https://s3.wp.wsu.edu/uploads/sites/403/2015/03/soil-amendments-2.pdf
https://s3.wp.wsu.edu/uploads/sites/403/2015/03/soil-amendments-3.pdf
https://s3.wp.wsu.edu/uploads/sites/403/2015/03/soil-amendments-4.pdf

*The Oregon Rain Garden Guide*, Sea Grant Oregon, ORESU-H_10-001 (2010)
*http://seagrant.oregonstate.edu/sgpubs/oregon-rain-garden-guide*

*Urban Hydrology for Small Watersheds,* USDA NRCS Conservation Engineering Division, Technical Release 55 (June 1986)
https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044171.pdf

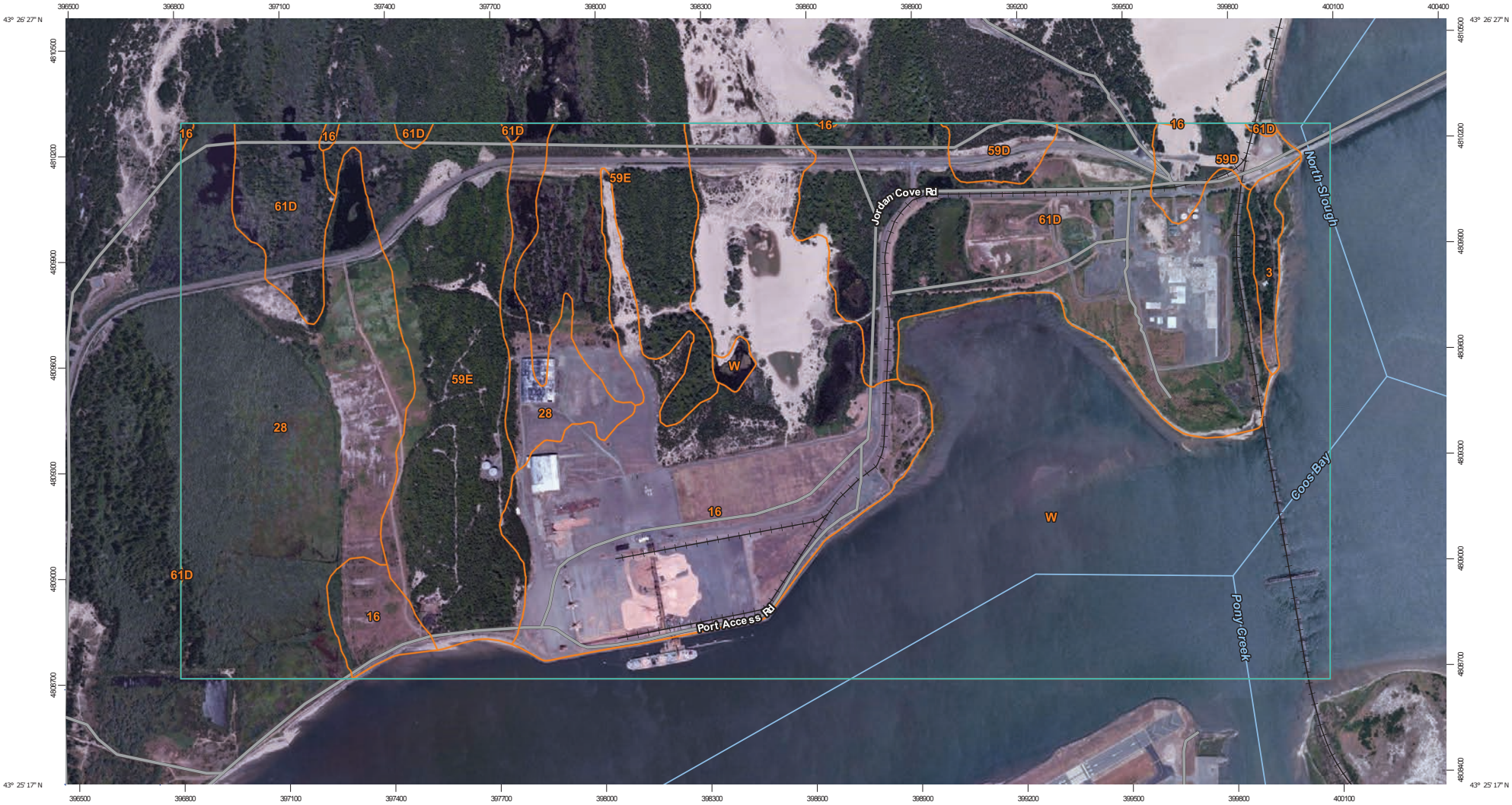
*Water Quality Design Storm Evaluation and Guidance Letter*, ODOT (October 22, 2008)
ftp://ftp.odot.state.or.us/techserv/Geo-Environmental/Stormwater%20Team/Water_Quality_Design_Storm/ODOT_Water_Quality_Design_Storm_Final.pdf

# Attachment E. Oregon's 2012 Integrated Report Database Search Results

| Basin Name | Watershed (USGS 4th Field Name) | USGS 4th Field HUC | Record ID | Water Body (Stream/Lake) | LLID | River Miles | Segment Length | Parameter | Season | Criteria | BeneficialUses | Status | AssessmentYear | Assessment Action | Suporting Data | Previous Status | Previous Action | Listing Year | Comments | Beach Name | EPA Beach ID | TMDLInfo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southern Oregon Coastal | Coos | 17100304 | 20673 | Coos Bay | 1243397433543 | 0 to 12.3 | 12.3 | Ammonia | Year Round | Table 20 Toxic Substances | Aquatic life | Cat 3: Insufficient data | 2004 | No action | Previous Data: [DEQ] LASAR 20698 River Mile 7.2: From 8/25/1999 to 8/25/1999, 0 out of 3 samples > applicable Table 20 criterion.<br>[DEQ] LASAR 20699 River Mile 10.1: From 8/25/1999 to 8/25/1999, 0 out of 2 samples > applicable Table 20 criterion.<br>[DEQ] LASAR 20700 River Mile 10.7: From 8/26/1999 to 8/26/1999, 0 out of 3 samples > applicable Table 20 criterion.<br>[DEQ] LASAR 20701 River Mile 3.6: From 8/24/1999 to 8/24/1999, 0 out of 3 samples > applicable Table 20 criterion.<br>[DEQ] LASAR 20703 River Mile 2.2: From 8/23/1999 to 8/23/1999, 0 out of 2 samples > applicable Table 20 criterion.<br>[DEQ] LASAR 25661 River Mile 9.5: From 8/22/2001 to 8/22/2001, 0 out of 2 samples > applicable Table 20 criterion.<br>[DEQ] LASAR 25665 River Mile 11.2: From 8/28/2001 to 8/28/2001, 0 out of 2 samples > applicable Table 20 criterion. | Previous Status: Cat 3: Insufficient data | Previous Action: Added to database | Previous Assessment Year: 2004 | | | | |
| Southern Oregon Coastal | Coos | 17100304 | 20674 | Coos Bay | 1243397433543 | 0 to 12.3 | 12.3 | Chlorophyll a | Summer | Reservoir, river, estuary, non-thermally stratified lake: 0.015 mg/l | Water contact recreation; Aesthetics; Livestock watering; Water supply; Fishing | Cat 3: Insufficient data | 2004 | No action | Previous Data: [DEQ] LASAR 25661 River Mile 9.5: From 8/22/2001 to 9/30/2001, average Chlorophyll a of 0.002 for 1 samples in 1 months.<br>[DEQ] LASAR 20703 River Mile 2.2: From 8/23/1999 to 9/30/1999, average Chlorophyll a of 0.002 for 1 samples in 1 months.<br>[DEQ] LASAR 25665 River Mile 11.2: From 8/28/2001 to 9/30/2001, average Chlorophyll a of 0.047 for 1 samples in 1 months.<br>[DEQ] LASAR 20700 River Mile 10.7: From 8/26/1999 to 9/30/1999, average Chlorophyll a of 0.002 for 1 samples in 1 months.<br>[DEQ] LASAR 20699 River Mile 10.1: From 8/25/1999 to 9/30/1999, average Chlorophyll a of 0.001 for 1 samples in 1 months.<br>[DEQ] LASAR 20698 River Mile 7.2: From 8/25/1999 to 9/30/1999, average Chlorophyll a of 0.002 for 1 samples in 1 months.<br>[DEQ] LASAR 20701 River Mile 3.6: From 8/24/1999 to 9/30/1999, average Chlorophyll a of 0.003 for 1 samples in 1 months. | Previous Status: Cat 3: Insufficient data | Previous Action: Added to database | Previous Assessment Year: 2004 | | | | |
| Southern Oregon Coastal | Coos | 17100304 | 7469 | Coos Bay | 1243397433543 | 7.8 to 12.3 | 4.5 | Chromium | Year Round | Toxic substances may not be introduced above natural background levels in the waters of the State in amounts, concentrations, or combinations that may be harmful, may chemically change to harmful forms in the environment, or may accumulate in sediment… | Resident fish and aquatic life; Anadromous fish passage; Drinking water | Cat 3B: Insufficient data, potential concern | 1998 | No action | Previous Data: Values exceeded reference values but did not meet listing criteria. No data on beneficial use impairment (e.g. bioassays). Minimum Data Requirements were not met (Two exceedences of a standard and at least 10% of the time) there are no standards for sediment concentrations. | Previous Status: Potential concern | Previous Action: Added to database | Previous Assessment Year: 1998 | | | | |
| Southern Oregon Coastal | Coos | 17100304 | 4978 | Coos Bay | 1243397433543 | 7.8 to 12.3 | 4.5 | Copper | Year Round | Toxic substances may not be introduced above natural background levels in the waters of the State in amounts, concentrations, or combinations that may be harmful, may chemically change to harmful forms in the environment, or may accumulate in sediment… | Drinking water; Resident fish and aquatic life; Anadromous fish passage | Cat 3B: Insufficient data, potential concern | 1998 | No action | Previous Data: Values exceeded reference values but did not meet listing criteria. No data on beneficial use impairment (e.g. bioassays). Minimum Data Requirements were not met (Two exceedences of a standard and at least 10% of the time) there are no standards for sediment concentrations. | Previous Status: Potential concern | Previous Action: Added to database | Previous Assessment Year: 1998 | | | | |
| Southern Oregon Coastal | Coos | 17100304 | 4950 | Coos Bay | 1243397433543 | 0 to 7.8 | 7.8 | Fecal Coliform | FallWinterSpring | | Water contact recreation | Cat 2: Attaining some criteria/uses | 1998 | No action | Previous Data: DEQ Data (6 Sites: Mile 1.0 - 7.0): 0% (0 of 45 - 54) FWS values exceeded fecal coliform standard (400) between WY 1986 - 1995. | Previous Status: Attaining | Previous Action: Added to database | Previous Assessment Year: 1998 | | | | |
| Southern Oregon Coastal | Coos | 17100304 | 4951 | Coos Bay | 1243397433543 | 0 to 7.8 | 7.8 | Fecal Coliform | Summer | | Water contact recreation | Cat 2: Attaining some criteria/uses | 1998 | No action | Previous Data: DEQ Data (6 Sites: Mile 1.0 - 7.0): 412087, 412088 = 0% (0 of 27, 29); 412083, 412084, 412086 = 3% (1 of 31, 32, 30); 412085 = 6% ( 2 of 31) Summer values exceeded fecal coliform standard (400) respectively with a maximum value of 1100 between WY 86 - 95. | Previous Status: Attaining | Previous Action: Added to database | Previous Assessment Year: 1998 | | | | |
| Southern Oregon Coastal | Coos | 17100304 | 4905 | Coos Bay | 1243397433543 | 0 to 7.8 | 7.8 | Fecal Coliform | Year Round | | Shellfish growing | Cat 2: Attaining some criteria/uses | 1998 | No action | Previous Data: DEQ Data (6 Sites: Mile 1.0 - 7.0): All sites met fecal coliform log mean criteria (14) with values ranging from 3 to 7 and all sites met 90% criteria (43) with values ranging from 12 to 33 between WY 1992 - 1995. | Previous Status: Attaining | Previous Action: Added to database | Previous Assessment Year: 1998 | | | | |
| Southern Oregon Coastal | Coos | 17100304 | 20675 | Coos Bay | 1243397433543 | 0 to 7.8 | 7.8 | Fecal Coliform | Year Round | Fecal coliform median of 14 organisms per 100 ml; no more than 10% > 43 organisms per 100 ml | Shellfish growing | Cat 5: Water quality limited, 303(d) list, TMDL needed | 2004 | No action | Previous Data: [DEQ/ODA - Salem] LASAR 13378 River Mile 4.8: From 1/4/1994 to 6/5/2002, 3 out of 74 samples (4%) > 43 organisms; median concentration of 3<br>[DEQ/ODA - Salem] LASAR 13375 River Mile 1.2: From 1/4/1994 to 8/27/2002, 0 out of 99 samples (0%) > 43 organisms; median concentration of 1<br>[DEQ] LASAR 25995 River Mile 5.8: From 8/27/2001 to 11/25/2003, 4 out of 6 samples (67%) > 43 organisms; median concentration of 58<br>[DEQ/ODA - Salem] LASAR 13379 River Mile 6.4: From 1/4/1994 to 6/5/2002, 1 out of 76 samples (1%) > 43 organisms; median concentration of 5<br>[DEQ/ODA - Salem] LASAR 13377 River Mile 3.5: From 1/4/1994 to 8/27/2002, 3 out of 101 samples (3%) > 43 organisms; median concentration of 2<br>[DEQ/ODA - Salem] LASAR 13376 River Mile 2.1: From 1/4/1994 to 8/27/2002, 1 out of 99 samples (1%) > 43 organisms; median concentration of 1<br>[DEQ/ODA - Salem] LASAR 13380 River Mile 7.7: From 1/4/1994 to 8/6/2002, 11 out of 112 samples (10%) > 43 organisms; median concentration of 5 | Previous Status: Cat 5: Water quality limited, 303(d) list, TMDL needed | Previous Action: Added to database | Previous Assessment Year: 2004 | | | | |
| Southern Oregon Coastal | Coos | 17100304 | 4963 | Coos Bay | 1243397433543 | 7.8 to 12.3 | 4.5 | Fecal Coliform | FallWinterSpring | Fecal coliform log mean of 200 organisms per 100 ml; no more than 10% > 400 per 100 ml | Water contact recreation | Cat 2: Attaining some criteria/uses | 1998 | No action | Previous Data: DEQ Data (9 Sites: Mile 7.75 - 12.0): 6 Sites = 0% (0 of 32 - 59); 412320 = 2% (1 of 66); 412322 = 4% (3 of 67); 412091 = 7% (4 of 59) FWS values with maximum values of 740,1200,1100 respectively exceeded fecal coliform standard (400) between WY 86 - 95. | Previous Status: Attaining | Previous Action: Added to database | Previous Assessment Year: 1998 | | | | |
| Southern Oregon Coastal | Coos | 17100304 | 4953 | Coos Bay | 1243397433543 | 7.8 to 12.3 | 4.5 | Fecal Coliform | Summer | Fecal coliform log mean of 200 organisms per 100 ml; no more than 10% > 400 per 100 ml | Water contact recreation | Cat 2: Attaining some criteria/uses | 1998 | No action | Previous Data: DEQ Data (9 Sites: Mile 7.75 - 12.0): All Sites = 0% (0 of 14 - 28) Summer values exceeded fecal coliform standard (400) between WY 1986 - 1995. | Previous Status: Attaining | Previous Action: Added to database | Previous Assessment Year: 1998 | | | | |
| Southern Oregon Coastal | Coos | 17100304 | 4689 | Coos Bay | 1243397433543 | 7.8 to 12.3 | 4.5 | Fecal Coliform | Year Round | Fecal coliform median of 14 organisms per 100 ml; no more than 10% > 43 organisms per 100 ml | Shellfish growing | Cat 5: Water quality limited, 303(d) list, TMDL needed | 2004 | No action | Previous Data: [DEQ/ODA - Salem] LASAR 13605 River Mile 8.1: From 1/4/1994 to 8/6/2002, 17 out of 118 samples (14%) > 43 organisms; median concentration of 7<br>[ODA] LASAR 20449 River Mile 10: From 5/24/1999 to 8/6/2002, 4 out of 51 samples (8%) > 43 organisms; median concentration of 8<br>[ODA] LASAR 13679 River Mile 8.4: From 3/18/1998 to 8/6/2002, 4 out of 59 samples (7%) > 43 organisms; median concentration of 4<br>[DEQ] LASAR 24990 River Mile 8.8: From 2/28/2001 to 2/28/2001, 0 out of 1 samples (0%) > 43 organisms; median concentration of 0<br>[ODA] LASAR 13671 River Mile 9.2: From 11/15/1995 to 8/6/2002, 11 out of 66 samples (17%) > 43 organisms; median concentration of 8<br>[DEQ/ODA - Salem] LASAR 13542 River Mile 10.8: From 1/4/1994 to 8/6/2002, 24 out of 127 samples (19%) > 43 organisms; median concentration of 13<br>[DEQ/ODA - Salem] LASAR 13384 River Mile 12: From 1/4/1994 to 8/6/2002, 22 out of 109 samples (20%) > 43 organisms; median concentration of 11<br>[DEQ/ODA - Salem] LASAR 13383 River Mile 11.7: From 1/4/1994 to 4/3/2002, 24 out of 114 samples (21%) > 43 organisms; median concentration of 13<br>[DEQ/ODA - Salem] LASAR 13382 River Mile 10.7: From 1/4/1994 to 8/6/2002, 16 out of 116 samples (14%) > 43 organisms; median concentration of 8<br>[DEQ/ODA - Salem] LASAR 13381 River Mile 9.4: From 1/4/1994 to 8/6/2002, 18 out of 122 samples (15%) > 43 organisms; median concentration of 8<br>[ODA] LASAR 13675 River Mile 9.4: From 3/18/1998 to 8/6/2002, 11 out of 65 samples (17%) > 43 organisms; median concentration of 8<br>[DEQ/ODA - Salem] LASAR 13603 River Mile 8.9: From 1/4/1994 to 2/7/2002, 16 out of 114 samples (14%) > 43 organisms; median concentration of 8<br><br>Previous Data:<br>DEQ Data (9 Sites: Mile 7.75 - 12.0): 5 Sites exceeded fecal coliform log mean criteria (14) with values ranging from 15 to 28 and all 9 sites exceeded 90% criteria (43) with values ranging from 46 - 170 between WY 1992 - 1995.<br>Previous Assessment Year: 1998 | Previous Status: Cat 5: Water quality limited, 303(d) list, TMDL needed | Previous Action: No status change | Previous Assessment Year: 2004 | | | | |
| Southern Oregon Coastal | Coos | 17100304 | 7676 | Coos Bay | 1243397433543 | 7.8 to 12.3 | 4.5 | Lead | Year Round | Toxic substances may not be introduced above natural background levels in the waters of the State in amounts, concentrations, or combinations that may be harmful, may chemically change to harmful forms in the environment, or may accumulate in sediment… | Resident fish and aquatic life; Anadromous fish passage; Drinking water | Cat 3B: Insufficient data, potential concern | 1998 | No action | Previous Data: Values exceeded reference values but did not meet listing criteria. No data on beneficial use impairment (e.g. bioassays). Minimum Data Requirements were not met (Two exceedences of a standard and at least 10% of the time) there are no standards for sediment concentrations. | Previous Status: Potential concern | Previous Action: Added to database | Previous Assessment Year: 1998 | | | | |
| Southern Oregon Coastal | Coos | 17100304 | 7783 | Coos Bay | 1243397433543 | 7.8 to 12.3 | 4.5 | Nickel | Year Round | Toxic substances may not be introduced above natural background levels in the waters of the State in amounts, concentrations, or combinations that may be harmful, may chemically change to harmful forms in the environment, or may accumulate in sediment… | Drinking water; Resident fish and aquatic life; Anadromous fish passage | Cat 3B: Insufficient data, potential concern | 1998 | No action | Previous Data: Values exceeded reference values but did not meet listing criteria. No data on beneficial use impairment (e.g. bioassays). Minimum Data Requirements were not met (Two exceedences of a standard and at least 10% of the time) there are no standards for sediment concentrations. | Previous Status: Potential concern | Previous Action: Added to database | Previous Assessment Year: 1998 | | | | |
| Southern Oregon Coastal | Coos | 17100304 | 20677 | Coos Bay | 1243397433543 | 0 to 12.3 | 12.3 | pH | FallWinterSpring | pH 6.5 to 8.5 | Resident fish and aquatic life; Water contact recreation | Cat 3: Insufficient data | 2004 | No action | Previous Data: [DEQ] LASAR 24990 River Mile 8.8: From 2/28/2001 to 2/28/2001, 0 out of 1 samples (0%) outside pH criteria range 6.5 to 8.5. | Previous Status: Cat 3: Insufficient data | Previous Action: Added to database | Previous Assessment Year: 2004 | | | | |
| Southern Oregon Coastal | Coos | 17100304 | 20678 | Coos Bay | 1243397433543 | 0 to 12.3 | 12.3 | pH | Summer | pH 6.5 to 8.5 | Water contact recreation; Resident fish and aquatic life | Cat 3: Insufficient data | 2004 | No action | Previous Data: [DEQ] LASAR 25661 River Mile 11.2: From 8/28/2001 to 8/28/2001, 0 out of 2 samples (0%) outside pH criteria range 6.5 to 8.5.<br>[DEQ] LASAR 25661 River Mile 9.5: From 8/22/2001 to 8/22/2001, 0 out of 2 samples (0%) outside pH criteria range 6.5 to 8.5. | Previous Status: Cat 3: Insufficient data | Previous Action: Added to database | Previous Assessment Year: 2004 | | | | |
| Southern Oregon Coastal | Coos | 17100304 | 7814 | Coos Bay | 1243397433543 | 7.8 to 12.3 | 4.5 | Polychlorinated Biphenyls (PCBs) | Year Round | Toxic substances may not be introduced above natural background levels in the waters of the State in amounts, concentrations, or combinations that may be harmful, may chemically change to harmful forms in the environment, or may accumulate in sediment… | Resident fish and aquatic life; Anadromous fish passage; Drinking water | Cat 2: Attaining some criteria/uses | 1998 | No action | Previous Data: Values exceeded reference values but did not meet listing criteria. No data on beneficial use impairment (e.g. bioassays). Minimum Data Requirements were not met (Two exceedences of a standard and at least 10% of the time) there are no standards for sediment concentrations. | Previous Status: Attaining | Previous Action: Added to database | Previous Assessment Year: 1998 | | | | |
| Southern Oregon Coastal | Coos | 17100304 | 4979 | Coos Bay | 1243397433543 | 7.8 to 12.3 | 4.5 | Polynuclear Aromatic Hydrocarbons | Year Round | Toxic substances may not be introduced above natural background levels in the waters of the State in amounts, concentrations, or combinations that may be harmful, may chemically change to harmful forms in the environment, or may accumulate in sediment… | Resident fish and aquatic life; Anadromous fish passage; Drinking water | Cat 2: Attaining some criteria/uses | 1998 | No action | Previous Data: Values exceeded reference values but did not meet listing criteria. No data on beneficial use impairment (e.g. bioassays). Minimum Data Requirements were not met (Two exceedences of a standard and at least 10% of the time) there are no standards for sediment concentrations. | Previous Status: Attaining | Previous Action: Added to database | Previous Assessment Year: 1998 | | | | |
| Southern Oregon Coastal | Coos | 17100304 | 4827 | Coos Bay | 1243397433543 | 0 to 7.8 | 7.8 | Sedimentation | Undefined | The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation, or industry may not be allowed. | Salmonid fish rearing; Salmonid fish spawning; Resident fish and aquatic life | Cat 3: Insufficient data | 1998 | No action | | Previous Status: Insufficient data | Previous Action: Added to database | Previous Assessment Year: 1998 | | | | |
| Southern Oregon Coastal | Coos | 17100304 | 4933 | Coos Bay | 1243397433543 | 7.8 to 12.3 | 4.5 | Sedimentation | Undefined | The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation, or industry may not be allowed. | Resident fish and aquatic life; Salmonid fish spawning; Salmonid fish rearing | Cat 3: Insufficient data | 1998 | No action | | Previous Status: Insufficient data | Previous Action: Added to database | Previous Assessment Year: 1998 | | | | |
| Southern Oregon Coastal | Coos | 17100304 | 4888 | Coos Bay | 1243397433543 | 7.8 to 12.3 | 4.5 | Tributyltin | Year Round | …Where no published EPA criteria exist for a toxic substance, public health advisories and other published scientific literature may be considered and used, if appropriate, to set guidance values. | Anadromous fish passage; Resident fish and aquatic life; Drinking water | Cat 3B: Insufficient data, potential concern | 1998 | No action | Previous Data: Advisory had been made against eating clams harvested from Jordan Cove area including all tideland between Jordan Point and the northern point of North Spit due to elevated level of tributyltin in clams, crabs and fish (OSHD, 10/95). Advisory was lifted in 1997. | Previous Status: Potential concern | Previous Action: Delisted - Meets standards | Previous Assessment Year: 1998 | | | | |
| Southern Oregon Coastal | Coos | 17100304 | 7951 | Coos Bay | 1243397433543 | 7.8 to 12.3 | 4.5 | Zinc | Year Round | Toxic substances may not be introduced above natural background levels in the waters of the State in amounts, concentrations, or combinations that may be harmful, may chemically change to harmful forms in the environment, or may accumulate in sediment… | Drinking water; Resident fish and aquatic life; Anadromous fish passage | Cat 3B: Insufficient data, potential concern | 1998 | No action | Previous Data: Values exceeded reference values but did not meet listing criteria. No data on beneficial use impairment (e.g. bioassays). Minimum Data Requirements were not met (Two exceedences of a standard and at least 10% of the time) there are no standards for sediment concentrations. | Previous Status: Potential concern | Previous Action: Added to database | Previous Assessment Year: 1998 | | | | |

# Attachment F. NRCS Soils Survey

Soil Map—Coos County, Oregon
(Jordan Cove soils)




Map Scale: 1:10,600 if printed on B landscape (17" x 11") sheet.

Meters: 0 150 300 600 900

Feet: 0 500 1000 2000 3000

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

USDA **Natural Resources Conservation Service**

Web Soil Survey
National Cooperative Soil Survey

3/17/2017
Page 1 of 3

## MAP LEGEND

**Area of Interest (AOI)**

- Area of Interest (AOI)

**Soils**

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

**Special Point Features**

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

**Water Features**

- Streams and Canals

**Transportation**

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

**Background**

- Aerial Photography

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Coos County, Oregon
Survey Area Data: Version 11, Sep 16, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 6, 2010—Jul 13, 2010

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

# Map Unit Legend

| Coos County, Oregon (OR011) | | | |
|---|---|---|---|
| **Map Unit Symbol** | **Map Unit Name** | **Acres in AOI** | **Percent of AOI** |
| 3 | Beaches | 9.1 | 0.7% |
| 16 | Dune land | 252.7 | 19.8% |
| 28 | Heceta fine sand | 216.0 | 16.9% |
| 59D | Waldport fine sand, 0 to 30 percent slopes | 28.5 | 2.2% |
| 59E | Waldport fine sand, 30 to 70 percent slopes | 199.7 | 15.6% |
| 61D | Waldport-Heceta fine sands, 0 to 30 percent slopes | 208.8 | 16.3% |
| W | Water | 364.5 | 28.5% |
| **Totals for Area of Interest** | | **1,279.4** | **100.0%** |

# Attachment G. ODOT Water Quality Design Storm

# Stormwater Management Program - Water Quality Design Storm

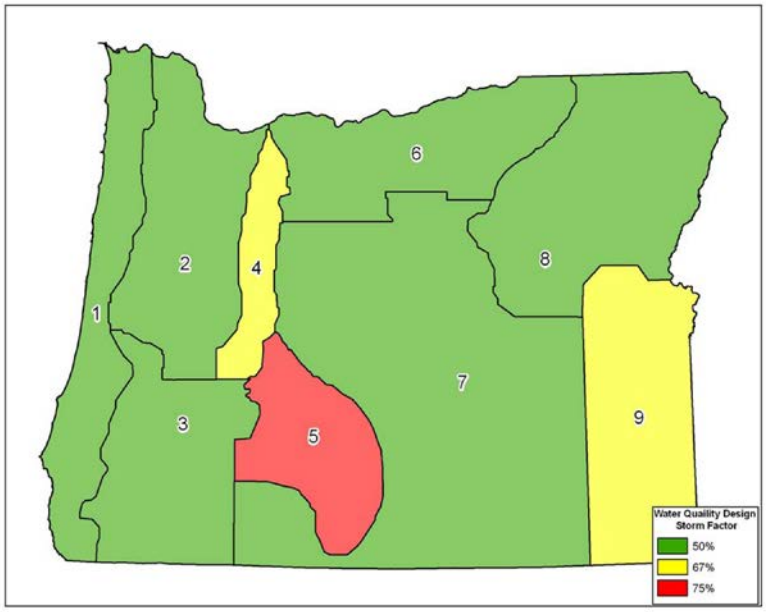
## Water Quality Design Storm

The Water Quality Design Storm defines the magnitude of the precipitation event that must be managed for water quality. Treatment facilities are to be designed to handle the volume and peak flow rate generated by the CIA during the Water Quality Design Storm.

Because Oregon's climate varies across the state, each major climate zone has its own Water Quality Design Storm. Percentage of the annual average precipitation for the design storm is the same for all the climate zones.

For cumulative rainfall from the 2-year, 24-hour storm for the project site, the Water Quality Design Storm is 50 percent except as follows:

- Climate Zone 4: 67 percent
- Climate Zone 5: 75 percent
- Climate Zone 9: 67 percent




For ODOT purposes, minimum storm size (0.7 inches during 24 hours) was selected to make sure that the "first flush" of high pollutant concentration is always captured. A maximum storm size has also been set in recognition that the large storms usually have low pollutant concentrations and loads at the end.

A detailed discussion of the development and rational for the selection of the Water Quality Design storm is in the Water Quality Design Storm Evaluation and Guidance.

William Fletcher -
Water Resources Program Coordinator
503.731.3024

Alvin Shoblom -
Senior Hydraulics Engineer
503.986.3365

# Attachment H. ODOT Rainfall Intensity-Duration-Frequency Table

# APPENDIX A - RAINFALL INTENSITY - DURATION - RECURRENCE INTERVAL CURVES 2005

## 1.0 Derivation of Curves

The Rainfall Intensity - Duration - Recurrence Interval (I-D-R) curves were computed in accordance with the method described in the 1973 NOAA Atlas 2 titled "Precipitation-Frequency Atlas of the Western United States, Volume X-Oregon." A regional rainfall analysis was made by comparing rainfall data for 136 cities and areas, and thirteen zones were established that have similar rainfall intensities. A set of I-D-R curves were calculated for each zone and the curves represent average values for that zone.

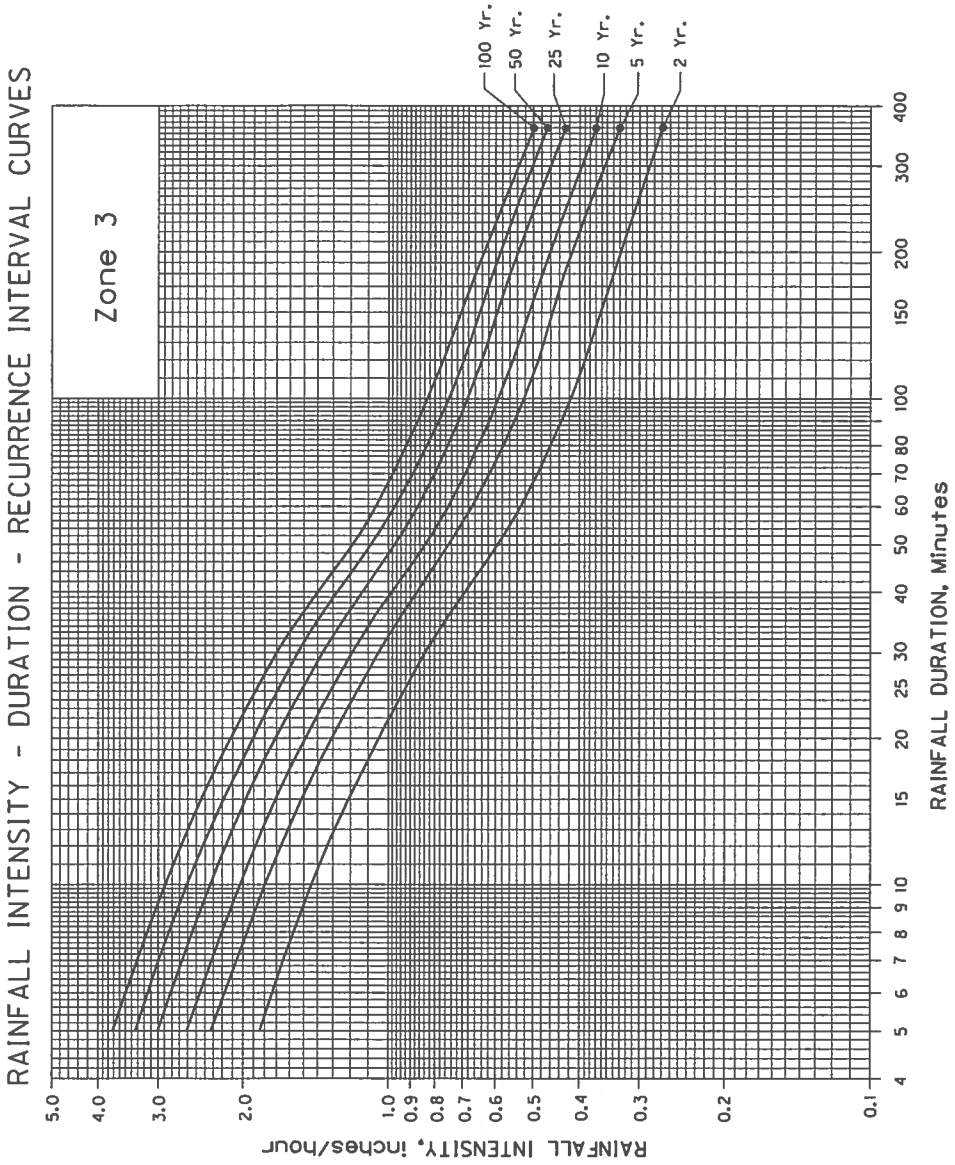
## 2.0 Use of Curves

The first step is to determine the zone in which the project is located. This can be accomplished by either using the enclosed map that shows the various zones or the alphabetical listing of cities and their corresponding zones. When the proper zone is located, the I-D-R curves for that zone will provide the needed rainfall intensities. The designer must use engineering judgement in selecting the proper zone if the proposed project lies within two zones or is on or near a dividing line. The zone with larger intensity should be used if no personal knowledge of the area is available, as this gives the most conservative design.

*Note: Rainfall Zone Map and Rainfall Zone Map with Highway Milepoints are in pdf formats.*

**TABLE 1: INDEX TO RAINFALL INTENSITY-DURATION-RECURRENCE INTERVAL CURVES**

| City | Zone | City | Zone | City | Zone |
|---|---|---|---|---|---|
| -A- | | | | | |
| | | Chemult | 10 | Fox | 12 |
| Albany | 7 | Chiloquin | 10 | Frenchglen | 13 |
| Alsea | 4 | Condon | 13 | | |
| Amity | 8 | Coos Bay | 3 | | |
| Andrews | 10 | Coquille | 4 | -G- | |
| Arlington | 11 | Corvallis | 8 | | |
| Ashland | 5 | Cottage Grove | 8 | Gladstone | 8 |
| Astoria | 1 | | | Glendale | 5 |
| Austin | 9 | | | Gold Beach | 1 |
| | | | | Grants Pass | 5 |
| | | -D- | | Gresham | 8 |
| -B- | | | | | |
| | | Dallas | 8 | | |
| Bandon | 1 | Dayton | 7 | -H- | |
| Baker | 13 | Detroit | 5 | | |
| Beatty | 13 | Drain | 5 | Haines | 10 |
| Beaverton | 7 | | | Hebo | 2 |
| Bend | 10 | | | Helix | 13 |
| Blue River | 5 | -E- | | Heppner | 13 |
| Boardman | 13 | | | Hermiston | 13 |
| Boring | 8 | Elgin | 12 | Hillsboro | 8 |
| Brookings | 1 | Elkton | 4 | Hood River | 5 |
| Brownsville | 8 | Enterprise | 10 | Huntington | 13 |
| Burns | 13 | Estacada | 5 | | |
| Burnt Woods | 5 | Eugene | 7 | | |
| | | | | -I- | |
| -C- | | -F- | | Imnaha | 10 |
| | | | | Independence | 8 |
| Canby | 8 | Florence | 3 | | |
| Canyonville | 5 | Forest Grove | 8 | | |
| Cascade Locks | 4 | Fort Klamath | 9 | | |
| Cave Junction | 5 | Fossil | 13 | | |


RAINFALL INTENSITY - DURATION - RECURRENCE INTERVAL CURVES
Zone 3
100 Yr.
50 Yr.
25 Yr.
10 Yr.
5 Yr.
2 Yr.
RAINFALL INTENSITY, inches/hour
5.0
4.0
3.0
2.0
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
RAINFALL DURATION, Minutes
4
5
6
7
8
9
10
15
20
25
30
40
50
60
70
80
100
150
200
300
400

# Attachment I. Storm Water System Drainage Structure Table, Culvert Table, and Flow Calculations

DRAINAGE STRUCTURE TABLE

| DRAINAGE STRUCTURE INFORMATION | | | | | | | | PIPE INFORMATION | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | PLAN DWG # | CENTER COORDINATES | | STR INSIDE DIMS | STR DETAIL TYPE | TOP EL | BOT SLAB TOC EL | N | | NE | | E | | SE | | S | | SW | | W | | NW | | REMARKS |
| | | NORTHING | EASTING | | | | | DIA | INV | DIA | INV | DIA | INV | DIA | INV | DIA | INV | DIA | INV | DIA | INV | DIA | INV | |
| I-1 | | 666267.94 | 3923956.04 | 4'-0" x 4'-0"" | Precast | 58.80 | 54.97 | | | | | | | | | | | | | 18 | 7.00 | | | |
| I-2 | | 666267.94 | 3923674.82 | 4'-0" x 4'-0"" | Precast | 60.80 | 54.07 | | | | | 15 | 54.85 | | | 18 | 54.65 | | | | | | | |
| I-3 | | 666119.53 | 3923674.82 | 5'-0" x 5'-0"" | Precast | 60.80 | 53.30 | 18 | 54.28 | | | 15 | 54.85 | | | | | 24 (238°) | 53.88 | | | | | |
| SC-4 | | 666045.51 | 3923554.71 | 5'-0" x 5'-0"" | Precast | 60.80 | 52.90 | | | 24 (58°) | 53.53 | | | | | | | | | 24 | 53.48 | | | |
| CU-5 | | 666045.51 | 3923300.18 | 5'-0" x 5'-0"" | Precast | 60.80 | 52.21 | | | | | 24 | 52.84 | | | | | | | 24 | 52.79 | | | |
| CU-6 | | 666045.51 | 3923027.90 | 5'-0" x 5'-0"" | Precast | 58.80 | 51.48 | | | | | 24 | 52.11 | | | | | | | 24 | 52.06 | | | |
| CU-7 | | 666045.51 | 3922856.55 | 5'-0" x 5'-0"" | Precast | 58.80 | 50.65 | | | | | 24 | 51.63 | | | | | | | 30 | 51.23 | | | |
| SC-8 | | 666045.51 | 3922768.80 | 5'-0" x 5'-0"" | Precast | 58.80 | 50.38 | 24 | 53.89 | | | 30 | 51.01 | | | | | | | 30 | 50.96 | | | |
| CU-9 | | 666045.51 | 3922628.22 | 6'-0" x 6'-0"" | Precast | 58.80 | 49.63 | | | | | 30 | 50.61 | | | | | | | 36 | 50.21 | | | |
| I-10 | | 666119.53 | 3923956.04 | 4'-0" x 4'-0"" | Precast | 58.80 | 54.97 | | | | | | | | | | | | | 15 | 55.55 | | | |
| I-11 | | 666334.23 | 3922891.30 | 4'-0" x 4'-0"" | Precast | 58.80 | 54.97 | | | | | | | | | 15 | 55.55 | | | | | | | |
| I-12 | | 666020.63 | 3921985.95 | 6'-0" x 6'-0"" | Precast | 46.00 | 38.74 | | | 36 (40°) | 39.37 | | | | | 36 | 39.32 | | | | | | | |
| I-13 | | 665907.35 | 3921985.95 | 6'-0" x 6'-0"" | Precast | 45.00 | 36.06 | 36 | 39.04 | | | | | | | 42 | 36.64 | | | 24 | 37.84 | | | |
| I-14 | | 665692.01 | 3921985.95 | 6'-0" x 6'-0"" | Precast | 44.50 | 35.47 | 42 | 36.10 | | | | | | | 42 | 36.05 | | | 24 | 37.84 | | | |
| I-15 | | 665468.97 | 3921985.95 | 6'-0" x 6'-0"" | Precast | 44.50 | 34.86 | 42 | 35.49 | | | | | | | 42 | 35.44 | | | 24 | 37.84 | | | |
| I-16 | | 665246.42 | 3921985.95 | 7'-0" x 7'-0"" | Precast | 44.50 | 33.90 | 42 | 34.88 | | | | | | | 48 | 34.48 | | | 24 | 37.84 | | | |
| I-17 | | 665024.57 | 3921985.95 | 7'-0" x 7'-0"" | Precast | 44.50 | 33.30 | 48 | 33.93 | | | | | | | 48 | 33.88 | | | 24 | 37.84 | | | |
| I-18 | | 664802.44 | 3921985.95 | 7'-0" x 7'-0"" | Precast | 43.50 | 32.69 | 48 | 33.32 | | | | | | | | | | | 48 (259°) | 33.27 | | | |
| EOP-19 | | 664739.74 | 3921746.02 | | | | | 48 | 32.62 | | | | | | | | | | | | | | | |
| I-20 | | 666439.38 | 3921309.45 | 4'-0" x 4'-0"" | Precast | 44.50 | 40.67 | 15 | 41.25 | | | | | | | | | | | | | | | |
| I-21 | | 666573.00 | 3921309.45 | 4'-0" x 4'-0"" | Precast | 44.50 | 40.14 | 15 | 41.13 | | | | | | | 15 | 40.92 | | | 18 | 40.72 | | | |
| I-22 | | 666573.00 | 3921164.50 | 5'-0" x 5'-0"" | Precast | 44.50 | 39.38 | 15 | 41.13 | | | 18 | 40.36 | | | 15 | 41.03 | | | 24 | 39.96 | | | |
| I-23 | | 666573.00 | 3921020.00 | 5'-0" x 5'-0"" | Precast | 44.50 | 38.97 | 15 | 41.13 | | | 24 | 39.60 | | | 15 | 41.03 | | | 24 | 39.55 | | | |
| I-24 | | 666573.00 | 3920814.21 | 5'-0" x 5'-0"" | Precast | 44.50 | 38.06 | | | | | 24 | 39.04 | | | 30 (193°) | 38.64 | | | | | | | |
| I-25 | | 666441.94 | 3920785.00 | 6'-0" x 6'-0"" | Precast | 44.50 | 34.73 | 30 (13°) | 38.30 | | | | | | | 30 | 35.71 | | | 36 | 35.31 | | | |
| I-26 | | 666258.00 | 3920785.00 | 5'-0" x 5'-0"" | Precast | 44.50 | 35.59 | 30 | 36.17 | | | 24 | 39.11 | | | 30 (182°) | 36.22 | | | | | | | |
| I-27 | | 666165.88 | 3920781.50 | 5'-0" x 5'-0"" | Precast | 44.50 | 35.87 | 30 (2°) | 36.45 | | | | | | | 30 | 36.50 | | | | | | | |
| I-28 | | 666045.38 | 3920832.66 | 4'-0" x 4'-0"" | Precast | 44.50 | 40.67 | | | | | | | | | 15 | 41.25 | | | | | | | |
| I-29 | | 665986.75 | 3920832.66 | 5'-0" x 5'-0"" | Precast | 44.50 | 36.95 | 15 | 41.10 | | | 24 | 37.58 | | | | | | | 24 | 37.53 | | | |
| I-30 | | 665986.75 | 3920781.50 | 5'-0" x 5'-0"" | Precast | 44.50 | 36.77 | 24 | 37.35 | | | 24 | 37.40 | | | | | | | | | | | |
| I-31 | | 665862.42 | 3920574.54 | 6'-0" x 6'-0"" | Precast | 43.00 | 36.77 | | | | | | | | | 42 | 37.35 | | | 36 (291°) | 37.75 | | | |
| I-32 | | 665360.14 | 3920574.54 | 7'-0" x 7'-0"" | Precast | 44.50 | 35.06 | 42 | 36.04 | | | | | 48 (154°) | 35.64 | | | | | | | | | |
| EOP-33 | | 665173.03 | 3920645.01 | | | | | 48 | 35.13 | | | | | | | | | | | | | | | |
| I-34 | | 666483.49 | 3921164.50 | 4'-0" x 4'-0"" | Precast | 44.50 | 40.67 | 15 | 41.25 | | | | | | | | | | | | | | | |
| I-35 | | 666483.49 | 3921020.00 | 4'-0" x 4'-0"" | Precast | 44.50 | 40.67 | 15 | 41.25 | | | | | | | | | | | | | | | |
| I-36 | | 666188.17 | 3921314.00 | 4'-0" x 4'-0"" | Precast | 44.50 | 40.67 | 15 | 41.25 | | | | | | | | | | | | | | | |
| I-37 | | 666258.00 | 3921314.00 | 4'-0" x 4'-0"" | Precast | 44.50 | 40.45 | | | | | | | | | 15 | 41.08 | | | 15 | 41.03 | | | |
| I-38 | | 666258.00 | 3921152.73 | 4'-0" x 4'-0"" | Precast | 44.50 | 39.85 | | | | | 15 | 40.63 | | | | | | | 18 | 40.43 | | | |
| I-39 | | 666258.00 | 3920958.51 | 5'-0" x 5'-0"" | Precast | 44.50 | 38.96 | | | | | 18 | 7.10 | | | 15 | 41.12 | | | 24 | 39.54 | | | |
| I-40 | | 666204.14 | 3920958.51 | 4'-0" x 4'-0"" | Precast | 44.50 | 40.67 | 15 | 41.25 | | | | | | | | | | | | | | | |
| I-41 | | 666188.14 | 3921219.33 | 4'-0" x 4'-0"" | Precast | 44.50 | 40.67 | | | | | | | | | 15 | 41.25 | | | | | | | |
| I-42 | | 666087.41 | 3921219.33 | 4'-0" x 4'-0"" | Precast | 44.50 | 40.37 | 15 | 41.00 | | | | | | | | | | | 15 | 40.95 | | | |
| I-43 | | 666087.41 | 3921031.83 | 4'-0" x 4'-0"" | Precast | 44.50 | 39.70 | | | | | 15 | 40.48 | | | 18 | 40.28 | | | | | | | |
| MH-44 | | 665986.75 | 3921031.83 | 5'-0" x 5'-0"" | Precast | 44.50 | 37.50 | 18 | 40.03 | | | 24 | 38.13 | | | | | | | 24 | 38.08 | | | |
| I-45 | | 664918.00 | 3921146.70 | 5'-0" x 5'-0"" | Precast | 44.50 | 38.50 | | | 24 (28°) | 39.13 | | | 15 (144°) | 40.32 | | | | | 24 (276°) | 39.08 | | | |
| MH-46 | | 665920.62 | 3920425.71 | 6'-0" x 6'-0"" | Precast | 44.50 | 38.62 | 36 (357°) | 39.25 | | | 36 (111°) | 39.20 | | | | | | | | | | | |
| I-47 | | 665367.84 | 3921258.25 | 4'-0" x 4'-0"" | Precast | 44.50 | 40.67 | | | | | | | 15 (136°) | 41.25 | | | | | | | | | |
| I-48 | | 665339.12 | 3921286.22 | 4'-0" x 4'-0"" | Precast | 44.50 | 40.50 | | | | | | | | | 15 | 41.08 | | | | | 15 (316°) | 41.13 | |
| I-49 | | 665251.72 | 3921286.22 | 4'-0" x 4'-0"" | Precast | 44.50 | 40.08 | 15 | 40.86 | | | | | | | 18 | 40.66 | | | | | | | |
| I-50 | | 665024.09 | 3921286.22 | 4'-0" x 4'-0"" | Precast | 44.50 | 39.46 | 18 | 40.09 | | | | | | | | | | | 18 | 40.04 | | | |
| I-51 | | 665024.09 | 3921203.27 | 5'-0" x 5'-0"" | Precast | 44.50 | 38.85 | | | | | 18 | 39.83 | | | | | 24 (208°) | 39.43 | | | | | |
| I-52 | | 664870.88 | 3921180.74 | 4'-0" x 4'-0"" | Precast | 44.50 | 39.89 | | | | | 15 | 40.52 | | | | | | | | | 15 (324°) | 40.47 | |
| EOP-53 | | 663701.28 | 3921395.58 | | | | | | | 24 (64°) | 27.12 | | | | | | | | | | | | | |
| I-54 | | 664870.88 | 3921470.87 | 4'-0" x 4'-0"" | Precast | 44.50 | 40.67 | | | | | | | | | | | | | 15 | 41.25 | | | |
| MH-55 | | 663437.55 | 3921940.98 | 5'-0" x 5'-0"" | Precast | 11.50 | 5.84 | 30 | 6.47 | | | | | | | 30 | 6.42 | | | | | | | |
| CDS-56 | | 663539.06 | 3921611.20 | 5'-0" | Precast | 11.00 | 2.25 | | | | | | | | | | | | | 30 | 7.50 | | | |
| I-57 | | 665907.35 | 3921803.14 | 5'-0" x 5'-0"" | Precast | 42.30 | 37.72 | | | | | 24 | 38.30 | | | | | | | | | | | |
| I-58 | | 665692.01 | 3921803.14 | 5'-0" x 5'-0"" | Precast | 42.30 | 37.72 | | | | | 24 | 38.30 | | | | | | | | | | | |
| I-59 | | 665468.97 | 3921803.14 | 5'-0" x 5'-0"" | Precast | 42.30 | 37.72 | | | | | 24 | 38.30 | | | | | | | | | | | |
| I-60 | | 665246.42 | 3921803.14 | 5'-0" x 5'-0"" | Precast | 42.30 | 37.72 | | | | | 24 | 38.30 | | | | | | | | | | | |
| I-61 | | 665024.57 | 3921803.14 | 5'-0" x 5'-0"" | Precast | 42.30 | 37.72 | | | | | 24 | 38.30 | | | | | | | | | | | |
| I-62 | | 664954.71 | 3920808.41 | 5'-0" x 5'-0"" | Precast | 44.90 | 37.60 | | | | | 24 (96°) | 38.23 | | | | | | | | | 24 (321°) | 38.18 | |
| I-63 | | 664462.17 | 3921709.83 | 4'-0" x 4'-0"" | Precast | 39.00 | 35.00 | 15 (341°) | 35.63 | | | | | | | 15 (183°) | 35.58 | | | | | | | |
| MH-64 | | 664164.86 | 3921694.53 | 5'-0" x 5'-0"" | Precast | 34.50 | 29.70 | 24 (3°) | 30.33 | | | | | | | | | 24 (205°) | 30.28 | | | | | |
| I-65 | | 664054.22 | 3921643.89 | 5'-0" x 5'-0"" | Precast | 34.00 | 28.85 | | | 24 (25°) | 29.83 | | | | | | | 30 (209°) | 29.43 | | | | | |
| MH-66 | | 663982.72 | 3921604.34 | 5'-0" x 5'-0"" | Precast | 34.00 | 28.60 | | | 30 (29°) | 29.23 | | | | | | | | | 24 | 29.18 | | | |
| I-67 | | 663982.72 | 3921513.67 | 5'-0" x 5'-0"" | Precast | 33.00 | 27.85 | | | | | 24 | 28.83 | | | 30 | 28.43 | | | | | | | |
| I-68 | | 663924.67 | 3921513.67 | 5'-0" x 5'-0"" | Precast | 33.00 | 27.62 | 30 | 28.25 | | | | | | | 30 | 28.20 | | | | | | | |
| I-69 | | 664551.71 | 3921679.69 | 4'-0" x 4'-0"" | Precast | 42.30 | 38.47 | | | | | | | | | 15 (161°) | 39.05 | | | | | | | |
| EOP-70 | | 663192.18 | 3921967.97 | | | | | | | | | | | | | | | | | | | 30 (313°) | 3.98 | |
| SC-71 | | 666303.32 | 3928313.39 | 6'-0" x 6'-0"" | Precast | 62.50 | 52.73 | | | 30 (27°) | 53.71 | | | | | 36 (169°) | 53.31 | | | 24 (290°) | 55.96 | | | |
| EOP-72 | | 666151.96 | 3920413.24 | | | 44.00 | | | | | | | | | | 36 (177°) | 40.00 | | | | | | | |

DRAINAGE STRUCTURE TABLE

| DRAINAGE STRUCTURE INFORMATION | | | | | | | | PIPE INFORMATION | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | PLAN DWG # | CENTER COORDINATES | | STR INSIDE DIMS | STR DETAIL TYPE | TOP EL | BOT SLAB TOC EL | N | | NE | | E | | SE | | S | | SW | | W | | NW | | REMARKS |
| | | NORTHING | EASTING | | | | | DIA | INV | DIA | INV | DIA | INV | DIA | INV | DIA | INV | DIA | INV | DIA | INV | DIA | INV | |
| I-73 | | 665815.69 | 3921304.29 | 4'-0" x 4'-0"" | Precast | 43.00 | 38.85 | | | 15 (46°) | 39.63 | | | | | 15 (176°) | 39.63 | | | | | 18 (313°) | 39.43 | |
| I-74 | | 665986.75 | 3921122.19 | 5'-0" x 5'-0"" | Precast | 46.00 | 37.78 | | | | | | | 24 (133°) | 38.41 | | | | | 24 | 38.36 | | | |
| I-75 | | 666150.39 | 3922891.30 | 4'-0" x 4'-0"" | Precast | 58.80 | 54.31 | 15 | 55.09 | | | | | | | | | | | 18 | 54.89 | | | |
| I-76 | | 666054.00 | 3920781.50 | 5'-0" x 5'-0"" | Precast | 44.50 | 36.20 | 30 | 36.78 | | | | | | | 24 | 37.18 | | | | | | | |
| CDS-77 | | 664756.03 | 3921746.02 | 8'-0" | Precast | 40.00 | 25.45 | | | | | 48 (79°) | 32.66 | | | 48 | 32.66 | | | | | | | |
| I-78 | | 666150.39 | 3922768.80 | 5'-0" x 5'-0"" | Precast | 58.80 | 53.57 | | | | | 18 | 54.58 | | | 24 | 54.15 | | | | | 18 (310°) | 54.55 | |
| CU-79 | | 667172.59 | 3928123.69 | 4'-0" x 4'-0"" | Precast | 61.80 | 57.97 | | | | | | | | | | | | | 15 (260°) | 58.55 | | | |
| CU-80 | | 667136.59 | 3927929.19 | 4'-0" x 4'-0"" | Precast | 61.80 | 57.28 | | | | | 15 (80°) | 58.06 | | | 18 | 57.86 | | | | | | | |
| CU-81 | | 666836.59 | 3927929.19 | 5'-0" x 5'-0"" | Precast | 61.80 | 56.13 | 18 | 57.11 | | | | | | | 24 (163°) | 56.71 | | | | | | | |
| CU-82 | | 666714.03 | 3927966.19 | 5'-0" x 5'-0"" | Precast | 61.80 | 55.76 | 24 (343°) | 56.39 | | | 24 | 56.34 | | | | | | | | | | | |
| CU-83 | | 666714.03 | 3928385.54 | 5'-0" x 5'-0"" | Precast | 61.80 | 54.31 | | | | | 15 (83°) | 58.16 | | | 30 (171°) | 54.89 | | | 24 | 55.29 | 24 (337°) | 56.83 | |
| CU-84 | | 666604.50 | 3928402.90 | 5'-0" x 5'-0"" | Precast | 61.80 | 53.98 | 30 (351°) | 54.61 | | | | | | | 30 | 54.56 | | | | | | | |
| CU-85 | | 666479.19 | 3928402.90 | 5'-0" x 5'-0"" | Precast | 61.80 | 53.62 | 30 | 54.25 | | | | | | | | | 30 (207°) | 54.20 | | | | | |
| CU-86 | | 666321.82 | 3928263.49 | 5'-0" x 5'-0"" | Precast | 61.80 | 55.51 | | | | | 24 (110°) | 56.09 | | | | | | | 24 | 56.14 | | | |
| EOP-87 | | 666139.32 | 3928345.61 | | | | | 36 (349°) | 52.89 | | | | | | | | | | | | | | | |
| CU-88 | | 667148.59 | 3928316.40 | 4'-0" x 4'-0"" | Precast | 61.80 | 57.97 | | | | | | | | | 15 | 58.55 | | | | | | | |
| I-89 | | 666875.03 | 3928316.40 | 5'-0" x 5'-0"" | Precast | 61.80 | 56.69 | 15 | 57.87 | | | 15 | 58.13 | 24 (157°) | 57.27 | | | | | | | | | |
| CU-90 | | 666875.03 | 3928483.03 | 4'-0" x 4'-0"" | Precast | 61.80 | 57.97 | | | | | | | | | | | | | 15 | 58.55 | | | |
| CU-91 | | 666732.03 | 3928541.17 | 4'-0" x 4'-0"" | Precast | 61.80 | 57.97 | | | | | | | | | | | | | 15 (263°) | 58.55 | | | |
| CU-92 | | 666628.77 | 3928110.19 | 4'-0" x 4'-0"" | Precast | 61.80 | 57.97 | | | | | | | | | | | | | 15 (248°) | 58.55 | | | |
| EOP-205A | | 666998.00 | 3921309.45 | | | | | | | | | | | | | 24 | 38.47 | | | | | | | |
| EOP-213A | | 667230.00 | 3921817.99 | | | | | | | | | | | | | 30 | 35.96 | | | | | | | |
| CU-95 | | 666045.51 | 3922489.07 | 5'-0" x 5'-0"" | Precast | 58.80 | 49.23 | | | | | 36 | 49.86 | | | | | | | 24 | 49.81 | | | |
| CU-96 | | 666045.51 | 3922386.14 | 6'-0" x 6'-0"" | Precast | 51.80 | 46.22 | | | | | 24 | 47.63 | | | | | | | 36 | 46.80 | | | |
| CU-97 | | 666045.51 | 3922232.90 | 5'-0" x 5'-0"" | Precast | 51.80 | 45.79 | 15 (16°) | 48.43 | | | 36 | 46.42 | | | | | | | 24 | 46.37 | | | |
| CU-98 | | 666045.51 | 3922095.13 | 6'-0" x 6'-0"" | Precast | 44.80 | 39.22 | 15 | 41.43 | | | 24 | 40.63 | | | | | | | 36 (281°) | 39.80 | | | |
| I-99 | | 666059.63 | 3922019.17 | 6'-0" x 6'-0"" | Precast | 44.80 | 38.92 | | | | | 36 (101°) | 39.55 | | | | | 36 (220°) | 39.50 | | | | | |
| I-100 | | 666244.52 | 3922482.14 | 4'-0" x 4'-0"" | Precast | 58.80 | 54.97 | | | | | 15 | 55.55 | | | | | | | | | | | |
| I-101 | | 666244.52 | 3922655.34 | 4'-0" x 4'-0"" | Precast | 58.80 | 54.34 | | | | | | | 18 (130°) | 54.92 | | | | | 15 | 55.12 | | | |
| I-102 | | 666117.99 | 3922254.05 | 4'-0" x 4'-0"" | Precast | 52.80 | 48.97 | | | | | | | | | 15 (196°) | 49.55 | | | | | | | |
| I-103 | | 666232.99 | 3922358.55 | 4'-0" x 4'-0"" | Precast | 55.00 | 51.17 | | | | | | | | | | | | | 15 (267°) | 51.75 | | | |
| I-104 | | 666217.14 | 3922095.13 | 4'-0" x 4'-0"" | Precast | 50.50 | 46.50 | | | | | 15 (87°) | 47.13 | | | 15 | 47.08 | | | | | | | |
| I-105 | | 663728.46 | 3921520.25 | 5'-0" x 5'-0"" | Precast | 31.50 | 26.92 | | | | | | | | | | | | | 24 | 27.50 | | | |
| EOP-106 | | 663522.68 | 3921467.23 | | | | | | | | | 30 | 4.78 | | | | | | | | | | | |
| EOP-107 | | 663827.70 | 3921513.67 | | | | | 30 | 27.96 | | | | | | | | | | | | | | | |
| EOP-108 | | 664611.30 | 3921616.02 | | | 42.00 | | | | | | | | | | | | | | 48 | 30.50 | | | |
| MH-109 | | 664611.30 | 3921555.27 | 7'-0" x 7'-0"" | Precast | 42.00 | 23.42 | | | | | 48 | 30.35 | | | | | | | 48 | 24.00 | | | |
| EOP-110 | | 664611.30 | 3921478.93 | | | | | | | | | 48 | 23.81 | | | | | | | | | | | |
| I-113 | | 664992.67 | 3920533.77 | 4'-0" x 4'-0"" | Precast | 34.80 | 30.97 | | | | | | | | | 15 | 31.55 | | | | | | | |
| MH-114 | | 664970.91 | 3920533.77 | 4'-0" x 4'-0"" | Precast | 36.00 | 30.87 | 15 | 31.50 | | | | | | | | | | | 15 | 31.45 | | | |
| MH-115 | | 664970.91 | 3920488.00 | 4'-0" x 4'-0"" | Precast | 36.00 | 30.71 | | | | | 15 | 31.34 | | | 15 | 31.29 | | | | | | | |
| I-116 | | 664892.92 | 3920488.00 | 4'-0" x 4'-0"" | Precast | 29.50 | 14.64 | 15 | 26.13 | | | 15 | 15.27 | | | | | | | 15 | 15.22 | | | |
| I-117 | | 664892.92 | 3920434.89 | 4'-0" x 4'-0"" | Precast | 27.50 | 14.31 | | | | | 15 | 15.09 | | | 18 | 14.89 | | | | | | | |
| CDS-118 | | 664746.54 | 3920434.89 | 4'-0" | Precast | 18.30 | 9.62 | 18 | 14.52 | | | | | | | 24 | 14.12 | | | | | | | |
| EOP-119 | | 664736.54 | 3920434.89 | | | | | 24 | 14.10 | | | | | | | | | | | | | | | |
| EOP-120 | | 664728.54 | 3920434.89 | | | 20.00 | | | | | | | | | | 24 | 11.80 | | | | | | | |
| I-121 | | 664892.92 | 3920600.08 | 4'-0" x 4'-0"" | Precast | 18.80 | 14.97 | | | | | | | | | | | | | 15 | 15.55 | | | |
| I-122 | | 665042.53 | 3920737.64 | 5'-0" x 5'-0"" | Precast | 44.50 | 37.27 | 24 (350°) | 37.85 | | | | | 24 (141°) | 37.90 | | | | | | | | | |
| I-123 | | 665227.61 | 3920705.01 | 5'-0" x 5'-0"" | Precast | 44.50 | 36.75 | | | | | | | | | 24 (170°) | 37.38 | | | 24 (260°) | 37.33 | | | |
| CDS-124 | | 665217.03 | 3920645.01 | 6'-0" | Precast | 46.00 | 29.74 | | | | | 24 (80°) | 37.18 | | | 48 | 35.24 | | | | | 48 (334°) | 35.24 | |
| EOP-125 | | 664290.49 | 3921429.77 | | | | | | | | | | | 24 (117°) | 26.19 | | | | | | | | | |
| CDS-126 | | 663447.80 | 3921940.98 | 5'-0" | Precast | 11.00 | 1.25 | | | | | | | | | 30 | 6.50 | | | | | | | |
| I-134 | | 664024.08 | 3921491.58 | 5'-0" x 5'-0"" | Precast | 31.00 | 26.42 | 24 | 27.00 | | | | | | | | | | | | | | | |
| MH-135 | | 664258.73 | 3921491.58 | 5'-0" x 5'-0"" | Precast | 34.50 | 25.78 | | | | | | | | | 24 | 26.41 | | | | | 24 (297°) | 26.36 | |
| EOP-136A | | 664689.92 | 3920777.41 | | | | | | | | | | | | | 15 | 12.04 | | | | | | | |
| EOP-138A | | 664689.92 | 3920988.66 | | | | | | | | | | | | | 15 | 12.04 | | | | | | | |
| CU-140 | | 666570.82 | 3927964.19 | 5'-0" x 5'-0"" | Precast | 61.80 | 56.98 | | | | | 15 (68°) | 58.16 | | | 24 | 57.56 | | | | | | | |
| CU-141 | | 666321.82 | 3927964.19 | 5'-0" x 5'-0"" | Precast | 61.80 | 56.31 | 24 | 56.94 | | | 24 | 56.89 | | | | | | | | | | | |
| I-142 | | 666100.95 | 3928172.23 | 6'-0" x 6'-0"" | Precast | 62.00 | 55.92 | | | | | | | | | | | 42 (231°) | 56.50 | | | | | |
| MH-143 | | 665993.67 | 3928040.18 | 5'-0" x 5'-0"" | Precast | 62.00 | 55.44 | | | 42 (51°) | 56.07 | | | | | | | 30 (240°) | 56.02 | | | | | |
| EOP-144 | | 665870.69 | 3927827.62 | | | 58.80 | | | | 30 (60°) | 54.05 | | | | | | | | | | | | | |
| OI-145 | | 666330.14 | 3923482.94 | 4'-0" x 4'-0"" | Precast | 58.80 | 54.97 | | | | | | | | | | | | | 15 | 55.55 | | | |
| OI-146 | | 666330.14 | 3923252.94 | 4'-0" x 4'-0"" | Precast | 57.80 | 53.65 | | | | | 15 | 54.43 | | | | | 18 (231°) | 54.23 | | | | | |
| OI-147 | | 666282.93 | 3923194.44 | 5'-0" x 5'-0"" | Precast | 57.80 | 53.06 | | | 18 (51°) | 54.04 | | | | | 24 | 53.64 | | | | | | | |
| OI-148 | | 666099.56 | 3923194.44 | 5'-0" x 5'-0"" | Precast | 57.80 | 52.55 | 24 | 53.18 | | | | | | | 24 | 53.13 | | | | | | | |
| OMH-149 | | 666012.77 | 3923194.44 | 5'-0" x 5'-0"" | Precast | 61.00 | 52.28 | 24 | 52.91 | | | | | | | | | | | 24 | 52.86 | | | |
| MH-150 | | 663728.46 | 3921452.06 | 5'-0" x 5'-0"" | Precast | 34.50 | 26.70 | | | | | 24 | 27.33 | | | | | 24 (244°) | 27.28 | | | | | |
| OMH-151 | | 666012.77 | 3922833.22 | 5'-0" x 5'-0"" | Precast | 60.00 | 51.33 | | | | | 24 | 51.96 | | | | | | | 24 | 51.91 | | | |
| OMH-152 | | 666012.77 | 3922562.16 | 4'-0" x 4'-0"" | Precast | 60.00 | 50.60 | | | | | 24 | 51.23 | | | | | | | 18 | 51.18 | | | |

DRAINAGE STRUCTURE TABLE

| DRAINAGE STRUCTURE INFORMATION | | | | | | | | PIPE INFORMATION | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | PLAN DWG # | CENTER COORDINATES | | STR INSIDE DIMS | STR DETAIL TYPE | TOP EL | BOT SLAB TOC EL | N | | NE | | E | | SE | | S | | SW | | W | | NW | | REMARKS |
| | | NORTHING | EASTING | | | | | DIA | INV | DIA | INV | DIA | INV | DIA | INV | DIA | INV | DIA | INV | DIA | INV | DIA | INV | |
| OMH-153 | | 666012.77 | 3922266.37 | 4'-0" x 4'-0"" | Precast | 54.00 | 49.70 | | | | | 18 | 50.33 | | | | | | | 15 | 50.28 | | | |
| OMH-154 | | 666012.77 | 3921885.71 | 4'-0" x 4'-0"" | Precast | 46.00 | 41.85 | | | | | 15 | 42.63 | | | 18 | 42.43 | | | | | | | |
| OMH-155 | | 665979.49 | 3921885.71 | 5'-0" x 5'-0"" | Precast | 46.00 | 41.35 | 18 | 42.33 | | | | | | | | | | | 24 | 41.93 | | | |
| OMH-156 | | 665979.49 | 3921845.46 | 5'-0" x 5'-0"" | Precast | 46.00 | 41.20 | | | | | 24 | 41.83 | | | | | | | 24 | 41.78 | | | |
| EOP-157 | | 665979.49 | 3921820.01 | | | | | | | | | 24 | 41.72 | | | | | | | | | | | |
| I-158 | | 665620.39 | 3921318.46 | 4'-0" x 4'-0"" | Precast | 44.50 | 40.67 | 15 (356°) | 41.25 | | | | | | | | | | | | | | | |
| I-159 | | 665865.83 | 3921355.34 | 4'-0" x 4'-0"" | Precast | 44.50 | 40.67 | | | | | | | | | | | 15 (226°) | 41.25 | | | | | |
| I-160 | | 665991.89 | 3921259.36 | 4'-0" x 4'-0"" | Precast | 44.50 | 40.67 | | | | | | | | | | | 15 (223°) | 41.25 | | | | | |
| I-161 | | 665920.49 | 3921192.73 | 5'-0" x 5'-0"" | Precast | 44.50 | 38.07 | | | 15 (43°) | 41.01 | | | 18 (133°) | 39.05 | | | | | | | 24 (313°) | 38.65 | |
| MH-162 | | 666441.94 | 3920594.07 | 6'-0" x 6'-0"" | Precast | 46.00 | 34.20 | | | | | 36 | 34.83 | | | | | 36 (218°) | 34.78 | | | | | |
| I-163 | | 666544.55 | 3920544.99 | 4'-0" x 4'-0"" | Precast | 44.50 | 40.67 | | | | | | | | | | | | | 15 | 41.25 | | | |
| I-164 | | 666412.13 | 3920570.97 | 6'-0" x 6'-0"" | Precast | 44.50 | 34.06 | | | 36 (38°) | 34.69 | | | | | | | | | 36 | 34.64 | | | |
| I-165 | | 666282.96 | 3920582.14 | 4'-0" x 4'-0"" | Precast | 44.50 | 40.67 | | | | | | | | | | | | | 15 | 41.25 | | | |
| I-166 | | 666144.13 | 3920586.05 | 4'-0" x 4'-0"" | Precast | 44.50 | 40.67 | | | | | | | | | | | | | 15 | 41.25 | | | |
| I-167 | | 666544.55 | 3920470.50 | 6'-0" x 6'-0"" | Precast | 44.50 | 33.03 | 42 | 33.61 | | | 15 | 41.06 | | | 42 | 33.66 | | | | | | | |
| I-168 | | 666412.13 | 3920470.50 | 6'-0" x 6'-0"" | Precast | 44.50 | 33.41 | 42 | 33.99 | | | 36 | 34.39 | | | 24 | 39.64 | | | | | | | |
| I-169 | | 666282.96 | 3920470.50 | 5'-0" x 5'-0"" | Precast | 44.50 | 39.38 | 24 | 39.96 | | | 15 | 40.97 | | | 24 | 40.01 | | | | | | | |
| I-170 | | 666144.13 | 3920470.50 | 5'-0" x 5'-0"" | Precast | 44.50 | 39.78 | 24 | 40.36 | | | 15 | 40.96 | | | | | | | | | | | |
| MH-171 | | 666594.00 | 3920470.50 | 6'-0" x 6'-0"" | Precast | 44.50 | 32.86 | | | | | | | | | 42 | 33.49 | | | 42 | 33.44 | | | |
| I-172 | | 665660.14 | 3920574.54 | 6'-0" x 6'-0"" | Precast | 44.50 | 36.21 | 42 | 36.84 | | | | | | | 42 | 36.79 | | | | | | | |
| MH-173 | | 664698.07 | 3920434.89 | 5'-0" x 5'-0"" | Precast | 20.00 | 11.09 | 24 | 11.72 | | | 24 | 11.67 | | | | | | | | | | | |
| EOP-174 | | 664698.07 | 3920562.48 | | | | | | | | | | | | | | | | | 24 | 11.35 | | | |
| I-175 | | 664559.22 | 3920446.29 | 4'-0" x 4'-0"" | Precast | 18.30 | 14.47 | | | | | | | | | 15 | 15.05 | | | | | | | |
| I-176 | | 664395.81 | 3920446.29 | 4'-0" x 4'-0"" | Precast | 18.30 | 13.86 | 15 | 14.64 | | | | | | | 18 | 14.44 | | | | | | | |
| EOP-177 | | 663539.06 | 3921601.20 | | | | | | | | | 30 | 7.48 | | | | | | | | | | | |
| EOP-178 | | 663532.68 | 3921599.57 | | | 13.00 | | | | | | | | | | 30 | 5.18 | | | | | | | |
| MH-179 | | 664313.90 | 3920469.32 | 5'-0" x 5'-0"" | Precast | 20.00 | 9.98 | 24 | 10.61 | | | 24 | 10.56 | | | | | | | | | | | |
| EOP-180 | | 664313.90 | 3920562.65 | | | | | | | | | | | | | | | | | 24 | 10.33 | | | |
| I-181 | | 664042.61 | 3920446.29 | 4'-0" x 4'-0"" | Precast | 18.30 | 14.47 | 15 | 15.05 | | | | | | | | | | | | | | | |
| I-182 | | 664215.03 | 3920446.29 | 4'-0" x 4'-0"" | Precast | 18.30 | 13.84 | 18 | 14.42 | | | | | | | 15 | 14.62 | | | | | | | |
| CDS-183 | | 664330.27 | 3920446.29 | 5'-0" | Precast | 18.30 | 8.48 | 18 | 14.28 | | | 24 | 13.73 | | | 18 | 14.13 | | | | | | | |
| EOP-183A | | 664330.27 | 3920467.69 | | | | | | | | | | | | | | | | | 24 | 13.68 | | | |
| EOP-183B | | 664323.90 | 3920469.32 | | | 20.00 | | | | | | | | | | 24 | 10.63 | | | | | | | |
| I-185 | | 663836.80 | 3920446.29 | 4'-0" x 4'-0"" | Precast | 18.30 | 14.47 | | | | | | | | | 15 | 15.05 | | | | | | | |
| I-186 | | 663657.32 | 3920446.29 | 4'-0" x 4'-0"" | Precast | 18.30 | 13.82 | 15 | 14.60 | | | | | | | 18 | 14.40 | | | | | | | |
| MH-189 | | 663555.56 | 3920469.32 | 5'-0" x 5'-0"" | Precast | 20.00 | 9.94 | 24 | 10.57 | | | 24 | 10.52 | | | | | | | | | | | |
| EOP-190 | | 663555.56 | 3920562.65 | | | | | | | | | | | | | | | | | 24 | 10.29 | | | |
| I-191 | | 663270.06 | 3920446.29 | 4'-0" x 4'-0"" | Precast | 18.30 | 14.47 | 15 | 15.05 | | | | | | | | | | | | | | | |
| I-192 | | 663457.15 | 3920446.29 | 4'-0" x 4'-0"" | Precast | 18.30 | 13.80 | 18 | 14.38 | | | | | | | 15 | 14.58 | | | | | | | |
| CDS-193 | | 663571.93 | 3920446.37 | 5'-0" | Precast | 18.30 | 8.44 | 18 | 14.19 | | | 24 | 13.69 | | | 18 | 14.09 | | | | | | | |
| EOP-193A | | 663571.93 | 3920467.69 | | | | | | | | | | | | | | | | | 24 | 13.64 | | | |
| EOP-193B | | 663565.56 | 3920469.32 | | | 20.00 | | | | | | | | | | 24 | 10.59 | | | | | | | |
| MH-195 | | 663414.80 | 3921940.98 | 5'-0" x 5'-0"" | Precast | 13.00 | 4.03 | 30 | 6.36 | | | | | | | 30 | 4.61 | | | 15 | 5.61 | | | |
| MH-196 | | 666594.00 | 3920413.30 | 6'-0" x 6'-0"" | Precast | 46.00 | 32.67 | | | | | 42 | 33.30 | | | 42 | 33.25 | | | | | | | |
| EOP-197 | | 666529.96 | 3920413.30 | | | | | 42 | 33.09 | | | | | | | | | | | | | | | |
| MH-198 | | 663216.96 | 3921940.98 | 5'-0" x 5'-0"" | Precast | 13.00 | 3.49 | 30 | 4.12 | | | | | 30 (133°) | 4.07 | | | | | | | | | |
| EOP-195A | | 663414.80 | 3921930.98 | | | 13.00 | | | | | | 15 | 5.63 | | | | | | | | | | | |
| MH-300 | | 663522.68 | 3921599.57 | 5'-0" x 5'-0"" | Precast | 13.00 | 4.53 | 30 | 5.16 | | | | | | | | | | | 30 | 5.11 | | | |
| I-301 | | 664743.48 | 3921500.32 | 4'-0" x 4'-0"" | Precast | 33.00 | 29.17 | | | | | | | 15 (151°) | 29.75 | | | | | | | | | |
| I-302 | | 664679.06 | 3921535.95 | 4'-0" x 4'-0"" | Precast | 33.00 | 28.94 | | | | | | | | | 15 | 29.52 | | | | | 15 (331°) | 29.57 | |
| I-303 | | 664505.86 | 3921535.95 | 4'-0" x 4'-0"" | Precast | 33.00 | 28.31 | 15 | 29.09 | | | | | | | 18 | 28.89 | | | | | | | |
| I-304 | | 664372.10 | 3921535.95 | 5'-0" x 5'-0"" | Precast | 33.00 | 27.58 | 18 | 28.56 | | | | | | | 24 (186°) | 28.16 | | | | | | | |
| I-305 | | 664177.70 | 3921516.58 | 5'-0" x 5'-0"" | Precast | 33.00 | 27.04 | 24 (6°) | 27.67 | | | | | | | 24 | 27.62 | | | | | | | |
| EOP-306 | | 664135.79 | 3921516.58 | | | | | 24 | 27.52 | | | | | | | | | | | | | | | |
| EOP-307 | | 664343.70 | 3921775.88 | | | 36.00 | | | | | | | | | | | | | | 18 (273°) | 32.33 | | | |
| I-308 | | 664347.37 | 3921703.92 | 5'-0" x 5'-0"" | Precast | 36.00 | 31.17 | 15 (3°) | 32.63 | | | 18 (93°) | 32.15 | | | 24 (183°) | 31.75 | | | | | | | |
| I-309 | | 665681.41 | 3928018.00 | 6'-0" x 6'-0"" | Precast | 62.00 | 56.42 | | | | | | | | | | | 36 (239°) | 57.00 | | | | | |
| EOP-310 | | 665648.78 | 3927962.95 | | | | | | | 36 (59°) | 56.84 | | | | | | | | | | | | | |

| CULVERT TABLE | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CULVERT NO. | PLAN DWG NO. | CENTERLINE COORDINATES | | | | LENGTH | INLET INV ELEVATION | OUTLET INV ELEVATION | END TYPE | PIPE SIZE | NUMBER OF BARRELS | PIPE MATERIAL | REMARKS |
| | | INLET END | | OUTLET END | | | | | | | | | |
| | | NORTHING | EASTING | NORTHING | EASTING | | | | | | | | |
| C-130 | | 666135.95 | 3928475.62 | 666135.95 | 3928379.26 | 96.36 | 60.00 | 59.76 | MITERED TO SLOPE | 24" | 1 | CHDPE | |
| C-132 | | 666314.86 | 3925231.67 | 666169.01 | 3925339.95 | 181.66 | 10.00 | 10.00 | MITERED TO SLOPE | 15" | 1 | CHDPE | |
| C-311 | | 667196.59 | 3927835.42 | 667196.59 | 3927923.11 | 87.69 | 14.20 | 14.00 | MITERED TO SLOPE | 15" | 1 | CHDPE | |
| C-313 | | 667194.59 | 3927835.42 | 667194.59 | 3927923.11 | 87.69 | 14.20 | 14.00 | MITERED TO SLOPE | 15" | 1 | CHDPE | |

**Storm Drainage Systems Flow Calculations**

| Structure and Conduit Info and Flow Determination | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Structure Information | | | | | | | Conduit Information | | | | | | | | | | Flow Determination | | | | | | | | | | | | | |
| System | Structure Type | Structure from | Structure to | Northing | Easting | Structure Ground El (ft) | Pipe Size (NPS) | Rectangular Conduit Width (ft) | Rectangular Conduit Height (ft) | Pipe Diameter ($D_o$) or Rectangular Equivilent Diameter (ft) | U/S Inv Elevation (ft) | D/S Inv Elevation (ft) | U/S Cover (ft) | D/S Cover (ft) | Length (ft) | Slope ft/ft | Run-off Factor (C) | Area ($ft^2$) | Other Area ($ft^2$) | Cummu. Area ($ft^2$) | Cummu. Area (ac) | Time of Concen. Inlet (min) | Time of Concen. System (min) | Pipe Travel Time (min) | Intensity $I_{50}$ (in/hr) | Flow $Q_{25}$ (cfs) | Flow (OCF Full) $Q_{cap}$ (cfs) | $Q_{25}/Q_{cap}$ | Comments |
| Storm Water | I | 1 | 2 | 666267.940 | 3923956.040 | 58.800 | 15 | | | 1.250 | 55.550 | 54.850 | 1.88 | 4.58 | 281.22 | 0.0025 | 0.95 | 24,800 | 0 | 24,800 | 0.57 | 5.00 | 5.00 | 1.64 | 3.00 | 1.62 | 3.50 | 0.46 | |
| Storm Water | I | 2 | 3 | 666267.940 | 3923674.820 | 60.800 | 18 | | | 1.500 | 54.650 | 54.280 | 4.48 | 4.85 | 148.41 | 0.0025 | 0.95 | 24,800 | 24,800 | 49,599 | 1.14 | 5.00 | 6.64 | 0.77 | 2.78 | 3.00 | 5.70 | 0.53 | |
| Storm Water | I | 3 | 4 | 666119.530 | 3923674.820 | 60.800 | 24 | | | 2.000 | 53.880 | 53.530 | 4.75 | 5.10 | 141.09 | 0.0025 | 0.95 | 24,800 | 74,399 | 99,199 | 2.28 | 5.00 | 7.41 | 0.60 | 2.67 | 5.78 | 12.24 | 0.47 | |
| Storm Water | SC | 4 | 5 | 666045.510 | 3923554.710 | 60.800 | 24 | | | 2.000 | 53.480 | 52.840 | 5.15 | 5.79 | 254.53 | 0.0025 | 0.95 | 24,800 | 99,199 | 123,998 | 2.85 | | 8.01 | 1.08 | 2.59 | 7.00 | 12.32 | 0.57 | |
| Storm Water | CU | 5 | 6 | 666045.510 | 3923300.180 | 60.800 | 24 | | | 2.000 | 52.790 | 52.110 | 5.84 | 4.52 | 272.28 | 0.0025 | 0.95 | 24,800 | 123,998 | 148,798 | 3.42 | 5.00 | 9.10 | 1.16 | 2.44 | 7.93 | 12.28 | 0.65 | |
| Storm Water | CU | 6 | 7 | 666045.510 | 3923027.900 | 58.800 | 24 | | | 2.000 | 52.060 | 51.630 | 4.57 | 5.00 | 171.35 | 0.0025 | 0.95 | 24,800 | 148,798 | 173,597 | 3.99 | 5.00 | 10.26 | 0.73 | 2.30 | 8.72 | 12.31 | 0.71 | |
| Storm Water | CU | 7 | 8 | 666045.510 | 3922856.550 | 58.800 | 30 | | | 2.500 | 51.230 | 51.010 | 4.82 | 5.04 | 87.75 | 0.0025 | 0.95 | 24,800 | 173,597 | 198,397 | 4.55 | 5.00 | 10.99 | 0.32 | 2.26 | 9.77 | 22.31 | 0.44 | |
| Storm Water | SC | 8 | 9 | 666045.510 | 3922768.800 | 58.800 | 30 | | | 2.500 | 50.960 | 50.610 | 5.09 | 5.44 | 140.58 | 0.0025 | 0.95 | 24,800 | 322,395 | 347,195 | 7.97 | | 11.31 | 0.52 | 2.24 | 16.95 | 22.23 | 0.76 | |
| Storm Water | CU | 9 | 95 | 666045.510 | 3922628.220 | 58.800 | 36 | | | 3.000 | 50.210 | 49.860 | 5.34 | 5.69 | 139.15 | 0.0025 | 0.95 | 24,800 | 347,195 | 371,995 | 8.54 | 5.00 | 11.82 | 0.45 | 2.21 | 17.90 | 36.34 | 0.49 | |
| Storm Water | I | 10 | 3 | 666119.530 | 3923956.040 | 58.800 | 15 | | | 1.250 | 55.550 | 54.850 | 1.88 | 4.58 | 281.22 | 0.0025 | 0.95 | 24,800 | 0 | 24,800 | 0.57 | 5.00 | 5.00 | 1.64 | 3.00 | 1.62 | 3.50 | 0.46 | |
| Storm Water | I | 11 | 75 | 666334.230 | 3922891.300 | 58.800 | 15 | | | 1.250 | 55.550 | 55.090 | 1.88 | 2.33 | 183.84 | 0.0025 | 0.95 | 24,800 | 0 | 24,800 | 0.57 | 5.00 | 5.00 | 1.07 | 3.00 | 1.62 | 3.51 | 0.46 | |
| Storm Water | I | 12 | 13 | 666020.630 | 3921985.950 | 46.000 | 36 | | | 3.000 | 39.320 | 39.040 | 3.43 | 2.71 | 113.28 | 0.0025 | 0.95 | 4,373 | 549,965 | 554,337 | 12.73 | 5.00 | 13.46 | 0.37 | 2.11 | 25.46 | 36.02 | 0.71 | |
| Storm Water | I | 13 | 14 | 665907.350 | 3921985.950 | 45.000 | 42 | | | 3.500 | 36.640 | 36.100 | 4.61 | 4.65 | 215.34 | 0.0025 | 0.95 | 32,536 | 654,922 | 687,458 | 15.78 | 5.00 | 13.83 | 0.63 | 2.08 | 31.23 | 54.73 | 0.57 | |
| Storm Water | I | 14 | 15 | 665692.010 | 3921985.950 | 44.500 | 42 | | | 3.500 | 36.050 | 35.490 | 4.70 | 5.26 | 223.04 | 0.0025 | 0.95 | 27,712 | 760,299 | 788,011 | 18.09 | 5.00 | 14.46 | 0.65 | 2.04 | 35.12 | 54.76 | 0.64 | |
| Storm Water | I | 15 | 16 | 665468.970 | 3921985.950 | 44.500 | 42 | | | 3.500 | 35.440 | 34.880 | 5.31 | 5.87 | 222.55 | 0.0025 | 0.95 | 27,712 | 860,844 | 888,556 | 20.40 | 5.00 | 15.11 | 0.65 | 2.00 | 38.82 | 54.82 | 0.71 | |
| Storm Water | I | 16 | 17 | 665246.420 | 3921985.950 | 44.500 | 48 | | | 4.000 | 34.480 | 33.930 | 5.77 | 6.32 | 221.85 | 0.0025 | 0.95 | 27,712 | 961,389 | 989,101 | 22.71 | 5.00 | 15.76 | 0.60 | 1.96 | 42.34 | 77.69 | 0.54 | |
| Storm Water | I | 17 | 18 | 665024.570 | 3921985.950 | 44.500 | 48 | | | 4.000 | 33.880 | 33.320 | 6.37 | 5.93 | 222.13 | 0.0025 | 0.95 | 24,373 | 1,057,292 | 1,081,665 | 24.83 | 5.00 | 16.36 | 0.59 | 1.93 | 45.43 | 78.34 | 0.58 | |
| Storm Water | I | 18 | 77 | 664802.440 | 3921985.950 | 43.500 | 48 | | | 4.000 | 33.270 | 32.660 | 5.98 | 3.09 | 244.38 | 0.0025 | 0.95 | 4,777 | 1,081,665 | 1,086,442 | 24.94 | 5.00 | 16.95 | 0.66 | 1.89 | 44.76 | 77.96 | 0.57 | |
| Storm Water | FREE_EXT | 19 | 108 | 664739.740 | 3921746.020 | | | | | | | | | | | | 0.95 | 0 | 1,129,815 | 1,129,815 | 25.94 | | 17.65 | 0.00 | 1.85 | 45.47 | | | |
| Storm Water | I | 20 | 21 | 666439.380 | 3921309.450 | 44.500 | 15 | | | 1.250 | 41.250 | 40.920 | 1.88 | 2.21 | 133.62 | 0.0025 | 0.95 | 16,290 | 0 | 16,290 | 0.37 | 5.00 | 5.00 | 0.78 | 3.00 | 1.07 | 3.49 | 0.31 | |
| Storm Water | I | 21 | 22 | 666573.000 | 3921309.450 | 44.500 | 18 | | | 1.500 | 40.720 | 40.360 | 2.11 | 2.47 | 144.95 | 0.0025 | 0.95 | 16,290 | 34,818 | 51,108 | 1.17 | 5.00 | 5.78 | 0.75 | 2.89 | 3.23 | 5.69 | 0.57 | |
| Storm Water | I | 22 | 23 | 666573.000 | 3921164.500 | 44.500 | 24 | | | 2.000 | 39.960 | 39.600 | 2.37 | 2.73 | 144.50 | 0.0025 | 0.95 | 16,290 | 85,926 | 102,216 | 2.35 | 5.00 | 6.53 | 0.62 | 2.79 | 6.22 | 12.27 | 0.51 | |
| Storm Water | I | 23 | 24 | 666573.000 | 3921020.000 | 44.500 | 24 | | | 2.000 | 39.550 | 39.040 | 2.78 | 3.29 | 205.79 | 0.0025 | 0.95 | 16,290 | 137,034 | 153,324 | 3.52 | 5.00 | 7.15 | 0.88 | 2.71 | 9.05 | 12.23 | 0.74 | |
| Storm Water | I | 24 | 25 | 666573.000 | 3920814.210 | 44.500 | 30 | | | 2.500 | 38.640 | 38.300 | 3.11 | 3.45 | 134.28 | 0.0025 | 0.95 | 16,290 | 153,324 | 169,614 | 3.89 | 5.00 | 8.03 | 0.49 | 2.59 | 9.57 | 22.42 | 0.43 | |
| Storm Water | I | 25 | 162 | 666441.940 | 3920785.000 | 44.500 | 36 | | | 3.000 | 35.310 | 34.830 | 5.94 | 7.92 | 190.93 | 0.0025 | 0.95 | 16,290 | 468,986 | 485,276 | 11.14 | 5.00 | 9.99 | 0.62 | 2.32 | 24.57 | 36.33 | 0.68 | |
| Storm Water | I | 26 | 25 | 666258.000 | 3920785.000 | 44.500 | 30 | | | 2.500 | 36.170 | 35.710 | 5.58 | 6.04 | 183.94 | 0.0025 | 0.95 | 16,290 | 283,082 | 299,372 | 6.87 | 5.00 | 9.31 | 0.68 | 2.41 | 15.76 | 22.28 | 0.71 | |
| Storm Water | I | 27 | 26 | 666165.880 | 3920781.500 | 44.500 | 30 | | | 2.500 | 36.450 | 36.220 | 5.30 | 5.53 | 92.19 | 0.0025 | 0.95 | 16,290 | 185,342 | 201,632 | 4.63 | 5.00 | 8.98 | 0.34 | 2.46 | 10.81 | 22.25 | 0.49 | |
| Storm Water | I | 28 | 29 | 666045.380 | 3920832.660 | 44.500 | 15 | | | 1.250 | 41.250 | 41.100 | 1.88 | 2.03 | 58.63 | 0.0026 | 0.95 | 16,290 | 0 | 16,290 | 0.37 | 5.00 | 5.00 | 0.34 | 3.00 | 1.07 | 3.55 | 0.30 | |
| Storm Water | I | 29 | 30 | 665986.750 | 3920832.660 | 44.500 | 24 | | | 2.000 | 37.530 | 37.400 | 4.80 | 4.93 | 51.16 | 0.0025 | 0.95 | 9,078 | 150,896 | 159,974 | 3.67 | 5.00 | 8.06 | 0.22 | 2.58 | 9.01 | 12.39 | 0.73 | |
| Storm Water | I | 30 | 76 | 665986.750 | 3920781.500 | 44.500 | 24 | | | 2.000 | 37.350 | 37.180 | 4.98 | 5.15 | 67.25 | 0.0025 | 0.95 | 9,078 | 159,974 | 169,052 | 3.88 | 5.00 | 8.28 | 0.28 | 2.55 | 9.42 | 12.36 | 0.76 | |
| Storm Water | I | 31 | 172 | 665862.420 | 3920574.540 | 43.000 | 42 | | | 3.500 | 37.350 | 36.840 | 1.90 | 3.91 | 202.28 | 0.0025 | 0.95 | 98,122 | 774,430 | 872,552 | 20.03 | 5.00 | 12.89 | 0.59 | 2.14 | 40.74 | 54.88 | 0.74 | |
| Storm Water | I | 32 | 124 | 665360.140 | 3920574.540 | 44.500 | 48 | | | 4.000 | 35.640 | 35.240 | 4.61 | 6.51 | 159.52 | 0.0025 | 0.95 | 53,815 | 897,171 | 950,986 | 21.83 | 5.00 | 14.36 | 0.43 | 2.05 | 42.51 | 78.13 | 0.54 | |
| Storm Water | FREE_EXT | 33 | 111 | 665173.030 | 3920645.010 | | | | | | | | | | | | 0.95 | 0 | 1,116,790 | 1,116,790 | 25.64 | | 14.91 | 0.00 | 2.02 | 49.10 | | | |
| Storm Water | I | 34 | 22 | 666483.490 | 3921164.500 | 44.500 | 15 | | | 1.250 | 41.250 | 41.030 | 1.88 | 2.10 | 89.51 | 0.0025 | 0.95 | 16,290 | 0 | 16,290 | 0.37 | 5.00 | 5.00 | 0.53 | 3.00 | 1.07 | 3.48 | 0.31 | |
| Storm Water | I | 35 | 23 | 666483.490 | 3921020.000 | 44.500 | 15 | | | 1.250 | 41.250 | 41.030 | 1.88 | 2.10 | 89.51 | 0.0025 | 0.95 | 16,290 | 0 | 16,290 | 0.37 | 5.00 | 5.00 | 0.53 | 3.00 | 1.07 | 3.48 | 0.31 | |
| Storm Water | I | 36 | 37 | 666188.170 | 3921314.000 | 44.500 | 15 | | | 1.250 | 41.250 | 41.080 | 1.88 | 2.05 | 69.83 | 0.0024 | 0.95 | 16,290 | 0 | 16,290 | 0.37 | 5.00 | 5.00 | 0.41 | 3.00 | 1.07 | 3.46 | 0.31 | |
| Storm Water | I | 37 | 38 | 666258.000 | 3921314.000 | 44.500 | 15 | | | 1.250 | 41.030 | 40.630 | 2.10 | 2.50 | 161.27 | 0.0025 | 0.95 | 16,290 | 16,290 | 32,580 | 0.75 | 5.00 | 5.41 | 0.94 | 2.94 | 2.09 | 3.49 | 0.60 | |
| Storm Water | I | 38 | 39 | 666258.000 | 3921152.730 | 44.500 | 18 | | | 1.500 | 40.430 | 39.940 | 2.40 | 2.89 | 194.22 | 0.0025 | 0.95 | 16,290 | 32,580 | 48,870 | 1.12 | 5.00 | 6.36 | 1.00 | 2.82 | 3.00 | 5.73 | 0.52 | |
| Storm Water | I | 39 | 26 | 666258.000 | 3920958.510 | 44.500 | 24 | | | 2.000 | 39.540 | 39.110 | 2.79 | 3.22 | 173.51 | 0.0025 | 0.95 | 16,290 | 65,160 | 81,450 | 1.87 | 5.00 | 7.35 | 0.74 | 2.68 | 4.76 | 12.23 | 0.39 | |
| Storm Water | I | 40 | 39 | 666204.140 | 3920958.510 | 44.500 | 15 | | | 1.250 | 41.250 | 41.120 | 1.88 | 2.01 | 53.86 | 0.0024 | 0.95 | 16,290 | 0 | 16,290 | 0.37 | 5.00 | 5.00 | 0.32 | 3.00 | 1.07 | 3.45 | 0.31 | |
| Storm Water | I | 41 | 42 | 666188.140 | 3921219.330 | 44.500 | 15 | | | 1.250 | 41.250 | 41.000 | 1.88 | 2.13 | 100.73 | 0.0025 | 0.95 | 16,290 | 0 | 16,290 | 0.37 | 5.00 | 5.00 | 0.59 | 3.00 | 1.07 | 3.50 | 0.30 | |
| Storm Water | I | 42 | 43 | 666087.410 | 3921219.330 | 44.500 | 15 | | | 1.250 | 40.950 | 40.480 | 2.18 | 2.65 | 187.50 | 0.0025 | 0.95 | 16,290 | 16,290 | 32,580 | 0.75 | 5.00 | 5.59 | 1.09 | 2.92 | 2.07 | 3.51 | 0.59 | |
| Storm Water | I | 43 | 44 | 666087.410 | 3921031.830 | 44.500 | 18 | | | 1.500 | 40.280 | 40.030 | 2.55 | 2.80 | 100.66 | 0.0025 | 0.95 | 16,290 | 32,580 | 48,870 | 1.12 | 5.00 | 6.68 | 0.52 | 2.77 | 2.95 | 5.69 | 0.52 | |
| Storm Water | MH | 44 | 29 | 665986.750 | 3921031.830 | 44.500 | 24 | | | 2.000 | 38.080 | 37.580 | 4.25 | 4.75 | 199.17 | 0.0025 | 0.95 | 0 | 134,606 | 134,606 | 3.09 | | 7.22 | 0.85 | 2.70 | 7.92 | 12.31 | 0.64 | |
| Storm Water | I | 45 | 62 | 664918.000 | 3921146.700 | 44.500 | 24 | | | 2.000 | 39.080 | 38.230 | 3.25 | 4.50 | 340.28 | 0.0025 | 0.95 | 15,070 | 96,916 | 111,986 | 2.57 | 5.00 | 7.83 | 1.45 | 2.61 | 6.39 | 12.28 | 0.52 | |
| Storm Water | MH | 46 | 31 | 665920.620 | 3920425.710 | 44.500 | 36 | | | 3.000 | 39.200 | 37.750 | 2.05 | 2.00 | 159.80 | 0.0091 | 0.95 | 0 | 774,430 | 774,430 | 17.78 | | 12.62 | 0.27 | 2.16 | 36.44 | 69.01 | 0.53 | |
| Storm Water | I | 47 | 48 | 665367.840 | 3921258.250 | 44.500 | 15 | | | 1.250 | 41.250 | 41.130 | 1.88 | 2.00 | 40.09 | 0.0030 | 0.95 | 15,070 | 0 | 15,070 | 0.35 | 5.00 | 5.00 | 0.21 | 3.00 | 0.99 | 3.84 | 0.26 | |
| Storm Water | I | 48 | 49 | 665339.120 | 3921286.220 | 44.500 | 15 | | | 1.250 | 41.080 | 40.860 | 2.05 | 2.27 | 87.40 | 0.0025 | 0.95 | 15,070 | 15,070 | 30,140 | 0.69 | 5.00 | 5.21 | 0.51 | 2.97 | 1.95 | 3.52 | 0.55 | |
| Storm Water | I | 49 | 50 | 665251.720 | 3921286.220 | 44.500 | 18 | | | 1.500 | 40.660 | 40.090 | 2.17 | 2.74 | 227.63 | 0.0025 | 0.95 | 15,070 | 30,140 | 45,210 | 1.04 | 5.00 | 5.72 | 1.17 | 2.90 | 2.86 | 5.71 | 0.50 | |
| Storm Water | I | 50 | 51 | 665024.090 | 3921286.220 | 44.500 | 18 | | | 1.500 | 40.040 | 39.830 | 2.79 | 3.00 | 82.95 | 0.0025 | 0.95 | 15,070 | 45,210 | 60,281 | 1.38 | 5.00 | 6.90 | 0.43 | 2.74 | 3.61 | 5.74 | 0.63 | |
| Storm Water | I | 51 | 45 | 665024.090 | 3921203.270 | 44.500 | 24 | | | 2.000 | 39.430 | 39.130 | 2.90 | 3.20 | 120.23 | 0.0025 | 0.95 | 15,070 | 60,281 | 75,351 | 1.73 | 5.00 | 7.32 | 0.51 | 2.68 | 4.41 | 12.28 | 0.36 | |
| Storm Water | I | 52 | 45 | 664870.880 | 3921180.740 | 44.500 | 15 | | | 1.250 | 40.470 | 40.320 | 2.66 | 2.81 | 58.13 | 0.0026 | 0.95 | 15,070 | 6,495 | 21,565 | 0.50 | 5.00 | 6.69 | 0.33 | 2.77 | 1.30 | 3.56 | 0.37 | |
| Storm Water | FREE_EXT | 53 | | 663701.280 | 3921395.580 | | | | | | | | | | | | 0.95 | 0 | 1 | 1 | 0.00 | | 5.56 | 0.00 | 2.92 | 0.00 | | | |
| Storm Water | I | 54 | 52 | 664870.880 | 3921470.870 | 44.500 | 15 | | | 1.250 | 41.250 | 40.520 | 1.88 | 2.61 | 290.13 | 0.0025 | 0.95 | 6,495 | 0 | 6,495 | 0.15 | 5.00 | 5.00 | 1.69 | 3.00 | 0.42 | 3.52 | 0.12 | |
| Storm Water | MH | 55 | 195 | 663437.550 | 3921940.980 | 11.500 | 30 | | | 2.500 | 6.420 | 6.360 | 2.33 | 3.89 | 22.75 | 0.0026 | 0.95 | 0 | 257,284 | 257,284 | 5.91 | | 8.43 | 0.08 | 2.53 | 14.22 | 22.88 | 0.62 | |
| Storm Water | CDS | 56 | 177 | 663539.060 | 3921611.200 | 11.000 | 30 | | | 2.500 | 7.500 | 7.480 | 0.75 | FREE | 10.00 | 0.0020 | 0.95 | 217,656 | 0 | 217,656 | 5.00 | 8.22 | 8.22 | 0.04 | 2.56 | 12.16 | 19.93 | 0.61 | |
| Storm Water | I | 57 | 13 | 665907.350 | 3921803.140 | 42.300 | 24 | | | 2.000 | 38.300 | 37.840 | 1.83 | 4.99 | 182.81 | 0.0025 | 0.95 | 100,585 | 0 | 100,585 | 2.31 | 5.00 | 5.00 | 0.78 | 3.00 | 6.58 | 12.33 | 0.53 | |
| Storm Water | I | 58 | 14 | 665692.010 | 3921803.140 | 42.300 | 24 | | | 2.000 | 38.300 | 37.840 | 1.83 | 4.49 | 182.81 | 0.0025 | 0.95 | 72,841 | 0 | 72,841 | 1.67 | 5.00 | 5.00 | 0.78 | 3.00 | 4.77 | 12.33 | 0.39 | |
| Storm Water | I | 59 | 15 | 665468.970 | 3921803.140 | 42.300 | 24 | | | 2.000 | 38.300 | 37.840 | 1.83 | 4.49 | 182.81 | 0.0025 | 0.95 | 72,833 | 0 | 72,833 | 1.67 | 5.00 | 5.00 | 0.78 | 3.00 | 4.77 | 12.33 | 0.39 | |
| Storm Water | I | 60 | 16 | 665246.420 | 3921803.140 | 42.300 | 24 | | | 2.000 | 38.300 | 37.840 | 1.83 | 4.49 | 182.81 | 0.0025 | 0.95 | 72,833 | 0 | 72,833 | 1.67 | 5.00 | 5.00 | 0.78 | 3.00 | 4.77 | 12.33 | 0.39 | |
| Storm Water | I | 61 | 17 | 665024.570 | 3921803.140 | 42.300 | 24 | | | 2.000 | 38.300 | 37.840 | 1.83 | 4.49 | 182.81 | 0.0025 | 0.95 | 68,191 | 0 | 68,191 | 1.57 | 5.00 | 5.00 | 0.78 | 3.00 | 4.46 | 12.33 | 0.36 | |
| Storm Water | I | 62 | 122 | 664954.710 | 3920808.410 | 44.900 | 24 | | | 2.000 | 38.180 | 37.900 | 4.55 | 4.43 | 112.79 | 0.0025 | 0.95 | 53,815 | 111,986 | 165,801 | 3.81 | 5.00 | 9.28 | 0.48 | 2.42 | 8.74 | 12.24 | 0.71 | |
| Storm Water | I | 63 | 308 | 664462.170 | 3921709.830 | 39.000 | 15 | | | 1.250 | 35.580 | 32.630 | 2.05 | 2.00 | 114.95 | 0.0257 | 0.95 | 26,209 | 26,209 | 52,418 | 1.20 | 5.00 | 5.14 | 0.21 | 2.98 | 3.41 | 11.24 | 0.30 | |
| Storm Water | MH | 64 | 65 | 664164.860 | 3921694.530 | 34.500 | 24 | | | 2.000 | 30.280 | 29.830 | 2.05 | 2.00 | 121.68 | 0.0037 | 0.95 | 0 | 131,209 | 131,209 | 3.01 | | 5.81 | 0.43 | 2.89 | 8.27 | 14.94 | 0.55 | |
| Storm Water | I | 65 | 66 | 664054.220 | 3921643.890 | 34.000 | 30 | | | 2.500 | 29.430 | 29.230 | 1.82 | 2.02 | 81.71 | 0.0024 | 0.95 | 26,209 | 131,209 | 157,418 | 3.61 | 5.00 | 6.24 | 0.30 | 2.83 | 9.72 | 22.04 | 0.44 | |
| Storm Water | MH | 66 | 67 | 663982.720 | 3921604.340 | 34.000 | 24 | | | 2.000 | 29.180 | 28.830 | 2.65 | 2.00 | 90.67 | 0.0039 | 0.95 | 0 | 157,418 | 157,418 | 3.61 | | 6.54 | 0.31 | 2.79 | 9.58 | 15.27 | 0.63 | |
| Storm Water | I | 67 | 68 | 663982.720 | 3921513.670 | 33.000 | 30 | | | 2.500 | 28.430 | 28.250 | 1.82 | 2.00 | 58.05 | 0.0031 | 0.95 | 26,209 | 157,418 | 183,627 | 4.22 | 5.00 | 6.85 | 0.19 | 2.75 | 11.01 | 24.81 | 0.44 | |
| Storm Water | I | 68 | 107 | 663924.670 | 3921513.670 | 33.000 | 30 | | | 2.500 | 28.200 | 27.960 | 2.05 | FREE | 96.97 | 0.0025 | 0.95 | 26,209 | 183,627 | 209,836 | 4.82 | 5.00 | 7.04 | 0.36 | 2.72 | 12.46 | 22.17 | 0.56 | |
| Storm Water | I | 69 | 63 | 664551.710 | 3921679.690 | 42.300 | 15 | | | 1.250 | 39.050 | 35.630 | 1.88 | 2.00 | 94.48 | 0.0362 | 0.95 | 26,209 | 0 | 26,209 | 0.60 | 5.00 | 5.00 | 0.14 | 3.00 | 1.71 | 13.35 | 0.13 | |
| Storm Water | FREE_EXT | 70 | | 663192.180 | 3921967.970 | | | | | | | | | | | | 0.95 | 0 | 257,286 | 257,286 | 5.91 | | 9.37 | 0.00 | 2.41 | 13.50 | | | |
| Storm Water | SC | 71 | 87 | 666303.320 | 3928313.390 | 62.500 | 36 | | | 3.000 | 53.310 | 52.890 | 5.94 | FREE | 167.14 | 0.0025 | 0.95 | 0 | 471,643 | 471,643 | 10.83 | | 11.63 | 0.54 | 2.22 | 22.82 | 36.32 | 0.63 | |

**Storm Drainage Systems Flow Calculations**

| Structure and Conduit Info and Flow Determination | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Structure Information | | | | | | | Conduit Information | | | | | | | | | | Flow Determination | | | | | | | | | | | | | |
| System | Structure Type | Structure from | Structure to | Northing | Easting | Structure Ground El (ft) | Pipe Size (NPS) | Rectangular Conduit Width (ft) | Rectangular Conduit Height (ft) | Pipe Diameter ($D_o$) or Rectangular Equivilent Diameter (ft) | U/S Inv Elevation (ft) | D/S Inv Elevation (ft) | U/S Cover (ft) | D/S Cover (ft) | Length (ft) | Slope ft/ft | Run-off Factor (C) | Area ($ft^2$) | Other Area ($ft^2$) | Cummu. Area ($ft^2$) | Cummu. Area (ac) | Time of Concen. Inlet (min) | Time of Concen. System (min) | Pipe Travel Time (min) | Intensity $I_{50}$ (in/hr) | Flow $Q_{25}$ (cfs) | Flow (OCF Full) $Q_{cap}$ (cfs) | $Q_{25}/Q_{cap}$ | Comments |
| Storm Water | FREE_ENT | 72 | 46 | 666151.960 | 3920413.240 | 44.000 | 36 | | | 3.000 | 40.000 | 39.250 | 0.75 | 2.00 | 231.68 | 0.0032 | 0.95 | 1 | 774,429 | 774,430 | 17.78 | 5.00 | 11.96 | 0.66 | 2.20 | 37.14 | 41.22 | 0.90 | |
| Storm Water | I | 73 | 161 | 665815.690 | 3921304.290 | 43.000 | 18 | | | 1.500 | 39.430 | 39.050 | 1.90 | 3.78 | 153.06 | 0.0025 | 0.95 | 14,289 | 28,579 | 42,868 | 0.98 | 5.00 | 5.63 | 0.79 | 2.91 | 2.72 | 5.69 | 0.48 | |
| Storm Water | I | 74 | 44 | 665986.750 | 3921122.190 | 46.000 | 24 | | | 2.000 | 38.360 | 38.130 | 5.47 | 4.20 | 90.36 | 0.0025 | 0.95 | 14,289 | 71,447 | 85,736 | 1.97 | 5.00 | 6.83 | 0.38 | 2.75 | 5.14 | 12.40 | 0.41 | |
| Storm Water | I | 201 | 21 | 666613.000 | 3921309.450 | 44.500 | 15 | | | 1.250 | 41.250 | 41.130 | 1.88 | 2.00 | 40.00 | 0.0030 | 0.95 | 18,528 | 0 | 18,528 | 0.43 | 5.00 | 5.00 | 0.21 | 3.00 | 1.21 | 3.84 | 0.32 | |
| Storm Water | I | 202 | 22 | 666613.000 | 3921164.500 | 44.500 | 15 | | | 1.250 | 41.250 | 41.130 | 1.88 | 2.00 | 40.00 | 0.0030 | 0.95 | 18,528 | 0 | 18,528 | 0.43 | 5.00 | 5.00 | 0.21 | 3.00 | 1.21 | 3.84 | 0.32 | |
| Storm Water | I | 203 | 23 | 666613.000 | 3921020.000 | 44.500 | 15 | | | 1.250 | 41.250 | 41.130 | 1.88 | 2.00 | 40.00 | 0.0030 | 0.95 | 18,528 | 0 | 18,528 | 0.43 | 5.00 | 5.00 | 0.21 | 3.00 | 1.21 | 3.84 | 0.32 | |
| Storm Water | I | 204 | 205 | 666748.120 | 3921309.450 | 44.500 | 15 | | | 1.250 | 41.250 | 40.780 | 1.88 | 2.35 | 187.88 | 0.0025 | 0.95 | 18,528 | 0 | 18,528 | 0.43 | 5.00 | 5.00 | 1.09 | 3.00 | 1.21 | 3.51 | 0.35 | |
| Storm Water | I | 205 | 205A | 666936.000 | 3921309.450 | 44.500 | 24 | | | 2.000 | 38.620 | 38.470 | 3.71 | FREE | 62.00 | 0.0024 | 0.95 | 18,528 | 148,224 | 166,752 | 3.83 | 5.00 | 8.87 | 0.27 | 2.47 | 9.00 | 12.09 | 0.74 | |
| Storm Water | I | 206 | 205 | 666936.000 | 3921164.500 | 44.500 | 24 | | | 2.000 | 39.030 | 38.670 | 3.30 | 3.66 | 144.95 | 0.0025 | 0.95 | 18,528 | 111,168 | 129,696 | 2.98 | 5.00 | 8.25 | 0.62 | 2.56 | 7.24 | 12.25 | 0.59 | |
| Storm Water | I | 207 | 206 | 666936.000 | 3921020.000 | 44.500 | 24 | | | 2.000 | 39.440 | 39.080 | 2.89 | 3.25 | 144.50 | 0.0025 | 0.95 | 18,528 | 74,112 | 92,640 | 2.13 | 5.00 | 7.63 | 0.62 | 2.64 | 5.34 | 12.27 | 0.44 | |
| Storm Water | I | 208 | 207 | 666936.000 | 3920904.520 | 44.500 | 18 | | | 1.500 | 40.130 | 39.840 | 2.70 | 2.99 | 115.48 | 0.0025 | 0.95 | 18,528 | 37,056 | 55,584 | 1.28 | 5.00 | 7.04 | 0.59 | 2.72 | 3.30 | 5.72 | 0.58 | |
| Storm Water | I | 209 | 208 | 666841.600 | 3920785.000 | 44.500 | 15 | | | 1.250 | 40.710 | 40.330 | 2.42 | 2.80 | 152.30 | 0.0025 | 0.95 | 18,528 | 18,528 | 37,056 | 0.85 | 5.00 | 6.15 | 0.89 | 2.84 | 2.30 | 3.50 | 0.66 | |
| Storm Water | I | 210 | 209 | 666645.000 | 3920785.000 | 44.500 | 15 | | | 1.250 | 41.250 | 40.760 | 1.88 | 2.37 | 196.60 | 0.0025 | 0.95 | 18,528 | 0 | 18,528 | 0.43 | 5.00 | 5.00 | 1.15 | 3.00 | 1.21 | 3.50 | 0.35 | |
| Storm Water | I | 211 | 206 | 666846.490 | 3921164.500 | 44.500 | 15 | | | 1.250 | 41.250 | 41.030 | 1.88 | 2.10 | 89.51 | 0.0025 | 0.95 | 18,528 | 0 | 18,528 | 0.43 | 5.00 | 5.00 | 0.53 | 3.00 | 1.21 | 3.48 | 0.35 | |
| Storm Water | I | 212 | 207 | 666846.490 | 3921020.000 | 44.500 | 15 | | | 1.250 | 41.250 | 41.030 | 1.88 | 2.10 | 89.51 | 0.0025 | 0.95 | 18,528 | 0 | 18,528 | 0.43 | 5.00 | 5.00 | 0.53 | 3.00 | 1.21 | 3.48 | 0.35 | |
| Storm Water | I | 75 | 78 | 666150.390 | 3922891.300 | 58.800 | 18 | | | 1.500 | 54.890 | 54.580 | 2.24 | 2.55 | 122.50 | 0.0025 | 0.95 | 24,800 | 24,800 | 49,599 | 1.14 | 5.00 | 6.07 | 0.63 | 2.85 | 3.09 | 5.74 | 0.54 | |
| Storm Water | I | 76 | 27 | 666054.000 | 3920781.500 | 44.500 | 30 | | | 2.500 | 36.780 | 36.500 | 4.97 | 5.25 | 111.88 | 0.0025 | 0.95 | 16,290 | 169,052 | 185,342 | 4.25 | 5.00 | 8.56 | 0.41 | 2.52 | 10.17 | 22.29 | 0.46 | |
| Storm Water | CDS | 77 | 19 | 664756.030 | 3921746.020 | 40.000 | 48 | | | 4.000 | 32.660 | 32.620 | 3.09 | FREE | 16.29 | 0.0025 | 0.95 | 43,373 | 1,086,442 | 1,129,815 | 25.94 | | 17.61 | 0.04 | 1.85 | 45.54 | 77.32 | 0.59 | |
| Storm Water | I | 78 | 8 | 666150.390 | 3922768.800 | 58.800 | 24 | | | 2.000 | 54.150 | 53.890 | 2.48 | 2.74 | 104.88 | 0.0025 | 0.95 | 24,800 | 99,199 | 123,998 | 2.85 | 5.00 | 6.77 | 0.45 | 2.76 | 7.46 | 12.24 | 0.61 | |
| Storm Water | CU | 79 | 80 | 667172.590 | 3928123.690 | 61.800 | 15 | | | 1.250 | 58.550 | 58.060 | 1.88 | 2.36 | 197.80 | 0.0025 | 0.95 | 28,866 | 0 | 28,866 | 0.66 | 5.00 | 5.00 | 1.16 | 3.00 | 1.89 | 3.49 | 0.54 | |
| Storm Water | CU | 80 | 81 | 667136.590 | 3927929.190 | 61.800 | 18 | | | 1.500 | 57.860 | 57.110 | 2.27 | 3.02 | 300.00 | 0.0025 | 0.95 | 28,866 | 28,866 | 57,732 | 1.33 | 5.00 | 6.16 | 1.55 | 2.84 | 3.58 | 5.71 | 0.63 | |
| Storm Water | CU | 81 | 82 | 666836.590 | 3927929.190 | 61.800 | 24 | | | 2.000 | 56.710 | 56.390 | 2.92 | 3.24 | 128.02 | 0.0025 | 0.95 | 28,866 | 57,732 | 86,598 | 1.99 | 5.00 | 7.71 | 0.55 | 2.63 | 4.97 | 12.29 | 0.40 | |
| Storm Water | CU | 82 | 83 | 666714.030 | 3927966.190 | 61.800 | 24 | | | 2.000 | 56.340 | 55.290 | 3.29 | 4.34 | 419.35 | 0.0025 | 0.95 | 28,866 | 86,598 | 115,464 | 2.65 | 5.00 | 8.25 | 1.79 | 2.56 | 6.44 | 12.30 | 0.52 | |
| Storm Water | CU | 83 | 84 | 666714.030 | 3928385.540 | 61.800 | 30 | | | 2.500 | 54.890 | 54.610 | 4.16 | 4.44 | 110.90 | 0.0025 | 0.95 | 28,866 | 230,929 | 259,795 | 5.96 | 5.00 | 10.04 | 0.41 | 2.32 | 13.13 | 22.39 | 0.59 | |
| Storm Water | CU | 84 | 85 | 666604.500 | 3928402.900 | 61.800 | 30 | | | 2.500 | 54.560 | 54.250 | 4.49 | 4.80 | 125.31 | 0.0025 | 0.95 | 35,308 | 259,795 | 295,103 | 6.77 | 5.00 | 10.44 | 0.46 | 2.29 | 14.75 | 22.16 | 0.67 | |
| Storm Water | CU | 85 | 71 | 666479.190 | 3928402.900 | 61.800 | 30 | | | 2.500 | 54.200 | 53.710 | 4.85 | 6.04 | 197.34 | 0.0025 | 0.95 | 35,308 | 295,103 | 330,411 | 7.59 | 5.00 | 10.91 | 0.73 | 2.26 | 16.31 | 22.20 | 0.73 | |
| Storm Water | CU | 86 | 71 | 666321.820 | 3928263.490 | 61.800 | 24 | | | 2.000 | 56.090 | 55.960 | 3.54 | 4.37 | 53.22 | 0.0024 | 0.95 | 35,308 | 105,924 | 141,232 | 3.24 | 5.00 | 8.26 | 0.23 | 2.56 | 7.88 | 12.15 | 0.65 | |
| Storm Water | FREE_EXT | 87 | | 666139.320 | 3928345.610 | | | | | | | | | | | | 0.95 | 0 | 471,643 | 471,643 | 10.83 | | 12.18 | 0.00 | 2.19 | 22.48 | | | |
| Storm Water | CU | 88 | 89 | 667148.590 | 3928316.400 | 61.800 | 15 | | | 1.250 | 58.550 | 57.870 | 1.88 | 2.56 | 273.56 | 0.0025 | 0.95 | 28,866 | 0 | 28,866 | 0.66 | 5.00 | 5.00 | 1.60 | 3.00 | 1.89 | 3.50 | 0.54 | |
| Storm Water | I | 89 | 83 | 666875.030 | 3928316.400 | 61.800 | 24 | | | 2.000 | 57.270 | 56.830 | 2.36 | 2.80 | 175.22 | 0.0025 | 0.95 | 28,866 | 57,732 | 86,598 | 1.99 | 5.00 | 6.60 | 0.75 | 2.78 | 5.26 | 12.31 | 0.43 | |
| Storm Water | CU | 90 | 89 | 666875.030 | 3928483.030 | 61.800 | 15 | | | 1.250 | 58.550 | 58.130 | 1.88 | 2.29 | 166.63 | 0.0025 | 0.95 | 28,866 | 0 | 28,866 | 0.66 | 5.00 | 5.00 | 0.97 | 3.00 | 1.89 | 3.52 | 0.54 | |
| Storm Water | CU | 91 | 83 | 666732.030 | 3928541.170 | 61.800 | 15 | | | 1.250 | 58.550 | 58.160 | 1.88 | 2.27 | 156.67 | 0.0025 | 0.95 | 28,866 | 0 | 28,866 | 0.66 | 5.00 | 5.00 | 0.92 | 3.00 | 1.89 | 3.50 | 0.54 | |
| Storm Water | CU | 92 | 140 | 666628.770 | 3928110.190 | 61.800 | 15 | | | 1.250 | 58.550 | 58.160 | 1.88 | 2.27 | 157.08 | 0.0025 | 0.95 | 35,308 | 0 | 35,308 | 0.81 | 5.00 | 5.00 | 0.92 | 3.00 | 2.31 | 3.50 | 0.66 | |
| Storm Water | FREE_EXT | 205A | | 666998.000 | 3921309.450 | | | | | | | | | | | | 0.95 | 0 | 166,752 | 166,752 | 3.83 | | 9.14 | 0.00 | 2.44 | 8.86 | | | |
| Storm Water | I | 213 | 213A | 667005.750 | 3921817.990 | 43.000 | 30 | | | 2.500 | 36.520 | 35.960 | 3.73 | FREE | 224.25 | 0.0025 | 0.95 | 58,824 | 235,294 | 294,118 | 6.75 | 5.00 | 8.54 | 0.82 | 2.52 | 16.16 | 22.27 | 0.73 | |
| Storm Water | I | 214 | 213 | 666795.750 | 3921817.990 | 43.000 | 30 | | | 2.500 | 37.090 | 36.570 | 3.16 | 3.68 | 210.00 | 0.0025 | 0.95 | 58,824 | 176,471 | 235,294 | 5.40 | 5.00 | 7.76 | 0.77 | 2.62 | 13.47 | 22.17 | 0.61 | |
| Storm Water | I | 215 | 214 | 666585.750 | 3921817.990 | 43.000 | 30 | | | 2.500 | 37.660 | 37.140 | 2.59 | 3.11 | 210.00 | 0.0025 | 0.95 | 58,824 | 117,647 | 176,471 | 4.05 | 5.00 | 6.99 | 0.77 | 2.73 | 10.51 | 22.17 | 0.47 | |
| Storm Water | I | 216 | 215 | 666375.750 | 3921817.990 | 43.000 | 24 | | | 2.000 | 38.580 | 38.060 | 2.25 | 2.77 | 210.00 | 0.0025 | 0.95 | 58,824 | 58,824 | 117,647 | 2.70 | 5.00 | 6.09 | 0.90 | 2.85 | 7.32 | 12.23 | 0.60 | |
| Storm Water | I | 217 | 216 | 666165.750 | 3921817.990 | 43.000 | 18 | | | 1.500 | 39.500 | 38.980 | 1.83 | 2.35 | 210.00 | 0.0025 | 0.95 | 58,824 | 0 | 58,824 | 1.35 | 5.00 | 5.00 | 1.09 | 3.00 | 3.85 | 5.68 | 0.68 | |
| Storm Water | FREE_EXT | 213A | | 667230.000 | 3921817.990 | | | | | | | | | | | | 0.95 | 0 | 294,118 | 294,118 | 6.75 | | 9.36 | 0.00 | 2.41 | 15.44 | | | |
| Storm Water | CU | 95 | 96 | 666045.510 | 3922489.070 | 58.800 | 24 | | | 2.000 | 49.810 | 47.630 | 6.82 | 2.00 | 102.93 | 0.0212 | 0.95 | 24,800 | 371,995 | 396,794 | 9.11 | 5.00 | 12.28 | 0.15 | 2.18 | 18.86 | 35.76 | 0.53 | |
| Storm Water | CU | 96 | 97 | 666045.510 | 3922386.140 | 51.800 | 36 | | | 3.000 | 46.800 | 46.420 | 1.75 | 2.13 | 153.24 | 0.0025 | 0.95 | 24,800 | 396,794 | 421,594 | 9.68 | 5.00 | 12.43 | 0.50 | 2.17 | 19.95 | 36.08 | 0.55 | |
| Storm Water | CU | 97 | 98 | 666045.510 | 3922232.900 | 51.800 | 24 | | | 2.000 | 46.370 | 40.630 | 3.26 | 2.00 | 137.77 | 0.0417 | 0.95 | 24,800 | 446,393 | 471,193 | 10.82 | 5.00 | 12.93 | 0.14 | 2.14 | 21.98 | 50.16 | 0.44 | |
| Storm Water | CU | 98 | 99 | 666045.510 | 3922095.130 | 44.800 | 36 | | | 3.000 | 39.800 | 39.550 | 1.75 | 2.00 | 77.26 | 0.0032 | 0.95 | 24,800 | 520,792 | 545,592 | 12.53 | 5.00 | 13.07 | 0.22 | 2.13 | 25.34 | 41.21 | 0.61 | |
| Storm Water | I | 99 | 12 | 666059.630 | 3922019.170 | 44.800 | 36 | | | 3.000 | 39.500 | 39.370 | 2.05 | 3.38 | 51.23 | 0.0025 | 0.95 | 4,373 | 545,592 | 549,965 | 12.63 | 5.00 | 13.29 | 0.17 | 2.12 | 25.38 | 36.50 | 0.70 | |
| Storm Water | I | 100 | 101 | 666244.520 | 3922482.140 | 58.800 | 15 | | | 1.250 | 55.550 | 55.120 | 1.88 | 2.31 | 173.20 | 0.0025 | 0.95 | 24,800 | 0 | 24,800 | 0.57 | 5.00 | 5.00 | 1.01 | 3.00 | 1.62 | 3.50 | 0.46 | |
| Storm Water | I | 101 | 78 | 666244.520 | 3922655.340 | 58.800 | 18 | | | 1.500 | 54.920 | 54.550 | 2.21 | 2.58 | 147.42 | 0.0025 | 0.95 | 24,800 | 24,800 | 49,599 | 1.14 | 5.00 | 6.01 | 0.76 | 2.86 | 3.10 | 5.72 | 0.54 | |
| Storm Water | I | 102 | 97 | 666117.990 | 3922254.050 | 52.800 | 15 | | | 1.250 | 49.550 | 48.430 | 1.88 | 2.00 | 75.50 | 0.0148 | 0.95 | 24,800 | 0 | 24,800 | 0.57 | 5.00 | 5.00 | 0.18 | 3.00 | 1.62 | 8.55 | 0.19 | |
| Storm Water | I | 103 | 104 | 666232.990 | 3922358.550 | 55.000 | 15 | | | 1.250 | 51.750 | 47.130 | 1.88 | 2.00 | 263.90 | 0.0175 | 0.95 | 24,800 | 0 | 24,800 | 0.57 | 5.00 | 5.00 | 0.58 | 3.00 | 1.62 | 9.28 | 0.17 | |
| Storm Water | I | 104 | 98 | 666217.140 | 3922095.130 | 50.500 | 15 | | | 1.250 | 47.080 | 41.430 | 2.05 | 2.00 | 171.63 | 0.0329 | 0.95 | 24,800 | 24,800 | 49,599 | 1.14 | 5.00 | 5.58 | 0.28 | 2.92 | 3.16 | 12.73 | 0.25 | |
| Storm Water | I | 105 | 150 | 663728.460 | 3921520.250 | 31.500 | 24 | | | 2.000 | 27.500 | 27.330 | 1.83 | 5.00 | 68.19 | 0.0025 | 0.95 | 1 | 0 | 1 | 0.00 | 5.00 | 5.00 | 0.29 | 3.00 | 0.00 | 12.27 | 0.00 | |
| Storm Water | FREE_EXT | 106 | | 663522.680 | 3921467.230 | | | | | | | | | | | | 0.95 | 0 | 217,657 | 217,657 | 5.00 | | 8.79 | 0.00 | 2.49 | 11.80 | | | |
| Storm Water | FREE_EXT | 107 | | 663827.700 | 3921513.670 | | | | | | | | | | | | 0.95 | 0 | 209,836 | 209,836 | 4.82 | | 7.40 | 0.00 | 2.67 | 12.24 | | | |
| Storm Water | FREE_ENT | 108 | 109 | 664611.300 | 3921616.020 | 42.000 | 48 | | | 4.000 | 30.500 | 30.350 | 7.25 | 7.40 | 60.75 | 0.0025 | 0.95 | 1 | 1,129,815 | 1,129,816 | 25.94 | 5.00 | 17.65 | 0.16 | 1.85 | 45.47 | 77.53 | 0.59 | |
| Storm Water | MH | 109 | 110 | 664611.300 | 3921555.270 | 42.000 | 48 | | | 4.000 | 24.000 | 23.810 | 13.75 | FREE | 76.34 | 0.0025 | 0.95 | 0 | 1,129,816 | 1,129,816 | 25.94 | | 17.82 | 0.21 | 1.84 | 45.22 | 77.84 | 0.58 | |
| Storm Water | FREE_EXT | 110 | | 664611.300 | 3921478.930 | | | | | | | | | | | | 0.95 | 0 | 1,129,816 | 1,129,816 | 25.94 | | 18.02 | 0.00 | 1.82 | 44.91 | | | |
| Storm Water | FREE_ENT | 111 | 112 | 665083.030 | 3920626.470 | 46.000 | 48 | | | 4.000 | 30.500 | 29.920 | 11.25 | FREE | 232.79 | 0.0025 | 0.95 | 1 | 1,116,790 | 1,116,791 | 25.64 | 5.00 | 14.91 | 0.63 | 2.02 | 49.10 | 77.88 | 0.63 | |
| Storm Water | FREE_EXT | 112 | | 664850.240 | 3920626.470 | | | | | | | | | | | | 0.95 | 0 | 1,116,791 | 1,116,791 | 25.64 | | 15.53 | 0.00 | 1.98 | 48.15 | | | |
| Storm Water | I | 113 | 114 | 664992.670 | 3920533.770 | 34.800 | 15 | | | 1.250 | 31.550 | 31.500 | 1.88 | 3.13 | 21.76 | 0.0023 | 0.95 | 9,363 | 0 | 9,363 | 0.21 | 5.00 | 5.00 | 0.13 | 3.00 | 0.61 | 3.36 | 0.18 | |
| Storm Water | MH | 114 | 115 | 664970.910 | 3920533.770 | 36.000 | 15 | | | 1.250 | 31.450 | 31.340 | 3.18 | 3.29 | 45.77 | 0.0024 | 0.95 | 0 | 9,363 | 9,363 | 0.21 | | 5.13 | 0.27 | 2.98 | 0.61 | 3.44 | 0.18 | |
| Storm Water | MH | 115 | 116 | 664970.910 | 3920488.000 | 36.000 | 15 | | | 1.250 | 31.290 | 26.130 | 3.34 | 2.00 | 77.99 | 0.0662 | 0.95 | 0 | 9,363 | 9,363 | 0.21 | | 5.40 | 0.09 | 2.94 | 0.60 | 18.05 | 0.03 | |
| Storm Water | I | 116 | 117 | 664892.920 | 3920488.000 | 29.500 | 15 | | | 1.250 | 15.220 | 15.090 | 12.91 | 11.04 | 53.11 | 0.0024 | 0.95 | 9,363 | 18,725 | 28,088 | 0.64 | 5.00 | 5.65 | 0.31 | 2.91 | 1.78 | 3.47 | 0.51 | |
| Storm Water | I | 117 | 118 | 664892.920 | 3920434.890 | 27.500 | 18 | | | 1.500 | 14.890 | 14.520 | 10.94 | 2.11 | 146.38 | 0.0025 | 0.95 | 30,354 | 28,088 | 58,442 | 1.34 | 5.00 | 5.97 | 0.75 | 2.87 | 3.66 | 5.74 | 0.64 | |
| Storm Water | CDS | 118 | 119 | 664746.540 | 3920434.890 | 18.300 | 24 | | | 2.000 | 14.120 | 14.100 | 2.01 | FREE | 10.00 | 0.0020 | 0.95 | 30,354 | 58,442 | 88,795 | 2.04 | | 6.72 | 0.05 | 2.77 | 5.36 | 10.99 | 0.49 | |
| Storm Water | FREE_EXT | 119 | 120 | 664736.540 | 3920434.890 | | | | | | | | | | | | 0.95 | 0 | 88,795 | 88,795 | 2.04 | 1.68 | 6.77 | 0.00 | 2.76 | 5.34 | | | |
| Storm Water | FREE_ENT | 120 | 173 | 664728.540 | 3920434.890 | 20.000 | 24 | | | 2.000 | 11.800 | 11.720 | 6.03 | 6.11 | 30.47 | 0.0026 | 0.95 | 1 | 88,795 | 88,796 | 2.04 | 5.00 | 6.77 | 0.13 | 2.76 | 5.34 | 12.59 | 0.42 | |
| Storm Water | I | 121 | 116 | 664892.920 | 3920600.080 | 18.800 | 15 | | | 1.250 | 15.550 | 15.270 | 1.88 | 12.86 | 112.08 | 0.0025 | 0.95 | 9,363 | 0 | 9,363 | 0.21 | 5.00 | 5.00 | 0.65 | 3.00 | 0.61 | 3.51 | 0.17 | |
| Storm Water | I | 122 | 123 | 665042.530 | 3920737.640 | 44.500 | 24 | | | 2.000 | 37.850 | 37.380 | 4.48 | 4.95 | 187.93 | 0.0025 | 0.95 | 1 | 165,801 | 165,802 | 3.81 | 5.00 | 9.77 | 0.80 | 2.35 | 8.50 | 12.29 | 0.69 | |
| Storm Water | I | 123 | 124 | 665227.610 | 3920705.010 | 44.500 | 24 | | | 2.000 | 37.330 | 37.180 | 5.00 | 6.65 | 60.93 | 0.0025 | 0.95 | 1 | 165,802 | 165,803 | 3.81 | 5.00 | 10.57 | 0.26 | 2.28 | 8.26 | 12.19 | 0.68 | |
| Storm Water | CDS | 124 | 33 | 665217.030 | 3920645.010 | 46.000 | 48 | | | 4.000 | 35.240 | 35.130 | 6.51 | FREE | 44.00 | 0.0025 | 0.95 | 1 | 1,116,789 | 1,116,790 | 25.64 | | 14.79 | 0.12 | 2.02 | 49.27 | 78.02 | 0.63 | |
| Storm Water | FREE_EXT | 125 | | 664290.490 | 3921429.770 | | | | | | | | | | | | 0.95 | 0 | 1 | 1 | 0.00 | | 6.30 | 0.00 | 2.82 | 0.00 | | | |

**Storm Drainage Systems Flow Calculations**

| Structure and Conduit Info and Flow Determination | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Structure Information | | | | | | | Conduit Information | | | | | | | | | | Flow Determination | | | | | | | | | | | | | |
| System | Structure Type | Structure from | Structure to | Northing | Easting | Structure Ground El (ft) | Pipe Size (NPS) | Rectangular Conduit Width (ft) | Rectangular Conduit Height (ft) | Pipe Diameter ($D_o$) or Rectangular Equivilent Diameter (ft) | U/S Inv Elevation (ft) | D/S Inv Elevation (ft) | U/S Cover (ft) | D/S Cover (ft) | Length (ft) | Slope ft/ft | Run-off Factor (C) | Area ($ft^2$) | Other Area ($ft^2$) | Cummu. Area ($ft^2$) | Cummu. Area (ac) | Time of Concen. Inlet (min) | Time of Concen. System (min) | Pipe Travel Time (min) | Intensity $I_{50}$ (in/hr) | Flow $Q_{25}$ (cfs) | Flow (OCF Full) $Q_{cap}$ (cfs) | $Q_{25}/Q_{cap}$ | Comments |
| Storm Water | FREE_ENT | 55A | 55B | 663437.800 | 3921938.480 | 11.500 | 15 | | | 1.250 | 9.125 | 9.110 | 1.00 | FREE | 7.50 | 0.0020 | 0.95 | 1 | 0 | 1 | 0.00 | 5.00 | 5.00 | 0.05 | 3.00 | 0.00 | 3.14 | 0.00 | |
| Storm Water | FREE_EXT | 55B | 195A | 663437.800 | 3921930.980 | | | | | | | | | | | | 0.95 | 0 | 1 | 1 | 0.00 | | 5.05 | 0.00 | 2.99 | 0.00 | | | |
| Storm Water | CDS | 126 | 55 | 663447.800 | 3921940.980 | 11.000 | 30 | | | 2.500 | 6.500 | 6.470 | 1.75 | 2.28 | 10.25 | 0.0029 | 0.95 | 257,284 | 0 | 257,284 | 5.91 | 8.39 | 8.39 | 0.03 | 2.54 | 14.24 | 24.10 | 0.59 | |
| Storm Water | FREE_ENT | 130 | 131 | 666135.950 | 3928475.620 | 63.000 | 24 | | | 2.000 | 60.000 | 59.760 | 0.83 | FREE | 96.36 | 0.0025 | 0.95 | 143,050 | 0 | 143,050 | 3.28 | 5.00 | 5.00 | 0.41 | 3.00 | 9.36 | 12.26 | 0.76 | |
| Storm Water | FREE_EXT | 131 | | 666135.950 | 3928379.260 | | | | | | | | | | | | 0.95 | 0 | 143,050 | 143,050 | 3.28 | | 5.41 | 0.00 | 2.94 | 9.18 | | | |
| Storm Water | FREE_ENT | 132 | 133 | 666314.863 | 3925231.666 | 20.000 | 15 | | | 1.250 | 10.004 | 9.996 | 8.62 | FREE | 181.66 | 0.0000 | 0.95 | 1 | 0 | 1 | 0.00 | 5.00 | 5.00 | 7.98 | 3.00 | 0.00 | 0.47 | 0.00 | |
| Storm Water | FREE_EXT | 133 | | 666169.005 | 3925339.953 | | | | | | | | | | | | 0.95 | 0 | 1 | 1 | 0.00 | | 12.98 | 0.00 | 2.14 | 0.00 | | | |
| Storm Water | I | 134 | 135 | 664024.080 | 3921491.580 | 31.000 | 24 | | | 2.000 | 27.000 | 26.410 | 1.83 | 5.92 | 234.65 | 0.0025 | 0.95 | 1 | 0 | 1 | 0.00 | 5.00 | 5.00 | 1.00 | 3.00 | 0.00 | 12.32 | 0.00 | |
| Storm Water | MH | 135 | 125 | 664258.730 | 3921491.580 | 34.500 | 24 | | | 2.000 | 26.360 | 26.190 | 5.97 | FREE | 69.49 | 0.0024 | 0.95 | 0 | 1 | 1 | 0.00 | | 6.00 | 0.30 | 2.86 | 0.00 | 12.15 | 0.00 | |
| Storm Water | CF | B | 136A | 664674.940 | 3920777.410 | 15.000 | 15 | | | 1.250 | 12.080 | 12.040 | 1.55 | FREE | 14.98 | 0.0027 | 0.95 | 9,438 | 0 | 9,438 | 0.22 | | 5.00 | 0.08 | 3.00 | 0.62 | 3.63 | 0.17 | |
| Storm Water | FREE_EXT | 136A | | 664689.920 | 3920777.410 | | | | | | | | | | | | 0.95 | 0 | 9,438 | 9,438 | 0.22 | | 5.08 | 0.00 | 2.99 | 0.62 | | | |
| Storm Water | CF | C | 138A | 664674.950 | 3920988.660 | 15.000 | 15 | | | 1.250 | 12.080 | 12.040 | 1.55 | FREE | 14.97 | 0.0027 | 0.95 | 7,369 | 0 | 7,369 | 0.17 | | 5.00 | 0.08 | 3.00 | 0.48 | 3.63 | 0.13 | |
| Storm Water | FREE_EXT | 138A | | 664689.920 | 3920988.660 | | | | | | | | | | | | 0.95 | 0 | 7,369 | 7,369 | 0.17 | | 5.08 | 0.00 | 2.99 | 0.48 | | | |
| Storm Water | CU | 140 | 141 | 666570.820 | 3927964.190 | 61.800 | 24 | | | 2.000 | 57.560 | 56.940 | 2.07 | 2.69 | 249.00 | 0.0025 | 0.95 | 35,308 | 35,308 | 70,616 | 1.62 | 5.00 | 5.92 | 1.06 | 2.88 | 4.43 | 12.26 | 0.36 | |
| Storm Water | CU | 141 | 86 | 666321.820 | 3927964.190 | 61.800 | 24 | | | 2.000 | 56.890 | 56.140 | 2.74 | 3.49 | 299.30 | 0.0025 | 0.95 | 35,308 | 70,616 | 105,924 | 2.43 | 5.00 | 6.98 | 1.27 | 2.73 | 6.31 | 12.30 | 0.51 | |
| Storm Water | I | 142 | 143 | 666100.950 | 3928172.230 | 62.000 | 42 | | | 3.500 | 56.500 | 56.070 | 1.75 | 2.18 | 170.14 | 0.0025 | 0.95 | 471,643 | 0 | 471,643 | 10.83 | 5.00 | 5.00 | 0.50 | 3.00 | 30.86 | 54.94 | 0.56 | |
| Storm Water | MH | 143 | 144 | 665993.670 | 3928040.180 | 62.000 | 30 | | | 2.500 | 56.020 | 54.050 | 3.23 | FREE | 245.57 | 0.0080 | 0.95 | 0 | 471,643 | 471,643 | 10.83 | | 5.50 | 0.50 | 2.93 | 30.16 | 39.91 | 0.76 | |
| Storm Water | FREE_EXT | 144 | | 665870.690 | 3927827.620 | | | | | | | | | | | | 0.95 | 0 | 471,643 | 471,643 | 10.83 | | 6.00 | 0.00 | 2.86 | 29.46 | | | |
| Oily Waste | OI | 145 | 146 | 666330.140 | 3923482.940 | 58.800 | 15 | | | 1.250 | 55.550 | 54.430 | 1.88 | 2.00 | 230.00 | 0.0049 | 0.95 | 26,649 | 0 | 26,649 | 0.61 | | 5.00 | 0.96 | 3.00 | 1.74 | 4.90 | 0.36 | |
| Oily Waste | OI | 146 | 147 | 666330.140 | 3923252.940 | 57.800 | 18 | | | 1.500 | 54.230 | 54.040 | 1.90 | 2.09 | 75.17 | 0.0025 | 0.95 | 26,649 | 26,649 | 53,297 | 1.22 | | 5.96 | 0.39 | 2.87 | 3.34 | 5.74 | 0.58 | |
| Oily Waste | OI | 147 | 148 | 666282.930 | 3923194.440 | 57.800 | 24 | | | 2.000 | 53.640 | 53.180 | 1.99 | 2.45 | 183.37 | 0.0025 | 0.95 | 26,649 | 53,297 | 79,946 | 1.84 | | 6.35 | 0.78 | 2.82 | 4.91 | 12.31 | 0.40 | |
| Oily Waste | OI | 148 | 149 | 666099.560 | 3923194.440 | 57.800 | 24 | | | 2.000 | 53.130 | 52.910 | 2.50 | 5.92 | 86.79 | 0.0025 | 0.95 | 26,649 | 79,946 | 106,594 | 2.45 | | 7.13 | 0.37 | 2.71 | 6.30 | 12.37 | 0.51 | |
| Oily Waste | OMH | 149 | 151 | 666012.770 | 3923194.440 | 61.000 | 24 | | | 2.000 | 52.860 | 51.960 | 5.97 | 5.87 | 361.22 | 0.0025 | 0.95 | 1 | 106,594 | 106,595 | 2.45 | | 7.49 | 1.54 | 2.66 | 6.19 | 12.27 | 0.50 | |
| Storm Water | MH | 150 | 53 | 663728.460 | 3921452.060 | 34.500 | 24 | | | 2.000 | 27.280 | 27.120 | 5.05 | FREE | 62.68 | 0.0026 | 0.95 | 0 | 1 | 1 | 0.00 | | 5.29 | 0.26 | 2.96 | 0.00 | 12.42 | 0.00 | |
| Oily Waste | OMH | 151 | 152 | 666012.770 | 3922833.220 | 60.000 | 24 | | | 2.000 | 51.910 | 51.230 | 5.92 | 6.60 | 271.06 | 0.0025 | 0.95 | 1 | 106,595 | 106,596 | 2.45 | | 9.04 | 1.15 | 2.45 | 5.70 | 12.31 | 0.46 | |
| Oily Waste | OMH | 152 | 153 | 666012.770 | 3922562.160 | 60.000 | 18 | | | 1.500 | 51.180 | 50.330 | 7.15 | 2.00 | 295.79 | 0.0029 | 0.95 | 1 | 106,596 | 106,597 | 2.45 | | 10.19 | 1.42 | 2.31 | 5.37 | 6.12 | 0.88 | |
| Oily Waste | OMH | 153 | 154 | 666012.770 | 3922266.370 | 54.000 | 15 | | | 1.250 | 50.280 | 42.630 | 2.35 | 2.00 | 380.66 | 0.0201 | 0.95 | 1 | 106,597 | 106,598 | 2.45 | | 11.61 | 0.78 | 2.22 | 5.16 | 9.95 | 0.52 | |
| Oily Waste | OMH | 154 | 155 | 666012.770 | 3921885.710 | 46.000 | 18 | | | 1.500 | 42.430 | 42.330 | 1.90 | 2.00 | 33.28 | 0.0030 | 0.95 | 1 | 106,598 | 106,599 | 2.45 | | 12.40 | 0.16 | 2.17 | 5.05 | 6.25 | 0.81 | |
| Oily Waste | OMH | 155 | 156 | 665979.490 | 3921885.710 | 46.000 | 24 | | | 2.000 | 41.930 | 41.830 | 1.90 | 2.00 | 40.25 | 0.0025 | 0.95 | 1 | 106,599 | 106,600 | 2.45 | | 12.55 | 0.17 | 2.16 | 5.03 | 12.25 | 0.41 | |
| Oily Waste | OMH | 156 | 157 | 665979.490 | 3921845.460 | 46.000 | 24 | | | 2.000 | 41.780 | 41.720 | 2.05 | FREE | 25.45 | 0.0024 | 0.95 | 1 | 106,600 | 106,601 | 2.45 | | 12.72 | 0.11 | 2.15 | 5.00 | 11.93 | 0.42 | |
| Oily Waste | FREE_EXT | 157 | | 665979.490 | 3921820.010 | | | | | | | | | | | | 0.95 | 0 | 106,601 | 106,601 | 2.45 | | 12.84 | 0.00 | 2.14 | 4.98 | | | |
| Storm Water | I | 158 | 73 | 665620.390 | 3921318.460 | 44.500 | 15 | | | 1.250 | 41.250 | 39.630 | 1.88 | 2.00 | 195.81 | 0.0083 | 0.95 | 14,289 | 0 | 14,289 | 0.33 | 5.00 | 5.00 | 0.63 | 3.00 | 0.93 | 6.38 | 0.15 | |
| Storm Water | I | 159 | 73 | 665865.830 | 3921355.340 | 44.500 | 15 | | | 1.250 | 41.250 | 39.630 | 1.88 | 2.00 | 71.56 | 0.0226 | 0.95 | 14,289 | 0 | 14,289 | 0.33 | 5.00 | 5.00 | 0.14 | 3.00 | 0.93 | 10.56 | 0.09 | |
| Storm Water | I | 160 | 161 | 665991.890 | 3921259.360 | 44.500 | 15 | | | 1.250 | 41.250 | 41.010 | 1.88 | 2.12 | 97.66 | 0.0025 | 0.95 | 14,289 | 0 | 14,289 | 0.33 | 5.00 | 5.00 | 0.57 | 3.00 | 0.93 | 3.48 | 0.27 | |
| Storm Water | I | 161 | 74 | 665920.490 | 3921192.730 | 44.500 | 24 | | | 2.000 | 38.650 | 38.410 | 3.68 | 5.42 | 96.78 | 0.0025 | 0.95 | 14,289 | 57,157 | 71,447 | 1.64 | 5.00 | 6.42 | 0.41 | 2.81 | 4.37 | 12.24 | 0.36 | |
| Storm Water | MH | 162 | 164 | 666441.940 | 3920594.070 | 46.000 | 36 | | | 3.000 | 34.780 | 34.690 | 7.97 | 6.56 | 37.71 | 0.0024 | 0.95 | 0 | 485,276 | 485,276 | 11.14 | | 10.61 | 0.13 | 2.28 | 24.15 | 35.39 | 0.68 | |
| Storm Water | I | 163 | 167 | 666544.550 | 3920544.990 | 44.500 | 15 | | | 1.250 | 41.250 | 41.060 | 1.88 | 2.07 | 74.49 | 0.0026 | 0.95 | 36,144 | 0 | 36,144 | 0.83 | 5.00 | 5.00 | 0.43 | 3.00 | 2.36 | 3.54 | 0.67 | |
| Storm Water | I | 164 | 168 | 666412.130 | 3920570.970 | 44.500 | 36 | | | 3.000 | 34.640 | 34.390 | 6.61 | 6.86 | 100.47 | 0.0025 | 0.95 | 36,144 | 485,276 | 521,420 | 11.97 | 5.00 | 10.73 | 0.33 | 2.27 | 25.86 | 36.14 | 0.72 | |
| Storm Water | I | 165 | 169 | 666282.960 | 3920582.140 | 44.500 | 15 | | | 1.250 | 41.250 | 40.970 | 1.88 | 2.16 | 111.64 | 0.0025 | 0.95 | 36,144 | 0 | 36,144 | 0.83 | 5.00 | 5.00 | 0.65 | 3.00 | 2.36 | 3.51 | 0.67 | |
| Storm Water | I | 166 | 170 | 666144.130 | 3920586.050 | 44.500 | 15 | | | 1.250 | 41.250 | 40.960 | 1.88 | 2.17 | 115.55 | 0.0025 | 0.95 | 36,144 | 0 | 36,144 | 0.83 | 5.00 | 5.00 | 0.67 | 3.00 | 2.36 | 3.52 | 0.67 | |
| Storm Water | I | 167 | 171 | 666544.550 | 3920470.500 | 44.500 | 42 | | | 3.500 | 33.610 | 33.490 | 7.14 | 7.26 | 49.45 | 0.0024 | 0.95 | 36,144 | 738,285 | 774,429 | 17.78 | 5.00 | 11.45 | 0.15 | 2.23 | 37.66 | 53.84 | 0.70 | |
| Storm Water | I | 168 | 167 | 666412.130 | 3920470.500 | 44.500 | 42 | | | 3.500 | 33.990 | 33.660 | 6.76 | 7.09 | 132.42 | 0.0025 | 0.95 | 36,144 | 665,997 | 702,141 | 16.12 | 5.00 | 11.06 | 0.39 | 2.25 | 34.52 | 54.56 | 0.63 | |
| Storm Water | I | 169 | 168 | 666282.960 | 3920470.500 | 44.500 | 24 | | | 2.000 | 39.960 | 39.640 | 2.37 | 2.69 | 129.17 | 0.0025 | 0.95 | 36,144 | 108,432 | 144,577 | 3.32 | 5.00 | 6.26 | 0.55 | 2.83 | 8.92 | 12.23 | 0.73 | |
| Storm Water | I | 170 | 169 | 666144.130 | 3920470.500 | 44.500 | 24 | | | 2.000 | 40.360 | 40.010 | 1.97 | 2.32 | 138.83 | 0.0025 | 0.95 | 36,144 | 36,144 | 72,288 | 1.66 | 5.00 | 5.67 | 0.59 | 2.91 | 4.59 | 12.34 | 0.37 | |
| Storm Water | MH | 171 | 196 | 666594.000 | 3920470.500 | 44.500 | 42 | | | 3.500 | 33.440 | 33.300 | 7.31 | 8.95 | 57.20 | 0.0024 | 0.95 | 0 | 774,429 | 774,429 | 17.78 | | 11.60 | 0.17 | 2.22 | 37.51 | 54.07 | 0.69 | |
| Storm Water | I | 172 | 32 | 665660.140 | 3920574.540 | 44.500 | 42 | | | 3.500 | 36.790 | 36.040 | 3.96 | 4.71 | 300.00 | 0.0025 | 0.95 | 24,619 | 872,552 | 897,171 | 20.60 | 5.00 | 13.48 | 0.88 | 2.10 | 41.17 | 54.64 | 0.75 | |
| Storm Water | MH | 173 | 174 | 664698.070 | 3920434.890 | 20.000 | 24 | | | 2.000 | 11.670 | 11.350 | 6.16 | FREE | 127.59 | 0.0025 | 0.95 | 0 | 88,796 | 88,796 | 2.04 | | 6.89 | 0.54 | 2.74 | 5.31 | 12.31 | 0.43 | |
| Storm Water | FREE_EXT | 174 | | 664698.070 | 3920562.480 | | | | | | | | | | | | 0.95 | 0 | 88,796 | 88,796 | 2.04 | | 7.44 | 0.00 | 2.67 | 5.17 | | | |
| Storm Water | I | 175 | 176 | 664559.220 | 3920446.290 | 18.300 | 15 | | | 1.250 | 15.050 | 14.640 | 1.88 | 2.29 | 163.41 | 0.0025 | 0.95 | 33,235 | 0 | 33,235 | 0.76 | 5.00 | 5.00 | 0.95 | 3.00 | 2.17 | 3.51 | 0.62 | |
| Storm Water | I | 176 | 183 | 664395.810 | 3920446.290 | 18.300 | 18 | | | 1.500 | 14.440 | 14.280 | 2.19 | 2.35 | 65.54 | 0.0024 | 0.95 | 33,235 | 33,235 | 66,469 | 1.53 | 5.00 | 5.95 | 0.34 | 2.87 | 4.16 | 5.64 | 0.74 | |
| Storm Water | FREE_EXT | 177 | 178 | 663539.060 | 3921601.200 | | | | | | | | | | | | 0.95 | 0 | 217,656 | 217,656 | 5.00 | | 8.26 | 0.00 | 2.56 | 12.14 | | | |
| Storm Water | FREE_ENT | 178 | 300 | 663532.680 | 3921599.570 | 13.000 | 30 | | | 2.500 | 5.180 | 5.160 | 5.07 | 5.09 | 10.00 | 0.0020 | 0.95 | 1 | 217,656 | 217,657 | 5.00 | 5.00 | 8.26 | 0.04 | 2.56 | 12.14 | 19.93 | 0.61 | |
| Storm Water | MH | 179 | 180 | 664313.900 | 3920469.320 | 20.000 | 24 | | | 2.000 | 10.560 | 10.330 | 7.27 | FREE | 93.33 | 0.0025 | 0.95 | 0 | 132,941 | 132,941 | 3.05 | | 6.74 | 0.40 | 2.76 | 8.01 | 12.20 | 0.66 | |
| Storm Water | FREE_EXT | 180 | | 664313.900 | 3920562.650 | | | | | | | | | | | | 0.95 | 0 | 132,941 | 132,941 | 3.05 | | 7.14 | 0.00 | 2.71 | 7.85 | | | |
| Storm Water | I | 181 | 182 | 664042.610 | 3920446.290 | 18.300 | 15 | | | 1.250 | 15.050 | 14.620 | 1.88 | 2.31 | 172.42 | 0.0025 | 0.95 | 33,235 | 0 | 33,235 | 0.76 | 5.00 | 5.00 | 1.01 | 3.00 | 2.17 | 3.50 | 0.62 | |
| Storm Water | I | 182 | 183 | 664215.030 | 3920446.290 | 18.300 | 18 | | | 1.500 | 14.420 | 14.130 | 2.21 | 2.50 | 115.24 | 0.0025 | 0.95 | 33,235 | 33,235 | 66,469 | 1.53 | 5.00 | 6.01 | 0.59 | 2.86 | 4.15 | 5.72 | 0.73 | |
| Storm Water | CDS | 183 | 183A | 664330.270 | 3920446.290 | 18.300 | 24 | | | 2.000 | 13.730 | 13.680 | 2.40 | FREE | 21.40 | 0.0023 | 0.95 | 1 | 132,939 | 132,940 | 3.05 | | 6.60 | 0.09 | 2.78 | 8.07 | 11.88 | 0.68 | |
| Storm Water | FREE_EXT | 183A | 183B | 664330.270 | 3920467.690 | | | | | | | | | | | | 0.95 | 0 | 132,940 | 132,940 | 3.05 | | 6.69 | 0.00 | 2.77 | 8.03 | | | |
| Storm Water | FREE_ENT | 183B | 179 | 664323.900 | 3920469.320 | 20.000 | 24 | | | 2.000 | 10.630 | 10.610 | 7.20 | 7.22 | 10.00 | 0.0020 | 0.95 | 1 | 132,940 | 132,941 | 3.05 | 5.00 | 6.69 | 0.05 | 2.77 | 8.03 | 10.99 | 0.73 | |
| Storm Water | I | 185 | 186 | 663836.800 | 3920446.290 | 18.300 | 15 | | | 1.250 | 15.050 | 14.600 | 1.88 | 2.33 | 179.48 | 0.0025 | 0.95 | 33,235 | 0 | 33,235 | 0.76 | 5.00 | 5.00 | 1.04 | 3.00 | 2.17 | 3.51 | 0.62 | |
| Storm Water | I | 186 | 193 | 663657.320 | 3920446.290 | 18.300 | 18 | | | 1.500 | 14.400 | 14.190 | 2.23 | 2.44 | 85.39 | 0.0025 | 0.95 | 33,235 | 33,235 | 66,469 | 1.53 | 5.00 | 6.04 | 0.44 | 2.86 | 4.14 | 5.66 | 0.73 | |
| Storm Water | MH | 189 | 190 | 663555.560 | 3920469.320 | 20.000 | 24 | | | 2.000 | 10.520 | 10.290 | 7.31 | FREE | 93.33 | 0.0025 | 0.95 | 0 | 132,941 | 132,941 | 3.05 | | 6.82 | 0.40 | 2.75 | 7.98 | 12.20 | 0.65 | |
| Storm Water | FREE_EXT | 190 | | 663555.560 | 3920562.650 | | | | | | | | | | | | 0.95 | 0 | 132,941 | 132,941 | 3.05 | | 7.22 | 0.00 | 2.70 | 7.82 | | | |
| Storm Water | I | 191 | 192 | 663270.060 | 3920446.290 | 18.300 | 15 | | | 1.250 | 15.050 | 14.580 | 1.88 | 2.35 | 187.09 | 0.0025 | 0.95 | 33,235 | 0 | 33,235 | 0.76 | 5.00 | 5.00 | 1.09 | 3.00 | 2.17 | 3.52 | 0.62 | |
| Storm Water | I | 192 | 193 | 663457.150 | 3920446.290 | 18.300 | 18 | | | 1.500 | 14.380 | 14.090 | 2.25 | 2.54 | 114.78 | 0.0025 | 0.95 | 33,235 | 33,235 | 66,469 | 1.53 | 5.00 | 6.09 | 0.59 | 2.85 | 4.13 | 5.74 | 0.72 | |
| Storm Water | CDS | 193 | 193A | 663571.930 | 3920446.370 | 18.300 | 24 | | | 2.000 | 13.690 | 13.640 | 2.44 | FREE | 21.32 | 0.0023 | 0.95 | 1 | 132,939 | 132,940 | 3.05 | | 6.68 | 0.09 | 2.77 | 8.04 | 11.90 | 0.68 | |
| Storm Water | FREE_EXT | 193A | 193B | 663571.930 | 3920467.690 | | | | | | | | | | | | 0.95 | 0 | 132,940 | 132,940 | 3.05 | | 6.77 | 0.00 | 2.76 | 8.00 | | | |
| Storm Water | FREE_ENT | 193B | 189 | 663565.560 | 3920469.320 | 20.000 | 24 | | | 2.000 | 10.590 | 10.570 | 7.24 | 7.26 | 10.00 | 0.0020 | 0.95 | 1 | 132,940 | 132,941 | 3.05 | 5.00 | 6.77 | 0.05 | 2.76 | 8.00 | 10.99 | 0.73 | |
| Storm Water | MH | 195 | 198 | 663414.800 | 3921940.980 | 13.000 | 30 | | | 2.500 | 4.610 | 4.120 | 5.64 | 6.13 | 197.84 | 0.0025 | 0.95 | 0 | 257,286 | 257,286 | 5.91 | | 8.51 | 0.73 | 2.52 | 14.16 | 22.17 | 0.64 | |
| Storm Water | MH | 196 | 197 | 666594.000 | 3920413.300 | 46.000 | 42 | | | 3.500 | 33.250 | 33.090 | 9.00 | FREE | 64.04 | 0.0025 | 0.95 | 0 | 774,429 | 774,429 | 17.78 | | 11.77 | 0.19 | 2.21 | 37.33 | 54.63 | 0.68 | |
| Storm Water | FREE_EXT | 197 | 72 | 666529.960 | 3920413.300 | | | | | | | | | | | | 0.95 | 0 | 774,429 | 774,429 | 17.78 | | 11.96 | 0.00 | 2.20 | 37.14 | | | |

**Storm Drainage Systems Flow Calculations**

| Structure and Conduit Info and Flow Determination | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Structure Information | | | | | | | Conduit Information | | | | | | | | | | Flow Determination | | | | | | | | | | | | |
| System | Structure Type | Structure from | Structure to | Northing | Easting | Structure Ground El (ft) | Pipe Size (NPS) | Rectangular Conduit Width (ft) | Rectangular Conduit Height (ft) | Pipe Diameter ($D_o$) or Rectangular Equivilent Diameter (ft) | U/S Inv Elevation (ft) | D/S Inv Elevation (ft) | U/S Cover (ft) | D/S Cover (ft) | Length (ft) | Slope ft/ft | Run-off Factor (C) | Area ($ft^2$) | Other Area ($ft^2$) | Cummu. Area ($ft^2$) | Cummu. Area (ac) | Time of Concen. Inlet (min) | Time of Concen. System (min) | Pipe Travel Time (min) | Intensity $I_{50}$ (in/hr) | Flow $Q_{25}$ (cfs) | Flow (OCF Full) $Q_{cap}$ (cfs) | $Q_{25}/Q_{cap}$ | Comments |
| Storm Water | MH | 198 | 70 | 663216.960 | 3921940.980 | 13.000 | 30 | | | 2.500 | 4.070 | 3.980 | 6.18 | FREE | 36.64 | 0.0025 | 0.95 | 0 | 257,286 | 257,286 | 5.91 | | 9.24 | 0.14 | 2.42 | 13.60 | 22.08 | 0.62 | |
| Storm Water | FREE_ENT | 195A | 195 | 663414.800 | 3921930.980 | 13.000 | 15 | | | 1.250 | 5.630 | 5.610 | 6.00 | 6.02 | 10.00 | 0.0020 | 0.95 | 1 | 1 | 2 | 0.00 | 5.00 | 5.05 | 0.07 | 2.99 | 0.00 | 3.14 | 0.00 | |
| Storm Water | MH | 300 | 106 | 663522.680 | 3921599.570 | 13.000 | 30 | | | 2.500 | 5.110 | 4.780 | 5.14 | FREE | 132.34 | 0.0025 | 0.95 | 0 | 217,657 | 217,657 | 5.00 | | 8.30 | 0.49 | 2.55 | 12.11 | 22.25 | 0.54 | |
| Storm Water | I | 301 | 302 | 664743.480 | 3921500.320 | 33.000 | 15 | | | 1.250 | 29.750 | 29.570 | 1.88 | 2.06 | 73.62 | 0.0024 | 0.95 | 19,258 | 0 | 19,258 | 0.44 | 5.00 | 5.00 | 0.43 | 3.00 | 1.26 | 3.47 | 0.36 | |
| Storm Water | I | 302 | 303 | 664679.060 | 3921535.950 | 33.000 | 15 | | | 1.250 | 29.520 | 29.090 | 2.11 | 2.54 | 173.20 | 0.0025 | 0.95 | 19,258 | 19,258 | 38,516 | 0.88 | 5.00 | 5.43 | 1.01 | 2.94 | 2.47 | 3.50 | 0.71 | |
| Storm Water | I | 303 | 304 | 664505.860 | 3921535.950 | 33.000 | 18 | | | 1.500 | 28.890 | 28.560 | 2.44 | 2.77 | 133.76 | 0.0025 | 0.95 | 19,258 | 38,516 | 57,773 | 1.33 | 5.00 | 6.45 | 0.70 | 2.80 | 3.53 | 5.67 | 0.62 | |
| Storm Water | I | 304 | 305 | 664372.100 | 3921535.950 | 33.000 | 24 | | | 2.000 | 28.160 | 27.670 | 2.67 | 3.16 | 195.36 | 0.0025 | 0.95 | 19,258 | 57,773 | 77,031 | 1.77 | 5.00 | 7.14 | 0.83 | 2.71 | 4.55 | 12.31 | 0.37 | |
| Storm Water | I | 305 | 306 | 664177.700 | 3921516.580 | 33.000 | 24 | | | 2.000 | 27.620 | 27.520 | 3.21 | FREE | 41.91 | 0.0024 | 0.95 | 19,258 | 77,031 | 96,289 | 2.21 | 5.00 | 7.97 | 0.18 | 2.60 | 5.45 | 12.00 | 0.45 | |
| Storm Water | FREE_EXT | 306 | | 664135.790 | 3921516.580 | | | | | | | | | | | | 0.95 | 0 | 96,289 | 96,289 | 2.21 | | 8.16 | 0.00 | 2.57 | 5.40 | | | |
| Storm Water | FREE_ENT | 307 | 308 | 664343.700 | 3921775.880 | 36.000 | 18 | | | 1.500 | 32.333 | 32.150 | 2.00 | 2.18 | 72.05 | 0.0025 | 0.95 | 52,582 | 0 | 52,582 | 1.21 | 5.00 | 5.00 | 0.37 | 3.00 | 3.44 | 5.76 | 0.60 | |
| Storm Water | I | 308 | 64 | 664347.370 | 3921703.920 | 36.000 | 24 | | | 2.000 | 31.750 | 30.330 | 2.08 | 2.00 | 182.75 | 0.0078 | 0.95 | 26,209 | 105,000 | 131,209 | 3.01 | 5.00 | 5.37 | 0.44 | 2.95 | 8.44 | 21.66 | 0.39 | |
| Storm Water | I | 309 | 310 | 665681.410 | 3928018.000 | 62.000 | 36 | | | 3.000 | 57.000 | 56.840 | 1.75 | FREE | 63.99 | 0.0025 | 0.95 | 1 | 0 | 1 | 0.00 | 5.00 | 5.00 | 0.21 | 3.00 | 0.00 | 36.23 | 0.00 | |
| Storm Water | FREE_EXT | 310 | | 665648.780 | 3927962.950 | | | | | | | | | | | | 0.95 | 0 | 1 | 1 | 0.00 | | 5.21 | 0.00 | 2.97 | 0.00 | | | |
| Storm Water | FREE_ENT | 311 | 312 | 667196.590 | 3927835.420 | 16.000 | 15 | | | 1.250 | 14.200 | 14.000 | 0.43 | FREE | 87.69 | 0.0023 | 0.95 | 1 | 0 | 1 | 0.00 | 5.00 | 5.00 | 0.54 | 3.00 | 0.00 | 3.35 | 0.00 | |
| Storm Water | FREE_EXT | 312 | | 667196.590 | 3927923.110 | | | | | | | | | | | | 0.95 | 0 | 1 | 1 | 0.00 | | 5.54 | 0.00 | 2.93 | 0.00 | | | |
| Storm Water | FREE_ENT | 313 | 314 | 667194.590 | 3927835.420 | 16.000 | 15 | | | 1.250 | 14.200 | 14.000 | 0.43 | FREE | 87.69 | 0.0023 | 0.95 | 1 | 0 | 1 | 0.00 | 5.00 | 5.00 | 0.54 | 3.00 | 0.00 | 3.35 | 0.00 | |
| Storm Water | FREE_EXT | 314 | | 667194.590 | 3927923.110 | | | | | | | | | | | | 0.95 | 0 | 1 | 1 | 0.00 | | 5.54 | 0.00 | 2.93 | 0.00 | | | |

# Attachment J. Storm Water System HGL Calculations

**Storm Drainage Systems HGL Calculations**

| System | Table A | | | | | | | | | | | | | | | | | | | | Table B | | | | | | | | | | | | | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | Pipe Losses (ft) | | | | | | Structure Losses (ft) | | | | | | | | |
| | Str. ID | NPS | Width (ft) | Height (ft) | Q (cfs) | L (ft) | $y_n$ (ft) | $y_c$ (ft) | $S_f$ (ft/ft) | Total Pipe Loss (Table B) | $EGL_o$ (ft) | Structure Head Loss Method | K (Table B) | $V_{pipe, U/S}$ (fps) | $KV^2/2g$ (ft) | $EGL_i$ (ft) | HGL (ft) | U/S TOC (ft) | Surf. Elev. (ft) | Freeboard (ft) | $H_f$ | $h_b$ | $H_c$ | $H_e$ | $H_j$ | Total | $d_{aho}$ | $K_o$ | $C_D$ | $C_d$ | $C_Q$ | $C_p$ | $C_B$ | K | |
| Storm Water | 1 | 15 | - | - | 1.62 | 281.22 | 0.60 | 0.51 | 0.23% | 0.64 | 56.33 | Culvert-Outlet | - | 2.79 | - | 56.33 | 56.33 | No Pipe | 58.80 | 2.47 | 0.64 | 0 | 0 | 0 | 0 | 0.64 | 0.60 | - | - | - | - | - | - | - | |
| Storm Water | 2 | 18 | - | - | 3.00 | 148.41 | 0.78 | 0.66 | 0.25% | 0.37 | 55.59 | Direct | 0.27 | 3.26 | 0.04 | 55.63 | 55.47 | 56.10 | 60.80 | 5.33 | 0.37 | 0 | 0 | 0 | 0 | 0.37 | 0.78 | 1.65 | 1.00 | 0.34 | 1.00 | 3.22 | 0.15 | 0.27 | |
| Storm Water | 3 | 24 | - | - | 5.78 | 141.09 | 0.97 | 0.85 | 0.18% | 0.25 | 55.08 | Direct | 0.10 | 3.83 | 0.02 | 55.10 | 54.87 | 55.78 | 60.80 | 5.93 | 0.25 | 0 | 0 | 0 | 0 | 0.25 | 0.97 | 1.43 | 1.00 | 0.32 | 0.59 | 2.47 | 0.15 | 0.10 | |
| Storm Water | 4 | 24 | - | - | 7.00 | 254.53 | 1.08 | 0.94 | 0.23% | 0.58 | 54.82 | Direct | 0.05 | 4.04 | 0.01 | 54.83 | 54.57 | 55.53 | 60.80 | 6.23 | 0.58 | 0 | 0 | 0 | 0 | 0.58 | 1.08 | 0.99 | 1.00 | 0.35 | 1.00 | 1.00 | 0.15 | 0.05 | |
| Storm Water | 5 | 24 | - | - | 7.93 | 272.28 | 1.17 | 1.00 | 0.23% | 0.64 | 54.23 | Direct | 0.02 | 4.15 | 0.00 | 54.23 | 53.97 | 54.84 | 60.80 | 6.83 | 0.64 | 0 | 0 | 0 | 0 | 0.64 | 1.17 | 0.28 | 1.00 | 0.36 | 1.00 | 1.00 | 0.15 | 0.02 | |
| Storm Water | 6 | 24 | - | - | 8.72 | 171.35 | 1.25 | 1.05 | 0.25% | 0.43 | 53.58 | Direct | 0.02 | 4.24 | 0.00 | 53.59 | 53.31 | 54.11 | 58.80 | 5.49 | 0.43 | 0 | 0 | 0 | 0 | 0.43 | 1.25 | 0.28 | 1.00 | 0.38 | 1.00 | 1.00 | 0.15 | 0.02 | |
| Storm Water | 7 | 30 | - | - | 9.77 | 87.75 | 1.16 | 1.04 | 0.05% | 0.04 | 53.03 | Direct | 0.01 | 2.78 | 0.00 | 53.03 | 52.91 | 53.63 | 58.80 | 5.89 | 0.04 | 0 | 0 | 0 | 0 | 0.04 | 1.68 | 0.23 | 1.00 | 0.39 | 1.00 | 1.00 | 0.15 | 0.01 | |
| Storm Water | 8 | 30 | - | - | 16.95 | 140.58 | 1.64 | 1.39 | 0.25% | 0.35 | 52.98 | Direct | 0.02 | 4.98 | 0.01 | 52.99 | 52.61 | 53.51 | 58.80 | 6.19 | 0.35 | 0 | 0 | 0 | 0 | 0.35 | 1.64 | 0.23 | 1.00 | 0.39 | 1.52 | 1.00 | 0.15 | 0.02 | |
| Storm Water | 9 | 36 | - | - | 17.90 | 139.15 | 1.49 | 1.35 | 0.06% | 0.09 | 52.27 | Direct | 0.01 | 4.02 | 0.00 | 52.27 | 52.02 | 53.11 | 58.80 | 6.78 | 0.09 | 0 | 0 | 0 | 0 | 0.09 | 1.81 | 0.23 | 1.00 | 0.37 | 1.00 | 1.00 | 0.15 | 0.01 | |
| Storm Water | 10 | 15 | - | - | 1.62 | 281.22 | 0.60 | 0.51 | 0.25% | 0.70 | 56.33 | Culvert-Outlet | - | 2.79 | - | 56.33 | 56.33 | No Pipe | 58.80 | 2.47 | 0.70 | 0 | 0 | 0 | 0 | 0.70 | 0.60 | - | - | - | - | - | - | - | |
| Storm Water | 11 | 15 | - | - | 1.62 | 183.84 | 0.60 | 0.51 | 0.22% | 0.40 | 56.33 | Culvert-Outlet | - | 2.80 | - | 56.33 | 56.33 | No Pipe | 58.80 | 2.47 | 0.40 | 0 | 0 | 0 | 0 | 0.40 | 0.60 | - | - | - | - | - | - | - | |
| Storm Water | 12 | 36 | - | - | 25.46 | 113.28 | 1.86 | 1.63 | 0.25% | 0.28 | 41.66 | Direct | 0.06 | 5.51 | 0.03 | 41.69 | 41.21 | 42.37 | 46.00 | 4.79 | 0.28 | 0 | 0 | 0 | 0 | 0.28 | 1.86 | 1.11 | 1.00 | 0.38 | 1.00 | 1.00 | 0.15 | 0.06 | |
| Storm Water | 13 | 42 | - | - | 31.23 | 215.34 | 1.90 | 1.73 | 0.19% | 0.41 | 39.34 | Culvert-Outlet | - | 5.86 | - | 39.34 | 39.34 | 42.04 | 45.00 | 5.66 | 0.41 | 0 | 0 | 0 | 0 | 0.41 | 1.90 | - | - | - | - | - | - | - | |
| Storm Water | 14 | 42 | - | - | 35.12 | 223.04 | 2.04 | 1.84 | 0.20% | 0.44 | 38.66 | Direct | 0.01 | 6.03 | 0.01 | 38.66 | 38.10 | 39.60 | 44.50 | 6.40 | 0.44 | 0 | 0 | 0 | 0 | 0.44 | 2.04 | 0.19 | 1.00 | 0.36 | 1.19 | 1.00 | 0.15 | 0.01 | |
| Storm Water | 15 | 42 | - | - | 38.82 | 222.55 | 2.18 | 1.94 | 0.25% | 0.56 | 38.21 | Direct | 0.01 | 6.17 | 0.01 | 38.22 | 37.63 | 38.99 | 44.50 | 6.87 | 0.56 | 0 | 0 | 0 | 0 | 0.56 | 2.18 | 0.19 | 1.00 | 0.38 | 1.17 | 1.00 | 0.15 | 0.01 | |
| Storm Water | 16 | 48 | - | - | 42.34 | 221.85 | 2.11 | 1.94 | 0.22% | 0.48 | 37.21 | Direct | 0.01 | 6.30 | 0.01 | 37.21 | 36.60 | 38.38 | 44.50 | 7.90 | 0.48 | 0 | 0 | 0 | 0 | 0.48 | 2.11 | 0.20 | 1.00 | 0.34 | 1.15 | 1.00 | 0.15 | 0.01 | |
| Storm Water | 17 | 48 | - | - | 45.43 | 222.13 | 2.19 | 2.02 | 0.25% | 0.56 | 36.72 | Direct | 0.01 | 6.45 | 0.01 | 36.72 | 36.08 | 37.93 | 44.50 | 8.42 | 0.56 | 0 | 0 | 0 | 0 | 0.56 | 2.19 | 0.20 | 1.00 | 0.35 | 1.13 | 1.00 | 0.15 | 0.01 | |
| Storm Water | 18 | 48 | - | - | 44.76 | 244.38 | 2.18 | 2.00 | 0.22% | 0.53 | 36.08 | Direct | 0.08 | 6.40 | 0.05 | 36.13 | 35.50 | 37.32 | 43.50 | 8.00 | 0.53 | 0 | 0 | 0 | 0 | 0.53 | 2.18 | 1.53 | 1.00 | 0.35 | 1.00 | 1.00 | 0.15 | 0.08 | |
| Storm Water | 20 | 15 | - | - | 1.07 | 133.62 | 0.47 | 0.41 | 0.09% | 0.11 | 41.87 | Culvert-Outlet | - | 2.49 | - | 41.87 | 41.87 | No Pipe | 44.50 | 2.63 | 0.11 | 0 | 0 | 0 | 0 | 0.11 | 0.47 | - | - | - | - | - | - | - | |
| Storm Water | 21 | 18 | - | - | 3.23 | 144.95 | 0.81 | 0.68 | 0.25% | 0.36 | 41.70 | Direct | 0.04 | 3.31 | 0.01 | 41.71 | 41.54 | 42.38 | 44.50 | 2.96 | 0.36 | 0 | 0 | 0 | 0 | 0.36 | 0.81 | 1.65 | 1.00 | 0.35 | 0.30 | 1.60 | 0.15 | 0.04 | |
| Storm Water | 22 | 24 | - | - | 6.22 | 144.50 | 1.01 | 0.88 | 0.06% | 0.09 | 41.21 | Direct | 0.03 | 3.85 | 0.01 | 41.22 | 40.99 | 41.86 | 44.50 | 3.51 | 0.09 | 0 | 0 | 0 | 0 | 0.09 | 1.02 | 0.28 | 1.00 | 0.33 | 1.58 | 1.45 | 0.15 | 0.03 | |
| Storm Water | 23 | 24 | - | - | 9.05 | 205.79 | 1.28 | 1.07 | 0.25% | 0.51 | 41.11 | Direct | 0.02 | 4.25 | 0.01 | 41.12 | 40.84 | 41.60 | 44.50 | 3.66 | 0.51 | 0 | 0 | 0 | 0 | 0.51 | 1.28 | 0.28 | 1.00 | 0.38 | 1.42 | 1.00 | 0.15 | 0.02 | |
| Storm Water | 24 | 30 | - | - | 9.57 | 134.28 | 1.14 | 1.03 | 0.25% | 0.34 | 40.08 | Direct | 0.07 | 4.38 | 0.02 | 40.10 | 39.80 | 41.04 | 44.50 | 4.70 | 0.34 | 0 | 0 | 0 | 0 | 0.34 | 1.14 | 1.55 | 1.00 | 0.31 | 1.00 | 1.00 | 0.15 | 0.07 | |
| Storm Water | 25 | 36 | - | - | 24.57 | 190.93 | 1.81 | 1.60 | 0.25% | 0.48 | 37.59 | Direct | 0.05 | 5.51 | 0.02 | 37.61 | 37.14 | 38.21 | 44.50 | 7.36 | 0.48 | 0 | 0 | 0 | 0 | 0.48 | 1.81 | 1.58 | 1.00 | 0.37 | 0.54 | 1.00 | 0.15 | 0.05 | |
| Storm Water | 26 | 30 | - | - | 15.76 | 183.94 | 1.55 | 1.34 | 0.25% | 0.46 | 38.10 | Direct | 0.02 | 4.91 | 0.01 | 38.11 | 37.73 | 38.72 | 44.50 | 6.77 | 0.46 | 0 | 0 | 0 | 0 | 0.46 | 1.55 | 0.28 | 1.00 | 0.38 | 1.39 | 1.01 | 0.15 | 0.02 | |
| Storm Water | 27 | 30 | - | - | 10.81 | 92.19 | 1.23 | 1.10 | 0.06% | 0.05 | 38.16 | Direct | 0.02 | 3.44 | 0.00 | 38.16 | 37.98 | 39.00 | 44.50 | 6.52 | 0.05 | 0 | 0 | 0 | 0 | 0.05 | 1.53 | 0.28 | 1.00 | 0.37 | 1.00 | 1.00 | 0.15 | 0.02 | |
| Storm Water | 28 | 15 | - | - | 1.07 | 58.63 | 0.47 | 0.41 | 0.26% | 0.15 | 41.87 | Culvert-Outlet | - | 2.52 | - | 41.87 | 41.87 | No Pipe | 44.50 | 2.63 | 0.15 | 0 | 0 | 0 | 0 | 0.15 | 0.47 | - | - | - | - | - | - | - | |
| Storm Water | 29 | 24 | - | - | 9.01 | 51.16 | 1.27 | 1.07 | 0.21% | 0.11 | 39.08 | Direct | 0.02 | 4.29 | 0.01 | 39.09 | 38.80 | 39.58 | 44.50 | 5.70 | 0.11 | 0 | 0 | 0 | 0 | 0.11 | 1.27 | 0.28 | 1.00 | 0.38 | 1.21 | 1.00 | 0.15 | 0.02 | |
| Storm Water | 30 | 24 | - | - | 9.42 | 67.25 | 1.31 | 1.10 | 0.25% | 0.17 | 38.95 | Direct | 0.10 | 4.32 | 0.03 | 38.98 | 38.69 | 39.40 | 44.50 | 5.81 | 0.17 | 0 | 0 | 0 | 0 | 0.17 | 1.31 | 1.64 | 1.00 | 0.39 | 1.00 | 1.00 | 0.15 | 0.10 | |
| Storm Water | 31 | 42 | - | - | 40.74 | 202.28 | 2.25 | 1.99 | 0.25% | 0.51 | 40.20 | Direct | 0.08 | 6.23 | 0.05 | 40.25 | 39.65 | 40.75 | 43.00 | 3.35 | 0.51 | 0 | 0 | 0 | 0 | 0.51 | 2.25 | 1.45 | 1.00 | 0.38 | 1.00 | 1.00 | 0.15 | 0.08 | |
| Storm Water | 32 | 48 | - | - | 42.51 | 159.52 | 2.11 | 1.95 | 0.08% | 0.13 | 38.37 | Direct | 0.04 | 6.34 | 0.03 | 38.40 | 37.77 | 39.54 | 44.50 | 6.73 | 0.13 | 0 | 0 | 0 | 0 | 0.13 | 2.11 | 0.80 | 1.00 | 0.34 | 1.00 | 1.00 | 0.15 | 0.04 | |
| Storm Water | 34 | 15 | - | - | 1.07 | 89.51 | 0.48 | 0.41 | 0.25% | 0.22 | 41.87 | Culvert-Outlet | - | 2.49 | - | 41.87 | 41.87 | No Pipe | 44.50 | 2.63 | 0.22 | 0 | 0 | 0 | 0 | 0.22 | 0.48 | - | - | - | - | - | - | - | |
| Storm Water | 35 | 15 | - | - | 1.07 | 89.51 | 0.48 | 0.41 | 0.25% | 0.22 | 41.87 | Culvert-Outlet | - | 2.49 | - | 41.87 | 41.87 | No Pipe | 44.50 | 2.63 | 0.22 | 0 | 0 | 0 | 0 | 0.22 | 0.48 | - | - | - | - | - | - | - | |
| Storm Water | 36 | 15 | - | - | 1.07 | 69.83 | 0.48 | 0.41 | 0.02% | 0.02 | 41.93 | Culvert-Outlet | - | 1.83 | - | 41.93 | 41.93 | No Pipe | 44.50 | 2.57 | 0.02 | 0 | 0 | 0 | 0 | 0.02 | 0.60 | - | - | - | - | - | - | - | |
| Storm Water | 37 | 15 | - | - | 2.09 | 161.27 | 0.70 | 0.58 | 0.25% | 0.40 | 41.86 | Direct | 0.16 | 2.97 | 0.02 | 41.89 | 41.75 | 42.33 | 44.50 | 2.75 | 0.40 | 0 | 0 | 0 | 0 | 0.40 | 0.70 | 1.70 | 1.00 | 0.35 | 1.00 | 1.78 | 0.15 | 0.16 | |
| Storm Water | 38 | 18 | - | - | 3.00 | 194.22 | 0.77 | 0.66 | 0.25% | 0.49 | 41.37 | Direct | 0.03 | 3.27 | 0.00 | 41.37 | 41.21 | 41.88 | 44.50 | 3.29 | 0.49 | 0 | 0 | 0 | 0 | 0.49 | 0.77 | 0.30 | 1.00 | 0.34 | 1.00 | 1.75 | 0.15 | 0.03 | |
| Storm Water | 39 | 24 | - | - | 4.76 | 173.51 | 0.87 | 0.77 | 0.25% | 0.43 | 40.61 | Direct | 0.03 | 3.64 | 0.01 | 40.62 | 40.41 | 41.44 | 44.50 | 4.09 | 0.43 | 0 | 0 | 0 | 0 | 0.43 | 0.87 | 0.28 | 1.00 | 0.30 | 1.47 | 1.61 | 0.15 | 0.03 | |
| Storm Water | 40 | 15 | - | - | 1.07 | 53.86 | 0.48 | 0.41 | 0.24% | 0.13 | 41.87 | Culvert-Outlet | - | 2.47 | - | 41.87 | 41.87 | No Pipe | 44.50 | 2.63 | 0.13 | 0 | 0 | 0 | 0 | 0.13 | 0.48 | - | - | - | - | - | - | - | |
| Storm Water | 41 | 15 | - | - | 1.07 | 100.73 | 0.47 | 0.41 | 0.02% | 0.02 | 41.87 | Culvert-Outlet | - | 2.43 | - | 41.87 | 41.87 | No Pipe | 44.50 | 2.63 | 0.02 | 0 | 0 | 0 | 0 | 0.02 | 0.48 | - | - | - | - | - | - | - | |
| Storm Water | 42 | 15 | - | - | 2.07 | 187.50 | 0.69 | 0.57 | 0.25% | 0.47 | 41.78 | Direct | 0.16 | 2.97 | 0.02 | 41.80 | 41.66 | 42.25 | 44.50 | 2.84 | 0.47 | 0 | 0 | 0 | 0 | 0.47 | 0.69 | 1.70 | 1.00 | 0.35 | 1.00 | 1.84 | 0.15 | 0.16 | |
| Storm Water | 43 | 18 | - | - | 2.95 | 100.66 | 0.77 | 0.65 | 0.25% | 0.25 | 41.21 | Direct | 0.15 | 3.24 | 0.02 | 41.24 | 41.07 | 41.73 | 44.50 | 3.43 | 0.25 | 0 | 0 | 0 | 0 | 0.25 | 0.77 | 1.65 | 1.00 | 0.33 | 1.00 | 1.83 | 0.15 | 0.15 | |
| Storm Water | 44 | 24 | - | - | 7.92 | 199.17 | 1.17 | 1.00 | 0.21% | 0.43 | 39.52 | Direct | 0.02 | 4.15 | 0.01 | 39.52 | 39.25 | 40.13 | 44.50 | 5.25 | 0.43 | 0 | 0 | 0 | 0 | 0.43 | 1.17 | 0.28 | 1.00 | 0.36 | 1.46 | 1.00 | 0.15 | 0.02 | |
| Storm Water | 45 | 24 | - | - | 6.39 | 340.28 | 1.03 | 0.89 | 0.17% | 0.59 | 40.35 | Direct | 0.05 | 3.94 | 0.01 | 40.36 | 40.12 | 41.13 | 44.50 | 4.38 | 0.59 | 0 | 0 | 0 | 0 | 0.59 | 1.03 | 1.54 | 1.00 | 0.33 | 0.65 | 1.00 | 0.15 | 0.05 | |
| Storm Water | 46 | 36 | - | - | 36.44 | 159.80 | 1.55 | 1.96 | 0.91% | 1.45 | 42.02 | Direct | 0.08 | 7.43 | 0.07 | 42.09 | 41.24 | 42.25 | 44.50 | 3.26 | 1.45 | 0 | 0 | 0 | 0 | 1.45 | 1.96 | 1.46 | 1.00 | 0.39 | 1.00 | 1.00 | 0.15 | 0.08 | |
| Storm Water | 47 | 15 | - | - | 0.99 | 40.09 | 0.43 | 0.39 | 0.02% | 0.01 | 41.92 | Culvert-Outlet | - | 1.65 | - | 41.92 | 41.92 | No Pipe | 44.50 | 2.58 | 0.01 | 0 | 0 | 0 | 0 | 0.01 | 0.61 | - | - | - | - | - | - | - | |
| Storm Water | 48 | 15 | - | - | 1.95 | 87.40 | 0.67 | 0.56 | 0.25% | 0.22 | 41.88 | Direct | 0.12 | 2.94 | 0.02 | 41.90 | 41.76 | 42.38 | 44.50 | 2.74 | 0.22 | 0 | 0 | 0 | 0 | 0.22 | 0.67 | 1.29 | 1.00 | 0.34 | 1.00 | 1.76 | 0.15 | 0.12 | |
| Storm Water | 49 | 18 | - | - | 2.86 | 227.63 | 0.75 | 0.64 | 0.20% | 0.46 | 41.57 | Direct | 0.02 | 3.23 | 0.00 | 41.58 | 41.42 | 42.11 | 44.50 | 3.08 | 0.46 | 0 | 0 | 0 | 0 | 0.46 | 0.75 | 0.30 | 1.00 | 0.33 | 1.00 | 1.64 | 0.15 | 0.02 | |
| Storm Water | 50 | 18 | - | - | 3.61 | 82.95 | 0.86 | 0.72 | 0.25% | 0.21 | 41.09 | Direct | 0.17 | 3.42 | 0.03 | 41.12 | 40.93 | 41.59 | 44.50 | 3.57 | 0.21 | 0 | 0 | 0 | 0 | 0.21 | 0.86 | 1.65 | 1.00 | 0.36 | 1.00 | 1.94 | 0.15 | 0.17 | |
| Storm Water | 51 | 24 | - | - | 4.41 | 120.23 | 0.83 | 0.74 | 0.08% | 0.10 | 40.46 | Direct | 0.07 | 3.58 | 0.01 | 40.47 | 40.27 | 41.33 | 44.50 | 4.23 | 0.10 | 0 | 0 | 0 | 0 | 0.10 | 0.83 | 1.48 | 1.00 | 0.29 | 1.00 | 1.00 | 0.15 | 0.07 | |
| Storm Water | 52 | 15 | - | - | 1.30 | 58.13 | 0.52 | 0.45 | 0.26% | 0.15 | 41.10 | Direct | 0.14 | 2.67 | 0.02 | 41.12 | 41.01 | 41.77 | 44.50 | 3.49 | 0.15 | 0 | 0 | 0 | 0 | 0.15 | 0.52 | 1.44 | 1.00 | 0.30 | 1.00 | 2.26 | 0.15 | 0.14 | |
| Storm Water | 54 | 15 | - | - | 0.42 | 290.13 | 0.29 | 0.25 | 0.17% | 0.48 | 41.63 | Culvert-Outlet | - | 1.93 | - | 41.63 | 41.63 | No Pipe | 44.50 | 2.87 | 0.48 | 0 | 0 | 0 | 0 | 0.48 | 0.29 | - | - | - | - | - | - | - | |
| Storm Water | 55 | 30 | - | - | 14.22 | 22.75 | 1.43 | 1.27 | 0.26% | 0.06 | 8.22 | Direct | 0.01 | 4.90 | 0.00 | 8.23 | 7.85 | 8.97 | 11.50 | 3.65 | 0.06 | 0 | 0 | 0 | 0 | 0.06 | 1.43 | 0.23 | 1.00 | 0.36 | 1.00 | 1.00 | 0.15 | 0.01 | |
| Storm Water | 56 | 30 | - | - | 12.16 | 10.00 | 1.41 | 1.17 | 0.20% | 0.02 | 9.33 | Culvert-Outlet | - | 4.25 | - | 9.33 | 9.33 | No Pipe | 11.00 | 1.67 | 0.02 | 0 | 0 | 0 | 0 | 0.02 | 1.41 | - | - | - | - | - | - | - | |
| Storm Water | 57 | 24 | - | - | 6.58 | 182.81 | 1.04 | 0.91 | 0.10% | 0.18 | 39.71 | Culvert-Outlet | - | 3.98 | - | 39.71 | 39.71 | No Pipe | 42.30 | 2.59 | 0.18 | 0 | 0 | 0 | 0 | 0.18 | 1.04 | - | - | - | - | - | - | - | |
| Storm Water | 58 | 24 | - | - | 4.77 | 182.81 | 0.86 | 0.77 | 0.25% | 0.46 | 39.48 | Culvert-Outlet | - | 3.66 | - | 39.48 | 39.48 | No Pipe | 42.30 | 2.82 | 0.46 | 0 | 0 | 0 | 0 | 0.46 | 0.86 | - | - | - | - | - | - | - | |
| Storm Water | 59 | 24 | - | - | 4.77 | 182.81 | 0.86 | 0.77 | 0.25% | 0.46 | 39.48 | Culvert-Outlet | - | 3.66 | - | 39.48 | 39.48 | No Pipe | 42.30 | 2.82 | 0.46 | 0 | 0 | 0 | 0 | 0.46 | 0.86 | - | - | - | - | - | - | - | |
| Storm Water | 60 | 24 | - | - | 4.77 | 182.81 | 0.86 | 0.77 | 0.25% | 0.46 | 39.48 | Culvert-Outlet | - | 3.66 | - | 39.48 | 39.48 | No Pipe | 42.30 | 2.82 | 0.46 | 0 | 0 | 0 | 0 | 0.46 | 0.86 | - | - | - | - | - | - | - | |
| Storm Water | 61 | 24 | - | - | 4.46 | 182.81 | 0.83 | 0.74 | 0.25% | 0.46 | 39.44 | Culvert-Outlet | - | 3.60 | - | 39.44 | 39.44 | No Pipe | 42.30 | 2.86 | 0.46 | 0 | 0 | 0 | 0 | 0.46 | 0.83 | - | - | - | - | - | - | - | |
| Storm Water | 62 | 24 | - | - | 8.74 | 112.79 | 1.25 | 1.05 | 0.25% | 0.28 | 39.71 | Direct | 0.16 | 4.23 | 0.04 | 39.75 | 39.48 | 40.23 | 44.90 | 5.42 | 0.28 | 0 | 0 | 0 | 0 | 0.28 | 1.25 | 1.24 | 1.00 | 0.38 | 1.00 | 2.28 | 0.15 | 0.16 | |
| Storm Water | 63 | 15 | - | - | 3.41 | 114.95 | 0.47 | 0.74 | 2.57% | 2.95 | 36.63 | Direct | 0.08 | 4.47 | 0.03 | 36.66 | 36.35 | 36.88 | 39.00 | 2.65 | 2.95 | 0 | 0 | 0 | 0 | 2.95 | 0.74 | 0.85 | 1.00 | 0.37 | 1.00 | 1.73 | 0.15 | 0.08 | |
| Storm Water | 64 | 24 | - | - | 8.27 | 121.68 | 1.06 | 1.02 | 0.37% | 0.45 | 31.71 | Direct | 0.04 | 4.87 | 0.01 | 31.73 | 31.36 | 32.33 | 34.50 | 3.14 | 0.45 | 0 | 0 | 0 | 0 | 0.45 | 1.06 | 0.78 | 1.00 | 0.34 | 1.00 | 1.00 | 0.15 | 0.04 | |
| Storm Water | 65 | 30 | - | - | 9.72 | 81.71 | 1.16 | 1.04 | 0.14% | 0.12 | 30.89 | Direct | 0.02 | 4.34 | 0.00 | 30.89 | 30.60 | 31.83 | 34.00 | 3.40 | 0.12 | 0 | 0 | 0 | 0 | 0.12 | 1.16 | 0.33 | 1.00 | 0.32 | 1.00 | 1.00 | 0.15 | 0.02 | |
| Storm Water | 66 | 24 | - | - | 9.58 | 90.67 | 1.15 | 1.11 | 0.39% | 0.35 | 30.74 | Direct | 0.08 | 5.12 | 0.03 | 30.77 | 30.36 | 31.73 | 34.00 | 3.64 | 0.35 | 0 | 0 | 0 | 0 | 0.35 | 1.15 | 1.47 | 1.00 | 0.36 | 1.00 | 1.00 | 0.15 | 0.08 | |
| Storm Water | 67 | 30 | - | - | 11.01 | 58.05 | 1.17 | 1.11 | 0.15% | 0.09 | 29.97 | Direct | 0.08 | 4.89 | 0.03 | 30.00 | 29.63 | 30.83 | 33.00 | 3.37 | 0.09 | 0 | 0 | 0 | 0 | 0.09 | 1.17 | 1.58 | 1.00 | 0.32 | 1.00 | 1.00 | 0.15 | 0.08 | |
| Storm Water | 68 | 30 | - | - | 12.46 | 96.97 | 1.34 | 1.19 | 0.25% | 0.24 | 29.88 | Direct | 0.01 | 4.64 | 0.00 | 29.88 | 29.55 | 30.75 | 33.00 | 3.45 | 0.24 | 0 | 0 | 0 | 0 | 0.24 | 1.34 | 0.23 | 1.00 | 0.34 | 1.00 | 1.00 | 0.15 | 0.01 | |
| Storm Water | 69 | 15 | - | - | 1.71 | 94.48 | 0.30 | 0.52 | 3.29% | 3.11 | 39.86 | Culvert-Outlet | - | 3.55 | - | 39.86 | 39.86 | No Pipe | 42.30 | 2.44 | 3.11 | 0 | 0 | 0 | 0 | 3.11 | 0.52 | - | - | - | - | - | - | - | |
| Storm Water | 71 | 36 | - | - | 22.82 | 167.14 | 1.73 | 1.54 | 0.25% | 0.42 | 55.49 | Direct | 0.05 | 5.42 | 0.02 | 55.52 | 55.06 | 56.21 | 62.50 | 7.44 | 0.42 | 0 | 0 | 0 | 0 | 0.42 | 1.73 | 1.06 | 1.00 | 0.36 | 0.91 | 1.00 | 0.15 | 0.05 | |
| Storm Water | 72 | 36 | - | - | 37.14 | 231.68 | 2.23 | 1.98 | 0.32% | 0.75 | 43.24 | Culvert-Outlet | - | 6.59 | - | 43.24 | 43.24 | No Pipe | FREE | 0.76 | 0.75 | 0 | 0 | 0 | 0 | 0.75 | 2.23 | - | - | - | - | - | - | - | |
| Storm Water | 73 | 18 | - | - | 2.72 | 153.06 | 0.73 | 0.63 | 0.25% | 0.38 | 40.32 | Direct | 0.07 | 3.18 | 0.01 | 40.33 | 40.17 | 40.88 | 43.00 | 2.83 | 0.38 | 0 | 0 | 0 | 0 | 0.38 | 0.73 | 1.22 | 1.00 | 0.33 | 0.74 | 1.52 | 0.15 | 0.07 | |
| Storm Water | 74 | 24 | - | - | 5.14 | 90.36 | 0.90 | 0.80 | 0.04% | 0.04 | 39.56 | Direct | 0.06 | 3.05 | 0.01 | 39.57 | 39.43 | 40.41 | 46.00 | 6.57 | 0.04 | 0 | 0 | 0 | 0 | 0.04 | 1.06 | 1.21 | 1.00 | 0.34 | 1.00 | 1.00 | 0.15 | 0.06 | |
| Storm Water | 201 | 15 | - | - | 1.21 | 40.00 | 0.48 | 0.43 | 0.30% | 0.12 | 41.91 | Culvert-Outlet | - | 2.77 | - | 41.91 | 41.91 | No Pipe | 44.50 | 2.59 | 0.12 | 0 | 0 | 0 | 0 | 0.12 | 0.48 | - | - | - | - | - | - | - | |

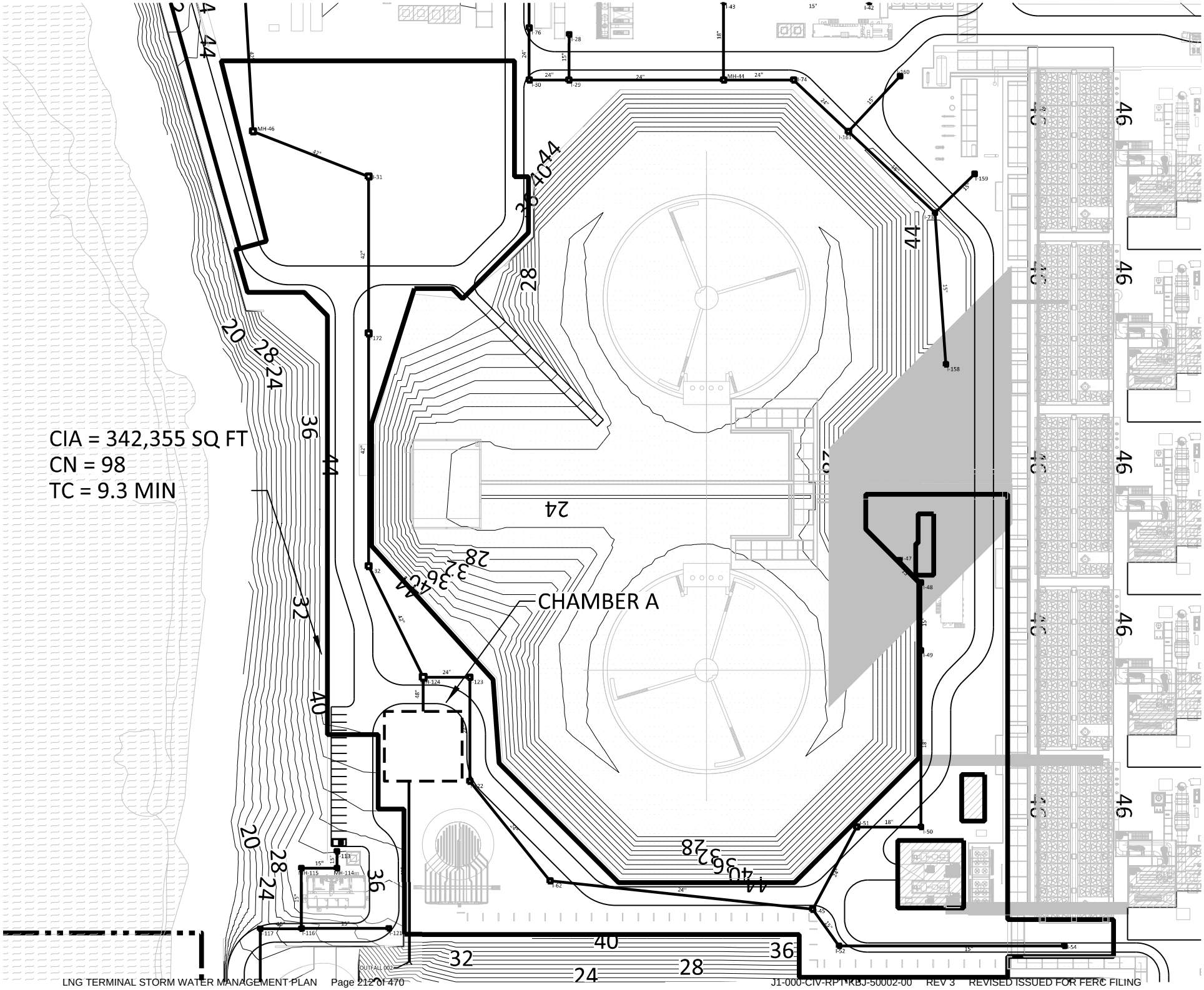
**Storm Drainage Systems HGL Calculations**

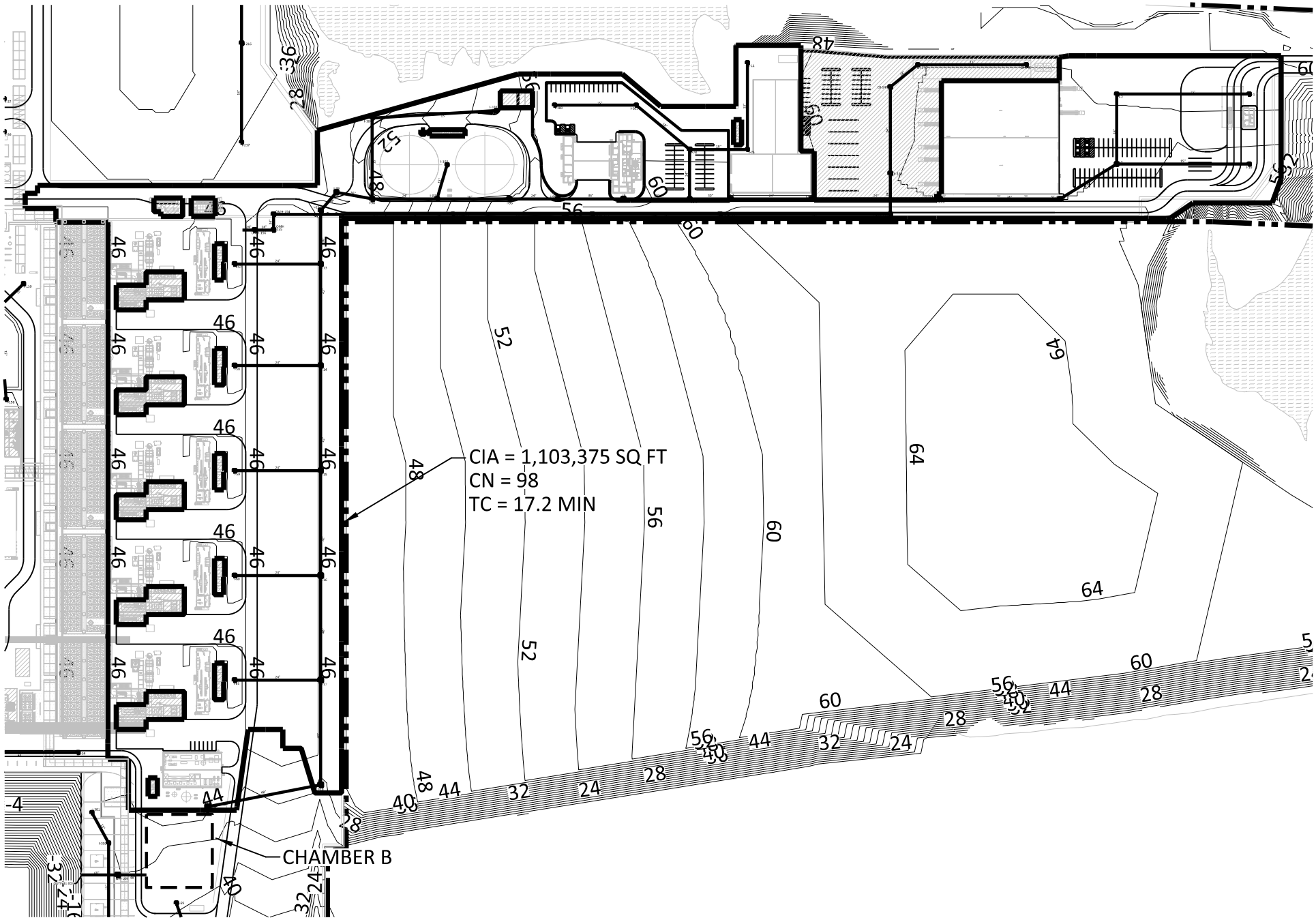
| System | Table A | | | | | | | | | | | | | | | | | | | | Table B | | | | | | | | | | | | | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | Pipe Losses (ft) | | | | | | Structure Losses (ft) | | | | | | | | |
| | Str. ID | NPS | Width (ft) | Height (ft) | Q (cfs) | L (ft) | $y_n$ (ft) | $y_c$ (ft) | $S_f$ (ft/ft) | Total Pipe Loss (Table B) | $EGL_o$ (ft) | Structure Head Loss Method | K (Table B) | $V_{pipe, U/S}$ (fps) | $KV^2/2g$ (ft) | $EGL_i$ (ft) | HGL (ft) | U/S TOC (ft) | Surf. Elev. (ft) | Freeboard (ft) | $H_f$ | $h_b$ | $H_c$ | $H_e$ | $H_j$ | Total | $d_{aho}$ | $K_o$ | $C_D$ | $C_d$ | $C_Q$ | $C_p$ | $C_B$ | K | |
| Storm Water | 202 | 15 | - | - | 1.21 | 40.00 | 0.48 | 0.43 | 0.30% | 0.12 | 41.91 | Culvert-Outlet | - | 2.77 | - | 41.91 | 41.91 | No Pipe | 44.50 | 2.59 | 0.12 | 0 | 0 | 0 | 0 | 0.12 | 0.48 | - | - | - | - | - | - | - | |
| Storm Water | 203 | 15 | - | - | 1.21 | 40.00 | 0.48 | 0.43 | 0.30% | 0.12 | 41.91 | Culvert-Outlet | - | 2.77 | - | 41.91 | 41.91 | No Pipe | 44.50 | 2.59 | 0.12 | 0 | 0 | 0 | 0 | 0.12 | 0.48 | - | - | - | - | - | - | - | |
| Storm Water | 204 | 15 | - | - | 1.21 | 187.88 | 0.51 | 0.43 | 0.25% | 0.47 | 41.91 | Culvert-Outlet | - | 2.59 | - | 41.91 | 41.91 | No Pipe | 44.50 | 2.59 | 0.47 | 0 | 0 | 0 | 0 | 0.47 | 0.51 | - | - | - | - | - | - | - | |
| Storm Water | 205 | 24 | - | - | 9.00 | 62.00 | 1.29 | 1.07 | 0.24% | 0.15 | 40.18 | Direct | 0.07 | 4.21 | 0.02 | 40.20 | 39.93 | 40.67 | 44.50 | 4.57 | 0.15 | 0 | 0 | 0 | 0 | 0.15 | 1.29 | 1.64 | 1.00 | 0.38 | 0.71 | 1.00 | 0.15 | 0.07 | |
| Storm Water | 206 | 24 | - | - | 7.24 | 144.95 | 1.11 | 0.96 | 0.13% | 0.19 | 40.39 | Direct | 0.02 | 4.05 | 0.01 | 40.40 | 40.14 | 41.08 | 44.50 | 4.36 | 0.19 | 0 | 0 | 0 | 0 | 0.19 | 1.11 | 0.28 | 1.00 | 0.35 | 1.37 | 1.00 | 0.15 | 0.02 | |
| Storm Water | 207 | 24 | - | - | 5.34 | 144.50 | 0.92 | 0.82 | 0.13% | 0.19 | 40.58 | Direct | 0.03 | 3.76 | 0.01 | 40.59 | 40.37 | 41.34 | 44.50 | 4.13 | 0.19 | 0 | 0 | 0 | 0 | 0.19 | 0.92 | 0.28 | 1.00 | 0.31 | 1.49 | 1.64 | 0.15 | 0.03 | |
| Storm Water | 208 | 18 | - | - | 3.30 | 115.48 | 0.82 | 0.69 | 0.25% | 0.29 | 41.12 | Direct | 0.11 | 3.34 | 0.02 | 41.14 | 40.97 | 41.58 | 44.50 | 3.53 | 0.29 | 0 | 0 | 0 | 0 | 0.29 | 0.82 | 1.14 | 1.00 | 0.35 | 1.00 | 1.90 | 0.15 | 0.11 | |
| Storm Water | 209 | 15 | - | - | 2.30 | 152.30 | 0.74 | 0.61 | 0.25% | 0.38 | 41.59 | Direct | 0.15 | 3.04 | 0.02 | 41.62 | 41.47 | 42.01 | 44.50 | 3.03 | 0.38 | 0 | 0 | 0 | 0 | 0.38 | 0.74 | 1.41 | 1.00 | 0.36 | 1.00 | 1.98 | 0.15 | 0.15 | |
| Storm Water | 210 | 15 | - | - | 1.21 | 196.60 | 0.51 | 0.43 | 0.13% | 0.25 | 41.91 | Culvert-Outlet | - | 2.59 | - | 41.91 | 41.91 | No Pipe | 44.50 | 2.59 | 0.25 | 0 | 0 | 0 | 0 | 0.25 | 0.51 | - | - | - | - | - | - | - | |
| Storm Water | 211 | 15 | - | - | 1.21 | 89.51 | 0.51 | 0.43 | 0.25% | 0.22 | 41.91 | Culvert-Outlet | - | 2.58 | - | 41.91 | 41.91 | No Pipe | 44.50 | 2.59 | 0.22 | 0 | 0 | 0 | 0 | 0.22 | 0.51 | - | - | - | - | - | - | - | |
| Storm Water | 212 | 15 | - | - | 1.21 | 89.51 | 0.51 | 0.43 | 0.25% | 0.22 | 41.91 | Culvert-Outlet | - | 2.58 | - | 41.91 | 41.91 | No Pipe | 44.50 | 2.59 | 0.22 | 0 | 0 | 0 | 0 | 0.22 | 0.51 | - | - | - | - | - | - | - | |
| Storm Water | 75 | 18 | - | - | 3.09 | 122.50 | 0.78 | 0.67 | 0.24% | 0.29 | 55.84 | Direct | 0.14 | 3.30 | 0.02 | 55.87 | 55.70 | 56.34 | 58.80 | 3.10 | 0.29 | 0 | 0 | 0 | 0 | 0.29 | 0.78 | 1.65 | 1.00 | 0.34 | 1.00 | 1.67 | 0.15 | 0.14 | |
| Storm Water | 76 | 30 | - | - | 10.17 | 111.88 | 1.19 | 1.07 | 0.10% | 0.11 | 38.27 | Direct | 0.01 | 4.43 | 0.00 | 38.27 | 37.97 | 39.18 | 44.50 | 6.53 | 0.11 | 0 | 0 | 0 | 0 | 0.11 | 1.19 | 0.23 | 1.00 | 0.32 | 1.00 | 1.00 | 0.15 | 0.01 | |
| Storm Water | 77 | 48 | - | - | 45.54 | 16.29 | 2.21 | 2.02 | 0.25% | 0.04 | 35.51 | Direct | 0.08 | 6.39 | 0.05 | 35.56 | 34.92 | 36.66 | 40.00 | 5.08 | 0.04 | 0 | 0 | 0 | 0 | 0.04 | 2.21 | 1.53 | 1.00 | 0.35 | 1.00 | 1.00 | 0.15 | 0.08 | |
| Storm Water | 78 | 24 | - | - | 7.46 | 104.88 | 1.13 | 0.97 | 0.25% | 0.26 | 55.54 | Direct | 0.07 | 4.08 | 0.02 | 55.55 | 55.30 | 56.05 | 58.80 | 3.50 | 0.26 | 0 | 0 | 0 | 0 | 0.26 | 1.13 | 1.32 | 1.00 | 0.35 | 0.64 | 1.46 | 0.15 | 0.07 | |
| Storm Water | 79 | 15 | - | - | 1.89 | 197.80 | 0.66 | 0.55 | 0.21% | 0.41 | 59.40 | Culvert-Outlet | - | 2.90 | - | 59.40 | 59.40 | No Pipe | 61.80 | 2.40 | 0.41 | 0 | 0 | 0 | 0 | 0.41 | 0.66 | - | - | - | - | - | - | - | |
| Storm Water | 80 | 18 | - | - | 3.58 | 300.00 | 0.86 | 0.72 | 0.25% | 0.75 | 58.90 | Direct | 0.11 | 3.40 | 0.02 | 58.92 | 58.74 | 59.31 | 61.80 | 3.06 | 0.75 | 0 | 0 | 0 | 0 | 0.75 | 0.86 | 1.63 | 1.00 | 0.36 | 1.00 | 1.26 | 0.15 | 0.11 | |
| Storm Water | 81 | 24 | - | - | 4.97 | 128.02 | 0.89 | 0.79 | 0.13% | 0.17 | 57.81 | Direct | 0.04 | 3.70 | 0.01 | 57.82 | 57.61 | 58.61 | 61.80 | 4.19 | 0.17 | 0 | 0 | 0 | 0 | 0.17 | 0.89 | 0.67 | 1.00 | 0.31 | 1.00 | 1.34 | 0.15 | 0.04 | |
| Storm Water | 82 | 24 | - | - | 6.44 | 419.35 | 1.03 | 0.90 | 0.23% | 0.98 | 57.61 | Direct | 0.11 | 3.95 | 0.03 | 57.64 | 57.40 | 58.39 | 61.80 | 4.40 | 0.98 | 0 | 0 | 0 | 0 | 0.98 | 1.03 | 1.58 | 1.00 | 0.34 | 1.00 | 1.42 | 0.15 | 0.11 | |
| Storm Water | 83 | 30 | - | - | 13.13 | 110.90 | 1.38 | 1.22 | 0.17% | 0.19 | 56.62 | Direct | 0.04 | 4.73 | 0.01 | 56.63 | 56.28 | 57.29 | 61.80 | 5.52 | 0.19 | 0 | 0 | 0 | 0 | 0.19 | 1.38 | 1.57 | 1.00 | 0.35 | 0.41 | 1.04 | 0.15 | 0.04 | |
| Storm Water | 84 | 30 | - | - | 14.75 | 125.31 | 1.49 | 1.29 | 0.18% | 0.22 | 56.41 | Direct | 0.02 | 4.82 | 0.01 | 56.42 | 56.06 | 57.11 | 61.80 | 5.74 | 0.22 | 0 | 0 | 0 | 0 | 0.22 | 1.49 | 0.44 | 1.00 | 0.37 | 1.00 | 1.00 | 0.15 | 0.02 | |
| Storm Water | 85 | 30 | - | - | 16.31 | 197.34 | 1.60 | 1.36 | 0.25% | 0.49 | 56.17 | Direct | 0.05 | 4.93 | 0.02 | 56.19 | 55.81 | 56.75 | 61.80 | 5.99 | 0.49 | 0 | 0 | 0 | 0 | 0.49 | 1.60 | 0.84 | 1.00 | 0.38 | 1.00 | 1.00 | 0.15 | 0.05 | |
| Storm Water | 86 | 24 | - | - | 7.88 | 53.22 | 1.17 | 1.00 | 0.24% | 0.13 | 57.53 | Direct | 0.06 | 4.10 | 0.02 | 57.54 | 57.28 | 58.14 | 61.80 | 4.52 | 0.13 | 0 | 0 | 0 | 0 | 0.13 | 1.17 | 0.75 | 1.00 | 0.36 | 1.00 | 1.47 | 0.15 | 0.06 | |
| Storm Water | 88 | 15 | - | - | 1.89 | 273.56 | 0.66 | 0.55 | 0.25% | 0.68 | 59.40 | Culvert-Outlet | - | 2.90 | - | 59.40 | 59.40 | No Pipe | 61.80 | 2.40 | 0.68 | 0 | 0 | 0 | 0 | 0.68 | 0.66 | - | - | - | - | - | - | - | |
| Storm Water | 89 | 24 | - | - | 5.26 | 175.22 | 0.91 | 0.81 | 0.25% | 0.44 | 58.40 | Direct | 0.06 | 3.76 | 0.01 | 58.42 | 58.20 | 59.12 | 61.80 | 3.60 | 0.44 | 0 | 0 | 0 | 0 | 0.44 | 0.91 | 0.82 | 1.00 | 0.31 | 1.15 | 1.46 | 0.15 | 0.06 | |
| Storm Water | 90 | 15 | - | - | 1.89 | 166.63 | 0.65 | 0.55 | 0.25% | 0.42 | 59.40 | Culvert-Outlet | - | 2.91 | - | 59.40 | 59.40 | No Pipe | 61.80 | 2.40 | 0.42 | 0 | 0 | 0 | 0 | 0.42 | 0.65 | - | - | - | - | - | - | - | |
| Storm Water | 91 | 15 | - | - | 1.89 | 156.67 | 0.65 | 0.55 | 0.25% | 0.39 | 59.40 | Culvert-Outlet | - | 2.90 | - | 59.40 | 59.40 | No Pipe | 61.80 | 2.40 | 0.39 | 0 | 0 | 0 | 0 | 0.39 | 0.65 | - | - | - | - | - | - | - | |
| Storm Water | 92 | 15 | - | - | 2.31 | 157.08 | 0.74 | 0.61 | 0.25% | 0.39 | 59.51 | Culvert-Outlet | - | 3.04 | - | 59.51 | 59.51 | No Pipe | 61.80 | 2.29 | 0.39 | 0 | 0 | 0 | 0 | 0.39 | 0.74 | - | - | - | - | - | - | - | |
| Storm Water | 213 | 30 | - | - | 16.16 | 224.25 | 1.58 | 1.36 | 0.25% | 0.56 | 38.48 | Direct | 0.01 | 4.93 | 0.00 | 38.48 | 38.11 | 39.07 | 43.00 | 4.89 | 0.56 | 0 | 0 | 0 | 0 | 0.56 | 1.58 | 0.23 | 1.00 | 0.38 | 1.00 | 1.00 | 0.15 | 0.01 | |
| Storm Water | 214 | 30 | - | - | 13.47 | 210.00 | 1.41 | 1.23 | 0.17% | 0.36 | 38.85 | Direct | 0.02 | 4.72 | 0.01 | 38.85 | 38.50 | 39.64 | 43.00 | 4.50 | 0.36 | 0 | 0 | 0 | 0 | 0.36 | 1.41 | 0.23 | 1.00 | 0.35 | 1.00 | 1.48 | 0.15 | 0.02 | |
| Storm Water | 215 | 30 | - | - | 10.51 | 210.00 | 1.21 | 1.08 | 0.16% | 0.33 | 39.18 | Direct | 0.02 | 4.45 | 0.00 | 39.18 | 38.88 | 40.06 | 43.00 | 4.12 | 0.33 | 0 | 0 | 0 | 0 | 0.33 | 1.21 | 0.23 | 1.00 | 0.32 | 1.00 | 1.38 | 0.15 | 0.02 | |
| Storm Water | 216 | 24 | - | - | 7.32 | 210.00 | 1.12 | 0.96 | 0.25% | 0.52 | 39.95 | Direct | 0.02 | 4.06 | 0.01 | 39.96 | 39.70 | 40.48 | 43.00 | 3.30 | 0.52 | 0 | 0 | 0 | 0 | 0.52 | 1.12 | 0.28 | 1.00 | 0.35 | 1.00 | 1.39 | 0.15 | 0.02 | |
| Storm Water | 217 | 18 | - | - | 3.85 | 210.00 | 0.91 | 0.75 | 0.25% | 0.52 | 40.68 | Culvert-Outlet | - | 3.45 | - | 40.68 | 40.68 | No Pipe | 43.00 | 2.32 | 0.52 | 0 | 0 | 0 | 0 | 0.52 | 0.91 | - | - | - | - | - | - | - | |
| Storm Water | 95 | 24 | - | - | 18.86 | 102.93 | 1.03 | 1.56 | 2.12% | 2.18 | 52.17 | Direct | 0.02 | 7.16 | 0.01 | 52.18 | 51.39 | 52.86 | 58.80 | 7.41 | 2.18 | 0 | 0 | 0 | 0 | 2.18 | 1.56 | 0.28 | 1.00 | 0.43 | 1.00 | 1.00 | 0.15 | 0.02 | |
| Storm Water | 96 | 36 | - | - | 19.95 | 153.24 | 1.60 | 1.43 | 0.08% | 0.12 | 49.13 | Direct | 0.01 | 3.75 | 0.00 | 49.14 | 48.92 | 49.63 | 51.80 | 2.88 | 0.12 | 0 | 0 | 0 | 0 | 0.12 | 2.11 | 0.23 | 1.00 | 0.41 | 1.00 | 1.00 | 0.15 | 0.01 | |
| Storm Water | 97 | 24 | - | - | 21.98 | 137.77 | 0.93 | 1.67 | 4.17% | 5.74 | 48.99 | Direct | 0.02 | 7.82 | 0.02 | 49.02 | 48.07 | 49.42 | 51.80 | 3.73 | 5.74 | 0 | 0 | 0 | 0 | 5.74 | 1.67 | 0.28 | 1.00 | 0.45 | 1.17 | 1.00 | 0.15 | 0.02 | |
| Storm Water | 98 | 36 | - | - | 25.34 | 77.26 | 1.70 | 1.62 | 0.29% | 0.22 | 42.08 | Direct | 0.03 | 6.12 | 0.02 | 42.10 | 41.52 | 42.63 | 44.80 | 3.28 | 0.22 | 0 | 0 | 0 | 0 | 0.22 | 1.70 | 0.47 | 1.00 | 0.36 | 1.14 | 1.00 | 0.15 | 0.03 | |
| Storm Water | 99 | 36 | - | - | 25.38 | 51.23 | 1.84 | 1.63 | 0.25% | 0.13 | 41.83 | Direct | 0.08 | 5.57 | 0.04 | 41.86 | 41.38 | 42.55 | 44.80 | 3.42 | 0.13 | 0 | 0 | 0 | 0 | 0.13 | 1.84 | 1.40 | 1.00 | 0.37 | 1.00 | 1.00 | 0.15 | 0.08 | |
| Storm Water | 100 | 15 | - | - | 1.62 | 173.20 | 0.60 | 0.51 | 0.22% | 0.38 | 56.33 | Culvert-Outlet | - | 2.79 | - | 56.33 | 56.33 | No Pipe | 58.80 | 2.47 | 0.38 | 0 | 0 | 0 | 0 | 0.38 | 0.60 | - | - | - | - | - | - | - | |
| Storm Water | 101 | 18 | - | - | 3.10 | 147.42 | 0.79 | 0.67 | 0.22% | 0.32 | 55.88 | Direct | 0.10 | 3.29 | 0.02 | 55.89 | 55.72 | 56.37 | 58.80 | 3.08 | 0.32 | 0 | 0 | 0 | 0 | 0.32 | 0.79 | 1.16 | 1.00 | 0.34 | 1.00 | 1.65 | 0.15 | 0.10 | |
| Storm Water | 102 | 15 | - | - | 1.62 | 75.50 | 0.37 | 0.51 | 1.48% | 1.12 | 50.34 | Culvert-Outlet | - | 3.49 | - | 50.34 | 50.34 | No Pipe | 52.80 | 2.46 | 1.12 | 0 | 0 | 0 | 0 | 1.12 | 0.51 | - | - | - | - | - | - | - | |
| Storm Water | 103 | 15 | - | - | 1.62 | 263.90 | 0.35 | 0.51 | 1.63% | 4.31 | 52.54 | Culvert-Outlet | - | 3.49 | - | 52.54 | 52.54 | No Pipe | 55.00 | 2.46 | 4.31 | 0 | 0 | 0 | 0 | 4.31 | 0.51 | - | - | - | - | - | - | - | |
| Storm Water | 104 | 15 | - | - | 3.16 | 171.63 | 0.42 | 0.72 | 3.29% | 5.65 | 48.09 | Direct | 0.16 | 4.35 | 0.05 | 48.14 | 47.84 | 48.38 | 50.50 | 2.66 | 5.65 | 0 | 0 | 0 | 0 | 5.65 | 0.72 | 1.69 | 1.00 | 0.36 | 1.00 | 1.74 | 0.15 | 0.16 | |
| Storm Water | 105 | 24 | - | - | 0.00 | 68.19 | 0.00 | 0.00 | 0.25% | 0.17 | 27.50 | Culvert-Outlet | - | 0.12 | - | 27.50 | 27.50 | No Pipe | 31.50 | 4.00 | 0.17 | 0 | 0 | 0 | 0 | 0.17 | 0.00 | - | - | - | - | - | - | - | |
| Storm Water | 108 | 48 | - | - | 45.47 | 60.75 | 2.21 | 2.02 | 0.25% | 0.15 | 33.66 | Culvert-Outlet | - | 6.40 | - | 33.66 | 33.66 | No Pipe | FREE | 8.34 | 0.15 | 0 | 0 | 0 | 0 | 0.15 | 2.21 | - | - | - | - | - | - | - | |
| Storm Water | 109 | 48 | - | - | 45.22 | 76.34 | 2.19 | 2.01 | 0.25% | 0.19 | 27.15 | Culvert-Outlet | - | 6.41 | - | 27.15 | 27.15 | 34.35 | 42.00 | 14.85 | 0.19 | 0 | 0 | 0 | 0 | 0.19 | 2.19 | - | - | - | - | - | - | - | |
| Storm Water | 111 | 48 | - | - | 49.10 | 232.79 | 2.31 | 2.10 | 0.25% | 0.58 | 33.80 | Culvert-Outlet | - | 6.54 | - | 33.80 | 33.80 | No Pipe | FREE | 12.20 | 0.58 | 0 | 0 | 0 | 0 | 0.58 | 2.31 | - | - | - | - | - | - | - | |
| Storm Water | 113 | 15 | - | - | 0.61 | 21.76 | 0.36 | 0.31 | 0.23% | 0.05 | 32.01 | Culvert-Outlet | - | 2.08 | - | 32.01 | 32.01 | No Pipe | 34.80 | 2.79 | 0.05 | 0 | 0 | 0 | 0 | 0.05 | 0.36 | - | - | - | - | - | - | - | |
| Storm Water | 114 | 15 | - | - | 0.61 | 45.77 | 0.36 | 0.30 | 0.24% | 0.11 | 31.88 | Direct | 0.06 | 2.11 | 0.00 | 31.88 | 31.81 | 32.75 | 36.00 | 4.19 | 0.11 | 0 | 0 | 0 | 0 | 0.11 | 0.36 | 1.70 | 1.00 | 0.24 | 1.00 | 1.00 | 0.15 | 0.06 | |
| Storm Water | 115 | 15 | - | - | 0.60 | 77.99 | 0.16 | 0.30 | 6.62% | 5.16 | 31.70 | Direct | 0.05 | 2.62 | 0.01 | 31.71 | 31.60 | 32.59 | 36.00 | 4.40 | 5.16 | 0 | 0 | 0 | 0 | 5.16 | 0.30 | 1.70 | 1.00 | 0.21 | 1.00 | 1.00 | 0.15 | 0.05 | |
| Storm Water | 116 | 15 | - | - | 1.78 | 53.11 | 0.64 | 0.53 | 0.06% | 0.03 | 16.18 | Direct | 0.76 | 1.86 | 0.04 | 16.23 | 16.17 | 16.52 | 29.50 | 13.33 | 0.03 | 0 | 0 | 0 | 0 | 0.03 | 0.91 | 0.36 | 1.00 | 0.41 | 1.73 | 19.54 | 0.15 | 0.76 | |
| Storm Water | 117 | 18 | - | - | 3.66 | 146.38 | 0.87 | 0.73 | 0.25% | 0.37 | 15.94 | Direct | 1.13 | 3.43 | 0.21 | 16.15 | 15.97 | 16.34 | 27.50 | 11.53 | 0.37 | 0 | 0 | 0 | 0 | 0.37 | 0.87 | 1.65 | 1.00 | 0.36 | 1.00 | 12.58 | 0.15 | 1.13 | |
| Storm Water | 118 | 24 | - | - | 5.36 | 10.00 | 0.99 | 0.82 | 0.20% | 0.02 | 15.29 | Direct | 0.01 | 3.47 | 0.00 | 15.30 | 15.11 | 16.02 | 18.30 | 3.19 | 0.02 | 0 | 0 | 0 | 0 | 0.02 | 0.99 | 0.20 | 1.00 | 0.33 | 1.00 | 1.00 | 0.15 | 0.01 | |
| Storm Water | 120 | 24 | - | - | 5.34 | 30.47 | 0.91 | 0.82 | 0.26% | 0.08 | 13.05 | Culvert-Outlet | - | 3.84 | - | 13.05 | 13.05 | No Pipe | FREE | 6.95 | 0.08 | 0 | 0 | 0 | 0 | 0.08 | 0.91 | - | - | - | - | - | - | - | |
| Storm Water | 121 | 15 | - | - | 0.61 | 112.08 | 0.35 | 0.31 | 0.01% | 0.01 | 16.24 | Culvert-Outlet | - | 0.91 | - | 16.24 | 16.24 | No Pipe | 18.80 | 2.56 | 0.01 | 0 | 0 | 0 | 0 | 0.01 | 0.67 | - | - | - | - | - | - | - | |
| Storm Water | 122 | 24 | - | - | 8.50 | 187.93 | 1.23 | 1.04 | 0.25% | 0.47 | 39.35 | Direct | 0.05 | 4.21 | 0.01 | 39.37 | 39.09 | 39.90 | 44.50 | 5.41 | 0.47 | 0 | 0 | 0 | 0 | 0.47 | 1.23 | 0.94 | 1.00 | 0.37 | 1.00 | 1.00 | 0.15 | 0.05 | |
| Storm Water | 123 | 24 | - | - | 8.26 | 60.93 | 1.21 | 1.02 | 0.25% | 0.15 | 38.81 | Direct | 0.09 | 4.16 | 0.02 | 38.83 | 38.56 | 39.38 | 44.50 | 5.94 | 0.15 | 0 | 0 | 0 | 0 | 0.15 | 1.21 | 1.64 | 1.00 | 0.37 | 1.00 | 1.00 | 0.15 | 0.09 | |
| Storm Water | 124 | 48 | - | - | 49.27 | 44.00 | 2.31 | 2.11 | 0.25% | 0.11 | 38.22 | Direct | 0.04 | 6.55 | 0.03 | 38.24 | 37.58 | 39.24 | 46.00 | 8.42 | 0.11 | 0 | 0 | 0 | 0 | 0.11 | 2.31 | 0.74 | 1.00 | 0.36 | 1.03 | 1.00 | 0.15 | 0.04 | |
| Storm Water | 55A | 15 | - | - | 0.00 | 7.50 | 0.01 | 0.00 | 0.20% | 0.02 | 9.13 | Culvert-Outlet | - | 0.12 | - | 9.13 | 9.13 | No Pipe | FREE | 2.37 | 0.02 | 0 | 0 | 0 | 0 | 0.02 | 0.01 | - | - | - | - | - | - | - | |
| Storm Water | 126 | 30 | - | - | 14.24 | 10.25 | 1.38 | 1.27 | 0.29% | 0.03 | 8.49 | Culvert-Outlet | - | 5.10 | - | 8.49 | 8.49 | No Pipe | 11.00 | 2.51 | 0.03 | 0 | 0 | 0 | 0 | 0.03 | 1.38 | - | - | - | - | - | - | - | |
| Storm Water | 130 | 24 | - | - | 9.36 | 96.36 | 1.31 | 1.09 | 0.25% | 0.24 | 61.74 | Culvert-Outlet | - | 4.29 | - | 61.74 | 61.74 | No Pipe | FREE | 1.26 | 0.24 | 0 | 0 | 0 | 0 | 0.24 | 1.31 | - | - | - | - | - | - | - | |
| Storm Water | 132 | 15 | - | - | 0.00 | 181.66 | 0.01 | 0.00 | 0.00% | 0.01 | 10.02 | Culvert-Outlet | - | 0.03 | - | 10.02 | 10.02 | No Pipe | FREE | 9.98 | 0.01 | 0 | 0 | 0 | 0 | 0.01 | 0.01 | - | - | - | - | - | - | - | |
| Storm Water | 134 | 24 | - | - | 0.00 | 234.65 | 0.00 | 0.00 | 0.25% | 0.59 | 27.00 | Culvert-Outlet | - | 0.12 | - | 27.00 | 27.00 | No Pipe | 31.00 | 4.00 | 0.59 | 0 | 0 | 0 | 0 | 0.59 | 0.00 | - | - | - | - | - | - | - | |
| Storm Water | 135 | 24 | - | - | 0.00 | 69.49 | 0.00 | 0.00 | 0.24% | 0.17 | 26.36 | Culvert-Outlet | - | 0.12 | - | 26.36 | 26.36 | 28.41 | 34.50 | 8.14 | 0.17 | 0 | 0 | 0 | 0 | 0.17 | 0.00 | - | - | - | - | - | - | - | |
| Storm Water | B | 15 | - | - | 0.62 | 14.98 | 0.35 | 0.31 | 0.27% | 0.04 | 12.54 | Culvert-Outlet | - | 2.20 | - | 12.54 | 12.54 | No Pipe | 15.00 | 2.46 | 0.04 | 0 | 0 | 0 | 0 | 0.04 | 0.35 | - | - | - | - | - | - | - | |
| Storm Water | C | 15 | - | - | 0.48 | 14.97 | 0.31 | 0.27 | 0.27% | 0.04 | 12.49 | Culvert-Outlet | - | 2.05 | - | 12.49 | 12.49 | No Pipe | 15.00 | 2.51 | 0.04 | 0 | 0 | 0 | 0 | 0.04 | 0.31 | - | - | - | - | - | - | - | |
| Storm Water | 140 | 24 | - | - | 4.43 | 249.00 | 0.83 | 0.74 | 0.17% | 0.42 | 58.59 | Direct | 0.08 | 3.58 | 0.02 | 58.61 | 58.41 | 59.41 | 61.80 | 3.39 | 0.42 | 0 | 0 | 0 | 0 | 0.42 | 0.83 | 1.54 | 1.00 | 0.30 | 1.00 | 1.16 | 0.15 | 0.08 | |
| Storm Water | 141 | 24 | - | - | 6.31 | 299.30 | 1.02 | 0.89 | 0.20% | 0.60 | 58.15 | Direct | 0.10 | 3.93 | 0.03 | 58.17 | 57.93 | 58.94 | 61.80 | 3.87 | 0.60 | 0 | 0 | 0 | 0 | 0.60 | 1.02 | 1.64 | 1.00 | 0.33 | 1.00 | 1.28 | 0.15 | 0.10 | |
| Storm Water | 142 | 42 | - | - | 30.86 | 170.14 | 1.88 | 1.72 | 0.08% | 0.14 | 59.19 | Culvert-Outlet | - | 5.40 | - | 59.19 | 59.19 | No Pipe | 62.00 | 2.81 | 0.14 | 0 | 0 | 0 | 0 | 0.14 | 2.01 | - | - | - | - | - | - | - | |
| Storm Water | 143 | 30 | - | - | 30.16 | 245.57 | 1.63 | 1.87 | 0.80% | 1.97 | 58.80 | Direct | 0.03 | 7.65 | 0.03 | 58.83 | 57.92 | 59.57 | 62.00 | 4.08 | 1.97 | 0 | 0 | 0 | 0 | 1.97 | 1.87 | 0.44 | 1.00 | 0.42 | 1.00 | 1.00 | 0.15 | 0.03 | |
| Oily Waste | 145 | 15 | - | - | 1.74 | 230.00 | 0.52 | 0.52 | 0.45% | 1.03 | 56.37 | Culvert-Outlet | - | 3.57 | - | 56.37 | 56.37 | No Pipe | 58.80 | 2.43 | 1.03 | 0 | 0 | 0 | 0 | 1.03 | 0.52 | - | - | - | - | - | - | - | |

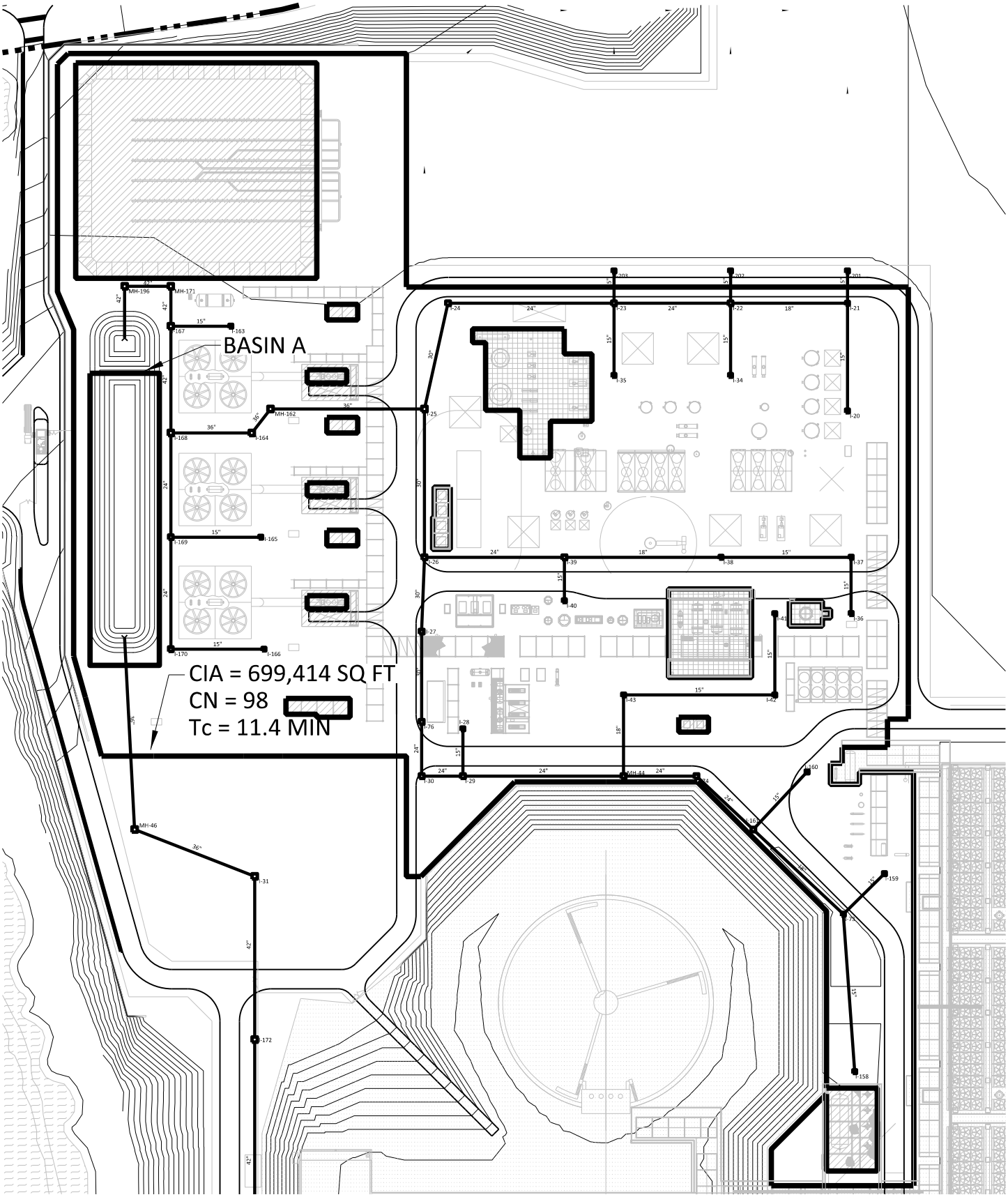
**Storm Drainage Systems HGL Calculations**

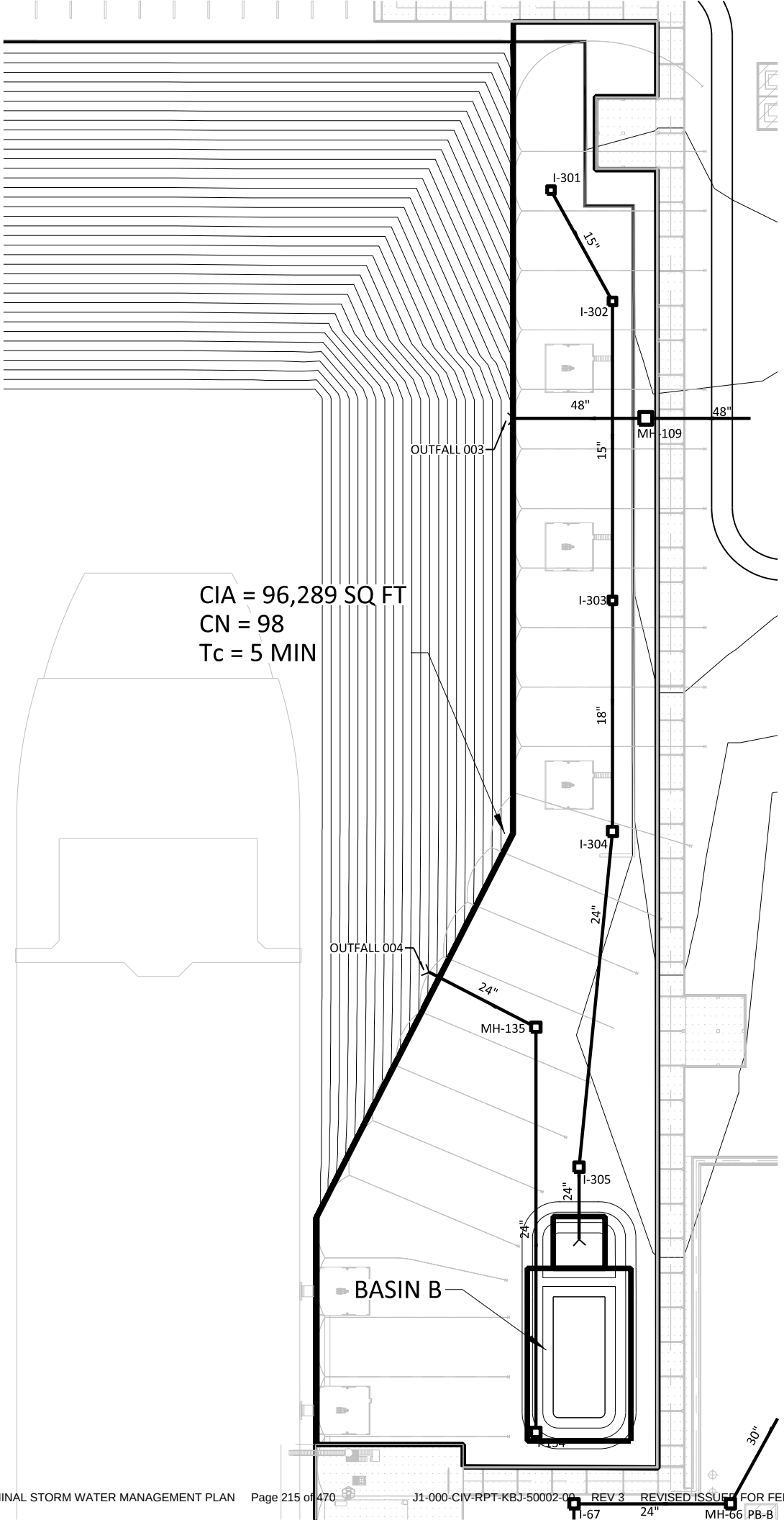
| System | Table A | | | | | | | | | | | | | | | | | | | | Table B | | | | | | | | | | | | | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | Pipe Losses (ft) | | | | | | Structure Losses (ft) | | | | | | | | |
| | Str. ID | NPS | Width (ft) | Height (ft) | Q (cfs) | L (ft) | $y_n$ (ft) | $y_c$ (ft) | $S_f$ (ft/ft) | Total Pipe Loss (Table B) | $EGL_o$ (ft) | Structure Head Loss Method | K (Table B) | $V_{pipe, U/S}$ (fps) | $KV^2/2g$ (ft) | $EGL_i$ (ft) | HGL (ft) | U/S TOC (ft) | Surf. Elev. (ft) | Freeboard (ft) | $H_f$ | $h_b$ | $H_c$ | $H_e$ | $H_j$ | Total | $d_{aho}$ | $K_o$ | $C_D$ | $C_d$ | $C_Q$ | $C_p$ | $C_B$ | K | |
| Oily Waste | 146 | 18 | - | - | 3.34 | 75.17 | 0.82 | 0.70 | 0.25% | 0.19 | 55.23 | Direct | 0.06 | 3.36 | 0.01 | 55.24 | 55.06 | 55.68 | 57.80 | 2.74 | 0.19 | 0 | 0 | 0 | 0 | 0.19 | 0.82 | 1.15 | 1.00 | 0.35 | 1.00 | 1.00 | 0.15 | 0.06 | |
| Oily Waste | 147 | 24 | - | - | 4.91 | 183.37 | 0.88 | 0.78 | 0.19% | 0.34 | 54.73 | Direct | 0.06 | 3.69 | 0.01 | 54.74 | 54.53 | 55.54 | 57.80 | 3.27 | 0.34 | 0 | 0 | 0 | 0 | 0.34 | 0.88 | 1.34 | 1.00 | 0.31 | 1.00 | 1.00 | 0.15 | 0.06 | |
| Oily Waste | 148 | 24 | - | - | 6.30 | 86.79 | 1.01 | 0.89 | 0.25% | 0.22 | 54.38 | Direct | 0.01 | 3.95 | 0.00 | 54.39 | 54.15 | 55.18 | 57.80 | 3.65 | 0.22 | 0 | 0 | 0 | 0 | 0.22 | 1.01 | 0.28 | 1.00 | 0.33 | 1.00 | 1.00 | 0.15 | 0.01 | |
| Oily Waste | 149 | 24 | - | - | 6.19 | 361.22 | 1.01 | 0.88 | 0.25% | 0.90 | 54.10 | Direct | 0.08 | 3.90 | 0.02 | 54.12 | 53.89 | 54.91 | 61.00 | 7.11 | 0.90 | 0 | 0 | 0 | 0 | 0.90 | 1.01 | 1.64 | 1.00 | 0.33 | 1.00 | 1.00 | 0.15 | 0.08 | |
| Storm Water | 150 | 24 | - | - | 0.00 | 62.68 | 0.00 | 0.00 | 0.26% | 0.16 | 27.28 | Culvert-Outlet | - | 0.12 | - | 27.28 | 27.28 | 29.33 | 34.50 | 7.22 | 0.16 | 0 | 0 | 0 | 0 | 0.16 | 0.00 | - | - | - | - | - | - | - | |
| Oily Waste | 151 | 24 | - | - | 5.70 | 271.06 | 0.96 | 0.84 | 0.22% | 0.58 | 53.10 | Direct | 0.01 | 3.83 | 0.00 | 53.10 | 52.87 | 53.96 | 60.00 | 7.13 | 0.58 | 0 | 0 | 0 | 0 | 0.58 | 0.96 | 0.28 | 1.00 | 0.32 | 1.00 | 1.00 | 0.15 | 0.01 | |
| Oily Waste | 152 | 18 | - | - | 5.37 | 295.79 | 1.09 | 0.89 | 0.29% | 0.85 | 52.51 | Direct | 0.02 | 3.89 | 0.00 | 52.51 | 52.28 | 53.23 | 60.00 | 7.72 | 0.85 | 0 | 0 | 0 | 0 | 0.85 | 1.09 | 0.30 | 1.00 | 0.41 | 1.00 | 1.00 | 0.15 | 0.02 | |
| Oily Waste | 153 | 15 | - | - | 5.16 | 380.66 | 0.64 | 0.92 | 2.01% | 7.65 | 51.64 | Direct | 0.02 | 5.32 | 0.01 | 51.65 | 51.21 | 51.83 | 54.00 | 2.79 | 7.65 | 0 | 0 | 0 | 0 | 7.65 | 0.92 | 0.36 | 1.00 | 0.42 | 1.00 | 1.00 | 0.15 | 0.02 | |
| Oily Waste | 154 | 18 | - | - | 5.05 | 33.28 | 1.02 | 0.86 | 0.30% | 0.10 | 43.69 | Direct | 0.10 | 3.93 | 0.02 | 43.72 | 43.48 | 43.88 | 46.00 | 2.52 | 0.10 | 0 | 0 | 0 | 0 | 0.10 | 1.02 | 1.65 | 1.00 | 0.40 | 1.00 | 1.00 | 0.15 | 0.10 | |
| Oily Waste | 155 | 24 | - | - | 5.03 | 40.25 | 0.89 | 0.79 | 0.25% | 0.10 | 43.04 | Direct | 0.08 | 3.70 | 0.02 | 43.05 | 42.84 | 43.83 | 46.00 | 3.16 | 0.10 | 0 | 0 | 0 | 0 | 0.10 | 0.89 | 1.64 | 1.00 | 0.31 | 1.00 | 1.00 | 0.15 | 0.08 | |
| Oily Waste | 156 | 24 | - | - | 5.00 | 25.45 | 0.90 | 0.79 | 0.24% | 0.06 | 42.89 | Direct | 0.01 | 3.62 | 0.00 | 42.89 | 42.69 | 43.83 | 46.00 | 3.31 | 0.06 | 0 | 0 | 0 | 0 | 0.06 | 0.90 | 0.28 | 1.00 | 0.31 | 1.00 | 1.00 | 0.15 | 0.01 | |
| Storm Water | 158 | 15 | - | - | 0.93 | 195.81 | 0.32 | 0.38 | 0.73% | 1.44 | 41.83 | Culvert-Outlet | - | 2.97 | - | 41.83 | 41.83 | No Pipe | 44.50 | 2.67 | 1.44 | 0 | 0 | 0 | 0 | 1.44 | 0.38 | - | - | - | - | - | - | - | |
| Storm Water | 159 | 15 | - | - | 0.93 | 71.56 | 0.25 | 0.38 | 2.01% | 1.44 | 41.83 | Culvert-Outlet | - | 2.97 | - | 41.83 | 41.83 | No Pipe | 44.50 | 2.67 | 1.44 | 0 | 0 | 0 | 0 | 1.44 | 0.38 | - | - | - | - | - | - | - | |
| Storm Water | 160 | 15 | - | - | 0.93 | 97.66 | 0.44 | 0.38 | 0.25% | 0.24 | 41.83 | Culvert-Outlet | - | 2.40 | - | 41.83 | 41.83 | No Pipe | 44.50 | 2.67 | 0.24 | 0 | 0 | 0 | 0 | 0.24 | 0.44 | - | - | - | - | - | - | - | |
| Storm Water | 161 | 24 | - | - | 4.37 | 96.78 | 0.83 | 0.73 | 0.11% | 0.10 | 39.67 | Direct | 0.04 | 3.56 | 0.01 | 39.68 | 39.48 | 40.55 | 44.50 | 5.02 | 0.10 | 0 | 0 | 0 | 0 | 0.10 | 0.83 | 0.28 | 1.00 | 0.29 | 1.48 | 1.98 | 0.15 | 0.04 | |
| Storm Water | 162 | 36 | - | - | 24.15 | 37.71 | 1.82 | 1.58 | 0.11% | 0.04 | 37.08 | Direct | 0.07 | 5.19 | 0.03 | 37.11 | 36.69 | 37.83 | 46.00 | 9.31 | 0.04 | 0 | 0 | 0 | 0 | 0.04 | 1.88 | 1.30 | 1.00 | 0.38 | 1.00 | 1.00 | 0.15 | 0.07 | |
| Storm Water | 163 | 15 | - | - | 2.36 | 74.49 | 0.75 | 0.62 | 0.26% | 0.19 | 42.22 | Culvert-Outlet | - | 3.09 | - | 42.22 | 42.22 | No Pipe | 44.50 | 2.28 | 0.19 | 0 | 0 | 0 | 0 | 0.19 | 0.75 | - | - | - | - | - | - | - | |
| Storm Water | 164 | 36 | - | - | 25.86 | 100.47 | 1.88 | 1.64 | 0.25% | 0.25 | 37.00 | Direct | 0.07 | 5.55 | 0.04 | 37.03 | 36.56 | 37.69 | 44.50 | 7.94 | 0.25 | 0 | 0 | 0 | 0 | 0.25 | 1.88 | 1.30 | 1.00 | 0.38 | 1.00 | 1.00 | 0.15 | 0.07 | |
| Storm Water | 165 | 15 | - | - | 2.36 | 111.64 | 0.75 | 0.62 | 0.25% | 0.28 | 42.22 | Culvert-Outlet | - | 3.07 | - | 42.22 | 42.22 | No Pipe | 44.50 | 2.28 | 0.28 | 0 | 0 | 0 | 0 | 0.28 | 0.75 | - | - | - | - | - | - | - | |
| Storm Water | 166 | 15 | - | - | 2.36 | 115.55 | 0.75 | 0.62 | 0.25% | 0.29 | 42.22 | Culvert-Outlet | - | 3.07 | - | 42.22 | 42.22 | No Pipe | 44.50 | 2.28 | 0.29 | 0 | 0 | 0 | 0 | 0.29 | 0.75 | - | - | - | - | - | - | - | |
| Storm Water | 167 | 42 | - | - | 37.66 | 49.45 | 2.16 | 1.91 | 0.24% | 0.12 | 36.34 | Direct | 0.01 | 6.04 | 0.01 | 36.34 | 35.78 | 37.16 | 44.50 | 8.72 | 0.12 | 0 | 0 | 0 | 0 | 0.12 | 2.16 | 0.19 | 1.00 | 0.37 | 1.16 | 1.00 | 0.15 | 0.01 | |
| Storm Water | 168 | 42 | - | - | 34.52 | 132.42 | 2.02 | 1.82 | 0.17% | 0.23 | 36.57 | Direct | 0.06 | 5.99 | 0.03 | 36.60 | 36.05 | 37.39 | 44.50 | 8.45 | 0.23 | 0 | 0 | 0 | 0 | 0.23 | 2.02 | 1.55 | 1.00 | 0.36 | 0.65 | 1.12 | 0.15 | 0.06 | |
| Storm Water | 169 | 24 | - | - | 8.92 | 129.17 | 1.27 | 1.07 | 0.25% | 0.32 | 41.51 | Direct | 0.04 | 4.24 | 0.01 | 41.52 | 41.24 | 42.01 | 44.50 | 3.26 | 0.32 | 0 | 0 | 0 | 0 | 0.32 | 1.27 | 0.28 | 1.00 | 0.38 | 1.58 | 1.40 | 0.15 | 0.04 | |
| Storm Water | 170 | 24 | - | - | 4.59 | 138.83 | 0.85 | 0.75 | 0.04% | 0.05 | 41.57 | Direct | 0.11 | 2.58 | 0.01 | 41.58 | 41.48 | 42.21 | 44.50 | 3.02 | 0.05 | 0 | 0 | 0 | 0 | 0.05 | 1.10 | 1.64 | 1.00 | 0.35 | 1.00 | 1.32 | 0.15 | 0.11 | |
| Storm Water | 171 | 42 | - | - | 37.51 | 57.20 | 2.15 | 1.90 | 0.24% | 0.14 | 36.16 | Direct | 0.09 | 6.06 | 0.05 | 36.21 | 35.64 | 36.99 | 44.50 | 8.86 | 0.14 | 0 | 0 | 0 | 0 | 0.14 | 2.15 | 1.55 | 1.00 | 0.37 | 1.00 | 1.00 | 0.15 | 0.09 | |
| Storm Water | 172 | 42 | - | - | 41.17 | 300.00 | 2.27 | 2.00 | 0.25% | 0.75 | 39.66 | Direct | 0.01 | 6.23 | 0.01 | 39.67 | 39.07 | 40.34 | 44.50 | 5.43 | 0.75 | 0 | 0 | 0 | 0 | 0.75 | 2.27 | 0.19 | 1.00 | 0.39 | 1.00 | 1.00 | 0.15 | 0.01 | |
| Storm Water | 173 | 24 | - | - | 5.31 | 127.59 | 0.92 | 0.81 | 0.25% | 0.32 | 12.81 | Direct | 0.08 | 3.77 | 0.02 | 12.83 | 12.61 | 13.72 | 20.00 | 7.39 | 0.32 | 0 | 0 | 0 | 0 | 0.32 | 0.92 | 1.64 | 1.00 | 0.31 | 1.00 | 1.00 | 0.15 | 0.08 | |
| Storm Water | 175 | 15 | - | - | 2.17 | 163.41 | 0.71 | 0.59 | 0.19% | 0.31 | 15.97 | Culvert-Outlet | - | 3.01 | - | 15.97 | 15.97 | No Pipe | 18.30 | 2.33 | 0.31 | 0 | 0 | 0 | 0 | 0.31 | 0.71 | - | - | - | - | - | - | - | |
| Storm Water | 176 | 18 | - | - | 4.16 | 65.54 | 0.96 | 0.78 | 0.24% | 0.16 | 15.59 | Direct | 0.03 | 3.48 | 0.01 | 15.59 | 15.41 | 15.89 | 18.30 | 2.89 | 0.16 | 0 | 0 | 0 | 0 | 0.16 | 0.96 | 0.30 | 1.00 | 0.38 | 1.00 | 1.59 | 0.15 | 0.03 | |
| Storm Water | 178 | 30 | - | - | 12.14 | 10.00 | 1.41 | 1.17 | 0.20% | 0.02 | 7.01 | Culvert-Outlet | - | 4.25 | - | 7.01 | 7.01 | No Pipe | FREE | 5.99 | 0.02 | 0 | 0 | 0 | 0 | 0.02 | 1.41 | - | - | - | - | - | - | - | |
| Storm Water | 179 | 24 | - | - | 8.01 | 93.33 | 1.18 | 1.01 | 0.25% | 0.23 | 12.01 | Direct | 0.09 | 4.13 | 0.02 | 12.03 | 11.77 | 12.61 | 20.00 | 8.23 | 0.23 | 0 | 0 | 0 | 0 | 0.23 | 1.18 | 1.64 | 1.00 | 0.37 | 1.00 | 1.00 | 0.15 | 0.09 | |
| Storm Water | 181 | 15 | - | - | 2.17 | 172.42 | 0.71 | 0.59 | 0.20% | 0.34 | 15.97 | Culvert-Outlet | - | 3.00 | - | 15.97 | 15.97 | No Pipe | 18.30 | 2.33 | 0.34 | 0 | 0 | 0 | 0 | 0.34 | 0.71 | - | - | - | - | - | - | - | |
| Storm Water | 182 | 18 | - | - | 4.15 | 115.24 | 0.95 | 0.78 | 0.25% | 0.29 | 15.56 | Direct | 0.03 | 3.52 | 0.01 | 15.57 | 15.37 | 15.87 | 18.30 | 2.93 | 0.29 | 0 | 0 | 0 | 0 | 0.29 | 0.95 | 0.30 | 1.00 | 0.38 | 1.00 | 1.61 | 0.15 | 0.03 | |
| Storm Water | 183 | 24 | - | - | 8.07 | 21.40 | 1.21 | 1.01 | 0.23% | 0.05 | 15.20 | Direct | 0.04 | 4.06 | 0.01 | 15.21 | 14.95 | 15.78 | 18.30 | 3.35 | 0.05 | 0 | 0 | 0 | 0 | 0.05 | 1.21 | 1.61 | 1.00 | 0.37 | 0.42 | 1.00 | 0.15 | 0.04 | |
| Storm Water | 183B | 24 | - | - | 8.03 | 10.00 | 1.27 | 1.01 | 0.20% | 0.02 | 12.24 | Culvert-Outlet | - | 3.81 | - | 12.24 | 12.24 | No Pipe | FREE | 7.76 | 0.02 | 0 | 0 | 0 | 0 | 0.02 | 1.27 | - | - | - | - | - | - | - | |
| Storm Water | 185 | 15 | - | - | 2.17 | 179.48 | 0.71 | 0.59 | 0.20% | 0.35 | 15.97 | Culvert-Outlet | - | 3.01 | - | 15.97 | 15.97 | No Pipe | 18.30 | 2.33 | 0.35 | 0 | 0 | 0 | 0 | 0.35 | 0.71 | - | - | - | - | - | - | - | |
| Storm Water | 186 | 18 | - | - | 4.14 | 85.39 | 0.95 | 0.78 | 0.25% | 0.21 | 15.54 | Direct | 0.03 | 3.49 | 0.01 | 15.55 | 15.36 | 15.85 | 18.30 | 2.94 | 0.21 | 0 | 0 | 0 | 0 | 0.21 | 0.95 | 0.30 | 1.00 | 0.38 | 1.00 | 1.61 | 0.15 | 0.03 | |
| Storm Water | 189 | 24 | - | - | 7.98 | 93.33 | 1.18 | 1.01 | 0.25% | 0.23 | 11.97 | Direct | 0.09 | 4.13 | 0.02 | 11.99 | 11.73 | 12.57 | 20.00 | 8.27 | 0.23 | 0 | 0 | 0 | 0 | 0.23 | 1.18 | 1.64 | 1.00 | 0.36 | 1.00 | 1.00 | 0.15 | 0.09 | |
| Storm Water | 191 | 15 | - | - | 2.17 | 187.09 | 0.71 | 0.59 | 0.20% | 0.38 | 15.97 | Culvert-Outlet | - | 3.01 | - | 15.97 | 15.97 | No Pipe | 18.30 | 2.33 | 0.38 | 0 | 0 | 0 | 0 | 0.38 | 0.71 | - | - | - | - | - | - | - | |
| Storm Water | 192 | 18 | - | - | 4.13 | 114.78 | 0.94 | 0.78 | 0.25% | 0.29 | 15.52 | Direct | 0.03 | 3.53 | 0.01 | 15.52 | 15.33 | 15.83 | 18.30 | 2.97 | 0.29 | 0 | 0 | 0 | 0 | 0.29 | 0.94 | 0.30 | 1.00 | 0.38 | 1.00 | 1.63 | 0.15 | 0.03 | |
| Storm Water | 193 | 24 | - | - | 8.04 | 21.32 | 1.21 | 1.01 | 0.23% | 0.05 | 15.15 | Direct | 0.04 | 4.06 | 0.01 | 15.16 | 14.91 | 15.69 | 18.30 | 3.39 | 0.05 | 0 | 0 | 0 | 0 | 0.05 | 1.21 | 1.61 | 1.00 | 0.37 | 0.42 | 1.00 | 0.15 | 0.04 | |
| Storm Water | 193B | 24 | - | - | 8.00 | 10.00 | 1.27 | 1.01 | 0.20% | 0.02 | 12.20 | Culvert-Outlet | - | 3.81 | - | 12.20 | 12.20 | No Pipe | FREE | 7.80 | 0.02 | 0 | 0 | 0 | 0 | 0.02 | 1.27 | - | - | - | - | - | - | - | |
| Storm Water | 195 | 30 | - | - | 14.16 | 197.84 | 1.45 | 1.27 | 0.25% | 0.49 | 6.60 | Culvert-Outlet | - | 4.78 | - | 6.60 | 6.60 | 8.86 | 13.00 | 6.40 | 0.49 | 0 | 0 | 0 | 0 | 0.49 | 1.45 | - | - | - | - | - | - | - | |
| Storm Water | 196 | 42 | - | - | 37.33 | 64.04 | 2.13 | 1.90 | 0.25% | 0.16 | 35.96 | Direct | 0.09 | 6.10 | 0.05 | 36.00 | 35.43 | 36.80 | 46.00 | 10.57 | 0.16 | 0 | 0 | 0 | 0 | 0.16 | 2.13 | 1.55 | 1.00 | 0.37 | 1.00 | 1.00 | 0.15 | 0.09 | |
| Storm Water | 198 | 30 | - | - | 13.60 | 36.64 | 1.42 | 1.24 | 0.25% | 0.09 | 5.84 | Direct | 0.07 | 4.72 | 0.02 | 5.86 | 5.51 | 6.62 | 13.00 | 7.49 | 0.09 | 0 | 0 | 0 | 0 | 0.09 | 1.42 | 1.22 | 1.00 | 0.36 | 1.00 | 1.00 | 0.15 | 0.07 | |
| Storm Water | 195A | 15 | - | - | 0.00 | 10.00 | 0.01 | 0.00 | 0.00% | 0.00 | 6.60 | Culvert-Outlet | - | 0.00 | - | 6.60 | 6.60 | No Pipe | FREE | 6.40 | 0.00 | 0 | 0 | 0 | 0 | 0.00 | 0.97 | - | - | - | - | - | - | - | |
| Storm Water | 300 | 30 | - | - | 12.11 | 132.34 | 1.32 | 1.17 | 0.25% | 0.33 | 6.76 | Direct | 0.08 | 4.62 | 0.03 | 6.79 | 6.45 | 7.66 | 13.00 | 6.55 | 0.33 | 0 | 0 | 0 | 0 | 0.33 | 1.32 | 1.58 | 1.00 | 0.34 | 1.00 | 1.00 | 0.15 | 0.08 | |
| Storm Water | 301 | 15 | - | - | 1.26 | 73.62 | 0.52 | 0.44 | 0.03% | 0.02 | 30.51 | Culvert-Outlet | - | 1.85 | - | 30.51 | 30.51 | No Pipe | 33.00 | 2.49 | 0.02 | 0 | 0 | 0 | 0 | 0.02 | 0.68 | - | - | - | - | - | - | - | |
| Storm Water | 302 | 15 | - | - | 2.47 | 173.20 | 0.78 | 0.63 | 0.25% | 0.43 | 30.44 | Direct | 0.10 | 3.08 | 0.01 | 30.46 | 30.31 | 30.82 | 33.00 | 2.69 | 0.43 | 0 | 0 | 0 | 0 | 0.43 | 0.78 | 1.01 | 1.00 | 0.38 | 1.00 | 1.76 | 0.15 | 0.10 | |
| Storm Water | 303 | 18 | - | - | 3.53 | 133.76 | 0.86 | 0.72 | 0.25% | 0.33 | 29.93 | Direct | 0.03 | 3.37 | 0.00 | 29.93 | 29.75 | 30.34 | 33.00 | 3.25 | 0.33 | 0 | 0 | 0 | 0 | 0.33 | 0.86 | 0.30 | 1.00 | 0.36 | 1.00 | 1.75 | 0.15 | 0.03 | |
| Storm Water | 304 | 24 | - | - | 4.55 | 195.36 | 0.84 | 0.75 | 0.21% | 0.42 | 29.21 | Direct | 0.03 | 3.62 | 0.01 | 29.21 | 29.01 | 30.06 | 33.00 | 3.99 | 0.42 | 0 | 0 | 0 | 0 | 0.42 | 0.84 | 0.42 | 1.00 | 0.30 | 1.00 | 1.58 | 0.15 | 0.03 | |
| Storm Water | 305 | 24 | - | - | 5.45 | 41.91 | 0.95 | 0.82 | 0.24% | 0.10 | 28.78 | Direct | 0.02 | 3.72 | 0.00 | 28.79 | 28.57 | 29.67 | 33.00 | 4.43 | 0.10 | 0 | 0 | 0 | 0 | 0.10 | 0.95 | 0.42 | 1.00 | 0.32 | 1.00 | 1.00 | 0.15 | 0.02 | |
| Storm Water | 307 | 18 | - | - | 3.44 | 72.05 | 0.84 | 0.71 | 0.19% | 0.14 | 33.44 | Culvert-Outlet | - | 3.39 | - | 33.44 | 33.44 | No Pipe | FREE | 2.56 | 0.14 | 0 | 0 | 0 | 0 | 0.14 | 0.84 | - | - | - | - | - | - | - | |
| Storm Water | 308 | 24 | - | - | 8.44 | 182.75 | 0.87 | 1.04 | 0.78% | 1.42 | 33.20 | Direct | 0.04 | 5.14 | 0.01 | 33.21 | 32.80 | 33.65 | 36.00 | 3.20 | 1.42 | 0 | 0 | 0 | 0 | 1.42 | 1.04 | 1.64 | 1.00 | 0.34 | 0.32 | 1.36 | 0.15 | 0.04 | |
| Storm Water | 309 | 36 | - | - | 0.00 | 63.99 | 0.00 | 0.00 | 0.25% | 0.16 | 57.00 | Culvert-Outlet | - | 0.12 | - | 57.00 | 57.00 | No Pipe | 62.00 | 5.00 | 0.16 | 0 | 0 | 0 | 0 | 0.16 | 0.00 | - | - | - | - | - | - | - | |
| Storm Water | 311 | 15 | - | - | 0.00 | 87.69 | 0.00 | 0.00 | 0.23% | 0.20 | 14.21 | Culvert-Outlet | - | 0.13 | - | 14.21 | 14.21 | No Pipe | FREE | 1.79 | 0.20 | 0 | 0 | 0 | 0 | 0.20 | 0.00 | - | - | - | - | - | - | - | |
| Storm Water | 313 | 15 | - | - | 0.00 | 87.69 | 0.00 | 0.00 | 0.23% | 0.20 | 14.21 | Culvert-Outlet | - | 0.13 | - | 14.21 | 14.21 | No Pipe | FREE | 1.79 | 0.20 | 0 | 0 | 0 | 0 | 0.20 | 0.00 | - | - | - | - | - | - | - | |

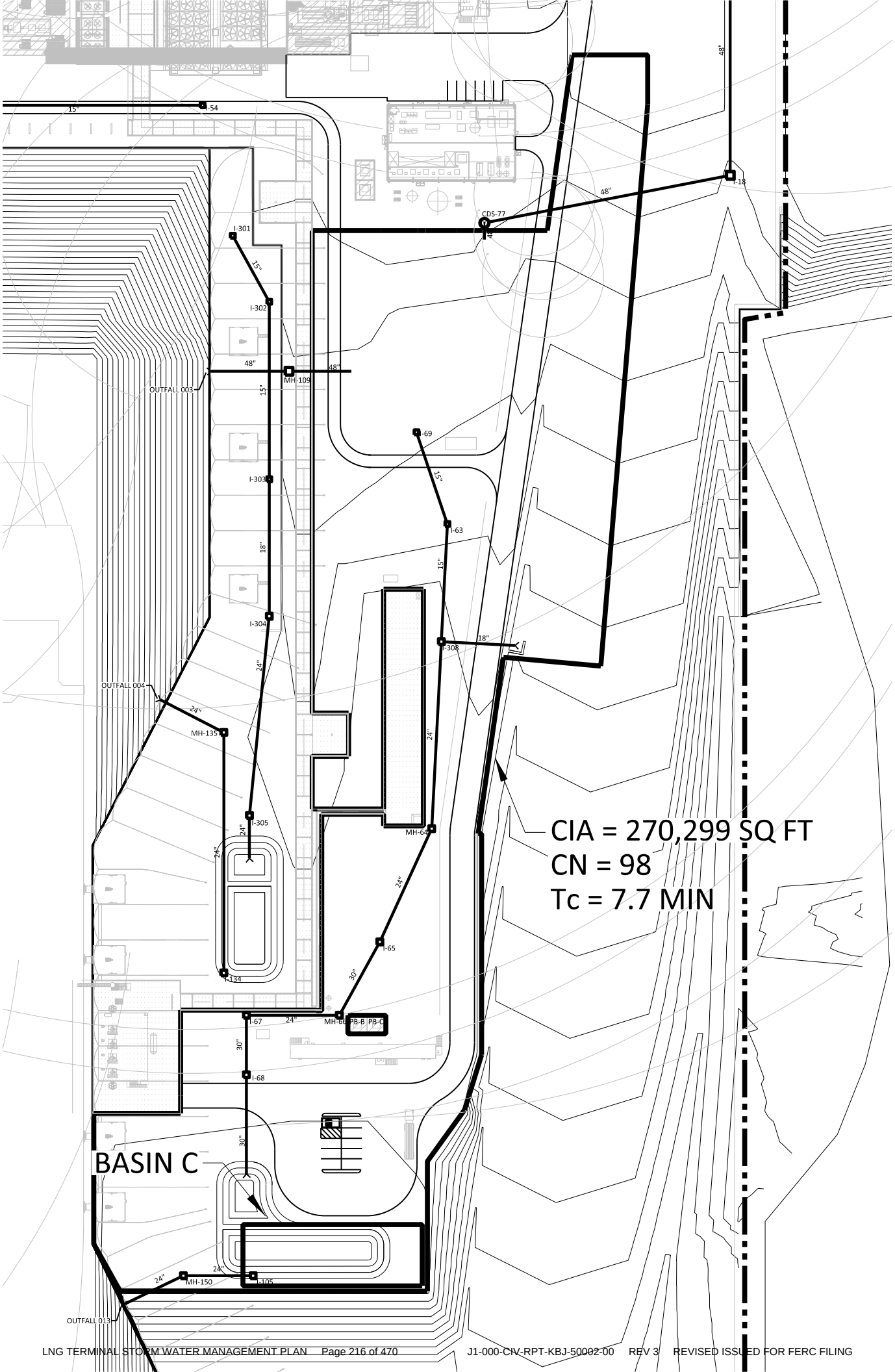
# Attachment K. Drainage Areas

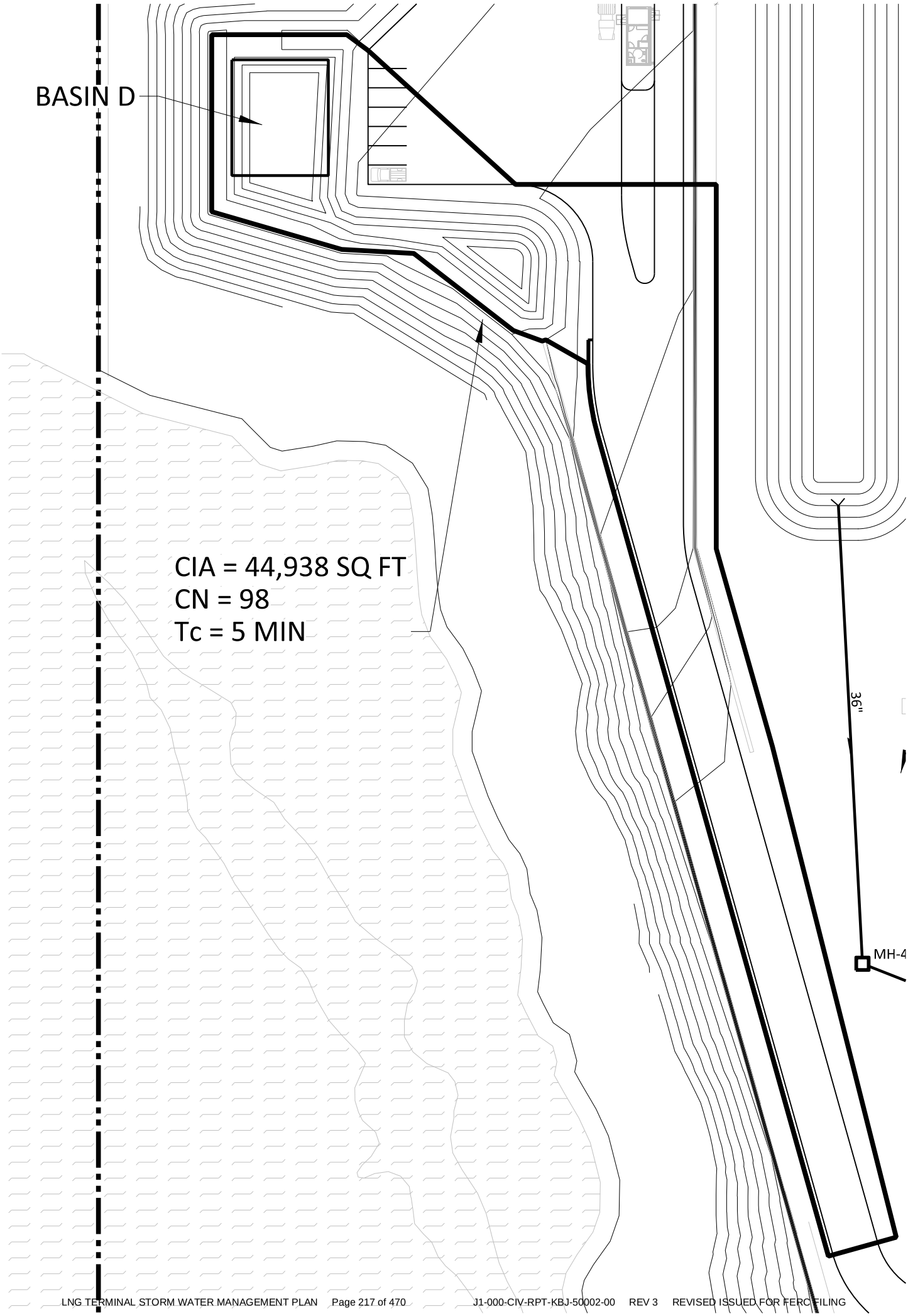

CIA = 342,355 SQ FT
CN = 98
TC = 9.3 MIN
CHAMBER A
MH-46
MH-44
MH-124
MH-115
MH-114
OUTFALL 002

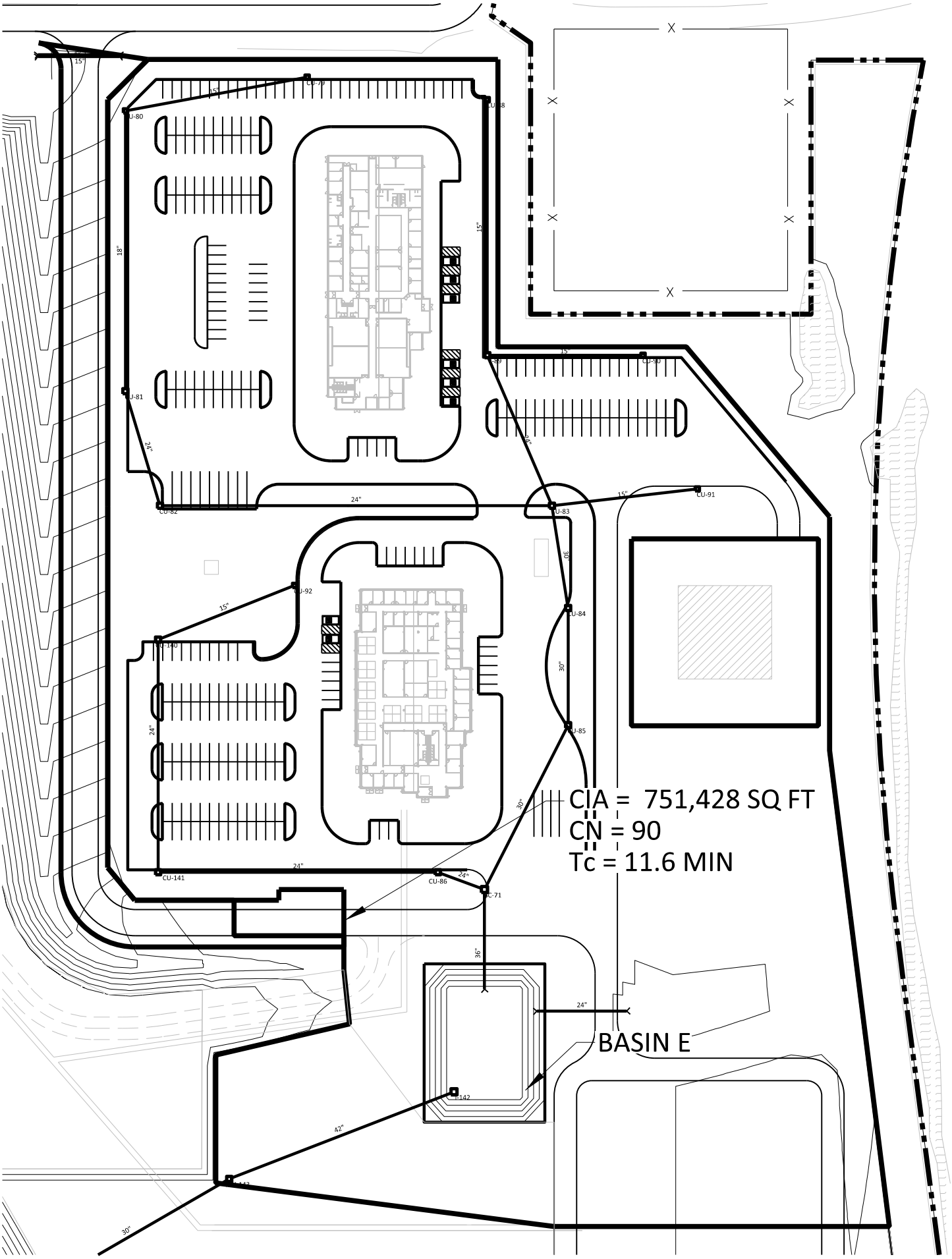

CIA = 1,103,375 SQ FT
CN = 98
TC = 17.2 MIN
CHAMBER B

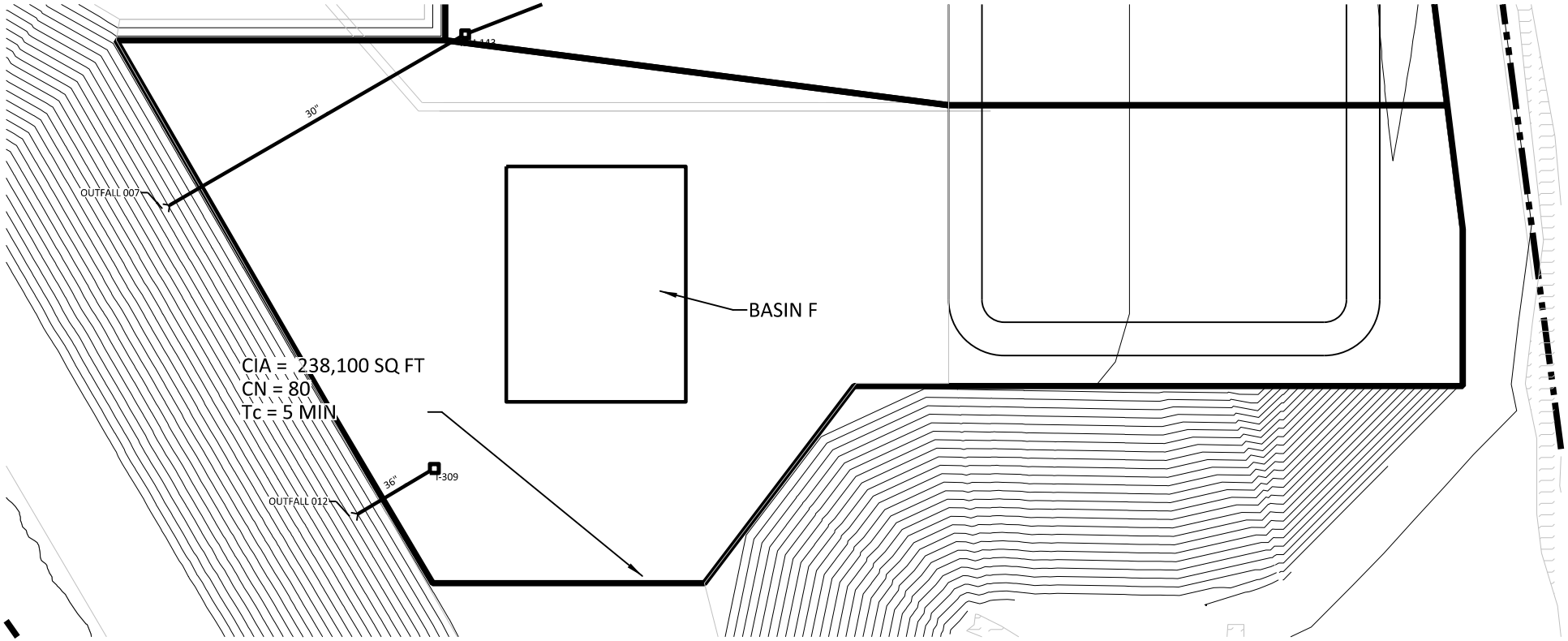

BASIN A
CIA = 699,414 SQ FT
CN = 98
Tc = 11.4 MIN

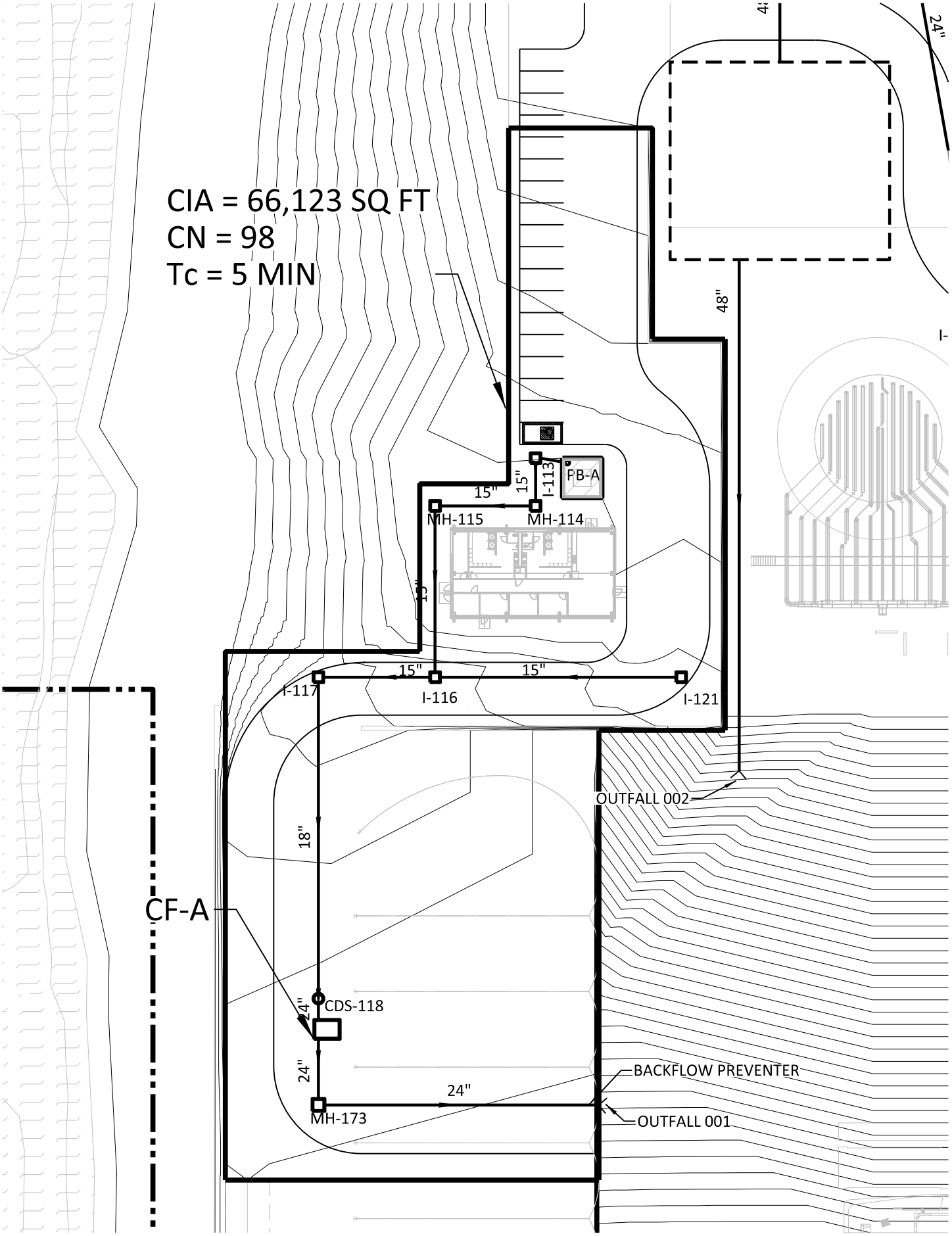

I-301
15"
I-302
48"
48"
MH-109
OUTFALL 003
15"
CIA = 96,289 SQ FT
CN = 98
Tc = 5 MIN
I-303
18"
I-304
24"
OUTFALL 004
24"
MH-135
I-305
24"
24"
BASIN B
30"
24"
I-67
MH-66
PB-B

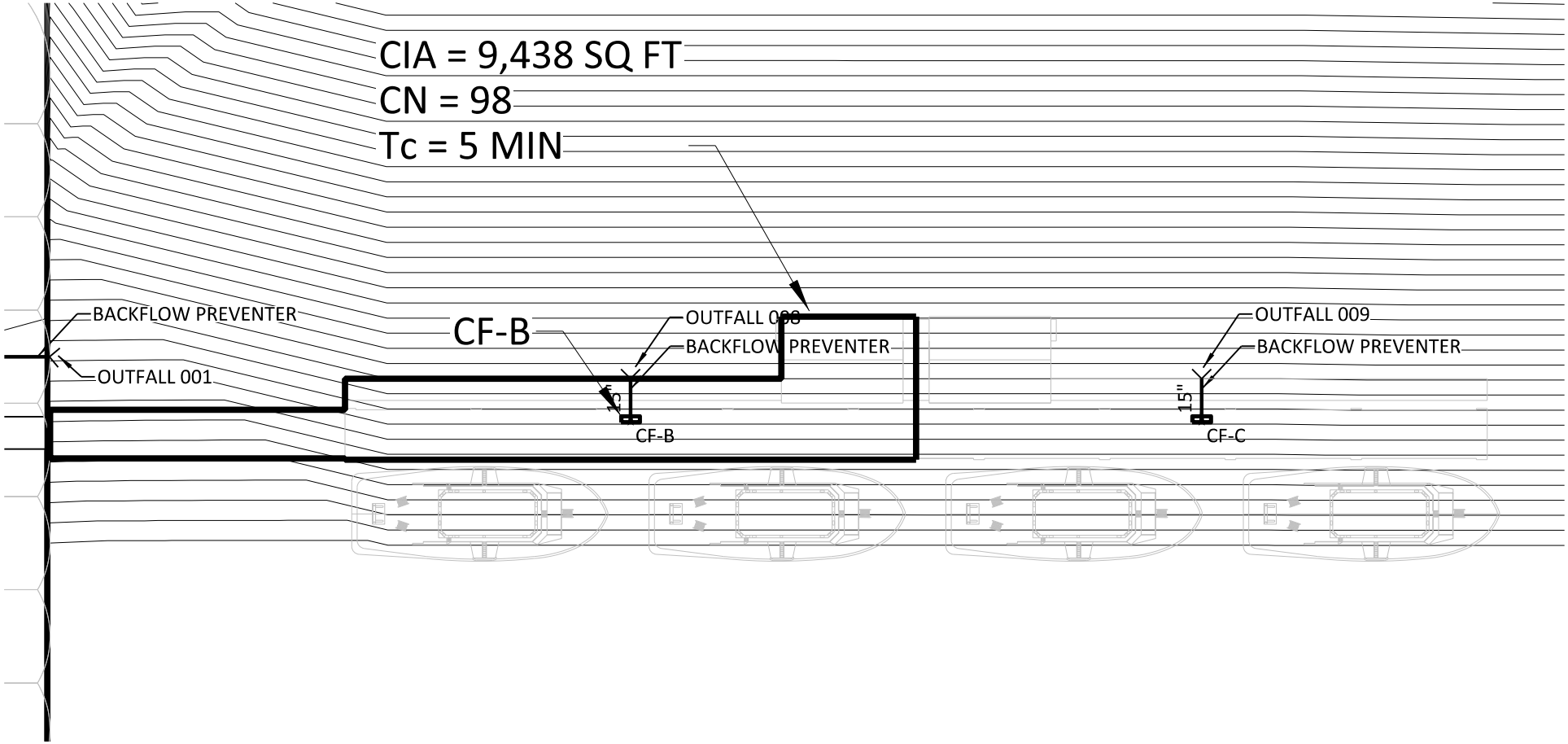

CIA = 270,299 SQ FT
CN = 98
Tc = 7.7 MIN
BASIN C
CDS-77
I-54
I-18
I-301
I-302
I-303
I-304
I-305
I-69
I-63
I-308
I-65
I-67
I-68
I-134
I-105
MH-109
MH-135
MH-64
MH-150
OUTFALL 003
OUTFALL 004
OUTFALL 013
PB-B
PB-C
15"
18"
24"
30"
48"

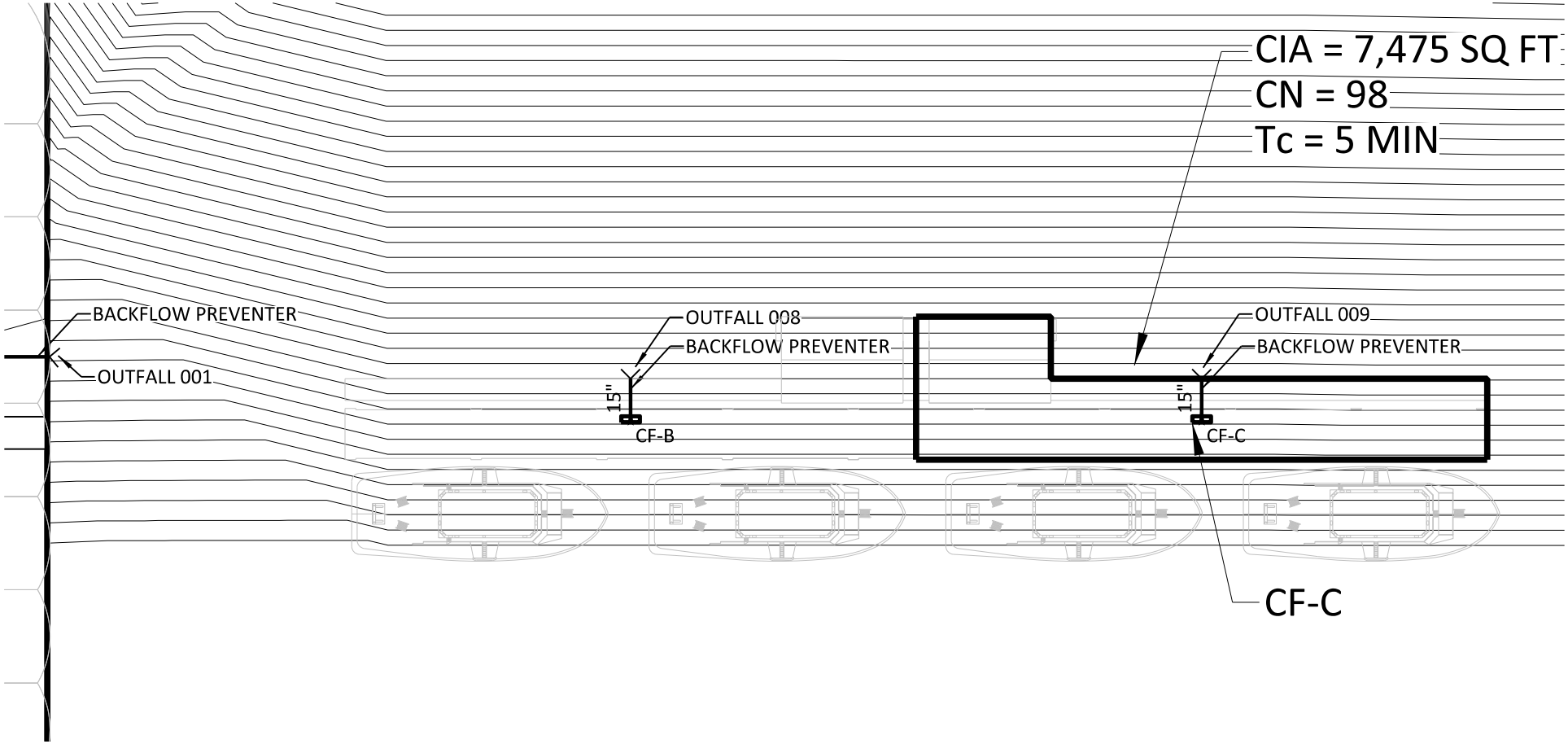

BASIN D
CIA = 44,938 SQ FT
CN = 98
Tc = 5 MIN
36"
MH-4

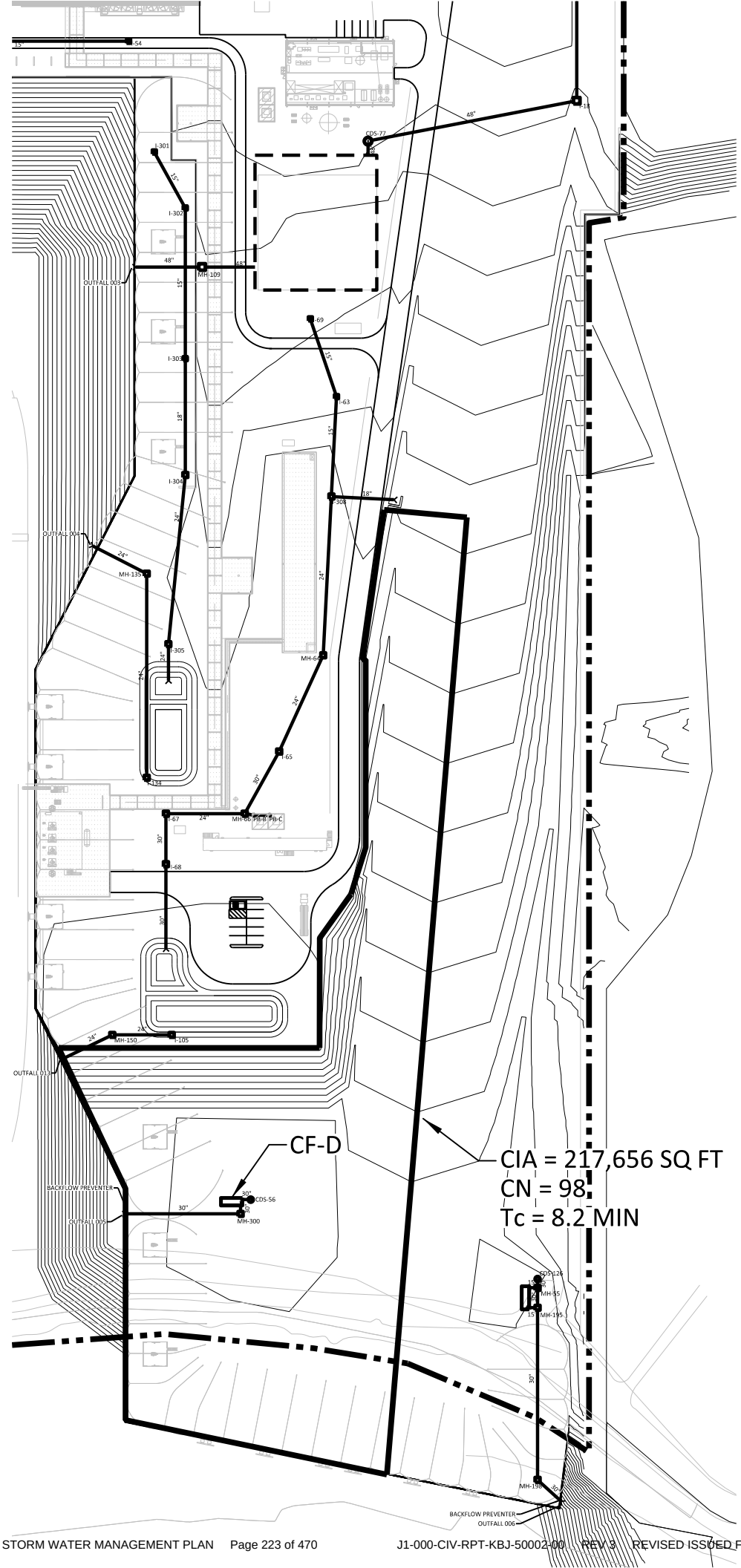

CIA = 751,428 SQ FT
CN = 90
Tc = 11.6 MIN
BASIN E
CU-79
CU-80
CU-81
CU-82
CU-83
CU-84
CU-85
CU-86
CU-88
CU-90
CU-91
CU-92
CU-140
CU-141
CU-71
15"
18"
24"
30"
36"
42"

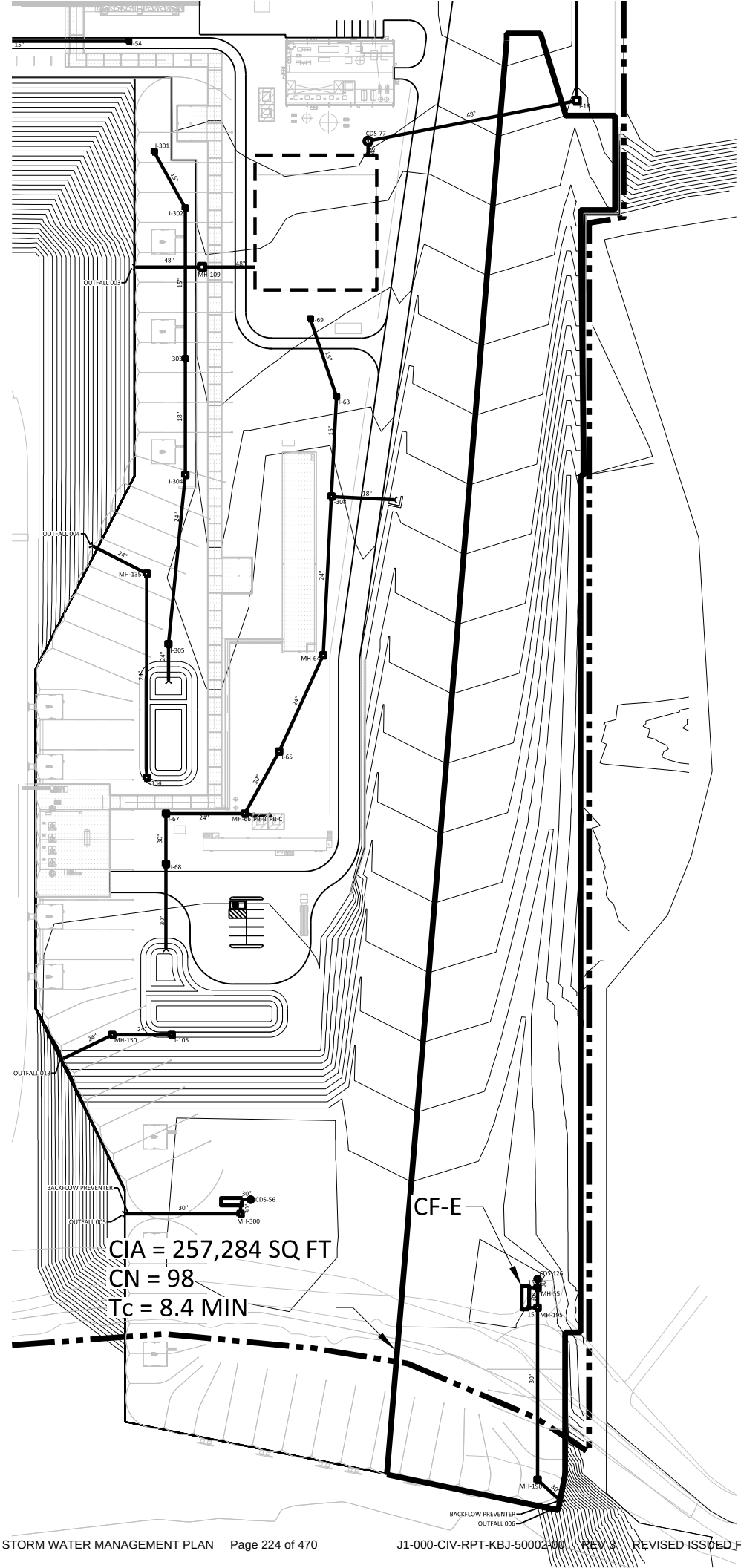

30"
OUTFALL 007
BASIN F
CIA = 238,100 SQ FT
CN = 80
Tc = 5 MIN
36"
I-309
OUTFALL 012

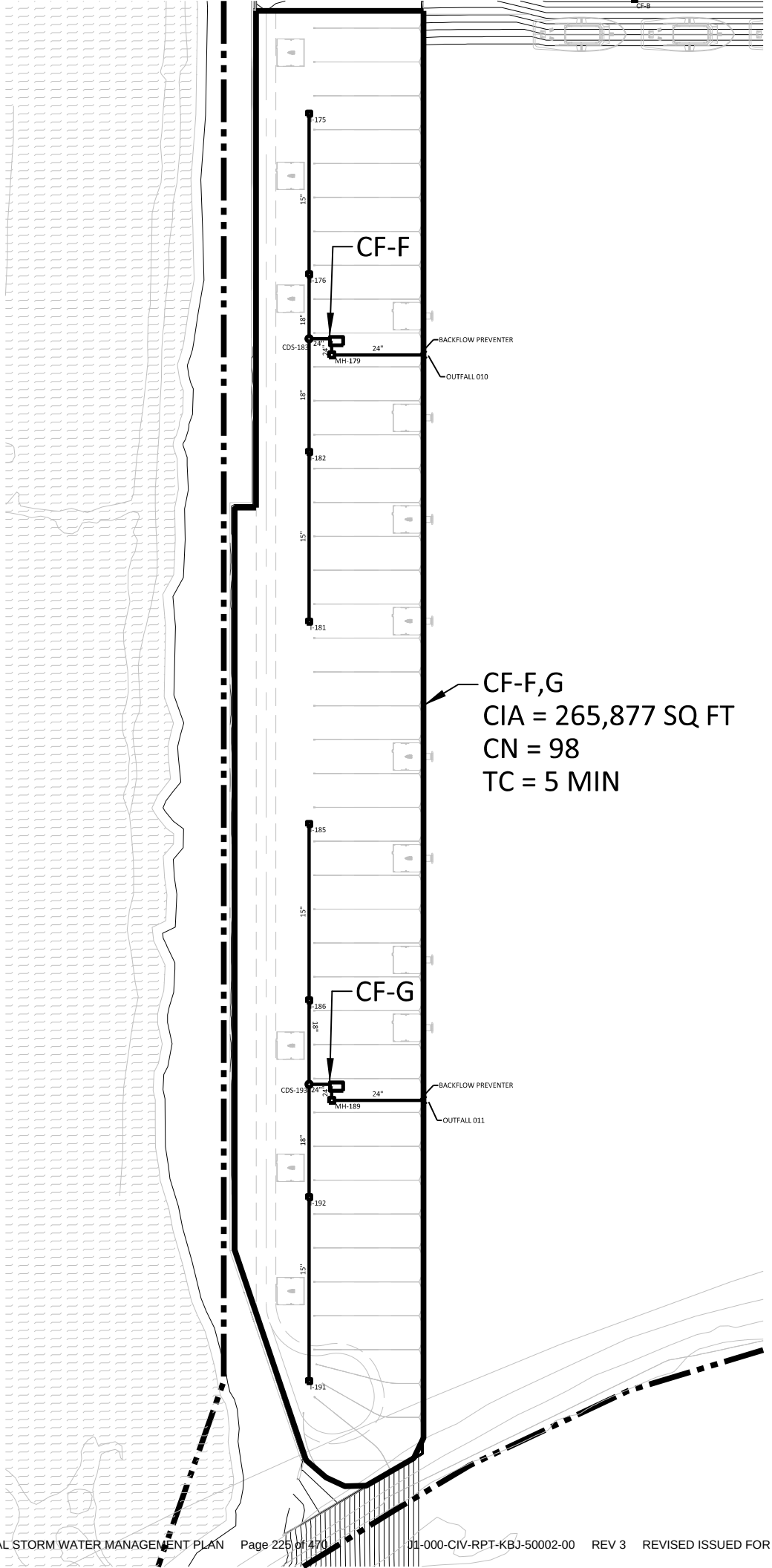

CIA = 66,123 SQ FT
CN = 98
Tc = 5 MIN
48"
24"
PB-A
I-113
15"
15"
MH-115
MH-114
15"
15"
15"
I-117
I-116
I-121
OUTFALL 002
18"
CF-A
24"
CDS-118
24"
24"
BACKFLOW PREVENTER
MH-173
OUTFALL 001

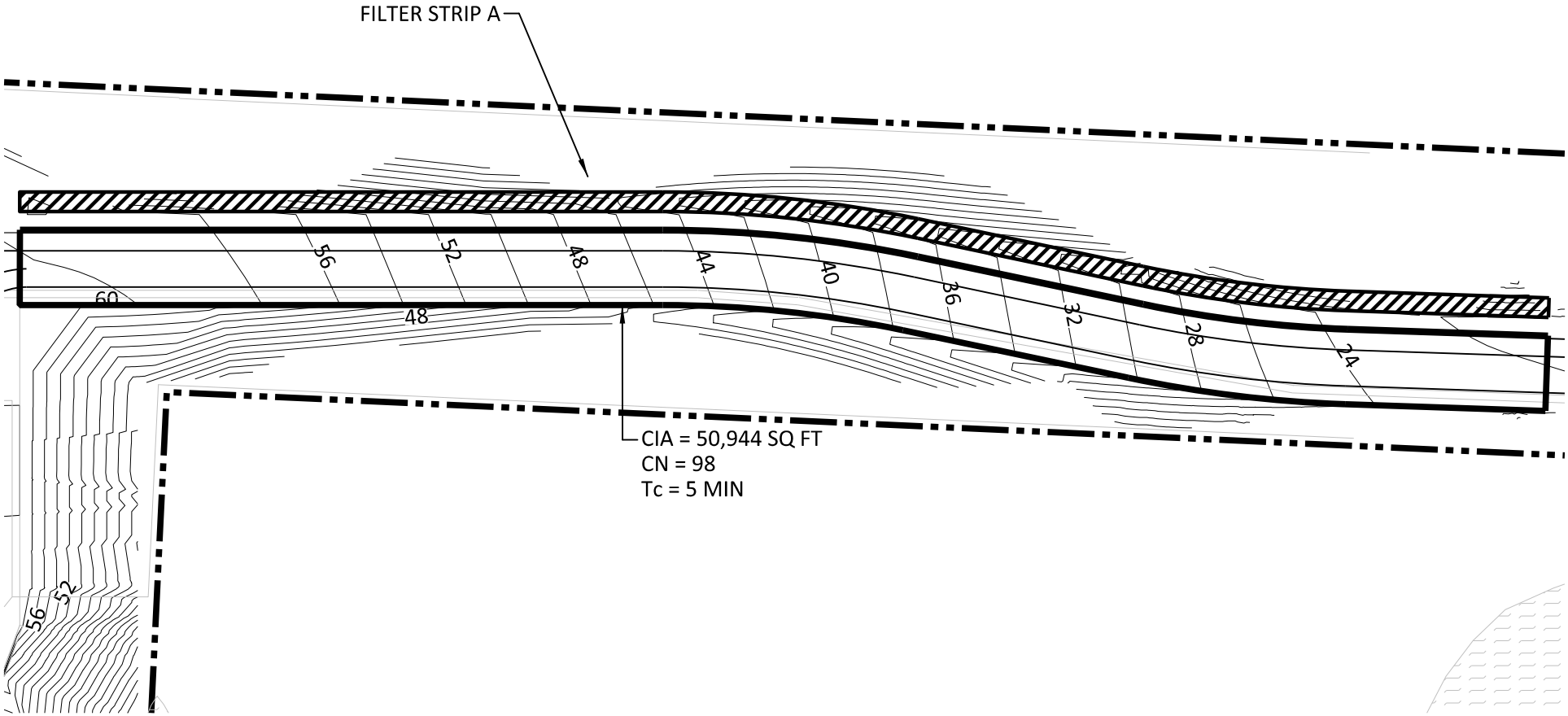

CIA = 9,438 SQ FT
CN = 98
Tc = 5 MIN
BACKFLOW PREVENTER
OUTFALL 001
CF-B
OUTFALL 008
BACKFLOW PREVENTER
15"
CF-B
OUTFALL 009
BACKFLOW PREVENTER
15"
CF-C

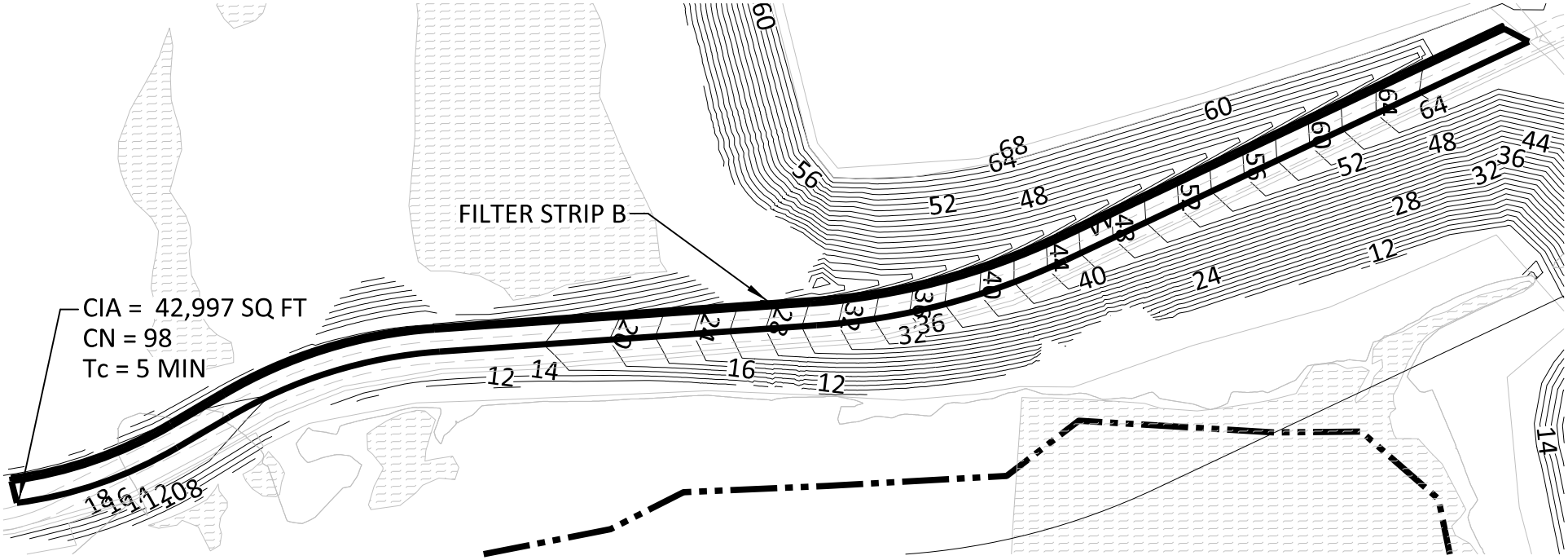

CIA = 7,475 SQ FT
CN = 98
Tc = 5 MIN
BACKFLOW PREVENTER
OUTFALL 001
OUTFALL 008
BACKFLOW PREVENTER
15"
CF-B
OUTFALL 009
BACKFLOW PREVENTER
15"
CF-C
CF-C

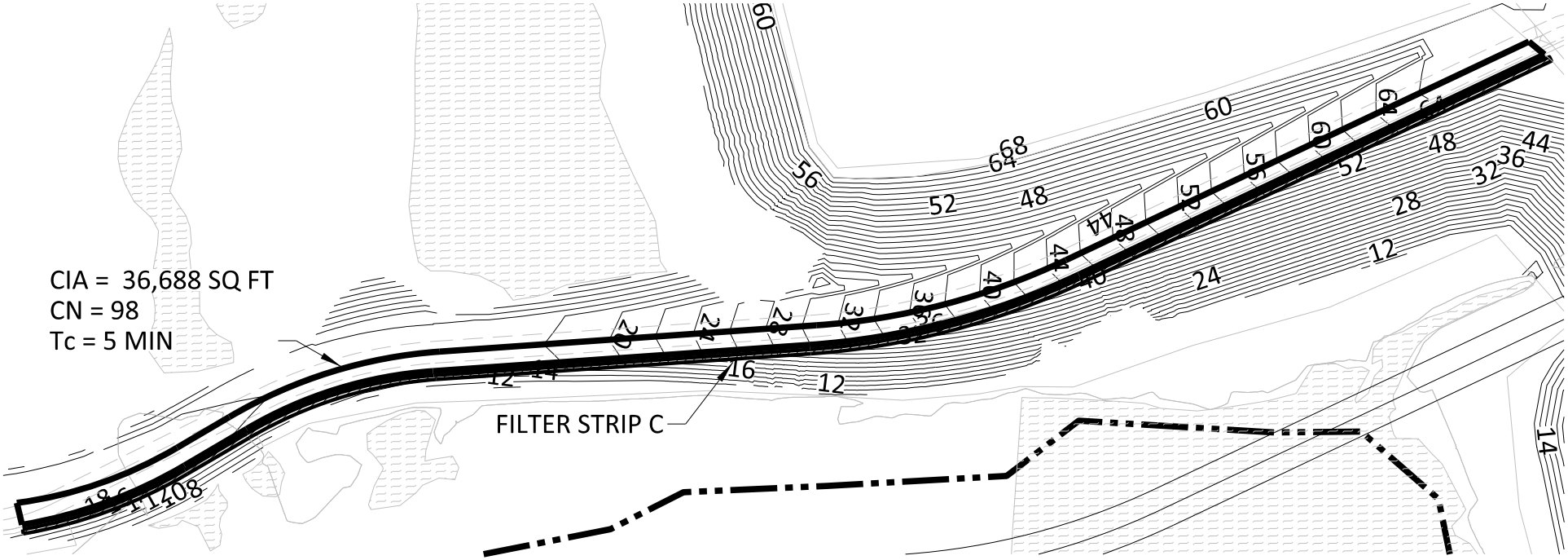

CF-D
CIA = 217,656 SQ FT
CN = 98
Tc = 8.2 MIN
OUTFALL 003
OUTFALL 004
OUTFALL 012
OUTFALL 005
OUTFALL 006
BACKFLOW PREVENTER
MH-109
MH-135
MH-150
MH-300
MH-195
CDS-77
CDS-56
CDS-126
I-301
I-302
I-303
I-304
I-305
I-308
I-63
I-69
I-65
I-67
I-68
I-105
I-134
48"
15"
18"
24"
30"

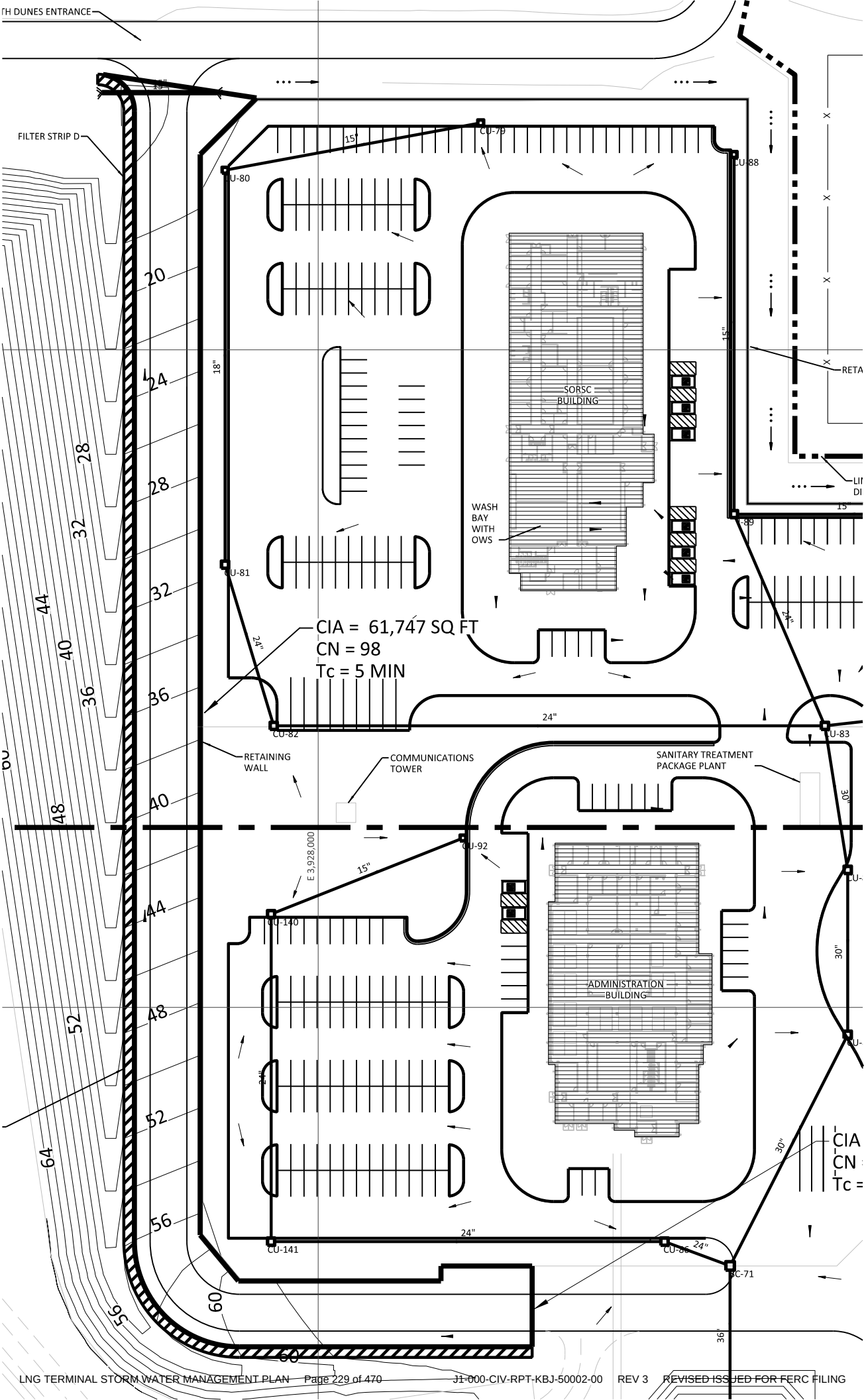

CF-E
CIA = 257,284 SQ FT
CN = 98
Tc = 8.4 MIN
OUTFALL 003
OUTFALL 004
OUTFALL 005
OUTFALL 006
BACKFLOW PREVENTER
MH-109
MH-135
MH-150
MH-300
MH-195
CDS-77
CDS-56
CDS-126
I-301
I-302
I-303
I-304
I-305
I-63
I-69
I-65
I-67
I-68
I-105
I-134
I-308
48"
15"
18"
24"
30"

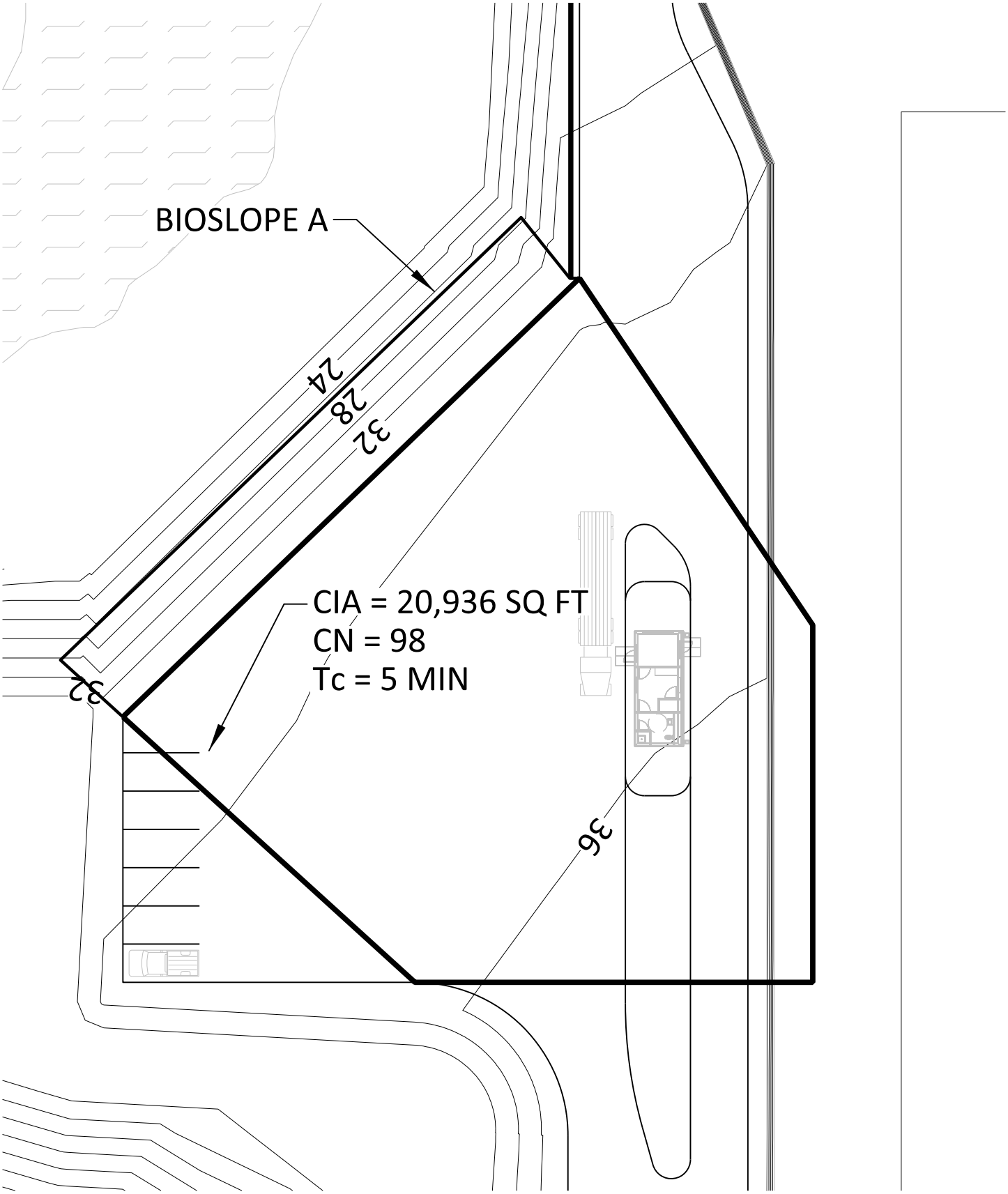

CF-B
175
15"
CF-F
176
18"
CDS-183
24"
24"
MH-179
24"
BACKFLOW PREVENTER
OUTFALL 010
18"
182
15"
181
CF-F,G
CIA = 265,877 SQ FT
CN = 98
TC = 5 MIN
185
15"
CF-G
186
18"
CDS-193
24"
24"
MH-189
24"
BACKFLOW PREVENTER
OUTFALL 011
18"
192
15"
191

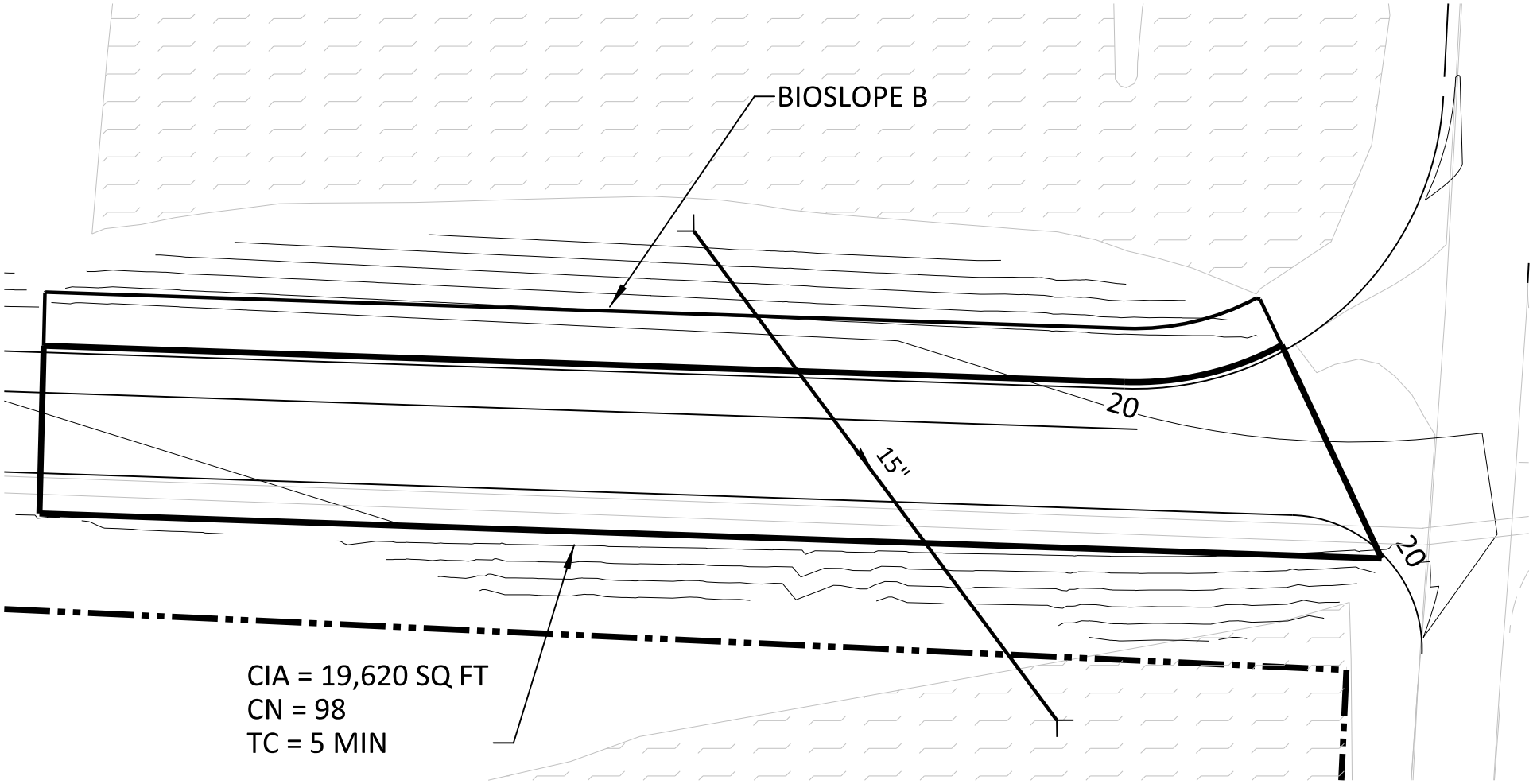

FILTER STRIP A
60
56
52
48
44
40
36
32
28
24
48
56
52
CIA = 50,944 SQ FT
CN = 98
Tc = 5 MIN

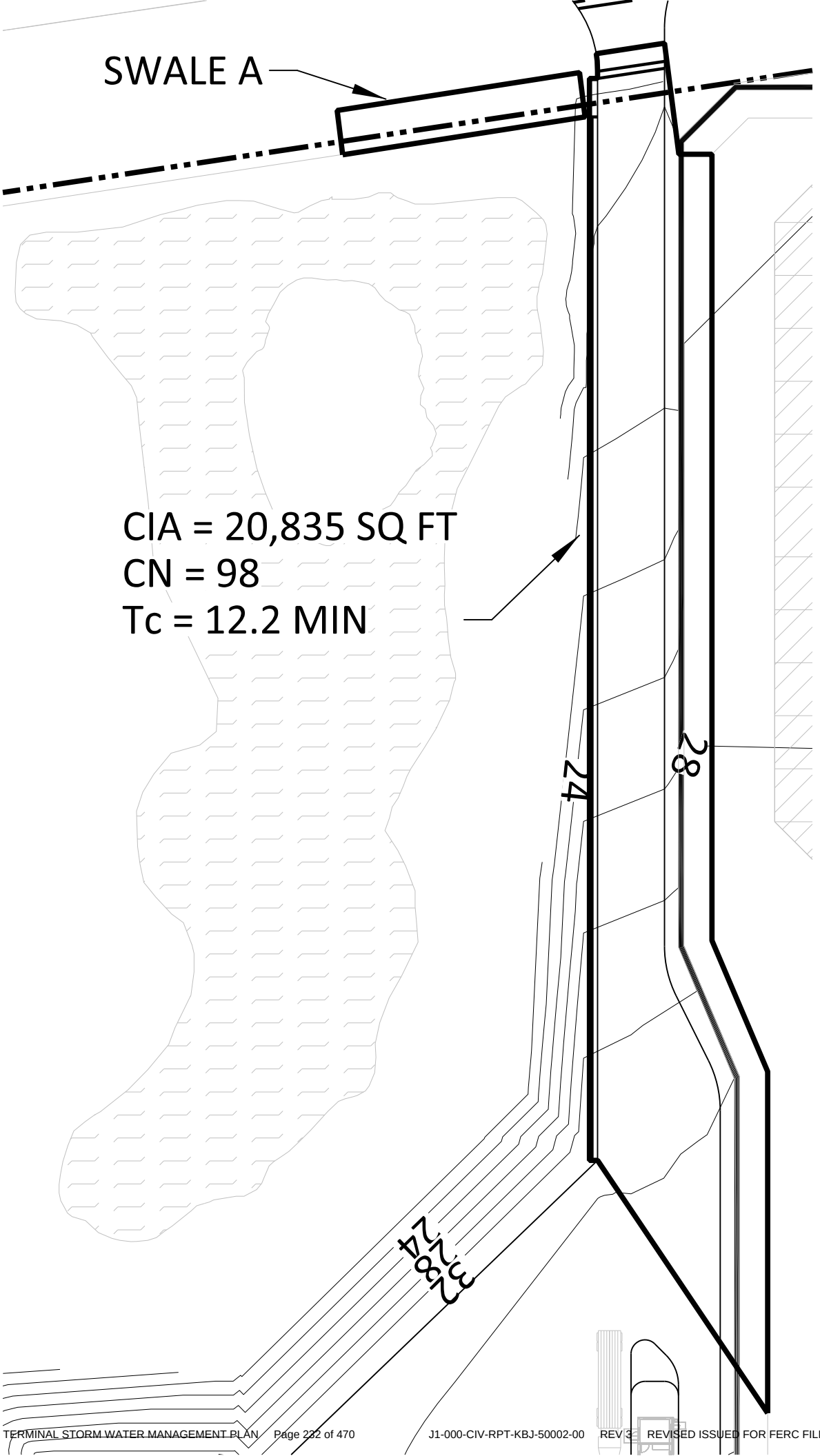

FILTER STRIP B
CIA = 42,997 SQ FT
CN = 98
Tc = 5 MIN


CIA = 36,688 SQ FT
CN = 98
Tc = 5 MIN
FILTER STRIP C


TH DUNES ENTRANCE
FILTER STRIP D
CU-79
CU-80
CU-88
CU-81
CU-82
CU-83
CU-89
CU-92
CU-140
CU-141
CU-86
CU-71
SORSC BUILDING
WASH BAY WITH OWS
CIA = 61,747 SQ FT
CN = 98
Tc = 5 MIN
RETAINING WALL
COMMUNICATIONS TOWER
SANITARY TREATMENT PACKAGE PLANT
ADMINISTRATION BUILDING
E 3,928,000
15"
18"
24"
30"
36"
20
24
28
32
36
40
44
48
52
56
60
64
44
40
36
32
28
24
48
52
56
60
95


BIOSLOPE A
24
28
32
32
36
CIA = 20,936 SQ FT
CN = 98
Tc = 5 MIN


BIOSLOPE B
20
15"
20
CIA = 19,620 SQ FT
CN = 98
TC = 5 MIN


SWALE A
CIA = 20,835 SQ FT
CN = 98
Tc = 12.2 MIN
28
24
28
32
24

# Attachment L. Infiltration Controls Summary

**Basin Calculation Summary**

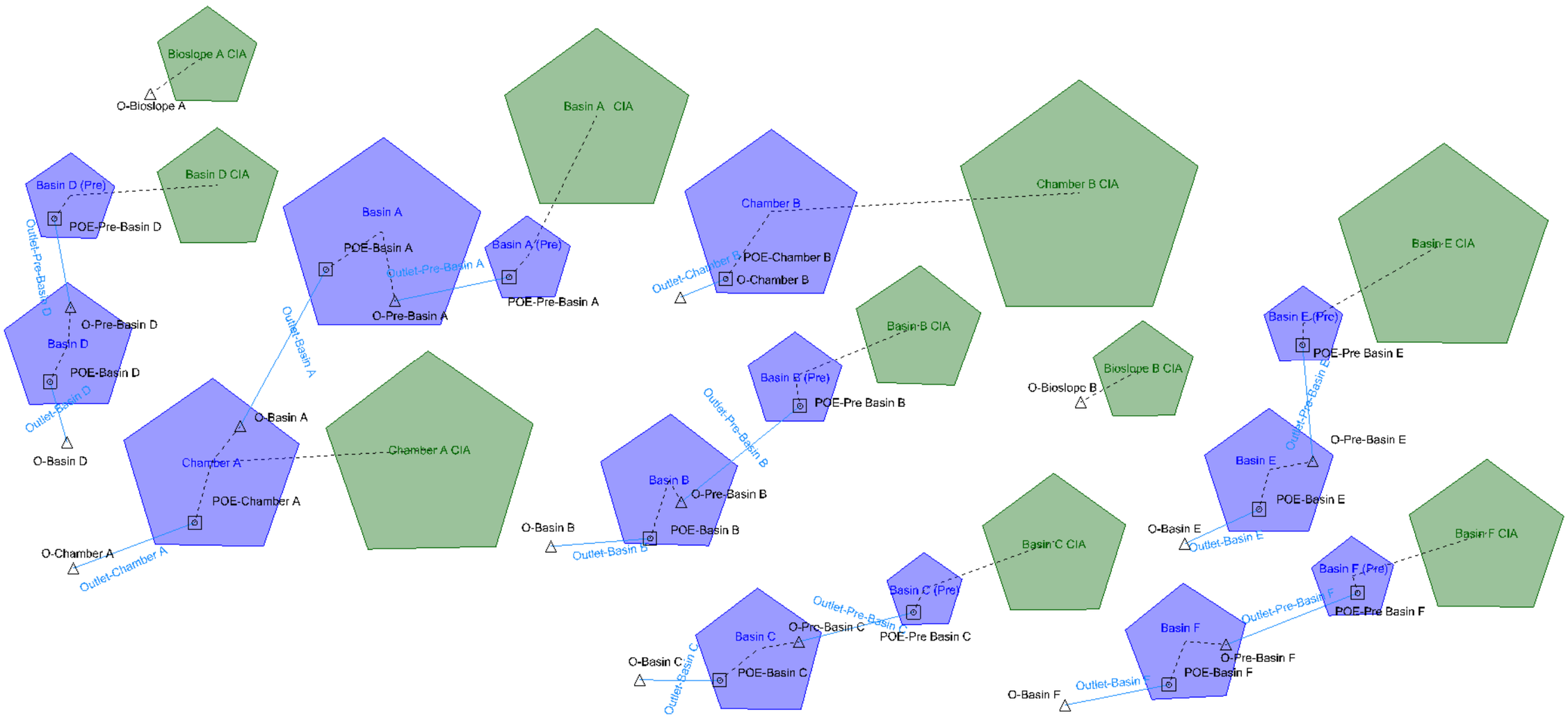
| Inputs to PondPack Model | | | | | | | | | | | | | | | | | | | PondPack Model Results | | | Summary | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Top Dimensions | | | Bot Dimensions | | Side Slope | | | | | | | | | | | | |
| Facility Notation | Long Description | Location | Type | Contributing Impervious Area (CIA) (ac) | CN | Tc (min) | Tc (hr) | Top El (ft) | Length (ft) | Width (ft) | Bot El (ft) | Length (ft) | Width (ft) | H | :V | Overall Height (ft) | Infiltration Rate (in/hr) | Void Space | 1/2 2-Yr Storm Max Water El (ft) | 2-yr Storm Max Water El (ft) | 100-yr Storm Max Water El (ft) | Overflow Elevation (ft) | 2-Yr Freeboard (ft) | 100-Yr Freeboard (ft) | Groundwater El (ft) | Depth Below Basin to Groundwater (ft) |
| Chamber A | Buried Infiltration Chamber A | West of LNG Tanks | StormTrap | 7.86 | 98 | 9.3 | 0.155 | 39 | 100 | 90 | 30.0 | 99.982 | 89.982 | 0.001 | 1 | 11.0 | 3 | 0.8 | 31.57 | 36.37 | 37.40 | 36.5 | 2.63 | 1.6 | 17.50 | 10.5 |
| Chamber B | Buried Infiltration Chamber B | Marine Area | StormTrap | 25.34 | 98 | 17.2 | 0.287 | 39 | 155 | 140 | 26.0 | 154.974 | 139.974 | 0.001 | 1 | 15.0 | 3 | 0.8 | 28.61 | 36.47 | 37.64 | 36.5 | 2.53 | 1.4 | 14.00 | 10.0 |
| Basin A | Open-Graded Aggregate Infiltration Basin A | West of STGs | Basin | 15.89 | 98 | 11.4 | 0.190 | 44 | 362 | 86 | 33.0 | 296 | 20 | 3 | 1 | 11.0 | 3 | 1 | 36.35 | 39.90 | 41.15 | 40.0 | 4.1 | 2.9 | 17.50 | 15.5 |
| Basin B | Open-Graded Aggregate Infiltration Basin B | Marine Area North | Basin | 2.26 | 98 | 5.0 | 0.083 | 33 | 100 | 60 | 27.0 | 64 | 24 | 3 | 1 | 6.0 | 3 | 1 | 28.71 | 29.77 | 30.49 | 30.0 | 3.23 | 2.5 | 14.00 | 13.0 |
| Basin C | Open-Graded Aggregate Infiltration Basin C | Marine Area South | Basin | 6.23 | 98 | 7.7 | 0.128 | 33 | 175 | 60 | 25.0 | 127 | 12 | 3 | 1 | 8.0 | 3 | 1 | 28.74 | 30.75 | 32.06 | 31.0 | 2.25 | 0.9 | 14.00 | 11.0 |
| Basin D | Vegetated Infiltration Basin D | NW Secondary Entrance | Basin | 1.03 | 98 | 5.0 | 0.083 | 32 | 60 | 50 | 26.0 | 24 | 14 | 3 | 1 | 6.0 | 3 | 1 | 27.77 | 29.84 | 30.57 | 30.0 | 2.16 | 1.4 | 17.50 | 8.5 |
| Basin E | Vegetated Infiltration Basin E | South Dunes Buildings | Basin | 17.25 | 90 | 11.6 | 0.193 | 62 | 170 | 130 | 52.0 | 110 | 70 | 3 | 1 | 10.0 | 3 | 1 | 53.24 | 58.41 | 59.51 | 58.5 | 3.59 | 2.5 | 10.00 | 42.0 |
| Basin F | Vegetated Infiltration Basin F | South Dunes Metering Station | Basin | 5.47 | 80 | 5.0 | 0.083 | 62 | 110 | 60 | 56.0 | 74 | 24 | 3 | 1 | 6.0 | 3 | 1 | 56.46 | 59.91 | 60.67 | 60.0 | 2.09 | 1.3 | 8.00 | 48.0 |

## Pretreatment Sedimenet Basin (Forebay) Calculation Summary

| Inputs to PondPack Model | | | | | | | | | | | | | | | | Model Results | | | Summary | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Top Dimensions | | | Bot Dimensions | | Side Slope | | | | | | | | | | | |
| Facility Notation | Long Description | Location | Contributing Impervious Area (CIA) (ac) | CN | Tc (min) | Tc (hr) | Pond Depth (ft) | Top El (ft) | Length (ft) | Width (ft) | Bot El (ft) | Length (ft) | Width (ft) | H | :V | 1/2 2-Yr Storm Max Water El | 2-yr Storm Max Water El (ft) | 100-yr Storm Max Water El | 1/2 2-Yr Depth (ft) | 2-Yr Depth (ft) | 100-Yr Depth (ft) | Groundwater El (ft) | Depth Below Basin to Groundwater (ft) | High Flow Weir El (ft) | Low Flow Weir El (ft) |
| Basin A (Pre) | Basin A Forebay - Pretreatment | West of STGs | 15.89 | 98 | 11.4 | 0.190 | 11 | 44 | 80 | 86 | 33.5 | 14 | 20 | 3 | 1 | 40.01 | 40.12 | 41.16 | 6.51 | 6.62 | 7.66 | 17.50 | 16.00 | 40.00 | 39.00 |
| Basin B (Pre) | Basin B Forebay - Pretreatment | Marine Area North | 2.26 | 98 | 5.0 | 0.083 | 6 | 33 | 50 | 60 | 27.5 | 14 | 24 | 3 | 1 | 28.79 | 29.77 | 30.49 | 1.29 | 2.27 | 2.99 | 14.00 | 13.50 | 30.00 | 29.00 |
| Basin C (Pre) | Basin C Forebay - Pretreatment | Marine Area South | 6.23 | 98 | 7.7 | 0.128 | 8 | 33 | 60 | 60 | 25.5 | 12 | 12 | 3 | 1 | 30.06 | 30.75 | 32.06 | 4.56 | 5.25 | 6.56 | 14.00 | 11.50 | 31.00 | 30.00 |
| Basin D (Pre) | Basin D Forebay - Pretreatment | NW Secondary Entrance | 1.03 | 98 | 5.0 | 0.083 | 6 | 32 | 50 | 50 | 26.5 | 14 | 14 | 3 | 1 | 29.62 | 29.85 | 30.58 | 3.12 | 3.35 | 4.08 | 17.50 | 9.00 | 30.00 | 29.00 |
| Basin E (Pre) | Basin E Forebay - Pretreatment | South Dunes Buildings | 17.25 | 90 | 11.6 | 0.193 | 10 | 62 | 70 | 130 | 52.5 | 10 | 70 | 3 | 1 | 57.88 | 58.59 | 59.52 | 5.38 | 6.09 | 7.02 | 10.00 | 42.50 | 58.50 | 57.50 |
| Basin F (Pre) | Basin F Forebay - Pretreatment | South Dunes Metering Station | 5.47 | 80 | 5.0 | 0.083 | 6 | 62 | 50 | 60 | 56.5 | 14 | 24 | 3 | 1 | 59.08 | 59.92 | 60.68 | 2.58 | 3.42 | 4.18 | 8.00 | 48.50 | 60.00 | 59.00 |

# Attachment M. Infiltration and Bioslope Controls Calculations (PondPack)

# PondPack Model - Infiltration and Bioslope Controls



Scenario Calculation Summary

**Scenario Summary**

| | | |
|---|---|---|
| Scenario: | Post-Development 1/2 of 2-Yr | |
| Output Increment: | 0.050 | hours |
| Duration: | 24.000 | hours |

**ICPM Calculation Tolerances**

| | | |
|---|---|---|
| Target Convergence: | 0.0000 | ft³/s |
| Maximum Iterations: | 35 | |
| ICPM Time Step: | 0.050 | hours |

**Storm Summary**

| | | |
|---|---|---|
| Return Event Tag: | 1 | |
| Total Depth: | 1.8 | in |
| Rainfall Type: | Time-Depth Curve | |
| Storm Event: | 1/2 of 2-Yr | |

Executive Summary [Nodes] | Executive Summary [Links] | Messages

| | Label | Scenario | Return Event (years) | Truncation | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow (ft³/s) | Maximum Water Surface Elevation (ft) | Maximum Pond Storage (ac-ft) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Basin A | Post-Development 1/2 o... | 1 | None | 2.017 | 7.950 | 6.2103 | (N/A) | (N/A) |
| 2 | Basin A (IN) | Post-Development 1/2 o... | 1 | None | 1.843 | 8.050 | 6.0471 | (N/A) | (N/A) |
| 3 | Basin A (OUT) | Post-Development 1/2 o... | 1 | None | 0.000 | 0.000 | 0.0000 | 36.35 | 0.711 |
| 4 | Basin A (Pre) | Post-Development 1/2 o... | 1 | None | 2.017 | 7.950 | 6.2103 | (N/A) | (N/A) |
| 5 | Basin A (Pre) | Post-Development 1/2 o... | 1 | None | 1.843 | 8.050 | 6.0471 | 40.01 | 0.229 |
| 6 | Basin B (IN) | Post-Development 1/2 o... | 1 | None | 0.272 | 7.950 | 0.8948 | (N/A) | (N/A) |
| 7 | Basin B (OUT) | Post-Development 1/2 o... | 1 | None | 0.000 | 0.000 | 0.0000 | 28.72 | 0.080 |
| 8 | Basin B (Pre)... | Post-Development 1/2 o... | 1 | None | 0.292 | 7.850 | 0.9111 | (N/A) | (N/A) |
| 9 | Basin B (Pre)... | Post-Development 1/2 o... | 1 | None | 0.272 | 7.950 | 0.8948 | 29.29 | 0.025 |
| 10 | Basin B CIA | Post-Development 1/2 o... | 1 | None | 0.292 | 7.850 | 0.9111 | (N/A) | (N/A) |
| 11 | Basin C (IN) | Post-Development 1/2 o... | 1 | None | 0.703 | 8.000 | 2.3504 | (N/A) | (N/A) |
| 12 | Basin C (OUT) | Post-Development 1/2 o... | 1 | None | 0.000 | 0.000 | 0.0000 | 28.68 | 0.272 |
| 13 | Basin C (Pre)... | Post-Development 1/2 o... | 1 | None | 0.787 | 7.900 | 2.4485 | (N/A) | (N/A) |
| 14 | Basin C (Pre)... | Post-Development 1/2 o... | 1 | None | 0.703 | 8.000 | 2.3504 | 30.56 | 0.102 |
| 15 | Basin C CIA | Post-Development 1/2 o... | 1 | None | 0.787 | 7.900 | 2.4485 | (N/A) | (N/A) |
| 16 | Basin D (IN) | Post-Development 1/2 o... | 1 | None | 0.101 | 8.000 | 0.3922 | (N/A) | (N/A) |
| 17 | Basin D (OUT) | Post-Development 1/2 o... | 1 | None | 0.000 | 0.000 | 0.0000 | 28.06 | 0.029 |
| 18 | Basin D (Pre)... | Post-Development 1/2 o... | 1 | None | 0.131 | 7.850 | 0.4080 | (N/A) | (N/A) |
| 19 | Basin D (Pre)... | Post-Development 1/2 o... | 1 | None | 0.101 | 8.000 | 0.3922 | 29.16 | 0.033 |
| 20 | Basin D CIA | Post-Development 1/2 o... | 1 | None | 0.131 | 7.850 | 0.4080 | (N/A) | (N/A) |
| 21 | Basin E (IN) | Post-Development 1/2 o... | 1 | None | 0.982 | 9.000 | 1.3775 | (N/A) | (N/A) |
| 22 | Basin E (OUT) | Post-Development 1/2 o... | 1 | None | 0.000 | 0.000 | 0.0000 | 53.24 | 0.239 |
| 23 | Basin E (Pre)... | Post-Development 1/2 o... | 1 | None | 1.266 | 8.000 | 3.5439 | (N/A) | (N/A) |
| 24 | Basin E (Pre)... | Post-Development 1/2 o... | 1 | None | 0.982 | 9.000 | 1.3775 | 57.88 | 0.302 |
| 25 | Basin E CIA | Post-Development 1/2 o... | 1 | None | 1.266 | 8.000 | 3.5439 | (N/A) | (N/A) |
| 26 | Basin F (IN) | Post-Development 1/2 o... | 1 | None | 0.145 | 11.200 | 0.1455 | (N/A) | (N/A) |
| 27 | Basin F (OUT) | Post-Development 1/2 o... | 1 | None | 0.000 | 0.000 | 0.0000 | 56.46 | 0.020 |
| 28 | Basin F (Pre)... | Post-Development 1/2 o... | 1 | None | 0.189 | 8.000 | 0.3357 | (N/A) | (N/A) |
| 29 | Basin F (Pre)... | Post-Development 1/2 o... | 1 | None | 0.145 | 11.200 | 0.1455 | 59.08 | 0.044 |
| 30 | Basin F CIA | Post-Development 1/2 o... | 1 | None | 0.189 | 8.000 | 0.3357 | (N/A) | (N/A) |
| 31 | Bioslope A CIA | Post-Development 1/2 o... | 1 | None | 0.061 | 7.850 | 0.1901 | (N/A) | (N/A) |
| 32 | Bioslope B CIA | Post-Development 1/2 o... | 1 | None | 0.057 | 7.850 | 0.1783 | (N/A) | (N/A) |
| 33 | Chamber A (IN) | Post-Development 1/2 o... | 1 | None | 1.003 | 7.900 | 3.1042 | (N/A) | (N/A) |
| 34 | Chamber A (O... | Post-Development 1/2 o... | 1 | None | 0.000 | 0.000 | 0.0000 | 31.57 | 0.259 |
| 35 | Chamber A CIA | Post-Development 1/2 o... | 1 | None | 1.003 | 7.900 | 3.1042 | (N/A) | (N/A) |
| 36 | Chamber B (IN) | Post-Development 1/2 o... | 1 | None | 3.208 | 8.000 | 9.5944 | (N/A) | (N/A) |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 37 | Chamber B (O... | Post-Development 1/2 o... | 1 | None | 0.000 | 0.000 | 0.0000 | 28.61 | 1.040 |
| 38 | Chamber B CIA | Post-Development 1/2 o... | 1 | None | 3.208 | 8.000 | 9.5944 | (N/A) | (N/A) |
| 39 | O-Basin B | Post-Development 1/2 o... | 1 | None | 0.000 | 0.000 | 0.0000 | (N/A) | (N/A) |
| 40 | O-Basin C | Post-Development 1/2 o... | 1 | None | 0.000 | 0.000 | 0.0000 | (N/A) | (N/A) |
| 41 | O-Basin D | Post-Development 1/2 o... | 1 | None | 0.000 | 0.000 | 0.0000 | (N/A) | (N/A) |
| 42 | O-Basin E | Post-Development 1/2 o... | 1 | None | 0.000 | 0.000 | 0.0000 | (N/A) | (N/A) |
| 43 | O-Basin F | Post-Development 1/2 o... | 1 | None | 0.000 | 0.000 | 0.0000 | (N/A) | (N/A) |
| 44 | O-BioslopeA | Post-Development 1/2 o... | 1 | None | 0.061 | 7.850 | 0.1901 | (N/A) | (N/A) |
| 45 | O-BioslopeB | Post-Development 1/2 o... | 1 | None | 0.057 | 7.850 | 0.1783 | (N/A) | (N/A) |
| 46 | O-Chamber A | Post-Development 1/2 o... | 1 | None | 0.000 | 0.000 | 0.0000 | (N/A) | (N/A) |
| 47 | O-Chamber B | Post-Development 1/2 o... | 1 | None | 0.000 | 0.000 | 0.0000 | (N/A) | (N/A) |

Scenario Calculation Summary

**Scenario Summary**

| | | |
|---|---|---|
| Scenario: | Post-Development 2-Yr | |
| Output Increment: | 0.050 | hours |
| Duration: | 24.000 | hours |

**ICPM Calculation Tolerances**

| | | |
|---|---|---|
| Target Convergence: | 0.0000 | ft³/s |
| Maximum Iterations: | 35 | |
| ICPM Time Step: | 0.050 | hours |

**Storm Summary**

| | | |
|---|---|---|
| Return Event Tag: | 2 | |
| Total Depth: | 3.5 | in |
| Rainfall Type: | Time-Depth Curve | |
| Storm Event: | 2-Yr | |

Executive Summary [Nodes] | Executive Summary [Links] | Messages

| | Label | Scenario | Return Event (years) | Truncation | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow (ft³/s) | Maximum Water Surface Elevation (ft) | Maximum Pond Storage (ac-ft) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Basin A | Post-Development 2-Yr | 2 | None | 4.315 | 7.950 | 12.9817 | (N/A) | (N/A) |
| 2 | Basin A (IN) | Post-Development 2-Yr | 2 | None | 4.096 | 7.950 | 12.9210 | (N/A) | (N/A) |
| 3 | Basin A (OUT) | Post-Development 2-Yr | 2 | None | 0.000 | 0.000 | 0.0000 | 39.90 | 2.065 |
| 4 | Basin A (Pre) | Post-Development 2-Yr | 2 | None | 4.315 | 7.950 | 12.9817 | (N/A) | (N/A) |
| 5 | Basin A (Pre) | Post-Development 2-Yr | 2 | None | 4.096 | 7.950 | 12.9210 | 40.12 | 0.238 |
| 6 | Basin B (IN) | Post-Development 2-Yr | 2 | None | 0.540 | 7.850 | 1.7154 | (N/A) | (N/A) |
| 7 | Basin B (OUT) | Post-Development 2-Yr | 2 | None | 0.000 | 0.000 | 0.0000 | 30.07 | 0.173 |
| 8 | Basin B (Pre)... | Post-Development 2-Yr | 2 | None | 0.625 | 7.850 | 1.9057 | (N/A) | (N/A) |
| 9 | Basin B (Pre)... | Post-Development 2-Yr | 2 | None | 0.540 | 7.850 | 1.7154 | 30.07 | 0.044 |
| 10 | Basin B CIA | Post-Development 2-Yr | 2 | None | 0.625 | 7.850 | 1.9057 | (N/A) | (N/A) |
| 11 | Basin C (IN) | Post-Development 2-Yr | 2 | None | 1.443 | 8.000 | 4.9468 | (N/A) | (N/A) |
| 12 | Basin C (OUT) | Post-Development 2-Yr | 2 | None | 0.000 | 0.000 | 0.0000 | 31.14 | 0.640 |
| 13 | Basin C (Pre)... | Post-Development 2-Yr | 2 | None | 1.684 | 7.900 | 5.1181 | (N/A) | (N/A) |
| 14 | Basin C (Pre)... | Post-Development 2-Yr | 2 | None | 1.443 | 8.000 | 4.9468 | 31.14 | 0.131 |
| 15 | Basin C CIA | Post-Development 2-Yr | 2 | None | 1.684 | 7.900 | 5.1181 | (N/A) | (N/A) |
| 16 | Basin D (IN) | Post-Development 2-Yr | 2 | None | 0.238 | 7.950 | 0.8342 | (N/A) | (N/A) |
| 17 | Basin D (OUT) | Post-Development 2-Yr | 2 | None | 0.000 | 0.000 | 0.0000 | 29.79 | 0.082 |
| 18 | Basin D (Pre)... | Post-Development 2-Yr | 2 | None | 0.280 | 7.850 | 0.8534 | (N/A) | (N/A) |
| 19 | Basin D (Pre)... | Post-Development 2-Yr | 2 | None | 0.238 | 7.950 | 0.8342 | 29.80 | 0.049 |
| 20 | Basin D CIA | Post-Development 2-Yr | 2 | None | 0.280 | 7.850 | 0.8534 | (N/A) | (N/A) |
| 21 | Basin E (IN) | Post-Development 2-Yr | 2 | None | 3.137 | 8.000 | 10.6283 | (N/A) | (N/A) |
| 22 | Basin E (OUT) | Post-Development 2-Yr | 2 | None | 0.000 | 0.000 | 0.0000 | 58.41 | 1.716 |
| 23 | Basin E (Pre)... | Post-Development 2-Yr | 2 | None | 3.505 | 8.000 | 10.7391 | (N/A) | (N/A) |
| 24 | Basin E (Pre)... | Post-Development 2-Yr | 2 | None | 3.137 | 8.000 | 10.6283 | 58.59 | 0.383 |
| 25 | Basin E CIA | Post-Development 2-Yr | 2 | None | 3.505 | 8.000 | 10.7391 | (N/A) | (N/A) |
| 26 | Basin F (IN) | Post-Development 2-Yr | 2 | None | 0.671 | 8.000 | 1.9859 | (N/A) | (N/A) |
| 27 | Basin F (OUT) | Post-Development 2-Yr | 2 | None | 0.000 | 0.000 | 0.0000 | 59.91 | 0.279 |
| 28 | Basin F (Pre)... | Post-Development 2-Yr | 2 | None | 0.744 | 7.950 | 2.0574 | (N/A) | (N/A) |
| 29 | Basin F (Pre)... | Post-Development 2-Yr | 2 | None | 0.671 | 8.000 | 1.9859 | 59.92 | 0.073 |
| 30 | Basin F CIA | Post-Development 2-Yr | 2 | None | 0.744 | 7.950 | 2.0574 | (N/A) | (N/A) |
| 31 | Bioslope A CIA | Post-Development 2-Yr | 2 | None | 0.130 | 7.850 | 0.3977 | (N/A) | (N/A) |
| 32 | Bioslope B CIA | Post-Development 2-Yr | 2 | None | 0.122 | 7.850 | 0.3729 | (N/A) | (N/A) |
| 33 | Chamber A (IN) | Post-Development 2-Yr | 2 | None | 2.145 | 7.900 | 6.4950 | (N/A) | (N/A) |
| 34 | Chamber A (O... | Post-Development 2-Yr | 2 | None | 0.000 | 0.000 | 0.0000 | 36.37 | 1.052 |
| 35 | Chamber A CIA | Post-Development 2-Yr | 2 | None | 2.145 | 7.900 | 6.4950 | (N/A) | (N/A) |
| 36 | Chamber B (IN) | Post-Development 2-Yr | 2 | None | 6.865 | 8.000 | 20.0770 | (N/A) | (N/A) |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 37 | Chamber B (O... | Post-Development 2-Yr | 2 | None | 0.000 | 0.000 | 0.0000 | 36.47 | 4.172 |
| 38 | Chamber B CIA | Post-Development 2-Yr | 2 | None | 6.865 | 8.000 | 20.0770 | (N/A) | (N/A) |
| 39 | O-Basin B | Post-Development 2-Yr | 2 | None | 0.000 | 0.000 | 0.0000 | (N/A) | (N/A) |
| 40 | O-Basin C | Post-Development 2-Yr | 2 | None | 0.000 | 0.000 | 0.0000 | (N/A) | (N/A) |
| 41 | O-Basin D | Post-Development 2-Yr | 2 | None | 0.000 | 0.000 | 0.0000 | (N/A) | (N/A) |
| 42 | O-Basin E | Post-Development 2-Yr | 2 | None | 0.000 | 0.000 | 0.0000 | (N/A) | (N/A) |
| 43 | O-Basin F | Post-Development 2-Yr | 2 | None | 0.000 | 0.000 | 0.0000 | (N/A) | (N/A) |
| 44 | O-BioslopeA | Post-Development 2-Yr | 2 | None | 0.130 | 7.850 | 0.3977 | (N/A) | (N/A) |
| 45 | O-BioslopeB | Post-Development 2-Yr | 2 | None | 0.122 | 7.850 | 0.3729 | (N/A) | (N/A) |
| 46 | O-Chamber A | Post-Development 2-Yr | 2 | None | 0.000 | 0.000 | 0.0000 | (N/A) | (N/A) |
| 47 | O-Chamber B | Post-Development 2-Yr | 2 | None | 0.000 | 0.000 | 0.0000 | (N/A) | (N/A) |

## Scenario Calculation Summary

**Scenario Summary**

| | | |
|---|---|---|
| Scenario: | Post-Development 100-Yr | |
| Output Increment: | 0.050 | hours |
| Duration: | 24.000 | hours |

**ICPM Calculation Tolerances**

| | | |
|---|---|---|
| Target Convergence: | 0.0000 | ft³/s |
| Maximum Iterations: | 35 | |
| ICPM Time Step: | 0.050 | hours |

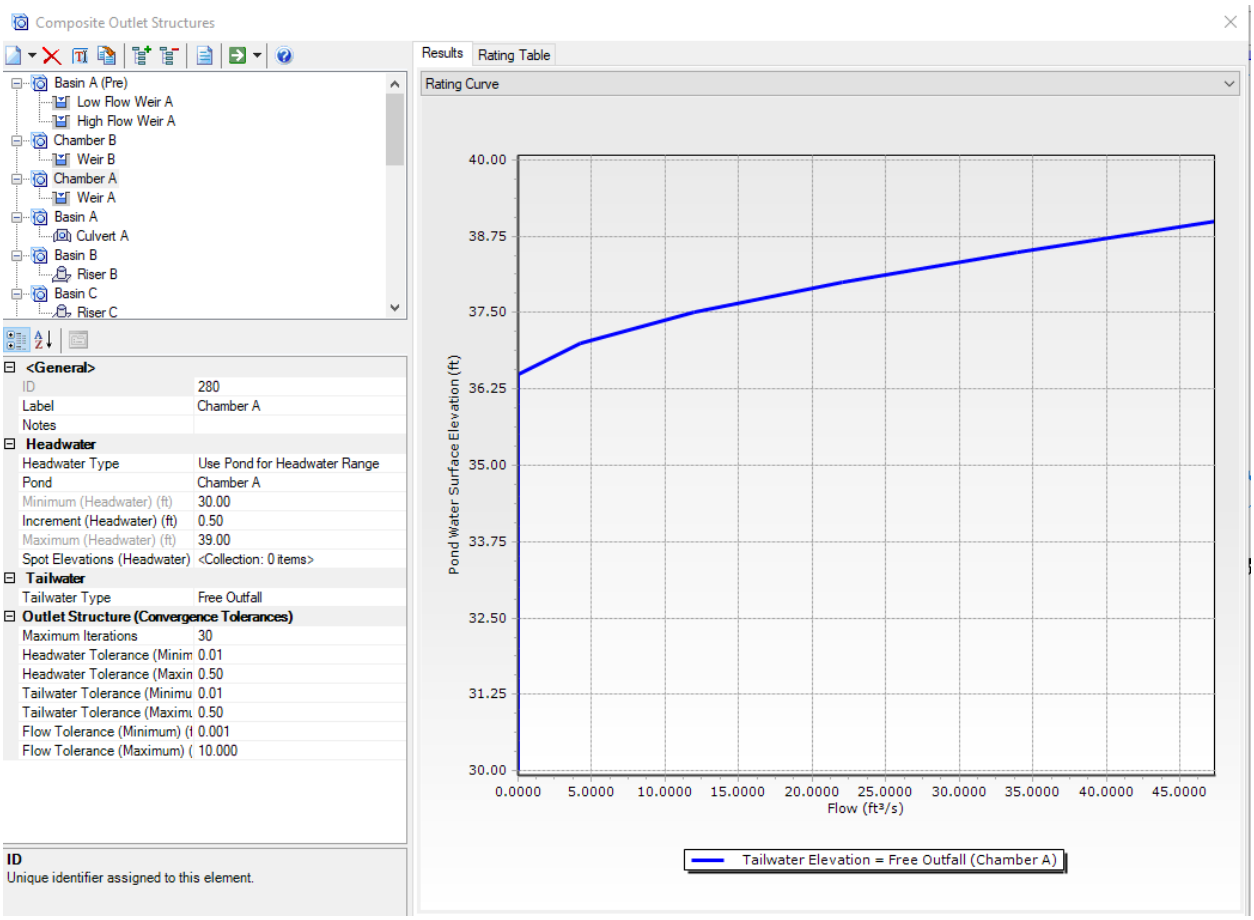
**Storm Summary**

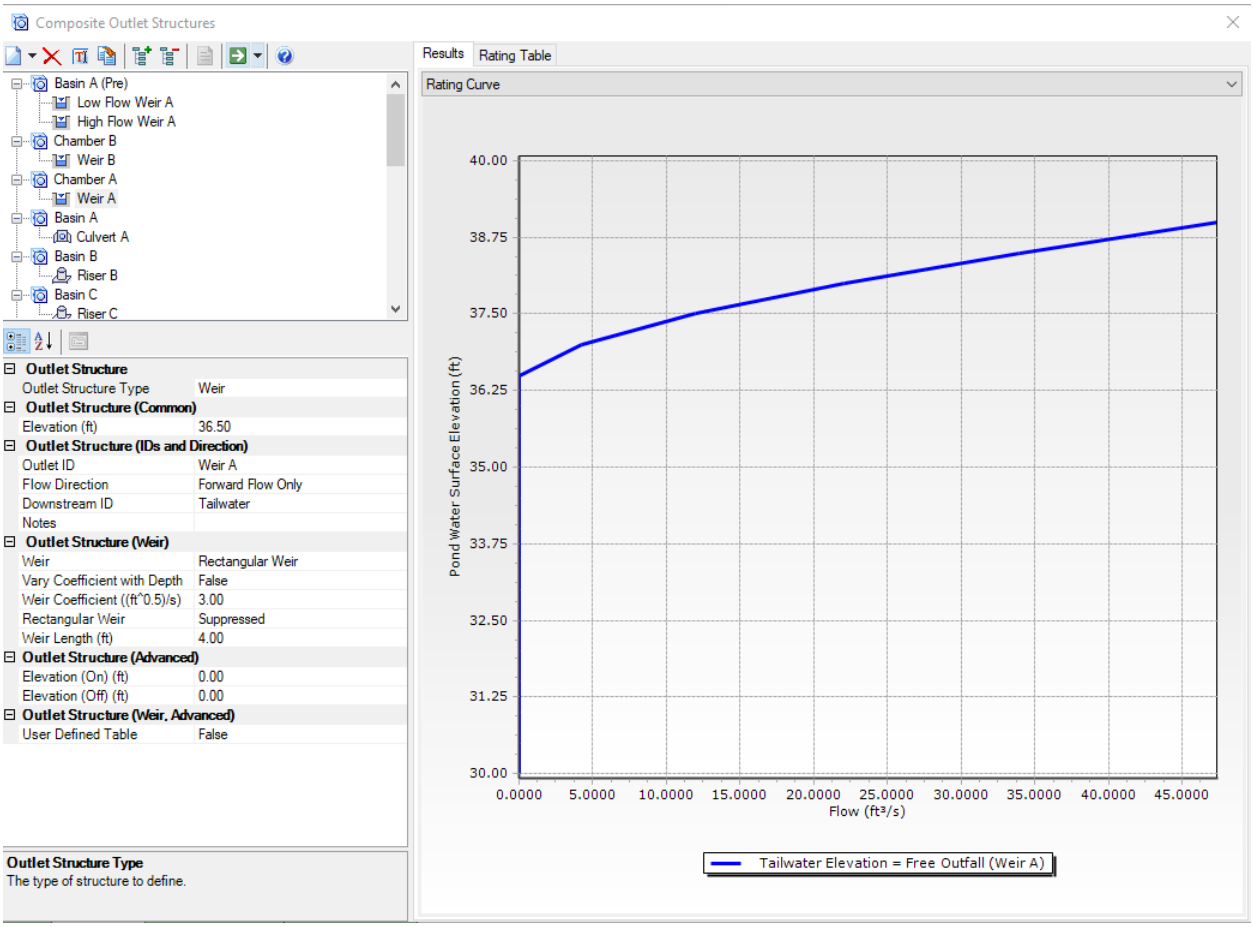
| | | |
|---|---|---|
| Return Event Tag: | 100 | |
| Total Depth: | 6.5 | in |
| Rainfall Type: | Time-Depth Curve | |
| Storm Event: | 100-Yr | |

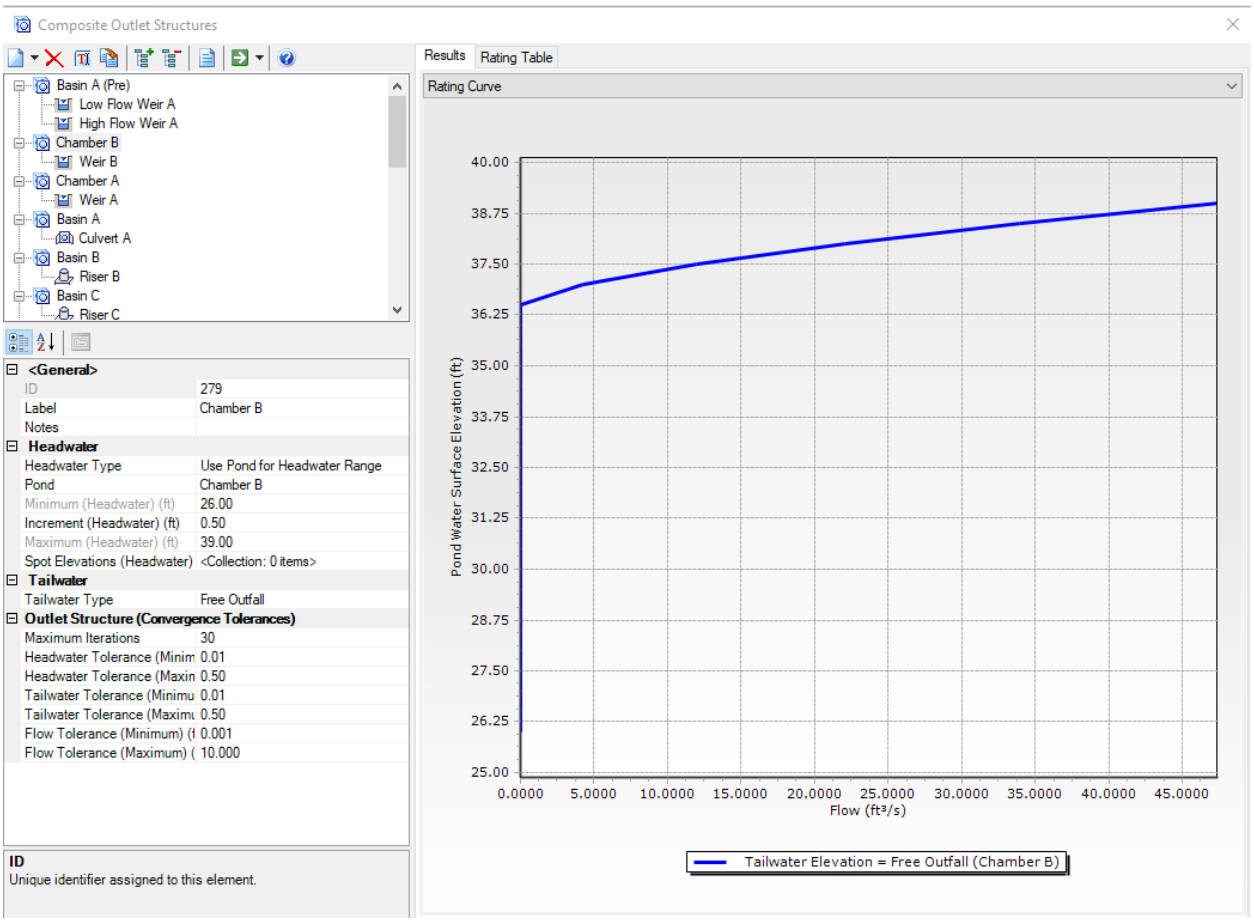
Executive Summary [Nodes] | Executive Summary [Links] | Messages

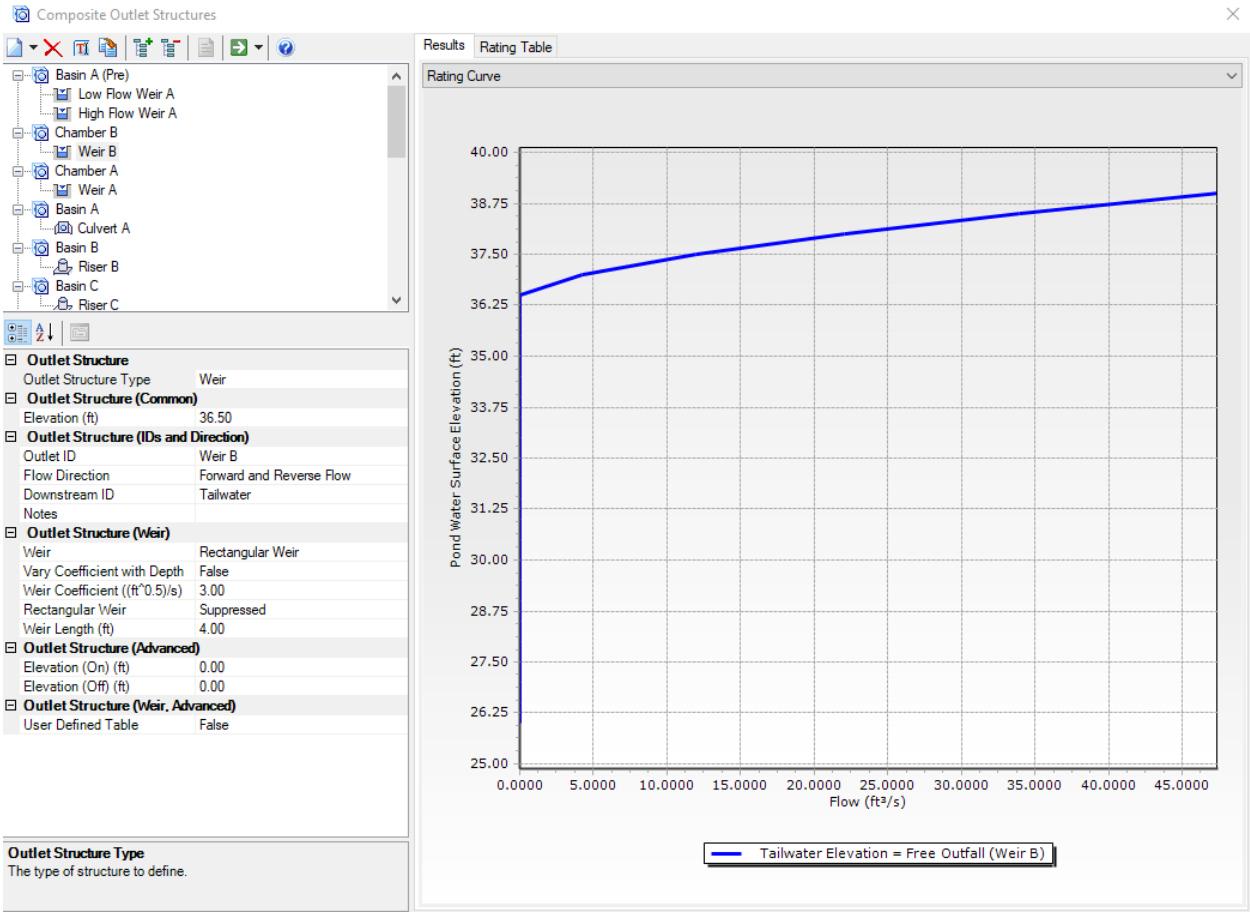
| | Label | Scenario | Return Event (years) | Truncation | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow (ft³/s) | Maximum Water Surface Elevation (ft) | Maximum Pond Storage (ac-ft) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Basin A | Post-Development 100-Yr | 100 | None | 8.272 | 7.950 | 24.4235 | (N/A) | (N/A) |
| 2 | Basin A (IN) | Post-Development 100-Yr | 100 | None | 8.012 | 7.950 | 23.9983 | (N/A) | (N/A) |
| 3 | Basin A (OUT) | Post-Development 100-Yr | 100 | None | 3.240 | 8.900 | 6.6898 | 41.15 | 2.702 |
| 4 | Basin A (Pre) | Post-Development 100-Yr | 100 | None | 8.272 | 7.950 | 24.4235 | (N/A) | (N/A) |
| 5 | Basin A (Pre) | Post-Development 100-Yr | 100 | None | 8.012 | 7.950 | 23.9983 | 41.16 | 0.329 |
| 6 | Basin B (IN) | Post-Development 100-Yr | 100 | None | 0.603 | 7.950 | 6.7713 | (N/A) | (N/A) |
| 7 | Basin B (OUT) | Post-Development 100-Yr | 100 | None | 0.000 | 0.000 | 0.0000 | 30.89 | 0.245 |
| 8 | Basin B (Pre)... | Post-Development 100-Yr | 100 | None | 1.199 | 7.850 | 3.5860 | (N/A) | (N/A) |
| 9 | Basin B (Pre)... | Post-Development 100-Yr | 100 | None | 0.603 | 7.950 | 6.7713 | 30.89 | 0.072 |
| 10 | Basin B CIA | Post-Development 100-Yr | 100 | None | 1.199 | 7.850 | 3.5860 | (N/A) | (N/A) |
| 11 | Basin C (IN) | Post-Development 100-Yr | 100 | None | 1.784 | 7.850 | 11.3850 | (N/A) | (N/A) |
| 12 | Basin C (OUT) | Post-Development 100-Yr | 100 | None | 0.140 | 8.100 | 2.8155 | 32.23 | 0.857 |
| 13 | Basin C (Pre)... | Post-Development 100-Yr | 100 | None | 3.229 | 7.900 | 9.6291 | (N/A) | (N/A) |
| 14 | Basin C (Pre)... | Post-Development 100-Yr | 100 | None | 1.784 | 7.850 | 11.3850 | 32.23 | 0.198 |
| 15 | Basin C CIA | Post-Development 100-Yr | 100 | None | 3.229 | 7.900 | 9.6291 | (N/A) | (N/A) |
| 16 | Basin D (IN) | Post-Development 100-Yr | 100 | None | 0.464 | 7.800 | 1.1298 | (N/A) | (N/A) |
| 17 | Basin D (OUT) | Post-Development 100-Yr | 100 | None | 0.129 | 8.350 | 0.5169 | 30.56 | 0.116 |
| 18 | Basin D (Pre)... | Post-Development 100-Yr | 100 | None | 0.537 | 7.850 | 1.6059 | (N/A) | (N/A) |
| 19 | Basin D (Pre)... | Post-Development 100-Yr | 100 | None | 0.464 | 7.800 | 1.1298 | 30.56 | 0.075 |
| 20 | Basin D CIA | Post-Development 100-Yr | 100 | None | 0.537 | 7.850 | 1.6059 | (N/A) | (N/A) |
| 21 | Basin E (IN) | Post-Development 100-Yr | 100 | None | 7.192 | 8.000 | 23.5392 | (N/A) | (N/A) |
| 22 | Basin E (OUT) | Post-Development 100-Yr | 100 | None | 3.425 | 9.100 | 6.1772 | 59.51 | 2.143 |
| 23 | Basin E (Pre)... | Post-Development 100-Yr | 100 | None | 7.641 | 7.950 | 23.7056 | (N/A) | (N/A) |
| 24 | Basin E (Pre)... | Post-Development 100-Yr | 100 | None | 7.192 | 8.000 | 23.5392 | 59.52 | 0.504 |
| 25 | Basin E CIA | Post-Development 100-Yr | 100 | None | 7.641 | 7.950 | 23.7056 | (N/A) | (N/A) |
| 26 | Basin F (IN) | Post-Development 100-Yr | 100 | None | 1.827 | 7.900 | 5.7317 | (N/A) | (N/A) |
| 27 | Basin F (OUT) | Post-Development 100-Yr | 100 | None | 0.958 | 8.450 | 2.1385 | 60.67 | 0.366 |
| 28 | Basin F (Pre)... | Post-Development 100-Yr | 100 | None | 1.927 | 7.900 | 5.9208 | (N/A) | (N/A) |
| 29 | Basin F (Pre)... | Post-Development 100-Yr | 100 | None | 1.827 | 7.900 | 5.7317 | 60.68 | 0.106 |
| 30 | Basin F CIA | Post-Development 100-Yr | 100 | None | 1.927 | 7.900 | 5.9208 | (N/A) | (N/A) |
| 31 | Bioslope A CIA | Post-Development 100-Yr | 100 | None | 0.250 | 7.850 | 0.7484 | (N/A) | (N/A) |
| 32 | Bioslope B CIA | Post-Development 100-Yr | 100 | None | 0.235 | 7.850 | 0.7016 | (N/A) | (N/A) |
| 33 | Chamber A (IN) | Post-Development 100-Yr | 100 | None | 7.352 | 8.050 | 13.0797 | (N/A) | (N/A) |
| 34 | Chamber A (O... | Post-Development 100-Yr | 100 | None | 5.089 | 8.400 | 10.4201 | 37.40 | 1.223 |
| 35 | Chamber A CIA | Post-Development 100-Yr | 100 | None | 4.112 | 7.900 | 12.2234 | (N/A) | (N/A) |
| 36 | Chamber B (IN) | Post-Development 100-Yr | 100 | None | 13.162 | 8.000 | 37.7862 | (N/A) | (N/A) |

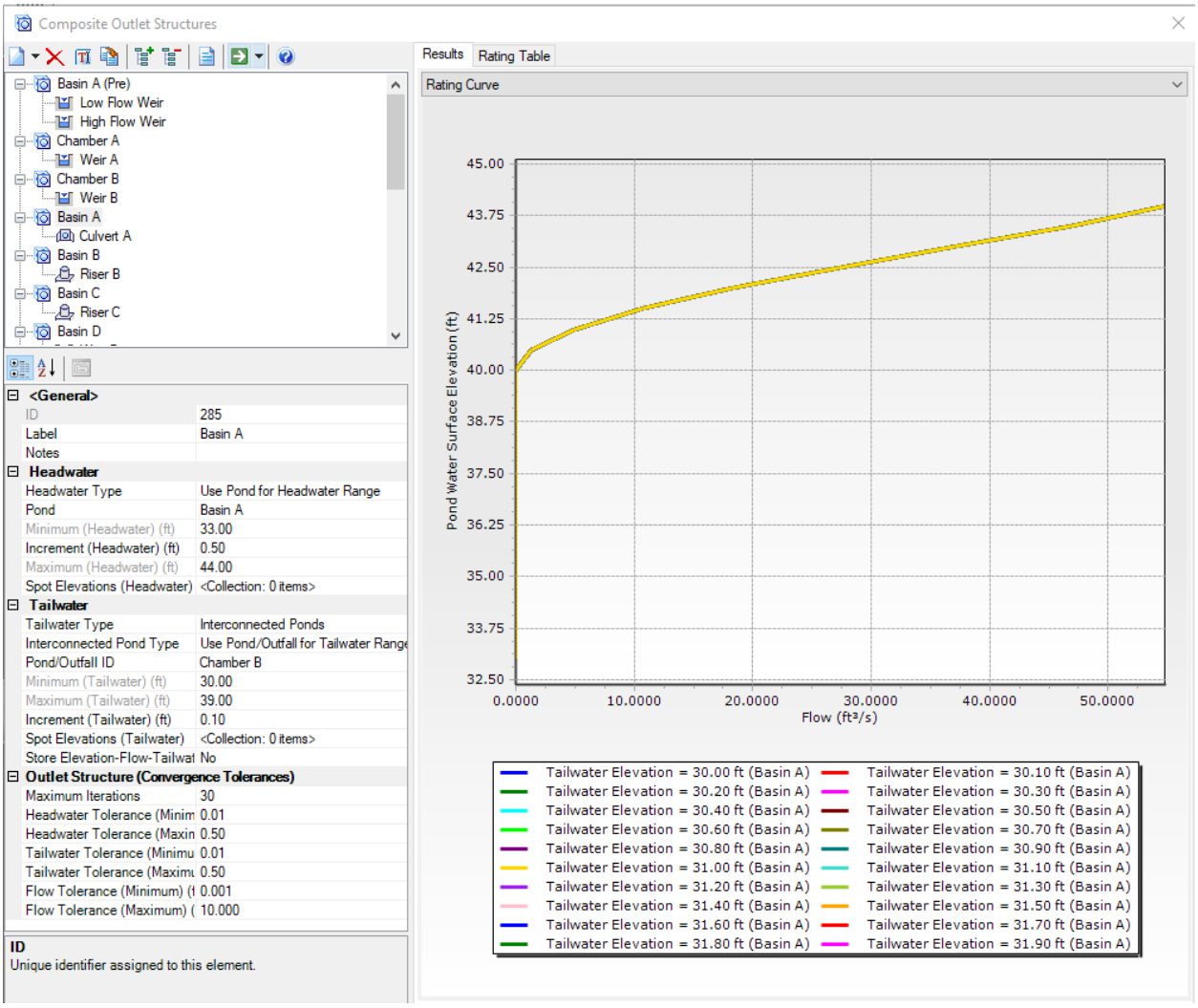
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 37 | Chamber B (O... | Post-Development 100-Yr | 100 | None | 6.084 | 8.550 | 14.8822 | 37.64 | 4.639 |
| 38 | Chamber B CIA | Post-Development 100-Yr | 100 | None | 13.162 | 8.000 | 37.7862 | (N/A) | (N/A) |
| 39 | O-Basin B | Post-Development 100-Yr | 100 | None | 0.000 | 0.000 | 0.0000 | (N/A) | (N/A) |
| 40 | O-Basin C | Post-Development 100-Yr | 100 | None | 0.140 | 8.100 | 2.8155 | (N/A) | (N/A) |
| 41 | O-Basin D | Post-Development 100-Yr | 100 | None | 0.129 | 8.350 | 0.5169 | (N/A) | (N/A) |
| 42 | O-Basin E | Post-Development 100-Yr | 100 | None | 3.425 | 9.100 | 6.1772 | (N/A) | (N/A) |
| 43 | O-Basin F | Post-Development 100-Yr | 100 | None | 0.958 | 8.450 | 2.1385 | (N/A) | (N/A) |
| 44 | O-BioslopeA | Post-Development 100-Yr | 100 | None | 0.250 | 7.850 | 0.7484 | (N/A) | (N/A) |
| 45 | O-BioslopeB | Post-Development 100-Yr | 100 | None | 0.235 | 7.850 | 0.7016 | (N/A) | (N/A) |
| 46 | O-Chamber A | Post-Development 100-Yr | 100 | None | 5.089 | 8.400 | 10.4201 | (N/A) | (N/A) |
| 47 | O-Chamber B | Post-Development 100-Yr | 100 | None | 6.084 | 8.550 | 14.8822 | (N/A) | (N/A) |

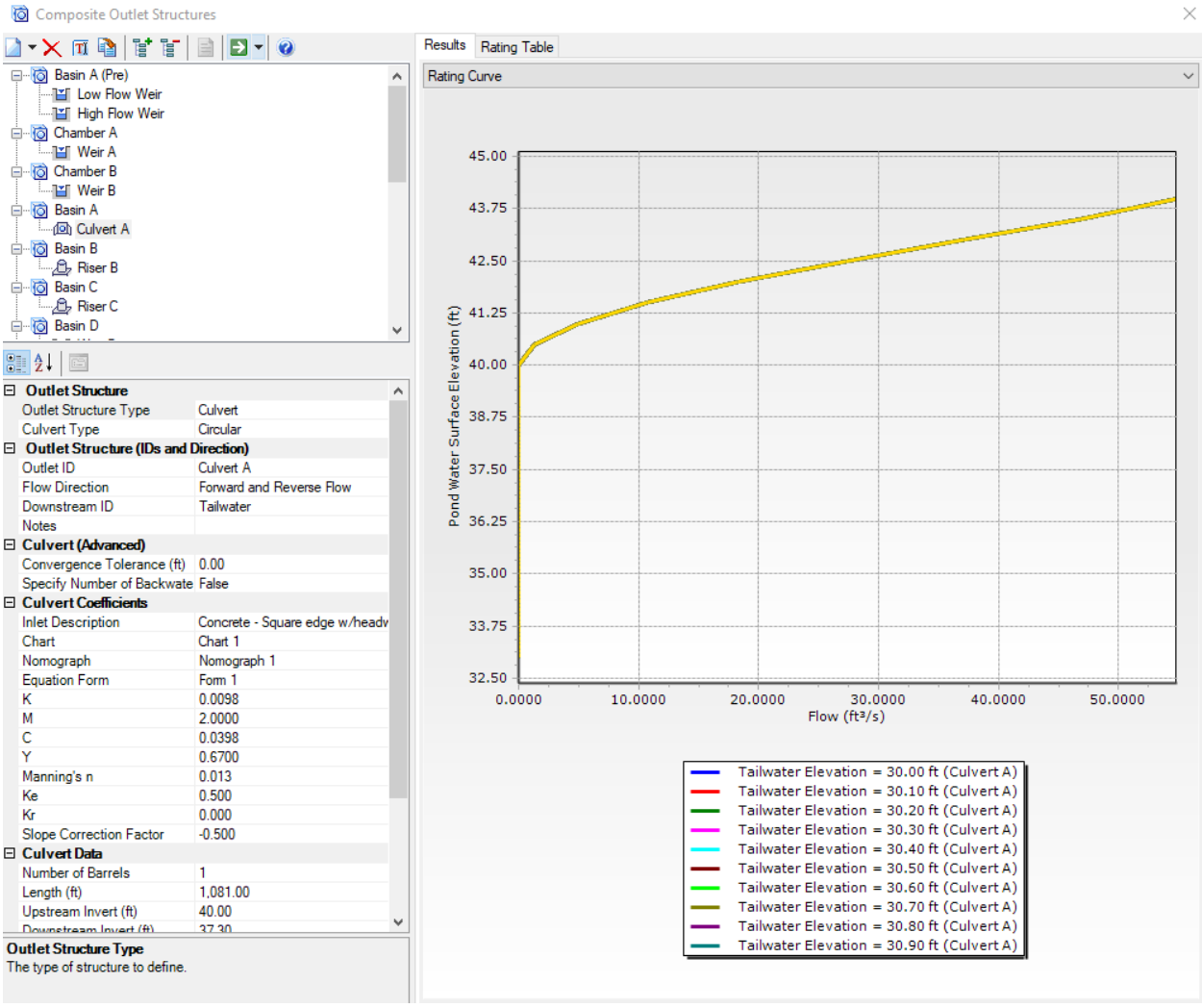

Composite Outlet Structures
Basin A (Pre)
Low Flow Weir A
High Flow Weir A
Chamber B
Weir B
Chamber A
Weir A
Basin A
Culvert A
Basin B
Riser B
Basin C
Riser C
<General>
ID 280
Label Chamber A
Notes
Headwater
Headwater Type Use Pond for Headwater Range
Pond Chamber A
Minimum (Headwater) (ft) 30.00
Increment (Headwater) (ft) 0.50
Maximum (Headwater) (ft) 39.00
Spot Elevations (Headwater) <Collection: 0 items>
Tailwater
Tailwater Type Free Outfall
Outlet Structure (Convergence Tolerances)
Maximum Iterations 30
Headwater Tolerance (Minim 0.01
Headwater Tolerance (Maxin 0.50
Tailwater Tolerance (Minimu 0.01
Tailwater Tolerance (Maxim 0.50
Flow Tolerance (Minimum) (f 0.001
Flow Tolerance (Maximum) ( 10.000
ID
Unique identifier assigned to this element.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
40.00
38.75
37.50
36.25
35.00
33.75
32.50
31.25
30.00
0.0000
5.0000
10.0000
15.0000
20.0000
25.0000
30.0000
35.0000
40.0000
45.0000
Flow (ft³/s)
Tailwater Elevation = Free Outfall (Chamber A)

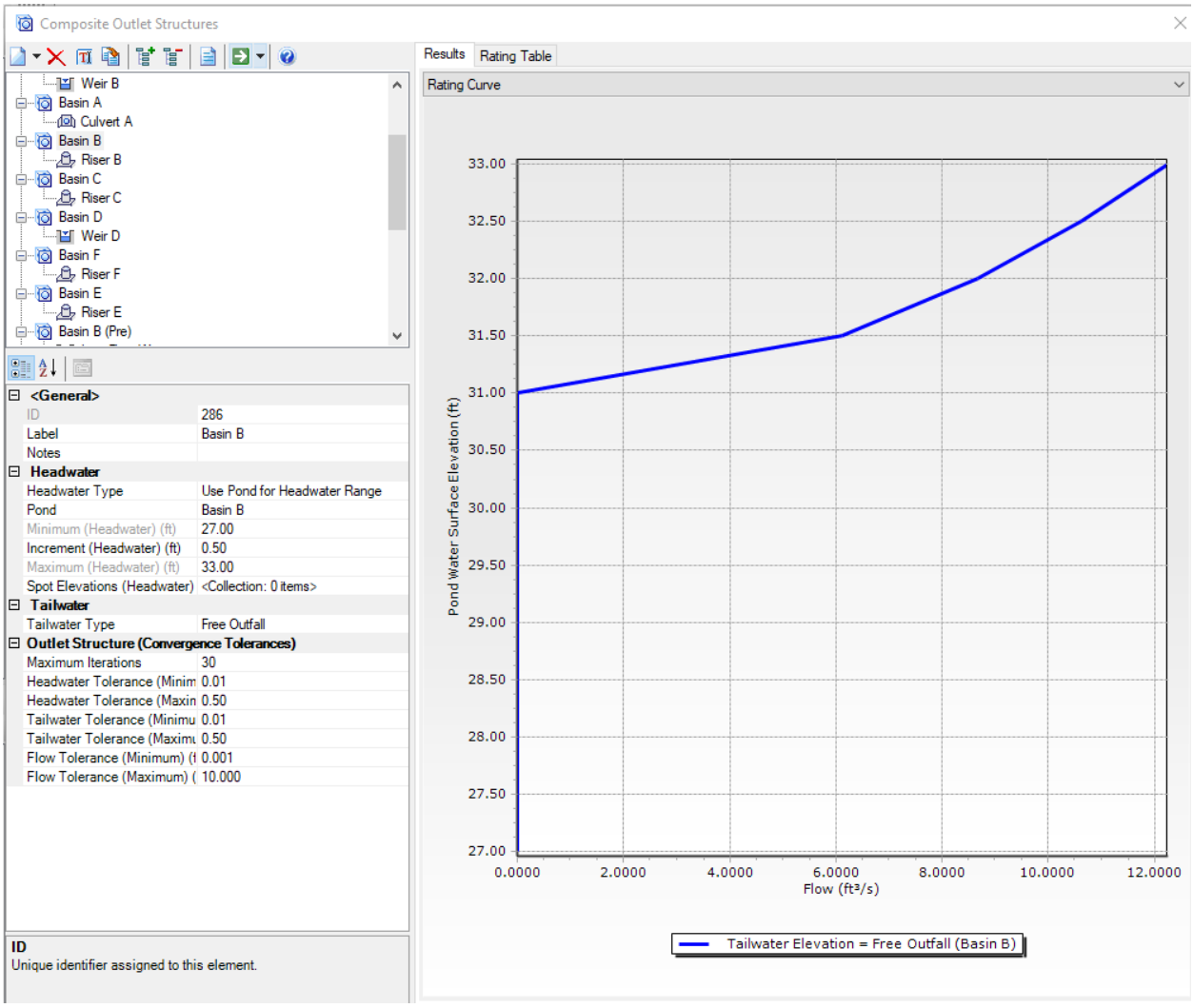

Composite Outlet Structures
Basin A (Pre)
Low Flow Weir A
High Flow Weir A
Chamber B
Weir B
Chamber A
Weir A
Basin A
Culvert A
Basin B
Riser B
Basin C
Riser C
Outlet Structure
Outlet Structure Type Weir
Outlet Structure (Common)
Elevation (ft) 36.50
Outlet Structure (IDs and Direction)
Outlet ID Weir A
Flow Direction Forward Flow Only
Downstream ID Tailwater
Notes
Outlet Structure (Weir)
Weir Rectangular Weir
Vary Coefficient with Depth False
Weir Coefficient ((ft^0.5)/s) 3.00
Rectangular Weir Suppressed
Weir Length (ft) 4.00
Outlet Structure (Advanced)
Elevation (On) (ft) 0.00
Elevation (Off) (ft) 0.00
Outlet Structure (Weir, Advanced)
User Defined Table False
Outlet Structure Type
The type of structure to define.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
40.00
38.75
37.50
36.25
35.00
33.75
32.50
31.25
30.00
0.0000
5.0000
10.0000
15.0000
20.0000
25.0000
30.0000
35.0000
40.0000
45.0000
Flow (ft³/s)
Tailwater Elevation = Free Outfall (Weir A)

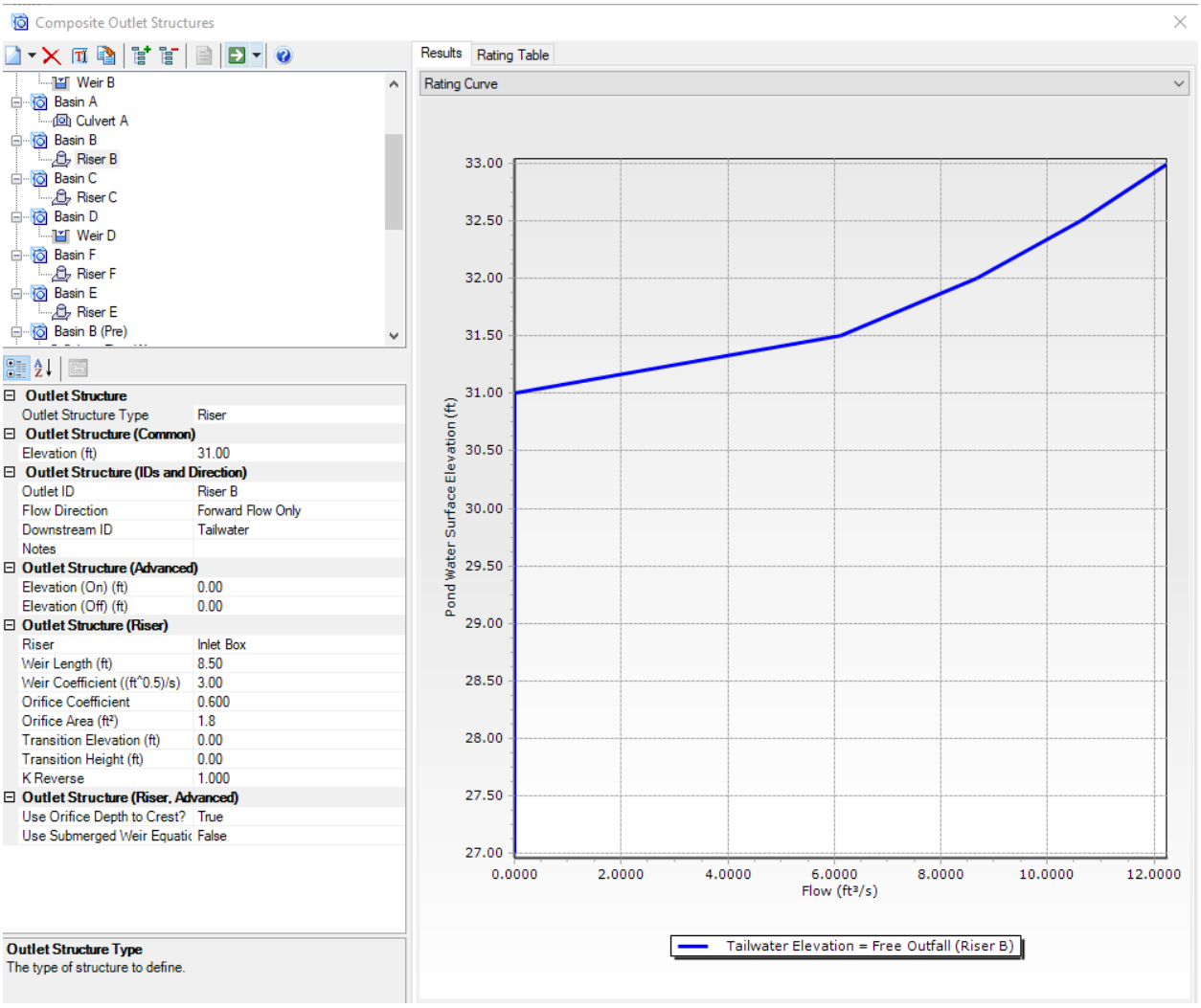

Composite Outlet Structures
Basin A (Pre)
Low Flow Weir A
High Flow Weir A
Chamber B
Weir B
Chamber A
Weir A
Basin A
Culvert A
Basin B
Riser B
Basin C
Riser C
<General>
ID 279
Label Chamber B
Notes
Headwater
Headwater Type Use Pond for Headwater Range
Pond Chamber B
Minimum (Headwater) (ft) 26.00
Increment (Headwater) (ft) 0.50
Maximum (Headwater) (ft) 39.00
Spot Elevations (Headwater) <Collection: 0 items>
Tailwater
Tailwater Type Free Outfall
Outlet Structure (Convergence Tolerances)
Maximum Iterations 30
Headwater Tolerance (Minim 0.01
Headwater Tolerance (Maxin 0.50
Tailwater Tolerance (Minimu 0.01
Tailwater Tolerance (Maxim 0.50
Flow Tolerance (Minimum) (f 0.001
Flow Tolerance (Maximum) ( 10.000
ID
Unique identifier assigned to this element.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
40.00
38.75
37.50
36.25
35.00
33.75
32.50
31.25
30.00
28.75
27.50
26.25
25.00
0.0000
5.0000
10.0000
15.0000
20.0000
25.0000
30.0000
35.0000
40.0000
45.0000
Flow (ft³/s)
Tailwater Elevation = Free Outfall (Chamber B)

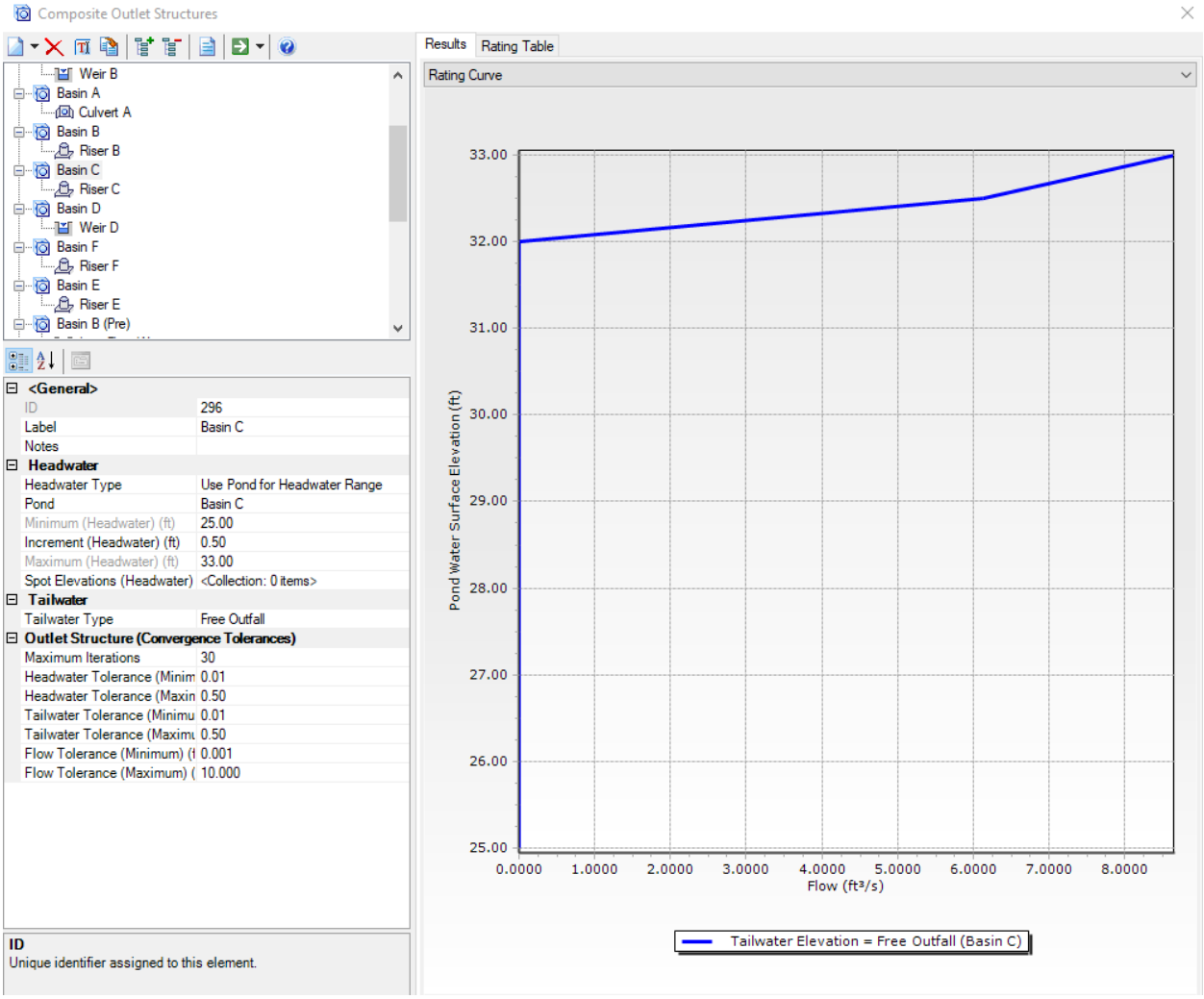

Composite Outlet Structures
Basin A (Pre)
Low Flow Weir A
High Flow Weir A
Chamber B
Weir B
Chamber A
Weir A
Basin A
Culvert A
Basin B
Riser B
Basin C
Riser C
Outlet Structure
Outlet Structure Type Weir
Outlet Structure (Common)
Elevation (ft) 36.50
Outlet Structure (IDs and Direction)
Outlet ID Weir B
Flow Direction Forward and Reverse Flow
Downstream ID Tailwater
Notes
Outlet Structure (Weir)
Weir Rectangular Weir
Vary Coefficient with Depth False
Weir Coefficient ((ft^0.5)/s) 3.00
Rectangular Weir Suppressed
Weir Length (ft) 4.00
Outlet Structure (Advanced)
Elevation (On) (ft) 0.00
Elevation (Off) (ft) 0.00
Outlet Structure (Weir, Advanced)
User Defined Table False
Outlet Structure Type
The type of structure to define.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
40.00
38.75
37.50
36.25
35.00
33.75
32.50
31.25
30.00
28.75
27.50
26.25
25.00
0.0000
5.0000
10.0000
15.0000
20.0000
25.0000
30.0000
35.0000
40.0000
45.0000
Flow (ft³/s)
Tailwater Elevation = Free Outfall (Weir B)

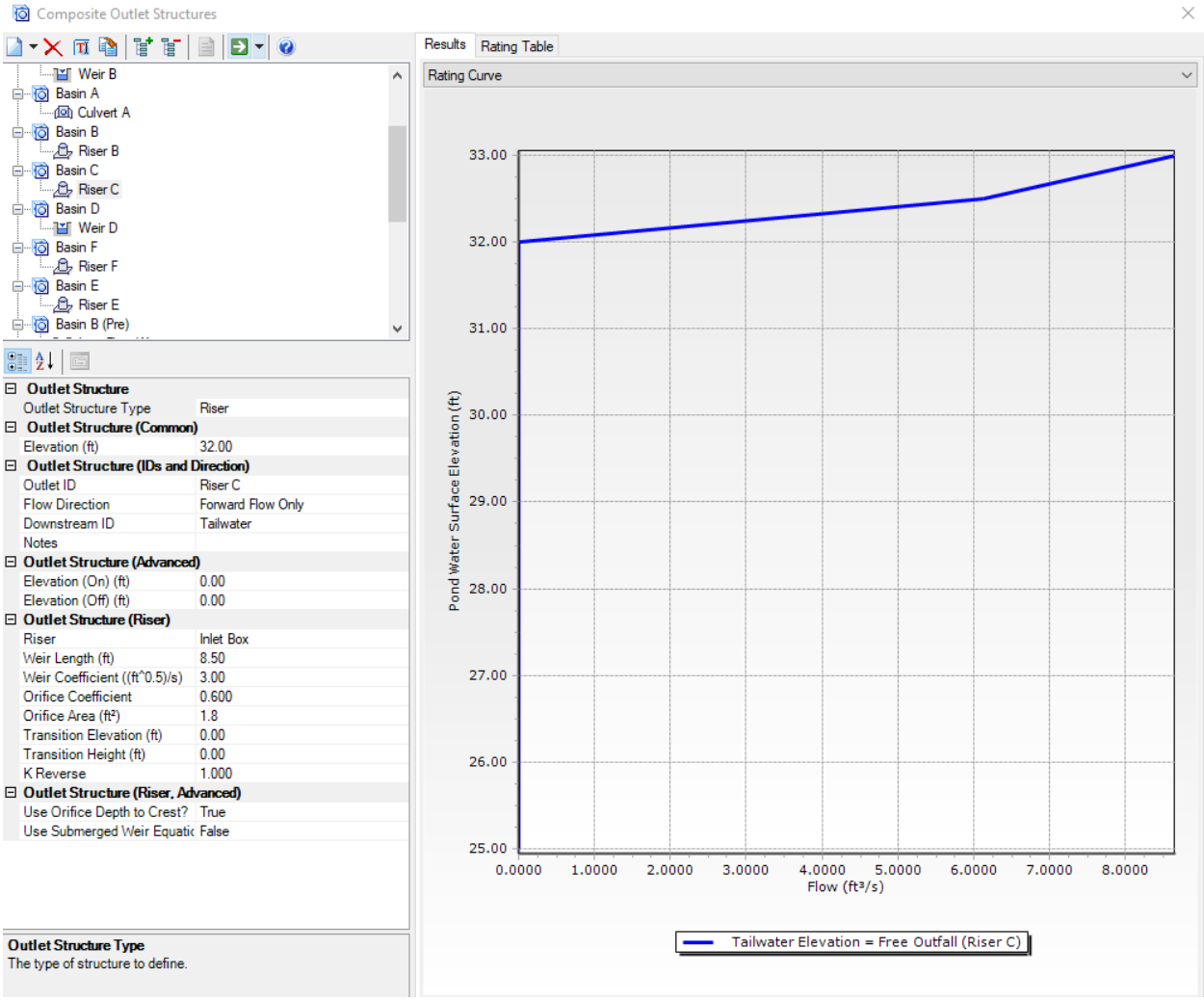

Composite Outlet Structures
Results
Rating Table
Rating Curve
Basin A (Pre)
Low Flow Weir
High Flow Weir
Chamber A
Weir A
Chamber B
Weir B
Basin A
Culvert A
Basin B
Riser B
Basin C
Riser C
Basin D
<General>
ID 285
Label Basin A
Notes
Headwater
Headwater Type Use Pond for Headwater Range
Pond Basin A
Minimum (Headwater) (ft) 33.00
Increment (Headwater) (ft) 0.50
Maximum (Headwater) (ft) 44.00
Spot Elevations (Headwater) <Collection: 0 items>
Tailwater
Tailwater Type Interconnected Ponds
Interconnected Pond Type Use Pond/Outfall for Tailwater Range
Pond/Outfall ID Chamber B
Minimum (Tailwater) (ft) 30.00
Maximum (Tailwater) (ft) 39.00
Increment (Tailwater) (ft) 0.10
Spot Elevations (Tailwater) <Collection: 0 items>
Store Elevation-Flow-Tailwat No
Outlet Structure (Convergence Tolerances)
Maximum Iterations 30
Headwater Tolerance (Minim 0.01
Headwater Tolerance (Maxin 0.50
Tailwater Tolerance (Minimu 0.01
Tailwater Tolerance (Maximu 0.50
Flow Tolerance (Minimum) (f 0.001
Flow Tolerance (Maximum) ( 10.000
ID
Unique identifier assigned to this element.
Pond Water Surface Elevation (ft)
45.00
43.75
42.50
41.25
40.00
38.75
37.50
36.25
35.00
33.75
32.50
0.0000
10.0000
20.0000
30.0000
40.0000
50.0000
Flow (ft³/s)
Tailwater Elevation = 30.00 ft (Basin A)
Tailwater Elevation = 30.10 ft (Basin A)
Tailwater Elevation = 30.20 ft (Basin A)
Tailwater Elevation = 30.30 ft (Basin A)
Tailwater Elevation = 30.40 ft (Basin A)
Tailwater Elevation = 30.50 ft (Basin A)
Tailwater Elevation = 30.60 ft (Basin A)
Tailwater Elevation = 30.70 ft (Basin A)
Tailwater Elevation = 30.80 ft (Basin A)
Tailwater Elevation = 30.90 ft (Basin A)
Tailwater Elevation = 31.00 ft (Basin A)
Tailwater Elevation = 31.10 ft (Basin A)
Tailwater Elevation = 31.20 ft (Basin A)
Tailwater Elevation = 31.30 ft (Basin A)
Tailwater Elevation = 31.40 ft (Basin A)
Tailwater Elevation = 31.50 ft (Basin A)
Tailwater Elevation = 31.60 ft (Basin A)
Tailwater Elevation = 31.70 ft (Basin A)
Tailwater Elevation = 31.80 ft (Basin A)
Tailwater Elevation = 31.90 ft (Basin A)

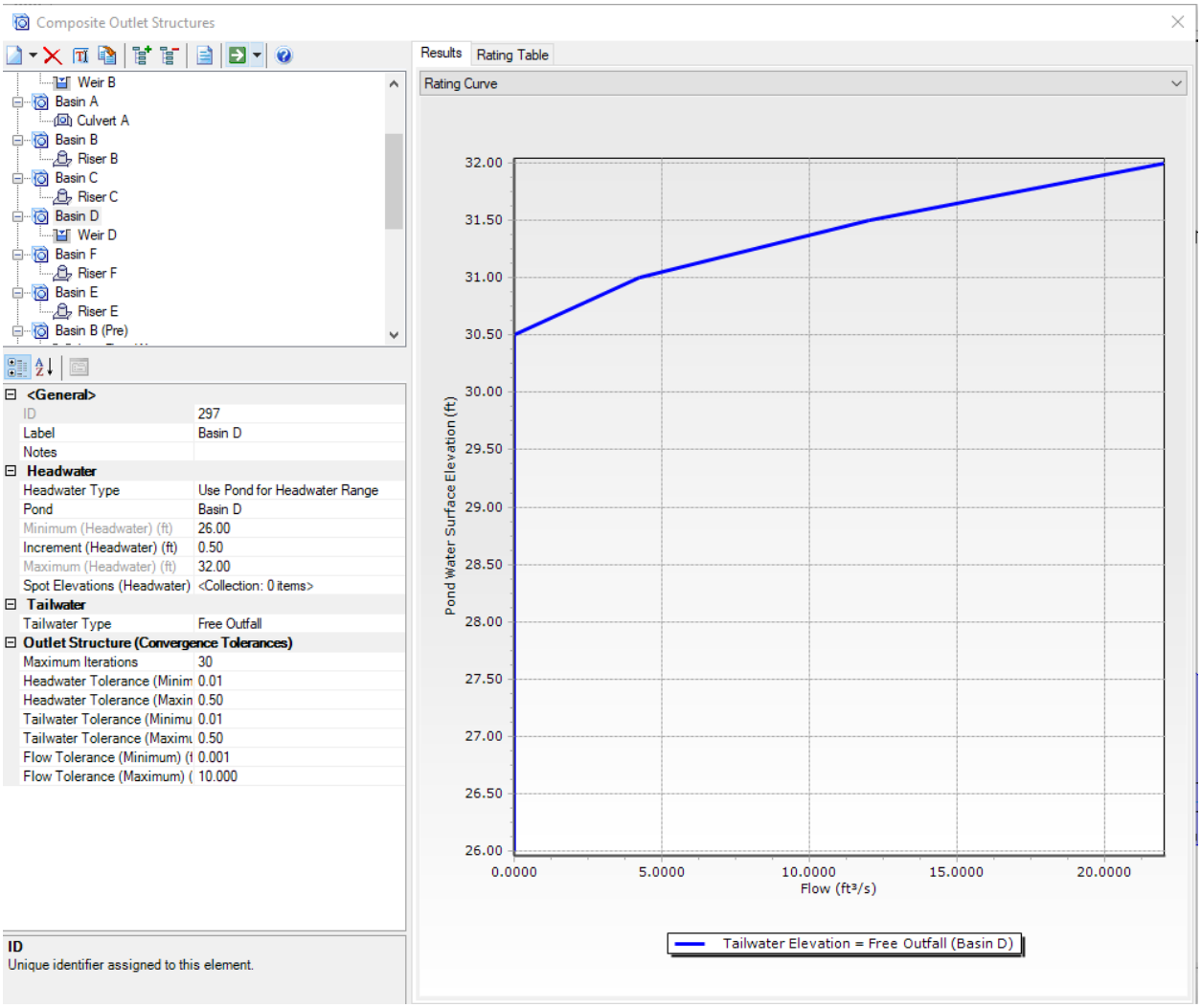

Composite Outlet Structures
Basin A (Pre)
Low Flow Weir
High Flow Weir
Chamber A
Weir A
Chamber B
Weir B
Basin A
Culvert A
Basin B
Riser B
Basin C
Riser C
Basin D
Outlet Structure
Outlet Structure Type Culvert
Culvert Type Circular
Outlet Structure (IDs and Direction)
Outlet ID Culvert A
Flow Direction Forward and Reverse Flow
Downstream ID Tailwater
Notes
Culvert (Advanced)
Convergence Tolerance (ft) 0.00
Specify Number of Backwate False
Culvert Coefficients
Inlet Description Concrete - Square edge w/headv
Chart Chart 1
Nomograph Nomograph 1
Equation Form Form 1
K 0.0098
M 2.0000
C 0.0398
Y 0.6700
Manning's n 0.013
Ke 0.500
Kr 0.000
Slope Correction Factor -0.500
Culvert Data
Number of Barrels 1
Length (ft) 1,081.00
Upstream Invert (ft) 40.00
Outlet Structure Type
The type of structure to define.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
45.00
43.75
42.50
41.25
40.00
38.75
37.50
36.25
35.00
33.75
32.50
0.0000
10.0000
20.0000
30.0000
40.0000
50.0000
Flow (ft³/s)
Tailwater Elevation = 30.00 ft (Culvert A)
Tailwater Elevation = 30.10 ft (Culvert A)
Tailwater Elevation = 30.20 ft (Culvert A)
Tailwater Elevation = 30.30 ft (Culvert A)
Tailwater Elevation = 30.40 ft (Culvert A)
Tailwater Elevation = 30.50 ft (Culvert A)
Tailwater Elevation = 30.60 ft (Culvert A)
Tailwater Elevation = 30.70 ft (Culvert A)
Tailwater Elevation = 30.80 ft (Culvert A)
Tailwater Elevation = 30.90 ft (Culvert A)

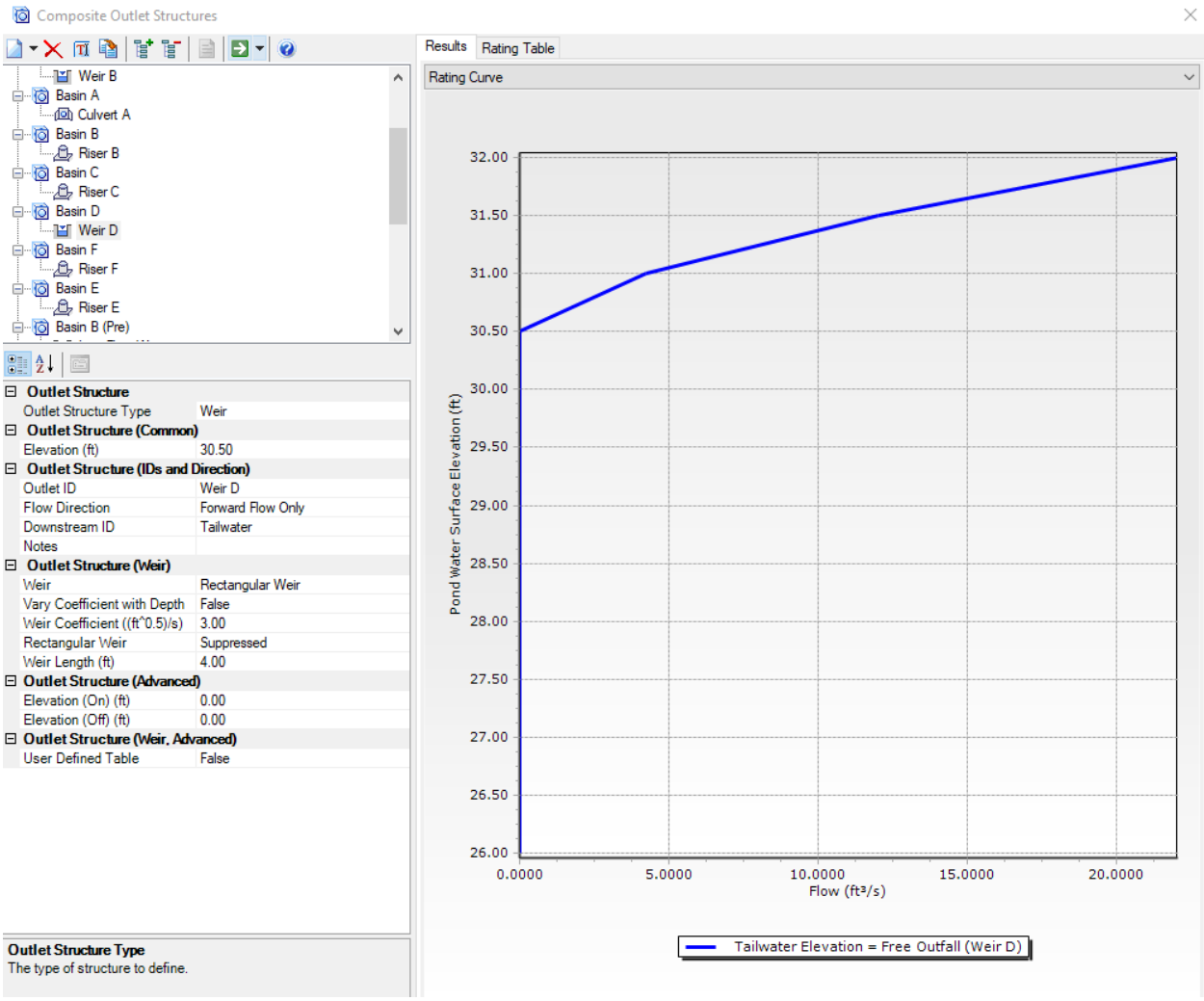

Composite Outlet Structures
Weir B
Basin A
Culvert A
Basin B
Riser B
Basin C
Riser C
Basin D
Weir D
Basin F
Riser F
Basin E
Riser E
Basin B (Pre)
<General>
ID 286
Label Basin B
Notes
Headwater
Headwater Type Use Pond for Headwater Range
Pond Basin B
Minimum (Headwater) (ft) 27.00
Increment (Headwater) (ft) 0.50
Maximum (Headwater) (ft) 33.00
Spot Elevations (Headwater) <Collection: 0 items>
Tailwater
Tailwater Type Free Outfall
Outlet Structure (Convergence Tolerances)
Maximum Iterations 30
Headwater Tolerance (Minim 0.01
Headwater Tolerance (Maxin 0.50
Tailwater Tolerance (Minimu 0.01
Tailwater Tolerance (Maxim 0.50
Flow Tolerance (Minimum) (I 0.001
Flow Tolerance (Maximum) ( 10.000
ID
Unique identifier assigned to this element.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
33.00
32.50
32.00
31.50
31.00
30.50
30.00
29.50
29.00
28.50
28.00
27.50
27.00
0.0000
2.0000
4.0000
6.0000
8.0000
10.0000
12.0000
Flow (ft³/s)
Tailwater Elevation = Free Outfall (Basin B)

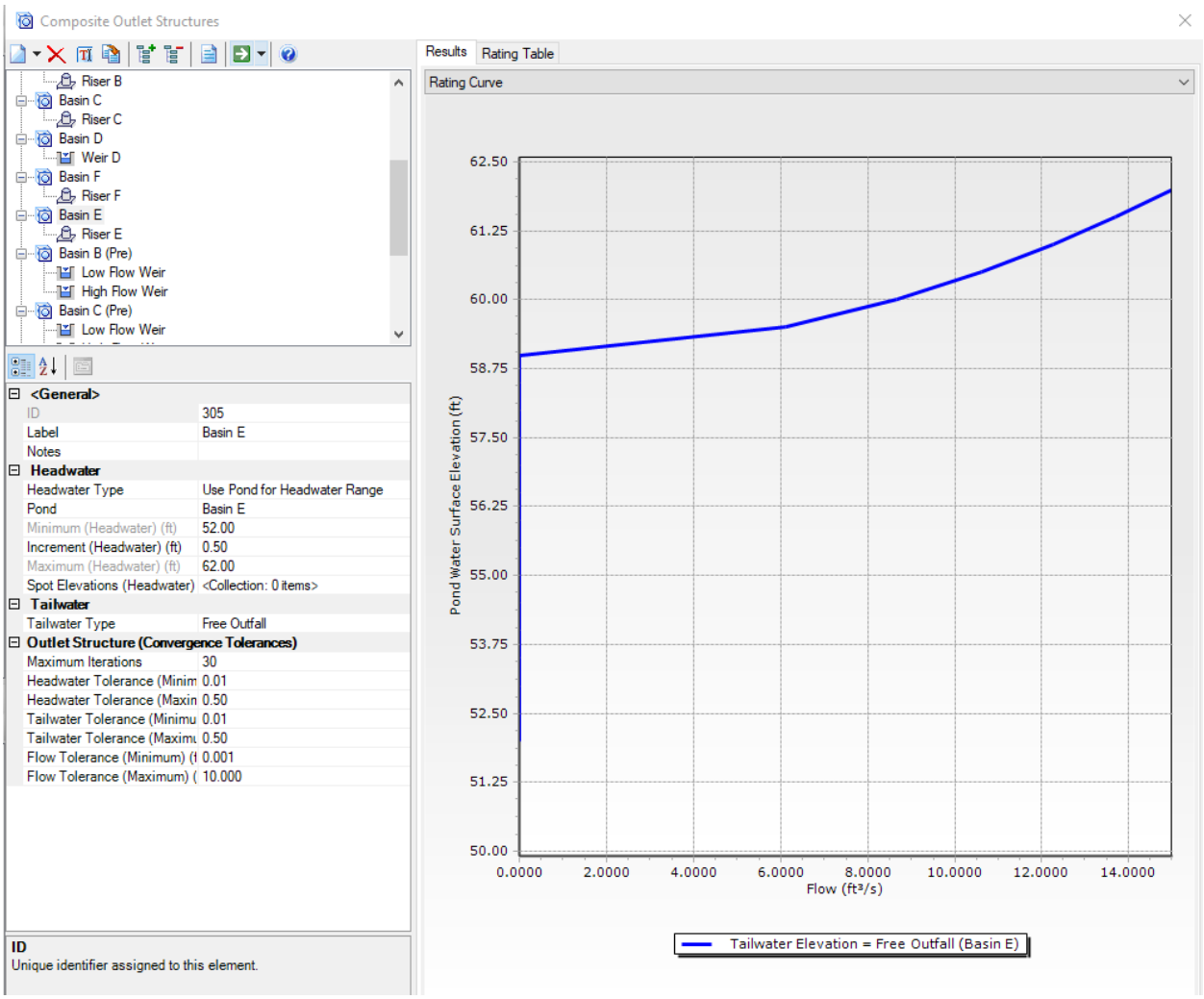

Composite Outlet Structures
Weir B
Basin A
Culvert A
Basin B
Riser B
Basin C
Riser C
Basin D
Weir D
Basin F
Riser F
Basin E
Riser E
Basin B (Pre)
Outlet Structure
Outlet Structure Type Riser
Outlet Structure (Common)
Elevation (ft) 31.00
Outlet Structure (IDs and Direction)
Outlet ID Riser B
Flow Direction Forward Flow Only
Downstream ID Tailwater
Notes
Outlet Structure (Advanced)
Elevation (On) (ft) 0.00
Elevation (Off) (ft) 0.00
Outlet Structure (Riser)
Riser Inlet Box
Weir Length (ft) 8.50
Weir Coefficient ((ft^0.5)/s) 3.00
Orifice Coefficient 0.600
Orifice Area (ft²) 1.8
Transition Elevation (ft) 0.00
Transition Height (ft) 0.00
K Reverse 1.000
Outlet Structure (Riser, Advanced)
Use Orifice Depth to Crest? True
Use Submerged Weir Equatic False
Outlet Structure Type
The type of structure to define.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
33.00
32.50
32.00
31.50
31.00
30.50
30.00
29.50
29.00
28.50
28.00
27.50
27.00
0.0000
2.0000
4.0000
6.0000
8.0000
10.0000
12.0000
Flow (ft³/s)
Tailwater Elevation = Free Outfall (Riser B)

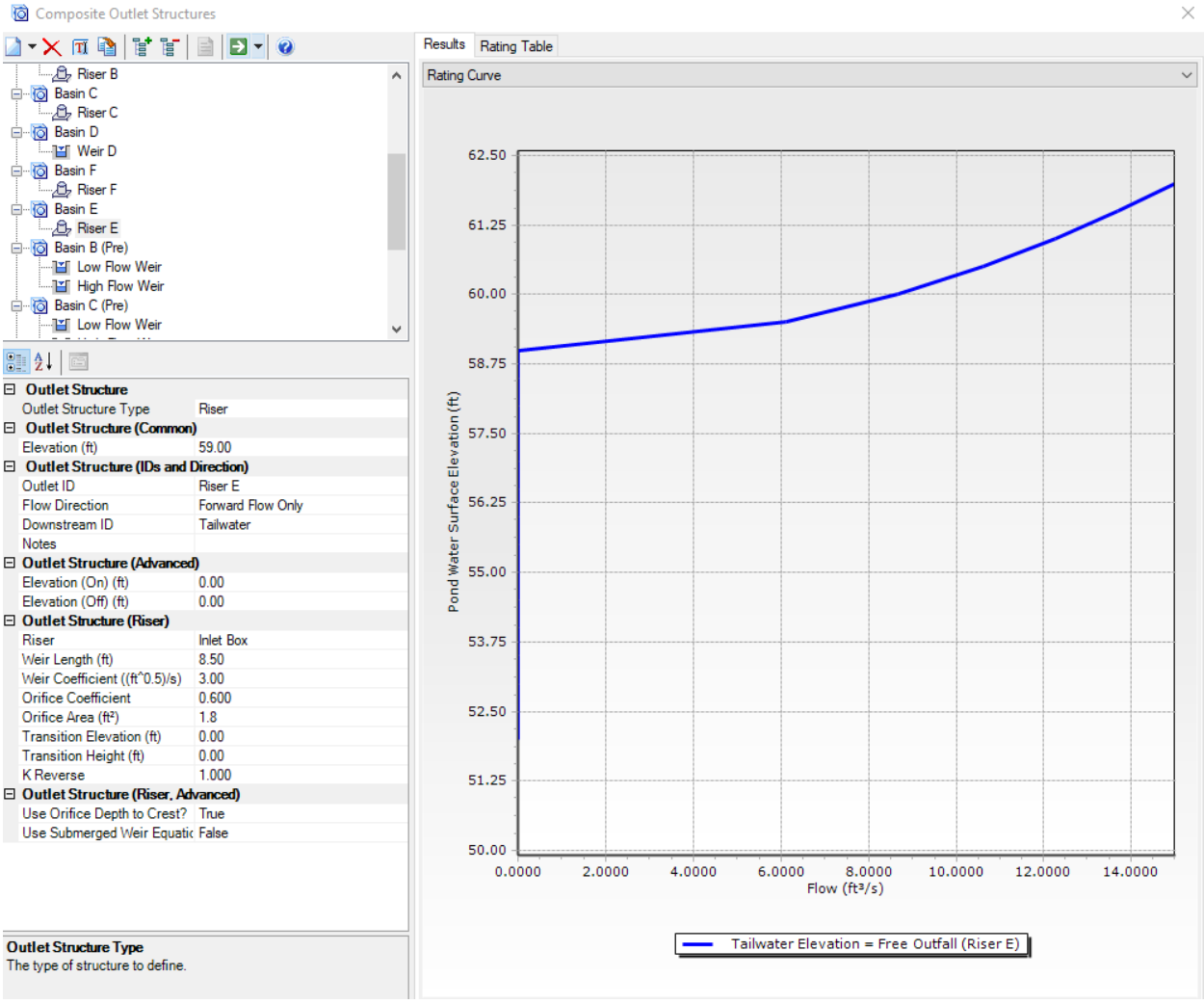

Composite Outlet Structures
Weir B
Basin A
Culvert A
Basin B
Riser B
Basin C
Riser C
Basin D
Weir D
Basin F
Riser F
Basin E
Riser E
Basin B (Pre)
<General>
ID 296
Label Basin C
Notes
Headwater
Headwater Type Use Pond for Headwater Range
Pond Basin C
Minimum (Headwater) (ft) 25.00
Increment (Headwater) (ft) 0.50
Maximum (Headwater) (ft) 33.00
Spot Elevations (Headwater) <Collection: 0 items>
Tailwater
Tailwater Type Free Outfall
Outlet Structure (Convergence Tolerances)
Maximum Iterations 30
Headwater Tolerance (Minim 0.01
Headwater Tolerance (Maxin 0.50
Tailwater Tolerance (Minimu 0.01
Tailwater Tolerance (Maximu 0.50
Flow Tolerance (Minimum) (f 0.001
Flow Tolerance (Maximum) ( 10.000
ID
Unique identifier assigned to this element.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
33.00
32.00
31.00
30.00
29.00
28.00
27.00
26.00
25.00
0.0000
1.0000
2.0000
3.0000
4.0000
5.0000
6.0000
7.0000
8.0000
Flow (ft³/s)
Tailwater Elevation = Free Outfall (Basin C)

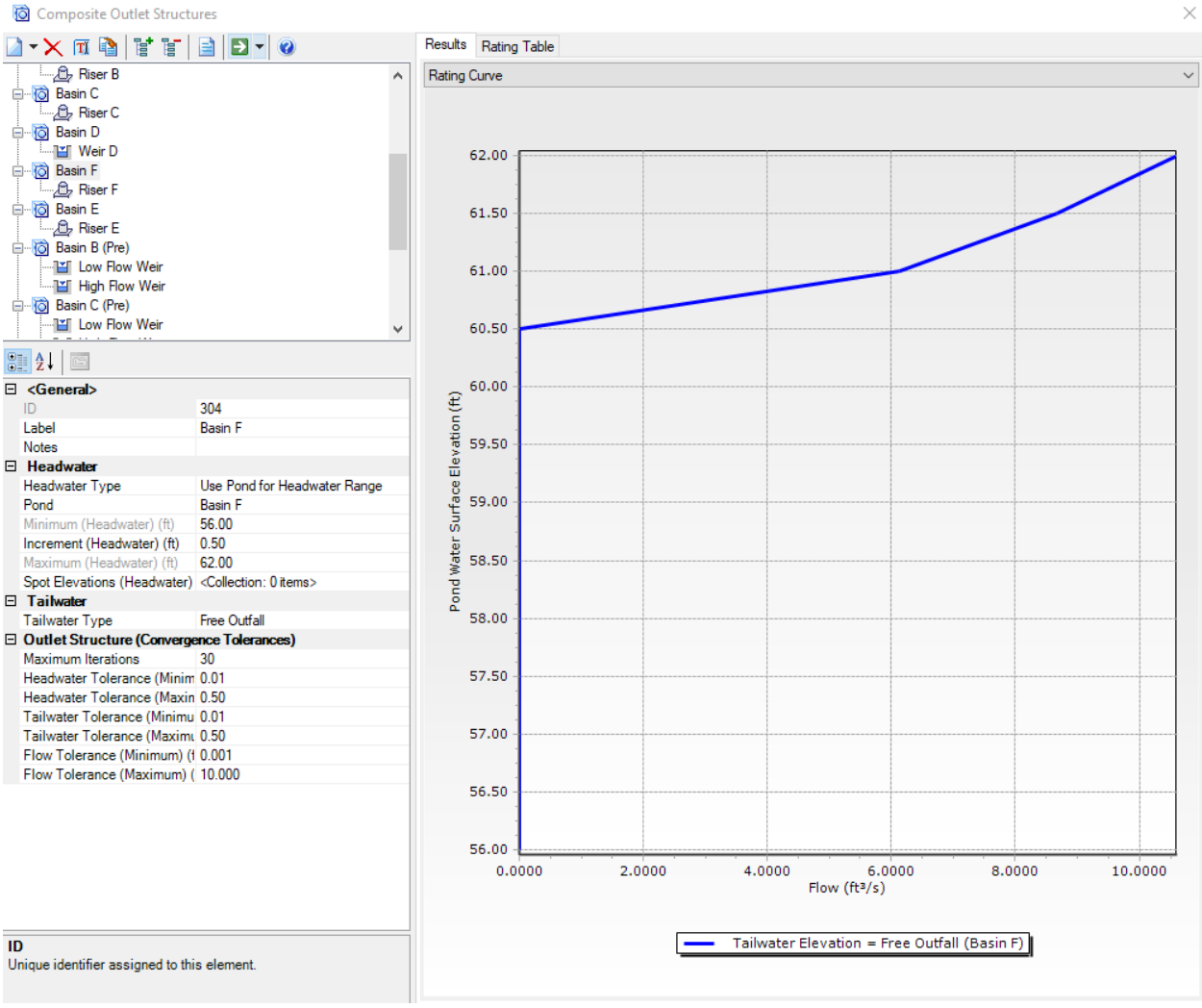

Composite Outlet Structures
Weir B
Basin A
Culvert A
Basin B
Riser B
Basin C
Riser C
Basin D
Weir D
Basin F
Riser F
Basin E
Riser E
Basin B (Pre)
Outlet Structure
Outlet Structure Type Riser
Outlet Structure (Common)
Elevation (ft) 32.00
Outlet Structure (IDs and Direction)
Outlet ID Riser C
Flow Direction Forward Flow Only
Downstream ID Tailwater
Notes
Outlet Structure (Advanced)
Elevation (On) (ft) 0.00
Elevation (Off) (ft) 0.00
Outlet Structure (Riser)
Riser Inlet Box
Weir Length (ft) 8.50
Weir Coefficient ((ft^0.5)/s) 3.00
Orifice Coefficient 0.600
Orifice Area (ft²) 1.8
Transition Elevation (ft) 0.00
Transition Height (ft) 0.00
K Reverse 1.000
Outlet Structure (Riser, Advanced)
Use Orifice Depth to Crest? True
Use Submerged Weir Equatic False
Outlet Structure Type
The type of structure to define.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
33.00
32.00
31.00
30.00
29.00
28.00
27.00
26.00
25.00
0.0000
1.0000
2.0000
3.0000
4.0000
5.0000
6.0000
7.0000
8.0000
Flow (ft³/s)
Tailwater Elevation = Free Outfall (Riser C)


Composite Outlet Structures
Weir B
Basin A
Culvert A
Basin B
Riser B
Basin C
Riser C
Basin D
Weir D
Basin F
Riser F
Basin E
Riser E
Basin B (Pre)
<General>
ID 297
Label Basin D
Notes
Headwater
Headwater Type Use Pond for Headwater Range
Pond Basin D
Minimum (Headwater) (ft) 26.00
Increment (Headwater) (ft) 0.50
Maximum (Headwater) (ft) 32.00
Spot Elevations (Headwater) <Collection: 0 items>
Tailwater
Tailwater Type Free Outfall
Outlet Structure (Convergence Tolerances)
Maximum Iterations 30
Headwater Tolerance (Minim 0.01
Headwater Tolerance (Maxin 0.50
Tailwater Tolerance (Minimu 0.01
Tailwater Tolerance (Maxim 0.50
Flow Tolerance (Minimum) (f 0.001
Flow Tolerance (Maximum) ( 10.000
ID
Unique identifier assigned to this element.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
32.00
31.50
31.00
30.50
30.00
29.50
29.00
28.50
28.00
27.50
27.00
26.50
26.00
0.0000
5.0000
10.0000
15.0000
20.0000
Flow (ft³/s)
Tailwater Elevation = Free Outfall (Basin D)


Composite Outlet Structures
Weir B
Basin A
Culvert A
Basin B
Riser B
Basin C
Riser C
Basin D
Weir D
Basin F
Riser F
Basin E
Riser E
Basin B (Pre)
Outlet Structure
Outlet Structure Type Weir
Outlet Structure (Common)
Elevation (ft) 30.50
Outlet Structure (IDs and Direction)
Outlet ID Weir D
Flow Direction Forward Flow Only
Downstream ID Tailwater
Notes
Outlet Structure (Weir)
Weir Rectangular Weir
Vary Coefficient with Depth False
Weir Coefficient ((ft^0.5)/s) 3.00
Rectangular Weir Suppressed
Weir Length (ft) 4.00
Outlet Structure (Advanced)
Elevation (On) (ft) 0.00
Elevation (Off) (ft) 0.00
Outlet Structure (Weir, Advanced)
User Defined Table False
Outlet Structure Type
The type of structure to define.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
32.00
31.50
31.00
30.50
30.00
29.50
29.00
28.50
28.00
27.50
27.00
26.50
26.00
0.0000
5.0000
10.0000
15.0000
20.0000
Flow (ft³/s)
Tailwater Elevation = Free Outfall (Weir D)


Composite Outlet Structures
Riser B
Basin C
Riser C
Basin D
Weir D
Basin F
Riser F
Basin E
Riser E
Basin B (Pre)
Low Flow Weir
High Flow Weir
Basin C (Pre)
Low Flow Weir
<General>
ID 305
Label Basin E
Notes
Headwater
Headwater Type Use Pond for Headwater Range
Pond Basin E
Minimum (Headwater) (ft) 52.00
Increment (Headwater) (ft) 0.50
Maximum (Headwater) (ft) 62.00
Spot Elevations (Headwater) <Collection: 0 items>
Tailwater
Tailwater Type Free Outfall
Outlet Structure (Convergence Tolerances)
Maximum Iterations 30
Headwater Tolerance (Minim 0.01
Headwater Tolerance (Maxin 0.50
Tailwater Tolerance (Minimu 0.01
Tailwater Tolerance (Maximu 0.50
Flow Tolerance (Minimum) (f 0.001
Flow Tolerance (Maximum) ( 10.000
ID
Unique identifier assigned to this element.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
62.50
61.25
60.00
58.75
57.50
56.25
55.00
53.75
52.50
51.25
50.00
0.0000
2.0000
4.0000
6.0000
8.0000
10.0000
12.0000
14.0000
Flow (ft³/s)
Tailwater Elevation = Free Outfall (Basin E)


Composite Outlet Structures
Riser B
Basin C
Riser C
Basin D
Weir D
Basin F
Riser F
Basin E
Riser E
Basin B (Pre)
Low Flow Weir
High Flow Weir
Basin C (Pre)
Low Flow Weir
Outlet Structure
Outlet Structure Type Riser
Outlet Structure (Common)
Elevation (ft) 59.00
Outlet Structure (IDs and Direction)
Outlet ID Riser E
Flow Direction Forward Flow Only
Downstream ID Tailwater
Notes
Outlet Structure (Advanced)
Elevation (On) (ft) 0.00
Elevation (Off) (ft) 0.00
Outlet Structure (Riser)
Riser Inlet Box
Weir Length (ft) 8.50
Weir Coefficient ((ft^0.5)/s) 3.00
Orifice Coefficient 0.600
Orifice Area (ft²) 1.8
Transition Elevation (ft) 0.00
Transition Height (ft) 0.00
K Reverse 1.000
Outlet Structure (Riser, Advanced)
Use Orifice Depth to Crest? True
Use Submerged Weir Equatic False
Outlet Structure Type
The type of structure to define.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
62.50
61.25
60.00
58.75
57.50
56.25
55.00
53.75
52.50
51.25
50.00
0.0000
2.0000
4.0000
6.0000
8.0000
10.0000
12.0000
14.0000
Flow (ft³/s)
Tailwater Elevation = Free Outfall (Riser E)


Composite Outlet Structures
Riser B
Basin C
Riser C
Basin D
Weir D
Basin F
Riser F
Basin E
Riser E
Basin B (Pre)
Low Flow Weir
High Flow Weir
Basin C (Pre)
Low Flow Weir
<General>
ID 304
Label Basin F
Notes
Headwater
Headwater Type Use Pond for Headwater Range
Pond Basin F
Minimum (Headwater) (ft) 56.00
Increment (Headwater) (ft) 0.50
Maximum (Headwater) (ft) 62.00
Spot Elevations (Headwater) <Collection: 0 items>
Tailwater
Tailwater Type Free Outfall
Outlet Structure (Convergence Tolerances)
Maximum Iterations 30
Headwater Tolerance (Minim 0.01
Headwater Tolerance (Maxin 0.50
Tailwater Tolerance (Minimu 0.01
Tailwater Tolerance (Maxim 0.50
Flow Tolerance (Minimum) (1 0.001
Flow Tolerance (Maximum) ( 10.000
ID
Unique identifier assigned to this element.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
62.00
61.50
61.00
60.50
60.00
59.50
59.00
58.50
58.00
57.50
57.00
56.50
56.00
0.0000
2.0000
4.0000
6.0000
8.0000
10.0000
Flow (ft³/s)
Tailwater Elevation = Free Outfall (Basin F)

Composite Outlet Structures

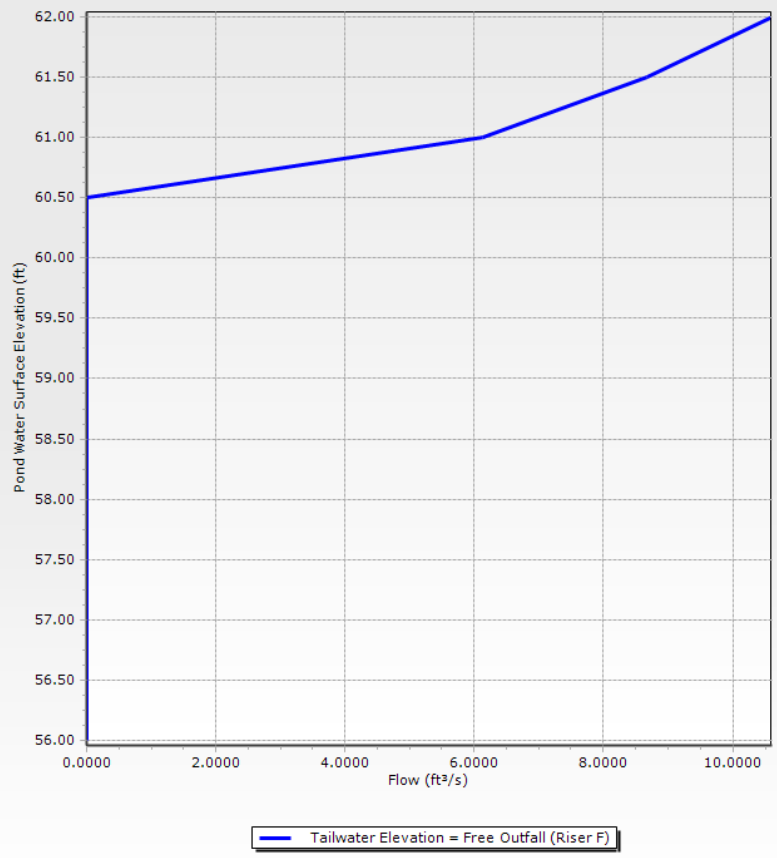
- Riser B
- Basin C
  - Riser C
- Basin D
  - Weir D
- Basin F
  - Riser F
- Basin E
  - Riser E
- Basin B (Pre)
  - Low Flow Weir
  - High Flow Weir
- Basin C (Pre)
  - Low Flow Weir

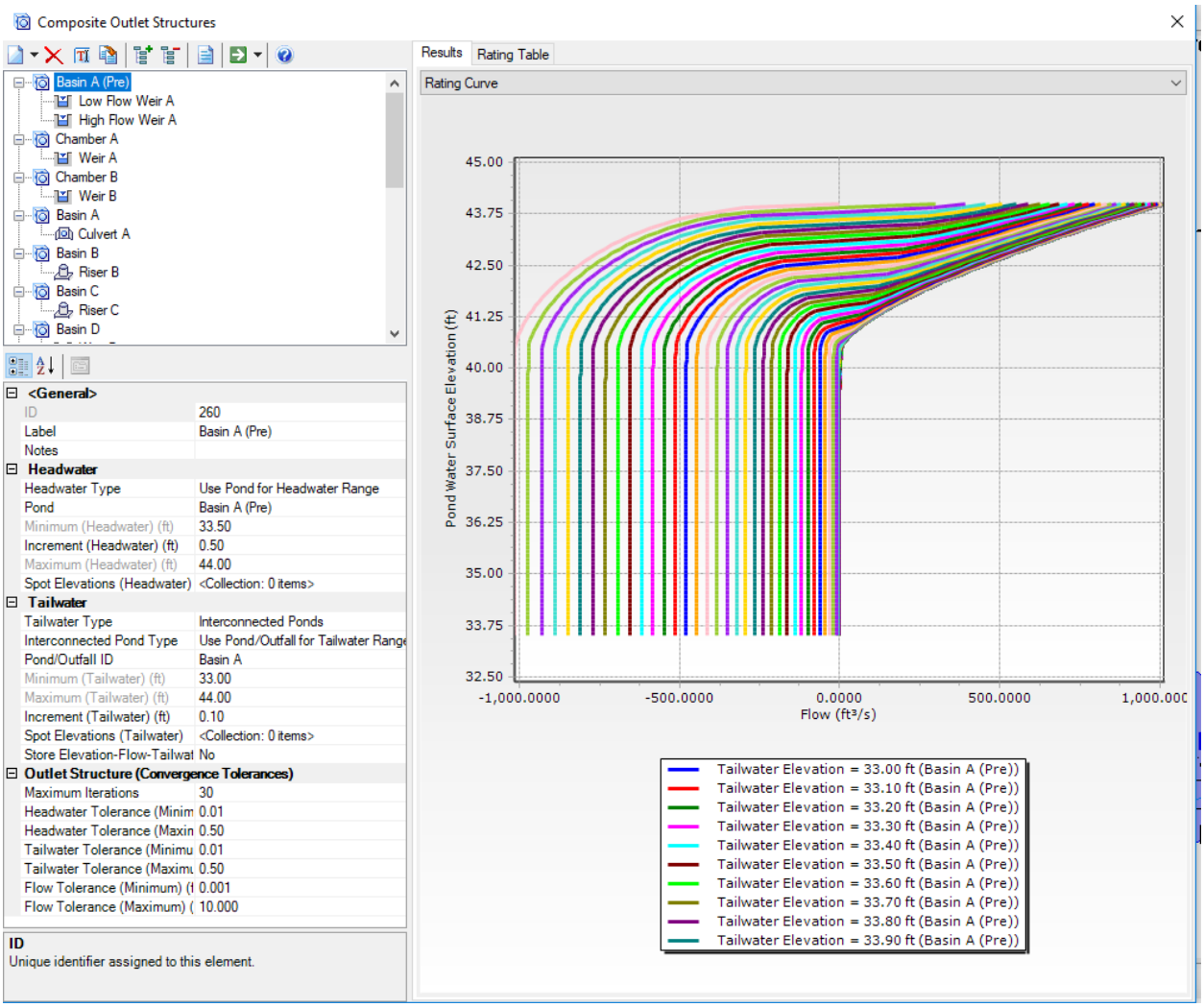
| | |
|---|---|
| **Outlet Structure** | |
| Outlet Structure Type | Riser |
| **Outlet Structure (Common)** | |
| Elevation (ft) | 60.50 |
| **Outlet Structure (IDs and Direction)** | |
| Outlet ID | Riser F |
| Flow Direction | Forward Flow Only |
| Downstream ID | Tailwater |
| Notes | |
| **Outlet Structure (Advanced)** | |
| Elevation (On) (ft) | 0.00 |
| Elevation (Off) (ft) | 0.00 |
| **Outlet Structure (Riser)** | |
| Riser | Inlet Box |
| Weir Length (ft) | 8.50 |
| Weir Coefficient ((ft^0.5)/s) | 3.00 |
| Orifice Coefficient | 0.600 |
| Orifice Area (ft²) | 1.8 |
| Transition Elevation (ft) | 0.00 |
| Transition Height (ft) | 0.00 |
| K Reverse | 1.000 |
| **Outlet Structure (Riser, Advanced)** | |
| Use Orifice Depth to Crest? | True |
| Use Submerged Weir Equatic | False |

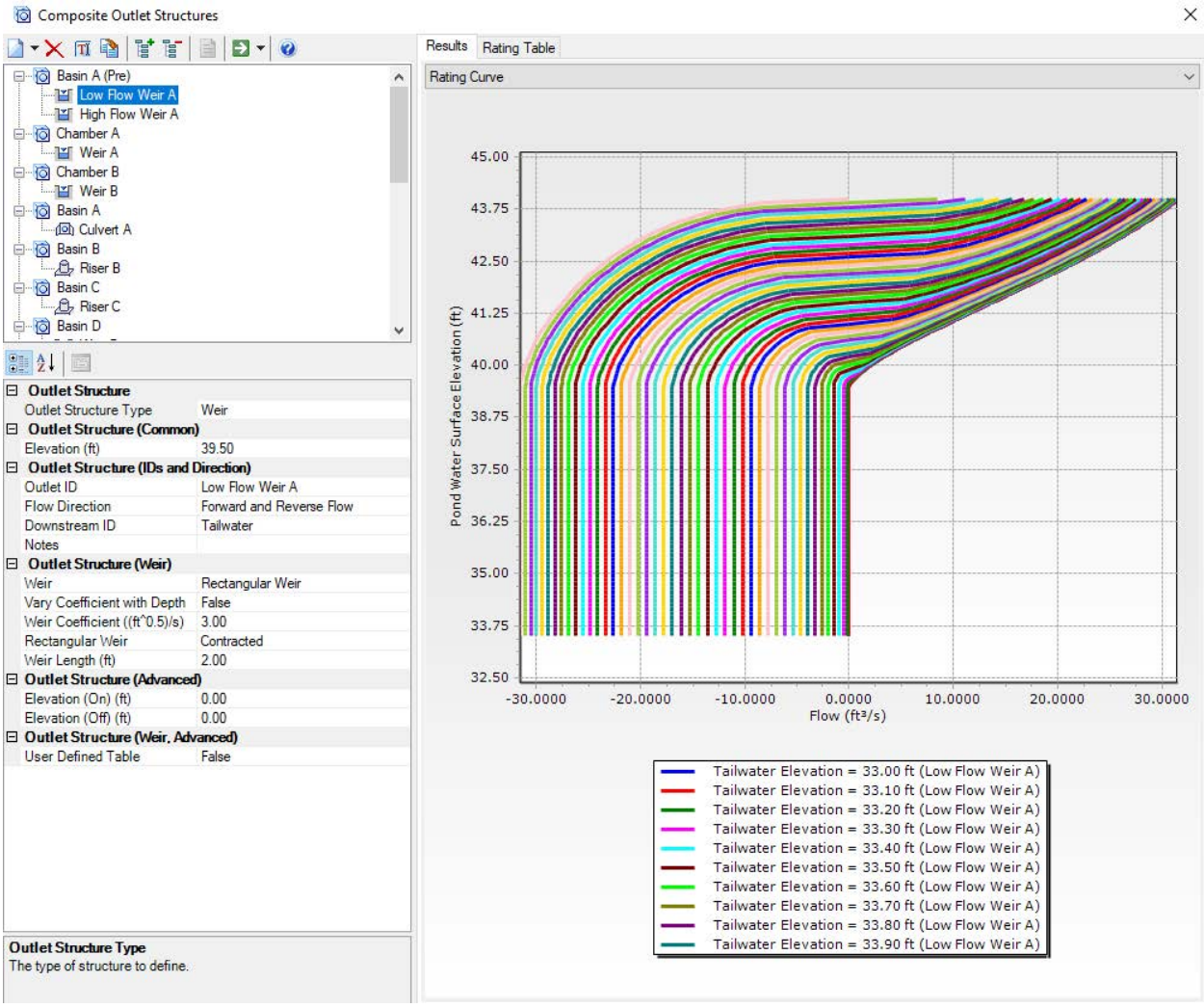
**Outlet Structure Type**
The type of structure to define.

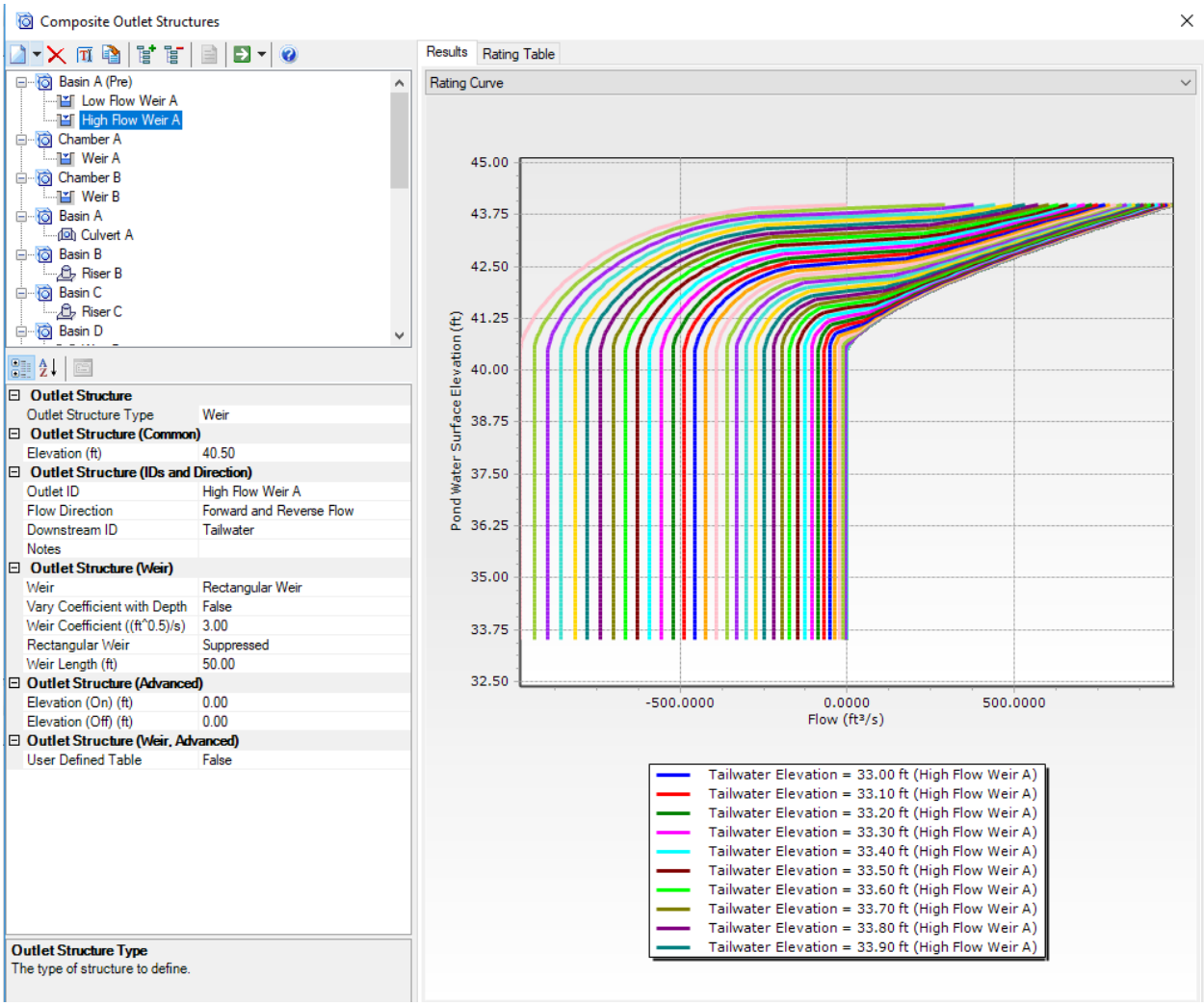
Results | Rating Table

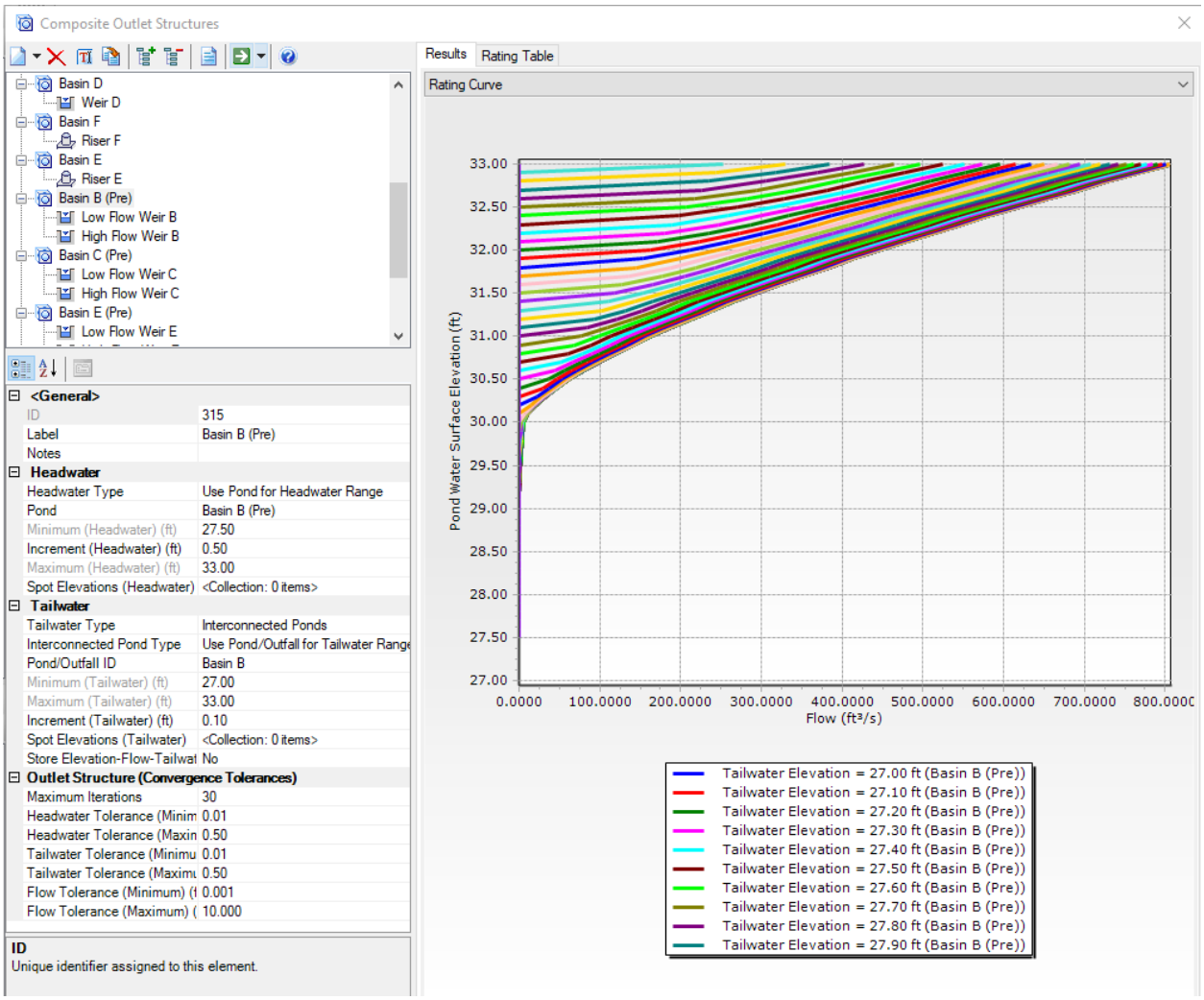
Rating Curve

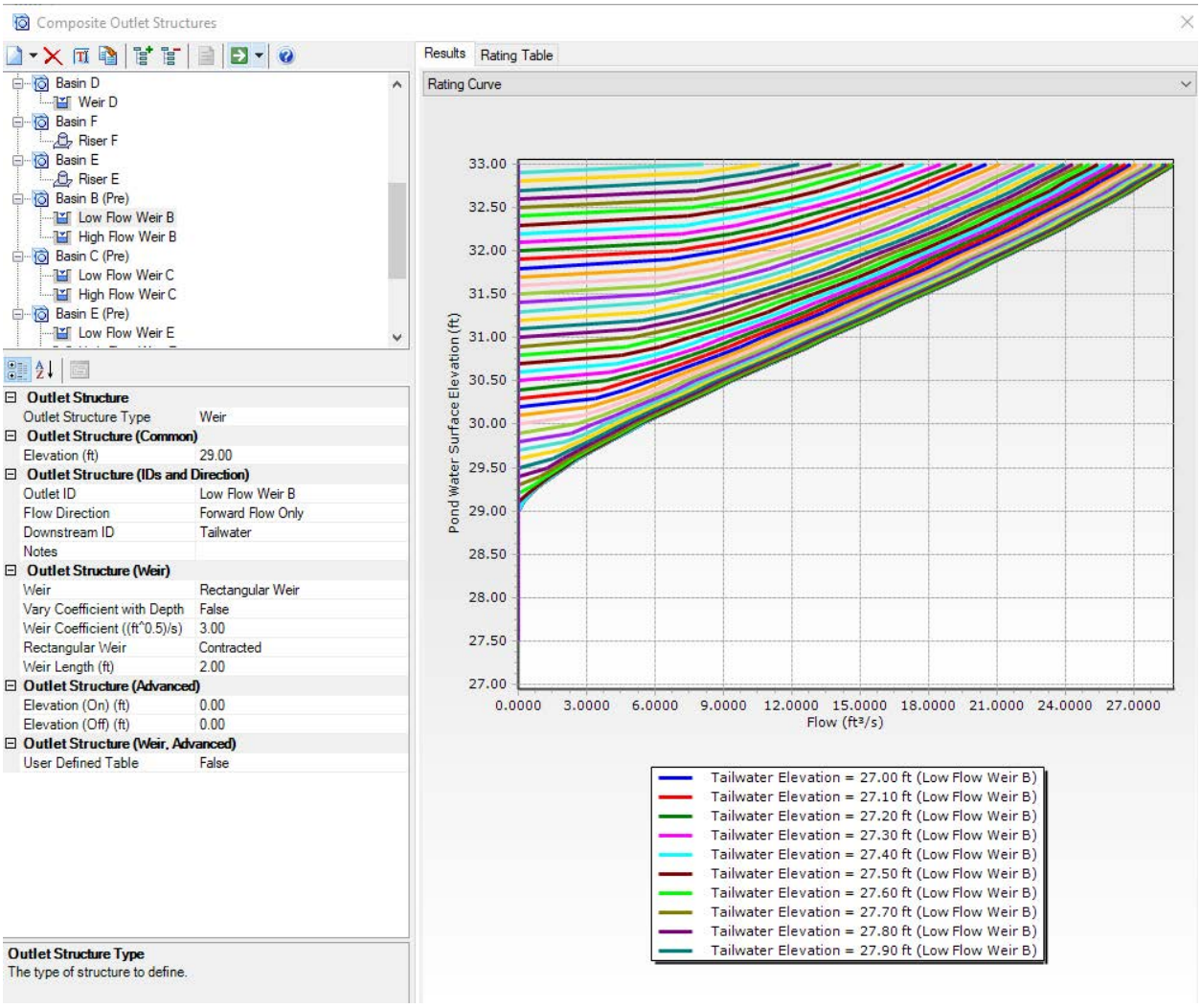


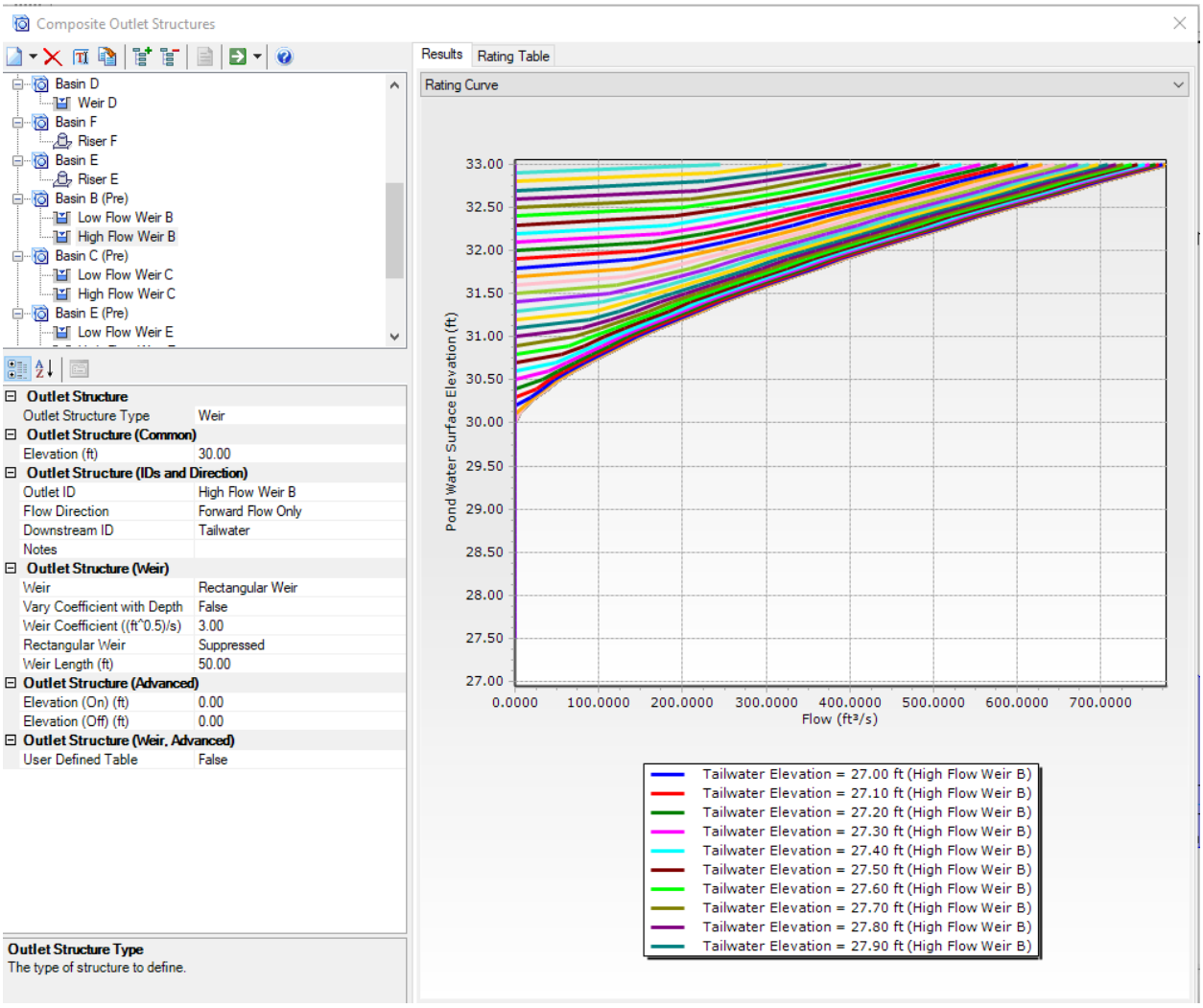

Composite Outlet Structures
Basin A (Pre)
Low Flow Weir A
High Flow Weir A
Chamber A
Weir A
Chamber B
Weir B
Basin A
Culvert A
Basin B
Riser B
Basin C
Riser C
Basin D
<General>
ID 260
Label Basin A (Pre)
Notes
Headwater
Headwater Type Use Pond for Headwater Range
Pond Basin A (Pre)
Minimum (Headwater) (ft) 33.50
Increment (Headwater) (ft) 0.50
Maximum (Headwater) (ft) 44.00
Spot Elevations (Headwater) <Collection: 0 items>
Tailwater
Tailwater Type Interconnected Ponds
Interconnected Pond Type Use Pond/Outfall for Tailwater Range
Pond/Outfall ID Basin A
Minimum (Tailwater) (ft) 33.00
Maximum (Tailwater) (ft) 44.00
Increment (Tailwater) (ft) 0.10
Spot Elevations (Tailwater) <Collection: 0 items>
Store Elevation-Flow-Tailwat No
Outlet Structure (Convergence Tolerances)
Maximum Iterations 30
Headwater Tolerance (Minim 0.01
Headwater Tolerance (Maxin 0.50
Tailwater Tolerance (Minimu 0.01
Tailwater Tolerance (Maximu 0.50
Flow Tolerance (Minimum) (I 0.001
Flow Tolerance (Maximum) ( 10.000
ID
Unique identifier assigned to this element.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
45.00
43.75
42.50
41.25
40.00
38.75
37.50
36.25
35.00
33.75
32.50
-1,000.0000
-500.0000
0.0000
500.0000
1,000.000
Flow (ft³/s)
Tailwater Elevation = 33.00 ft (Basin A (Pre))
Tailwater Elevation = 33.10 ft (Basin A (Pre))
Tailwater Elevation = 33.20 ft (Basin A (Pre))
Tailwater Elevation = 33.30 ft (Basin A (Pre))
Tailwater Elevation = 33.40 ft (Basin A (Pre))
Tailwater Elevation = 33.50 ft (Basin A (Pre))
Tailwater Elevation = 33.60 ft (Basin A (Pre))
Tailwater Elevation = 33.70 ft (Basin A (Pre))
Tailwater Elevation = 33.80 ft (Basin A (Pre))
Tailwater Elevation = 33.90 ft (Basin A (Pre))

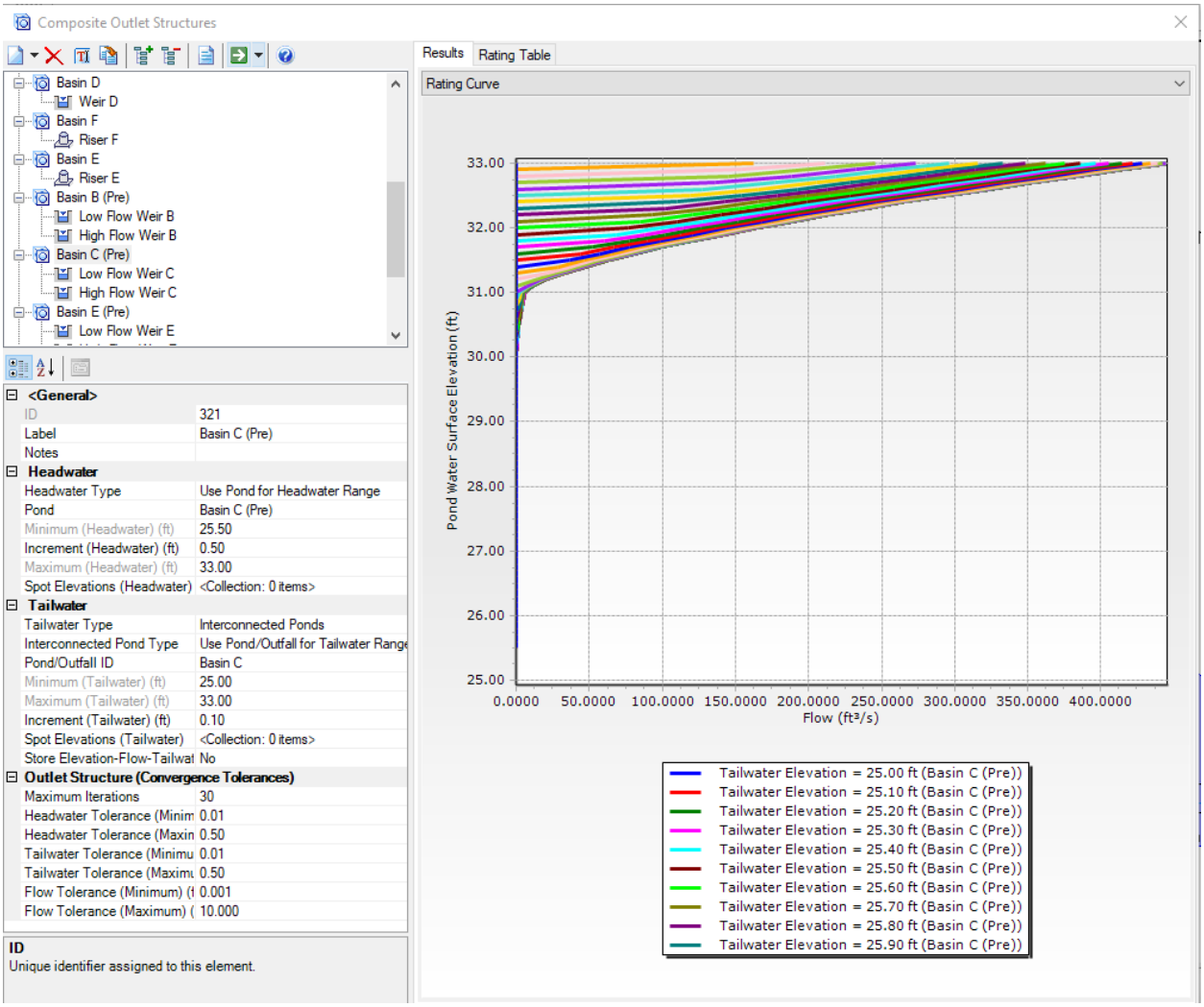

Composite Outlet Structures
Basin A (Pre)
Low Flow Weir A
High Flow Weir A
Chamber A
Weir A
Chamber B
Weir B
Basin A
Culvert A
Basin B
Riser B
Basin C
Riser C
Basin D
Outlet Structure
Outlet Structure Type Weir
Outlet Structure (Common)
Elevation (ft) 39.50
Outlet Structure (IDs and Direction)
Outlet ID Low Flow Weir A
Flow Direction Forward and Reverse Flow
Downstream ID Tailwater
Notes
Outlet Structure (Weir)
Weir Rectangular Weir
Vary Coefficient with Depth False
Weir Coefficient ((ft^0.5)/s) 3.00
Rectangular Weir Contracted
Weir Length (ft) 2.00
Outlet Structure (Advanced)
Elevation (On) (ft) 0.00
Elevation (Off) (ft) 0.00
Outlet Structure (Weir, Advanced)
User Defined Table False
Outlet Structure Type
The type of structure to define.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
45.00
43.75
42.50
41.25
40.00
38.75
37.50
36.25
35.00
33.75
32.50
-30.0000
-20.0000
-10.0000
0.0000
10.0000
20.0000
30.0000
Flow (ft³/s)
Tailwater Elevation = 33.00 ft (Low Flow Weir A)
Tailwater Elevation = 33.10 ft (Low Flow Weir A)
Tailwater Elevation = 33.20 ft (Low Flow Weir A)
Tailwater Elevation = 33.30 ft (Low Flow Weir A)
Tailwater Elevation = 33.40 ft (Low Flow Weir A)
Tailwater Elevation = 33.50 ft (Low Flow Weir A)
Tailwater Elevation = 33.60 ft (Low Flow Weir A)
Tailwater Elevation = 33.70 ft (Low Flow Weir A)
Tailwater Elevation = 33.80 ft (Low Flow Weir A)
Tailwater Elevation = 33.90 ft (Low Flow Weir A)

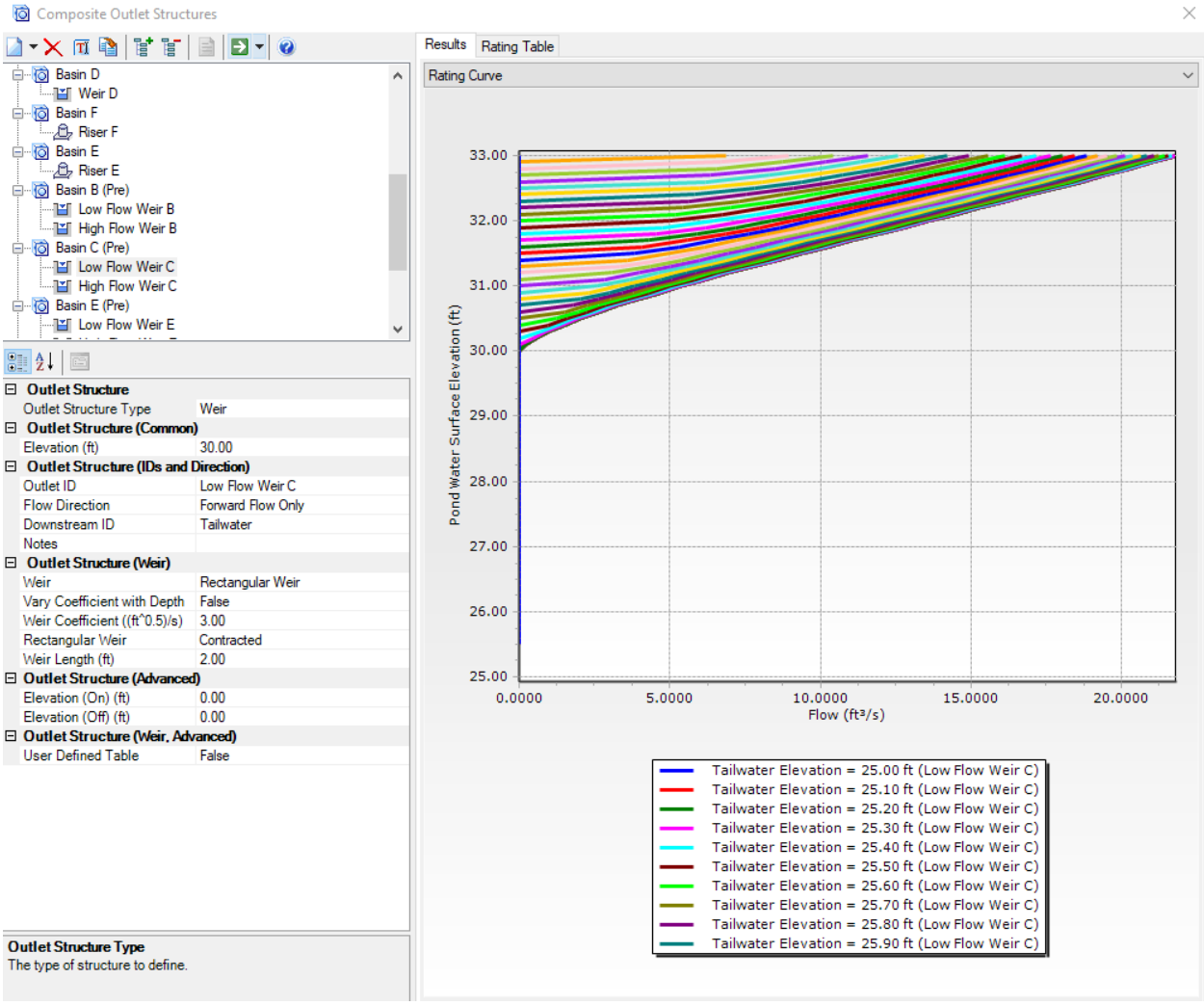

Composite Outlet Structures
Basin A (Pre)
Low Flow Weir A
High Flow Weir A
Chamber A
Weir A
Chamber B
Weir B
Basin A
Culvert A
Basin B
Riser B
Basin C
Riser C
Basin D
Outlet Structure
Outlet Structure Type Weir
Outlet Structure (Common)
Elevation (ft) 40.50
Outlet Structure (IDs and Direction)
Outlet ID High Flow Weir A
Flow Direction Forward and Reverse Flow
Downstream ID Tailwater
Notes
Outlet Structure (Weir)
Weir Rectangular Weir
Vary Coefficient with Depth False
Weir Coefficient ((ft^0.5)/s) 3.00
Rectangular Weir Suppressed
Weir Length (ft) 50.00
Outlet Structure (Advanced)
Elevation (On) (ft) 0.00
Elevation (Off) (ft) 0.00
Outlet Structure (Weir, Advanced)
User Defined Table False
Outlet Structure Type
The type of structure to define.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
45.00
43.75
42.50
41.25
40.00
38.75
37.50
36.25
35.00
33.75
32.50
-500.0000
0.0000
500.0000
Flow (ft³/s)
Tailwater Elevation = 33.00 ft (High Flow Weir A)
Tailwater Elevation = 33.10 ft (High Flow Weir A)
Tailwater Elevation = 33.20 ft (High Flow Weir A)
Tailwater Elevation = 33.30 ft (High Flow Weir A)
Tailwater Elevation = 33.40 ft (High Flow Weir A)
Tailwater Elevation = 33.50 ft (High Flow Weir A)
Tailwater Elevation = 33.60 ft (High Flow Weir A)
Tailwater Elevation = 33.70 ft (High Flow Weir A)
Tailwater Elevation = 33.80 ft (High Flow Weir A)
Tailwater Elevation = 33.90 ft (High Flow Weir A)

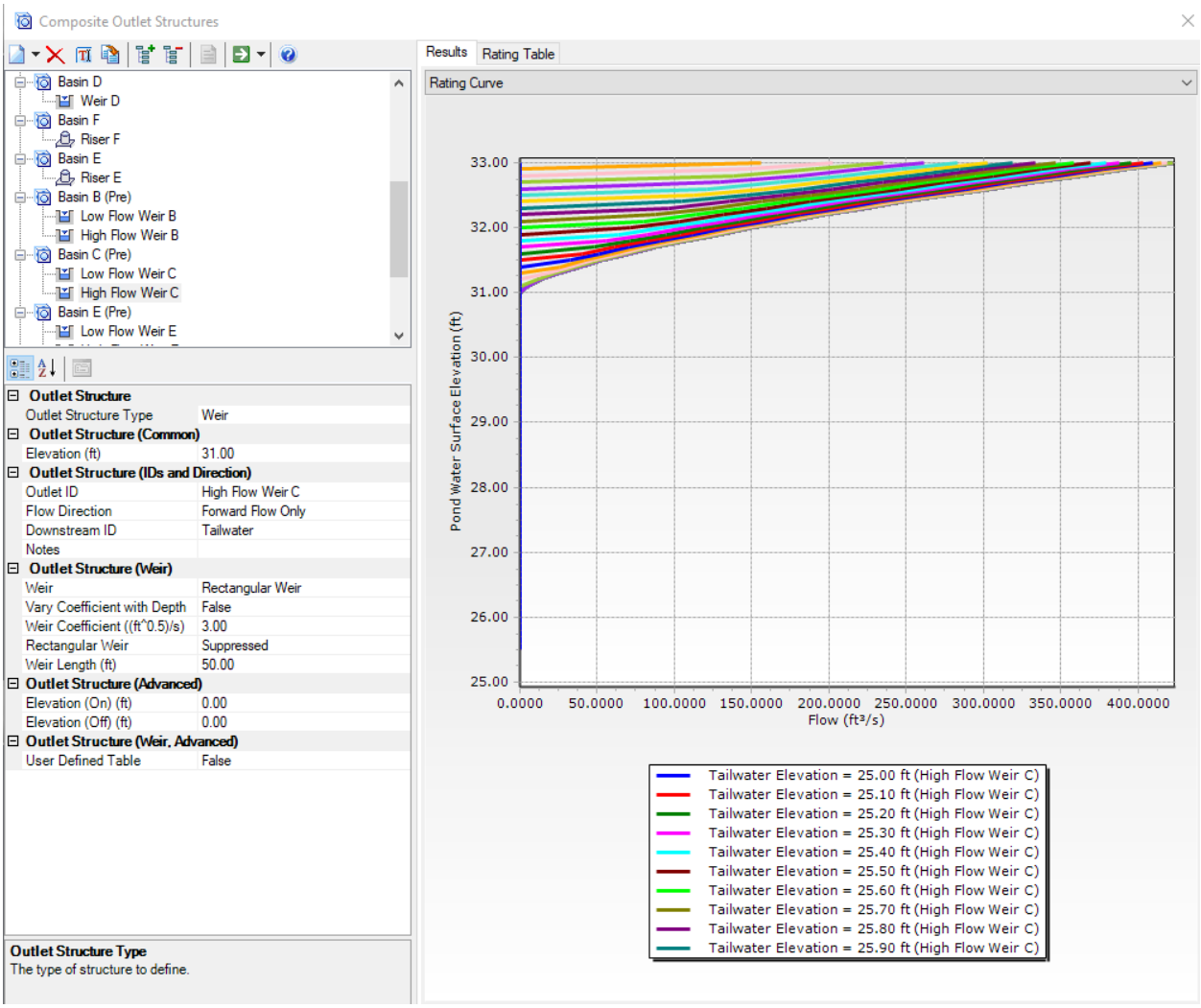

Composite Outlet Structures
Results
Rating Table
Rating Curve
Basin D
Weir D
Basin F
Riser F
Basin E
Riser E
Basin B (Pre)
Low Flow Weir B
High Flow Weir B
Basin C (Pre)
Low Flow Weir C
High Flow Weir C
Basin E (Pre)
Low Flow Weir E
<General>
ID 315
Label Basin B (Pre)
Notes
Headwater
Headwater Type Use Pond for Headwater Range
Pond Basin B (Pre)
Minimum (Headwater) (ft) 27.50
Increment (Headwater) (ft) 0.50
Maximum (Headwater) (ft) 33.00
Spot Elevations (Headwater) <Collection: 0 items>
Tailwater
Tailwater Type Interconnected Ponds
Interconnected Pond Type Use Pond/Outfall for Tailwater Range
Pond/Outfall ID Basin B
Minimum (Tailwater) (ft) 27.00
Maximum (Tailwater) (ft) 33.00
Increment (Tailwater) (ft) 0.10
Spot Elevations (Tailwater) <Collection: 0 items>
Store Elevation-Flow-Tailwat No
Outlet Structure (Convergence Tolerances)
Maximum Iterations 30
Headwater Tolerance (Minim 0.01
Headwater Tolerance (Maxin 0.50
Tailwater Tolerance (Minimu 0.01
Tailwater Tolerance (Maximu 0.50
Flow Tolerance (Minimum) (t 0.001
Flow Tolerance (Maximum) ( 10.000
ID
Unique identifier assigned to this element.
Pond Water Surface Elevation (ft)
33.00
32.50
32.00
31.50
31.00
30.50
30.00
29.50
29.00
28.50
28.00
27.50
27.00
0.0000
100.0000
200.0000
300.0000
400.0000
500.0000
600.0000
700.0000
800.0000
Flow (ft³/s)
Tailwater Elevation = 27.00 ft (Basin B (Pre))
Tailwater Elevation = 27.10 ft (Basin B (Pre))
Tailwater Elevation = 27.20 ft (Basin B (Pre))
Tailwater Elevation = 27.30 ft (Basin B (Pre))
Tailwater Elevation = 27.40 ft (Basin B (Pre))
Tailwater Elevation = 27.50 ft (Basin B (Pre))
Tailwater Elevation = 27.60 ft (Basin B (Pre))
Tailwater Elevation = 27.70 ft (Basin B (Pre))
Tailwater Elevation = 27.80 ft (Basin B (Pre))
Tailwater Elevation = 27.90 ft (Basin B (Pre))

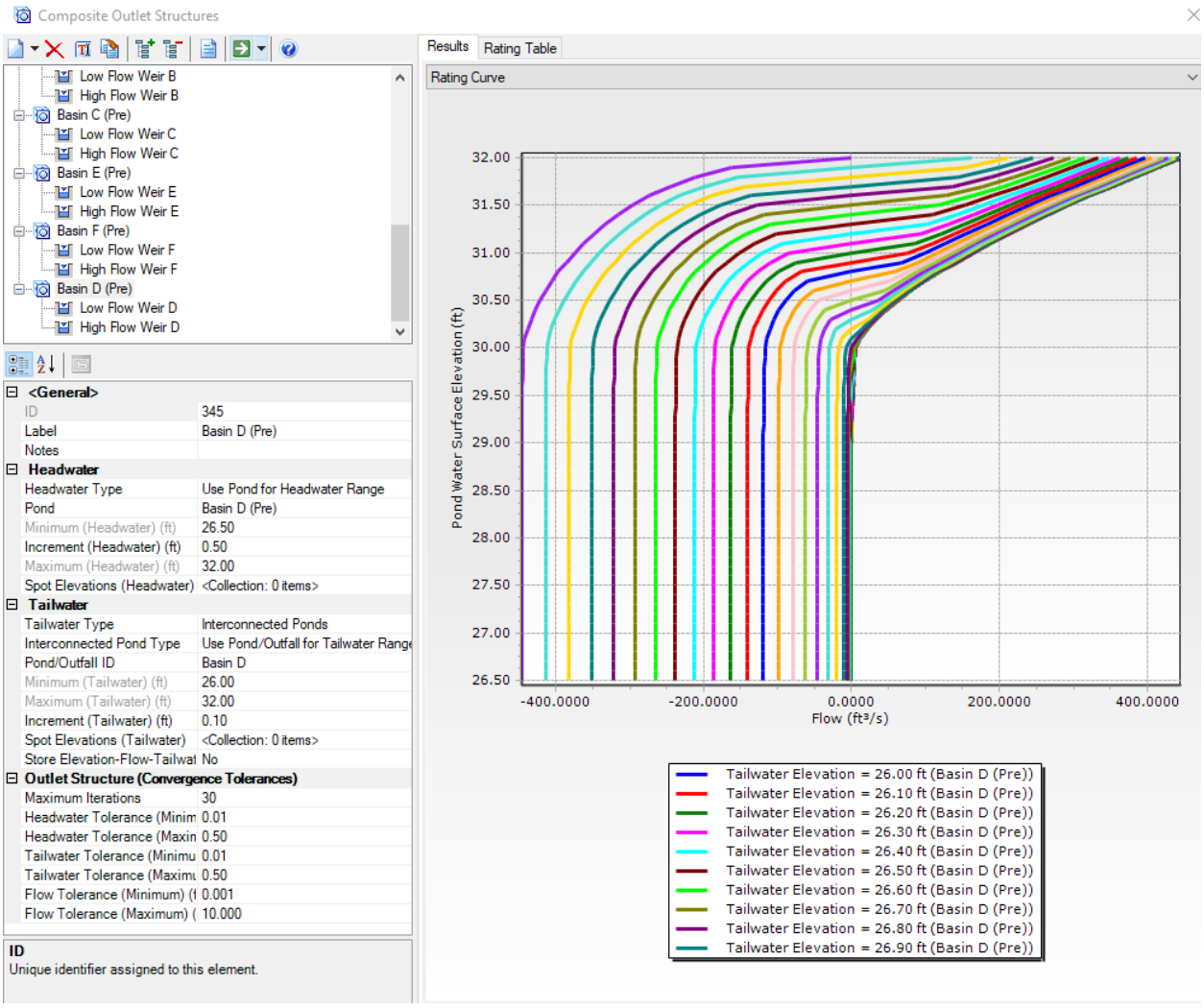

Composite Outlet Structures
Basin D
Weir D
Basin F
Riser F
Basin E
Riser E
Basin B (Pre)
Low Flow Weir B
High Flow Weir B
Basin C (Pre)
Low Flow Weir C
High Flow Weir C
Basin E (Pre)
Low Flow Weir E
Outlet Structure
Outlet Structure Type Weir
Outlet Structure (Common)
Elevation (ft) 29.00
Outlet Structure (IDs and Direction)
Outlet ID Low Flow Weir B
Flow Direction Forward Flow Only
Downstream ID Tailwater
Notes
Outlet Structure (Weir)
Weir Rectangular Weir
Vary Coefficient with Depth False
Weir Coefficient ((ft^0.5)/s) 3.00
Rectangular Weir Contracted
Weir Length (ft) 2.00
Outlet Structure (Advanced)
Elevation (On) (ft) 0.00
Elevation (Off) (ft) 0.00
Outlet Structure (Weir, Advanced)
User Defined Table False
Outlet Structure Type
The type of structure to define.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
33.00
32.50
32.00
31.50
31.00
30.50
30.00
29.50
29.00
28.50
28.00
27.50
27.00
0.0000
3.0000
6.0000
9.0000
12.0000
15.0000
18.0000
21.0000
24.0000
27.0000
Flow (ft³/s)
Tailwater Elevation = 27.00 ft (Low Flow Weir B)
Tailwater Elevation = 27.10 ft (Low Flow Weir B)
Tailwater Elevation = 27.20 ft (Low Flow Weir B)
Tailwater Elevation = 27.30 ft (Low Flow Weir B)
Tailwater Elevation = 27.40 ft (Low Flow Weir B)
Tailwater Elevation = 27.50 ft (Low Flow Weir B)
Tailwater Elevation = 27.60 ft (Low Flow Weir B)
Tailwater Elevation = 27.70 ft (Low Flow Weir B)
Tailwater Elevation = 27.80 ft (Low Flow Weir B)
Tailwater Elevation = 27.90 ft (Low Flow Weir B)

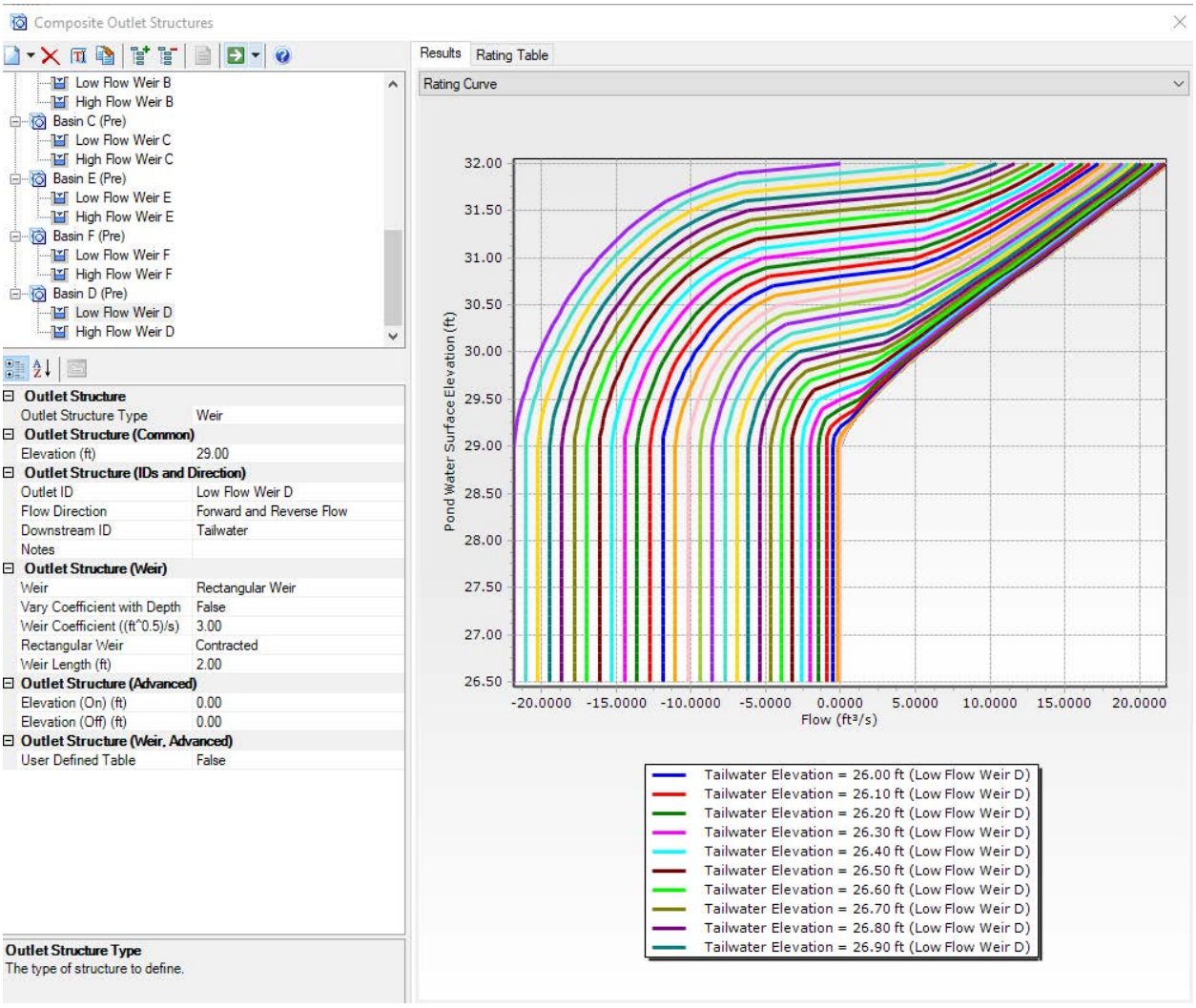

Composite Outlet Structures
Basin D
Weir D
Basin F
Riser F
Basin E
Riser E
Basin B (Pre)
Low Flow Weir B
High Flow Weir B
Basin C (Pre)
Low Flow Weir C
High Flow Weir C
Basin E (Pre)
Low Flow Weir E
Outlet Structure
Outlet Structure Type Weir
Outlet Structure (Common)
Elevation (ft) 30.00
Outlet Structure (IDs and Direction)
Outlet ID High Flow Weir B
Flow Direction Forward Flow Only
Downstream ID Tailwater
Notes
Outlet Structure (Weir)
Weir Rectangular Weir
Vary Coefficient with Depth False
Weir Coefficient ((ft^0.5)/s) 3.00
Rectangular Weir Suppressed
Weir Length (ft) 50.00
Outlet Structure (Advanced)
Elevation (On) (ft) 0.00
Elevation (Off) (ft) 0.00
Outlet Structure (Weir, Advanced)
User Defined Table False
Outlet Structure Type
The type of structure to define.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
33.00
32.50
32.00
31.50
31.00
30.50
30.00
29.50
29.00
28.50
28.00
27.50
27.00
0.0000
100.0000
200.0000
300.0000
400.0000
500.0000
600.0000
700.0000
Flow (ft³/s)
Tailwater Elevation = 27.00 ft (High Flow Weir B)
Tailwater Elevation = 27.10 ft (High Flow Weir B)
Tailwater Elevation = 27.20 ft (High Flow Weir B)
Tailwater Elevation = 27.30 ft (High Flow Weir B)
Tailwater Elevation = 27.40 ft (High Flow Weir B)
Tailwater Elevation = 27.50 ft (High Flow Weir B)
Tailwater Elevation = 27.60 ft (High Flow Weir B)
Tailwater Elevation = 27.70 ft (High Flow Weir B)
Tailwater Elevation = 27.80 ft (High Flow Weir B)
Tailwater Elevation = 27.90 ft (High Flow Weir B)

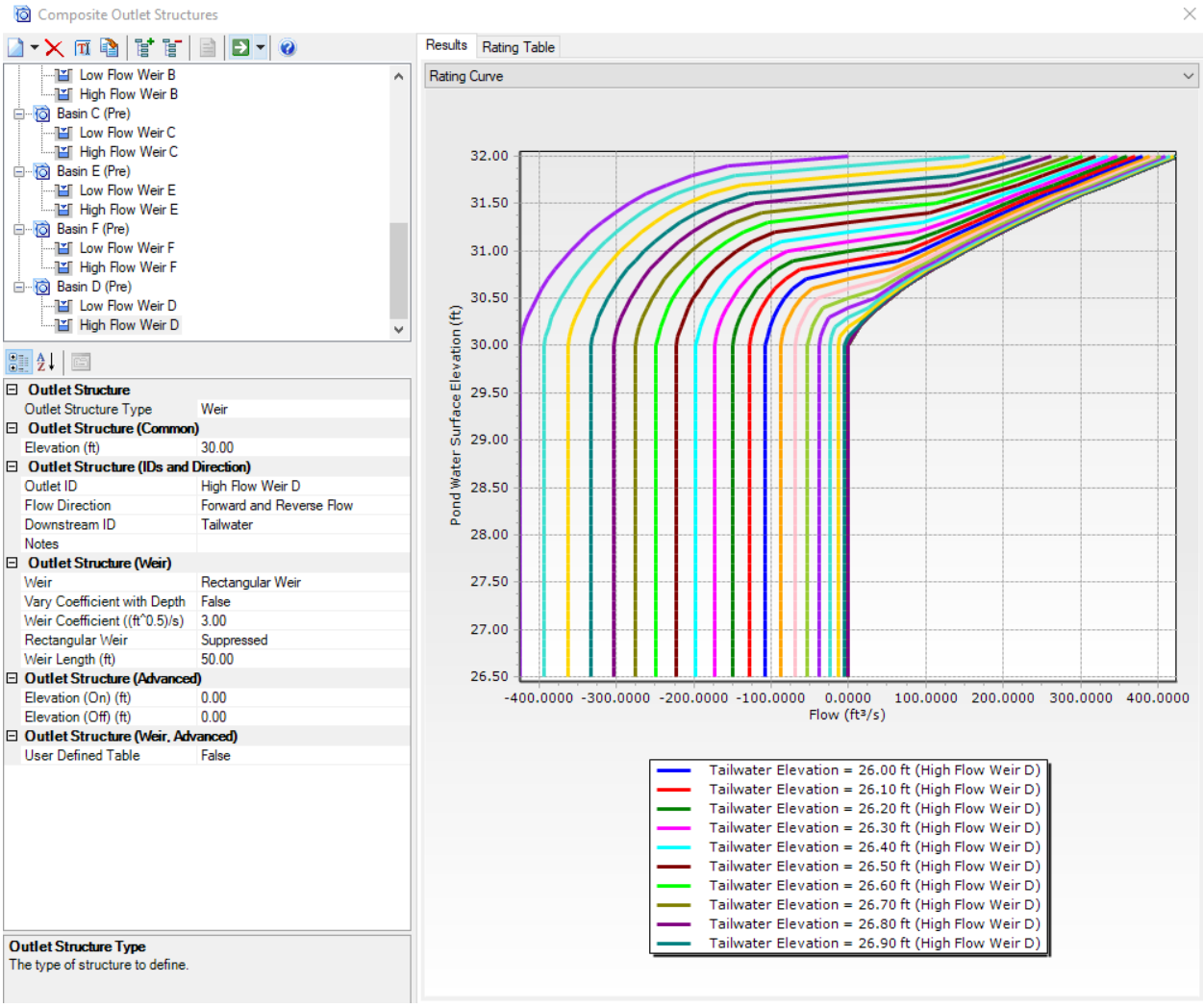

Composite Outlet Structures
Basin D
Weir D
Basin F
Riser F
Basin E
Riser E
Basin B (Pre)
Low Flow Weir B
High Flow Weir B
Basin C (Pre)
Low Flow Weir C
High Flow Weir C
Basin E (Pre)
Low Flow Weir E
<General>
ID 321
Label Basin C (Pre)
Notes
Headwater
Headwater Type Use Pond for Headwater Range
Pond Basin C (Pre)
Minimum (Headwater) (ft) 25.50
Increment (Headwater) (ft) 0.50
Maximum (Headwater) (ft) 33.00
Spot Elevations (Headwater) <Collection: 0 items>
Tailwater
Tailwater Type Interconnected Ponds
Interconnected Pond Type Use Pond/Outfall for Tailwater Range
Pond/Outfall ID Basin C
Minimum (Tailwater) (ft) 25.00
Maximum (Tailwater) (ft) 33.00
Increment (Tailwater) (ft) 0.10
Spot Elevations (Tailwater) <Collection: 0 items>
Store Elevation-Flow-Tailwat No
Outlet Structure (Convergence Tolerances)
Maximum Iterations 30
Headwater Tolerance (Minim 0.01
Headwater Tolerance (Maxin 0.50
Tailwater Tolerance (Minimu 0.01
Tailwater Tolerance (Maxim 0.50
Flow Tolerance (Minimum) (f 0.001
Flow Tolerance (Maximum) ( 10.000
ID
Unique identifier assigned to this element.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
33.00
32.00
31.00
30.00
29.00
28.00
27.00
26.00
25.00
0.0000 50.0000 100.0000 150.0000 200.0000 250.0000 300.0000 350.0000 400.0000
Flow (ft³/s)
Tailwater Elevation = 25.00 ft (Basin C (Pre))
Tailwater Elevation = 25.10 ft (Basin C (Pre))
Tailwater Elevation = 25.20 ft (Basin C (Pre))
Tailwater Elevation = 25.30 ft (Basin C (Pre))
Tailwater Elevation = 25.40 ft (Basin C (Pre))
Tailwater Elevation = 25.50 ft (Basin C (Pre))
Tailwater Elevation = 25.60 ft (Basin C (Pre))
Tailwater Elevation = 25.70 ft (Basin C (Pre))
Tailwater Elevation = 25.80 ft (Basin C (Pre))
Tailwater Elevation = 25.90 ft (Basin C (Pre))

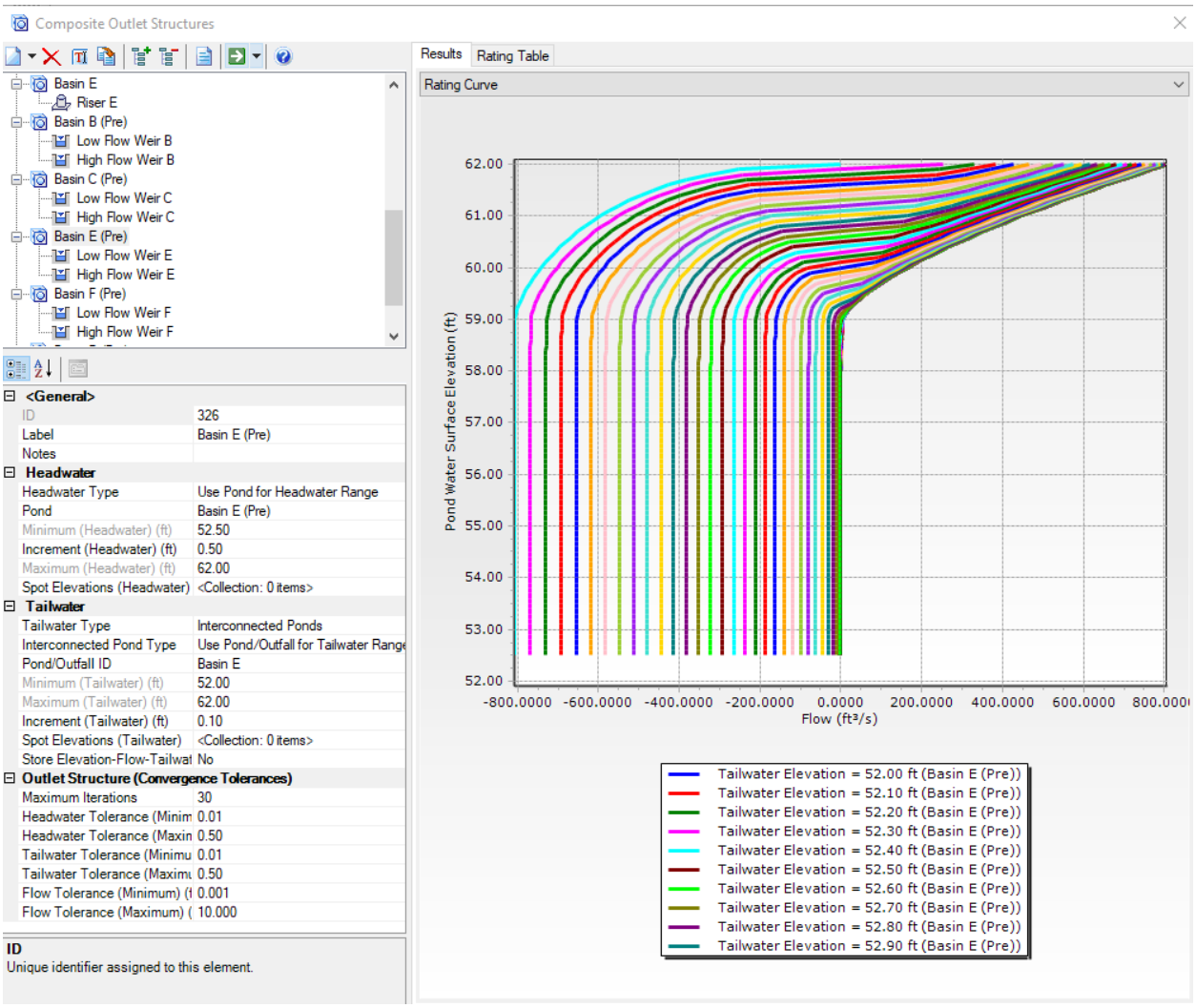

Composite Outlet Structures
Basin D
Weir D
Basin F
Riser F
Basin E
Riser E
Basin B (Pre)
Low Flow Weir B
High Flow Weir B
Basin C (Pre)
Low Flow Weir C
High Flow Weir C
Basin E (Pre)
Low Flow Weir E
Outlet Structure
Outlet Structure Type Weir
Outlet Structure (Common)
Elevation (ft) 30.00
Outlet Structure (IDs and Direction)
Outlet ID Low Flow Weir C
Flow Direction Forward Flow Only
Downstream ID Tailwater
Notes
Outlet Structure (Weir)
Weir Rectangular Weir
Vary Coefficient with Depth False
Weir Coefficient ((ft^0.5)/s) 3.00
Rectangular Weir Contracted
Weir Length (ft) 2.00
Outlet Structure (Advanced)
Elevation (On) (ft) 0.00
Elevation (Off) (ft) 0.00
Outlet Structure (Weir, Advanced)
User Defined Table False
Outlet Structure Type
The type of structure to define.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
33.00
32.00
31.00
30.00
29.00
28.00
27.00
26.00
25.00
0.0000
5.0000
10.0000
15.0000
20.0000
Flow (ft³/s)
Tailwater Elevation = 25.00 ft (Low Flow Weir C)
Tailwater Elevation = 25.10 ft (Low Flow Weir C)
Tailwater Elevation = 25.20 ft (Low Flow Weir C)
Tailwater Elevation = 25.30 ft (Low Flow Weir C)
Tailwater Elevation = 25.40 ft (Low Flow Weir C)
Tailwater Elevation = 25.50 ft (Low Flow Weir C)
Tailwater Elevation = 25.60 ft (Low Flow Weir C)
Tailwater Elevation = 25.70 ft (Low Flow Weir C)
Tailwater Elevation = 25.80 ft (Low Flow Weir C)
Tailwater Elevation = 25.90 ft (Low Flow Weir C)

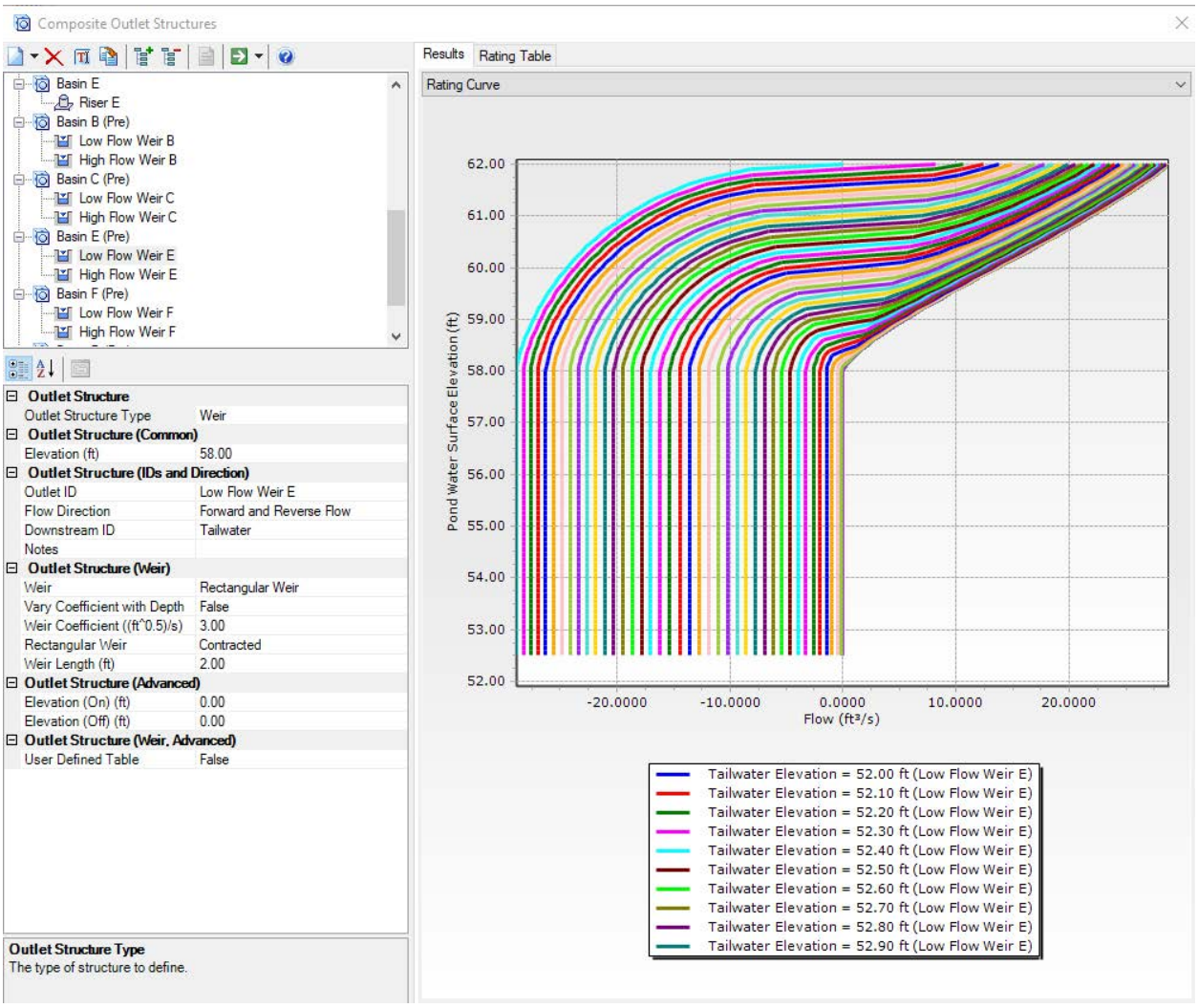

Composite Outlet Structures
Basin D
Weir D
Basin F
Riser F
Basin E
Riser E
Basin B (Pre)
Low Flow Weir B
High Flow Weir B
Basin C (Pre)
Low Flow Weir C
High Flow Weir C
Basin E (Pre)
Low Flow Weir E
Outlet Structure
Outlet Structure Type Weir
Outlet Structure (Common)
Elevation (ft) 31.00
Outlet Structure (IDs and Direction)
Outlet ID High Flow Weir C
Flow Direction Forward Flow Only
Downstream ID Tailwater
Notes
Outlet Structure (Weir)
Weir Rectangular Weir
Vary Coefficient with Depth False
Weir Coefficient ((ft^0.5)/s) 3.00
Rectangular Weir Suppressed
Weir Length (ft) 50.00
Outlet Structure (Advanced)
Elevation (On) (ft) 0.00
Elevation (Off) (ft) 0.00
Outlet Structure (Weir, Advanced)
User Defined Table False
Outlet Structure Type
The type of structure to define.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
33.00
32.00
31.00
30.00
29.00
28.00
27.00
26.00
25.00
0.0000
50.0000
100.0000
150.0000
200.0000
250.0000
300.0000
350.0000
400.0000
Flow (ft³/s)
Tailwater Elevation = 25.00 ft (High Flow Weir C)
Tailwater Elevation = 25.10 ft (High Flow Weir C)
Tailwater Elevation = 25.20 ft (High Flow Weir C)
Tailwater Elevation = 25.30 ft (High Flow Weir C)
Tailwater Elevation = 25.40 ft (High Flow Weir C)
Tailwater Elevation = 25.50 ft (High Flow Weir C)
Tailwater Elevation = 25.60 ft (High Flow Weir C)
Tailwater Elevation = 25.70 ft (High Flow Weir C)
Tailwater Elevation = 25.80 ft (High Flow Weir C)
Tailwater Elevation = 25.90 ft (High Flow Weir C)

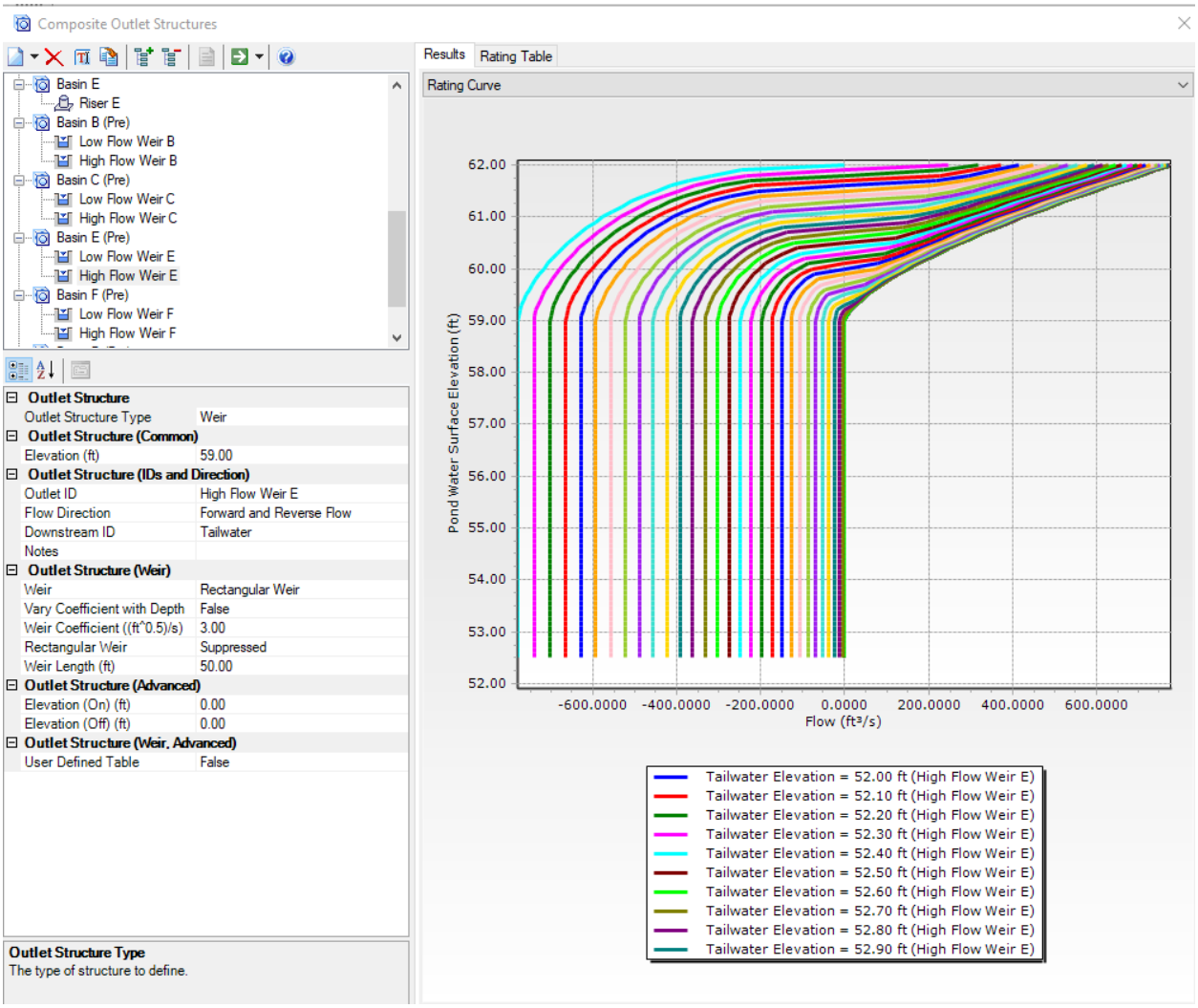

Composite Outlet Structures
Low Flow Weir B
High Flow Weir B
Basin C (Pre)
Low Flow Weir C
High Flow Weir C
Basin E (Pre)
Low Flow Weir E
High Flow Weir E
Basin F (Pre)
Low Flow Weir F
High Flow Weir F
Basin D (Pre)
Low Flow Weir D
High Flow Weir D
<General>
ID 345
Label Basin D (Pre)
Notes
Headwater
Headwater Type Use Pond for Headwater Range
Pond Basin D (Pre)
Minimum (Headwater) (ft) 26.50
Increment (Headwater) (ft) 0.50
Maximum (Headwater) (ft) 32.00
Spot Elevations (Headwater) <Collection: 0 items>
Tailwater
Tailwater Type Interconnected Ponds
Interconnected Pond Type Use Pond/Outfall for Tailwater Range
Pond/Outfall ID Basin D
Minimum (Tailwater) (ft) 26.00
Maximum (Tailwater) (ft) 32.00
Increment (Tailwater) (ft) 0.10
Spot Elevations (Tailwater) <Collection: 0 items>
Store Elevation-Flow-Tailwat No
Outlet Structure (Convergence Tolerances)
Maximum Iterations 30
Headwater Tolerance (Minim 0.01
Headwater Tolerance (Maxin 0.50
Tailwater Tolerance (Minimu 0.01
Tailwater Tolerance (Maxim 0.50
Flow Tolerance (Minimum) (t 0.001
Flow Tolerance (Maximum) ( 10.000
ID
Unique identifier assigned to this element.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
32.00
31.50
31.00
30.50
30.00
29.50
29.00
28.50
28.00
27.50
27.00
26.50
-400.0000
-200.0000
0.0000
200.0000
400.0000
Flow (ft³/s)
Tailwater Elevation = 26.00 ft (Basin D (Pre))
Tailwater Elevation = 26.10 ft (Basin D (Pre))
Tailwater Elevation = 26.20 ft (Basin D (Pre))
Tailwater Elevation = 26.30 ft (Basin D (Pre))
Tailwater Elevation = 26.40 ft (Basin D (Pre))
Tailwater Elevation = 26.50 ft (Basin D (Pre))
Tailwater Elevation = 26.60 ft (Basin D (Pre))
Tailwater Elevation = 26.70 ft (Basin D (Pre))
Tailwater Elevation = 26.80 ft (Basin D (Pre))
Tailwater Elevation = 26.90 ft (Basin D (Pre))

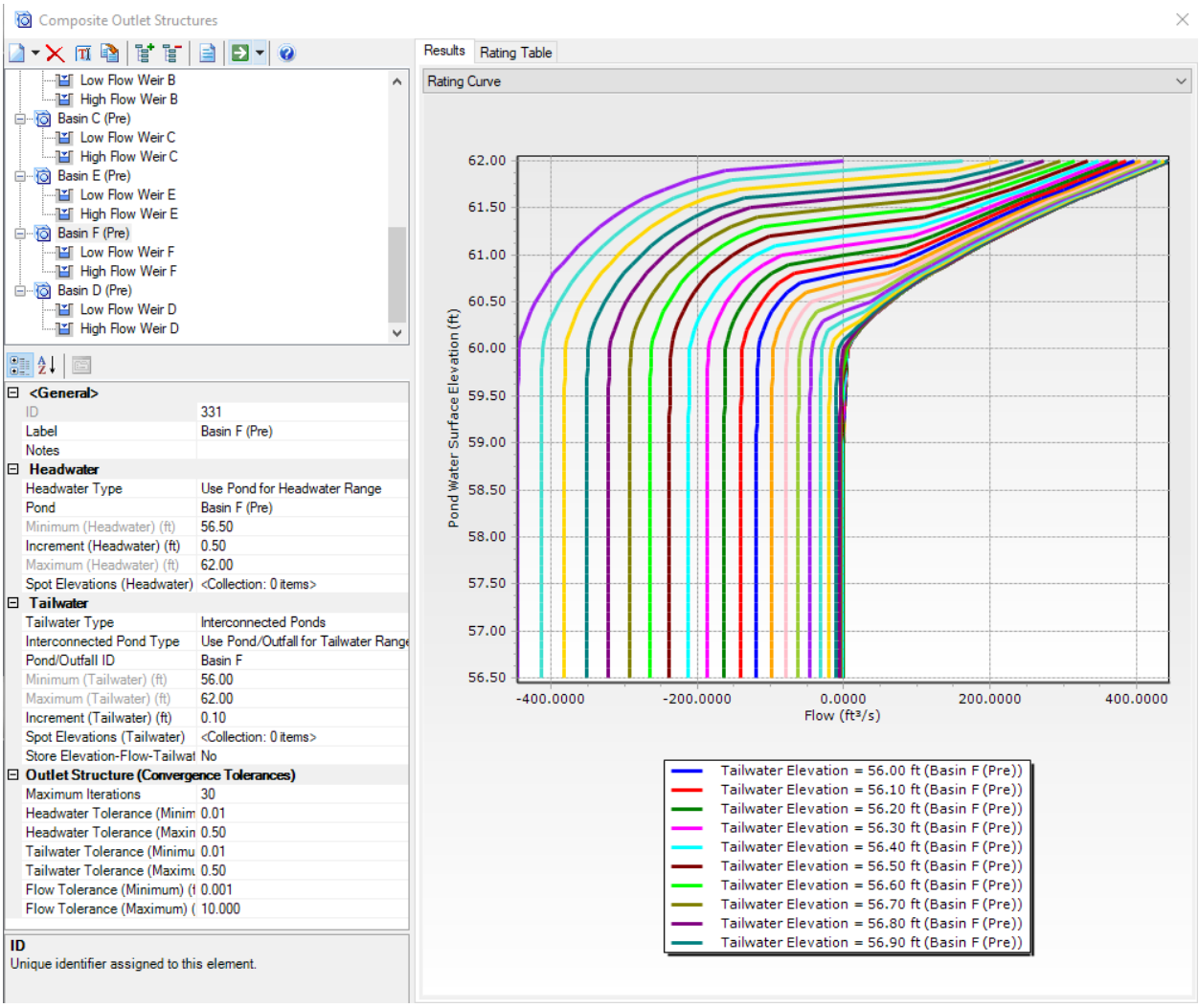

Composite Outlet Structures
Low Flow Weir B
High Flow Weir B
Basin C (Pre)
Low Flow Weir C
High Flow Weir C
Basin E (Pre)
Low Flow Weir E
High Flow Weir E
Basin F (Pre)
Low Flow Weir F
High Flow Weir F
Basin D (Pre)
Low Flow Weir D
High Flow Weir D
Outlet Structure
Outlet Structure Type Weir
Outlet Structure (Common)
Elevation (ft) 29.00
Outlet Structure (IDs and Direction)
Outlet ID Low Flow Weir D
Flow Direction Forward and Reverse Flow
Downstream ID Tailwater
Notes
Outlet Structure (Weir)
Weir Rectangular Weir
Vary Coefficient with Depth False
Weir Coefficient ((ft^0.5)/s) 3.00
Rectangular Weir Contracted
Weir Length (ft) 2.00
Outlet Structure (Advanced)
Elevation (On) (ft) 0.00
Elevation (Off) (ft) 0.00
Outlet Structure (Weir, Advanced)
User Defined Table False
Outlet Structure Type
The type of structure to define.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
Flow (ft³/s)
Tailwater Elevation = 26.00 ft (Low Flow Weir D)
Tailwater Elevation = 26.10 ft (Low Flow Weir D)
Tailwater Elevation = 26.20 ft (Low Flow Weir D)
Tailwater Elevation = 26.30 ft (Low Flow Weir D)
Tailwater Elevation = 26.40 ft (Low Flow Weir D)
Tailwater Elevation = 26.50 ft (Low Flow Weir D)
Tailwater Elevation = 26.60 ft (Low Flow Weir D)
Tailwater Elevation = 26.70 ft (Low Flow Weir D)
Tailwater Elevation = 26.80 ft (Low Flow Weir D)
Tailwater Elevation = 26.90 ft (Low Flow Weir D)

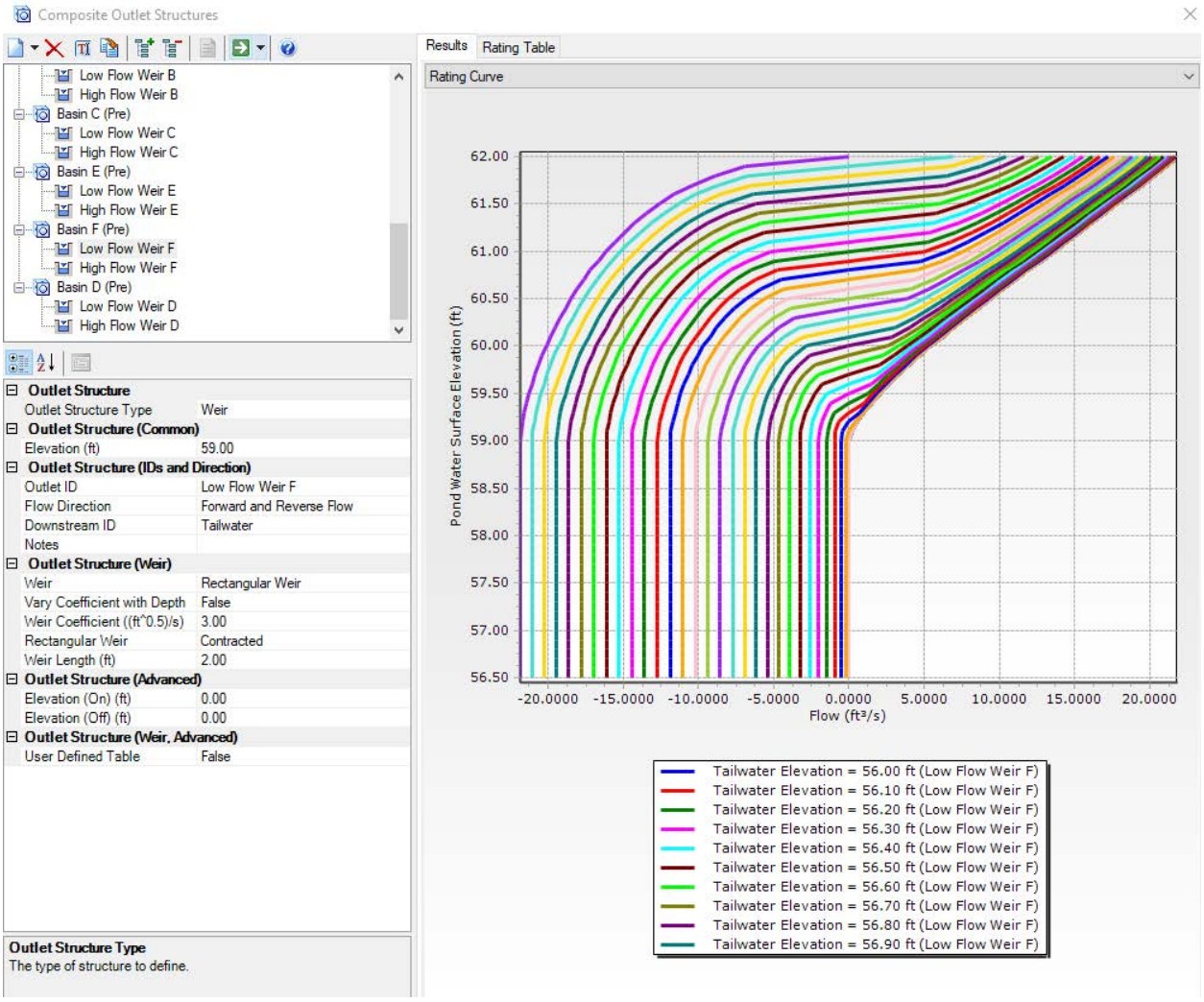

Composite Outlet Structures
Low Flow Weir B
High Flow Weir B
Basin C (Pre)
Low Flow Weir C
High Flow Weir C
Basin E (Pre)
Low Flow Weir E
High Flow Weir E
Basin F (Pre)
Low Flow Weir F
High Flow Weir F
Basin D (Pre)
Low Flow Weir D
High Flow Weir D
Outlet Structure
Outlet Structure Type Weir
Outlet Structure (Common)
Elevation (ft) 30.00
Outlet Structure (IDs and Direction)
Outlet ID High Flow Weir D
Flow Direction Forward and Reverse Flow
Downstream ID Tailwater
Notes
Outlet Structure (Weir)
Weir Rectangular Weir
Vary Coefficient with Depth False
Weir Coefficient ((ft^0.5)/s) 3.00
Rectangular Weir Suppressed
Weir Length (ft) 50.00
Outlet Structure (Advanced)
Elevation (On) (ft) 0.00
Elevation (Off) (ft) 0.00
Outlet Structure (Weir, Advanced)
User Defined Table False
Outlet Structure Type
The type of structure to define.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
32.00
31.50
31.00
30.50
30.00
29.50
29.00
28.50
28.00
27.50
27.00
26.50
-400.0000 -300.0000 -200.0000 -100.0000 0.0000 100.0000 200.0000 300.0000 400.0000
Flow (ft³/s)
Tailwater Elevation = 26.00 ft (High Flow Weir D)
Tailwater Elevation = 26.10 ft (High Flow Weir D)
Tailwater Elevation = 26.20 ft (High Flow Weir D)
Tailwater Elevation = 26.30 ft (High Flow Weir D)
Tailwater Elevation = 26.40 ft (High Flow Weir D)
Tailwater Elevation = 26.50 ft (High Flow Weir D)
Tailwater Elevation = 26.60 ft (High Flow Weir D)
Tailwater Elevation = 26.70 ft (High Flow Weir D)
Tailwater Elevation = 26.80 ft (High Flow Weir D)
Tailwater Elevation = 26.90 ft (High Flow Weir D)

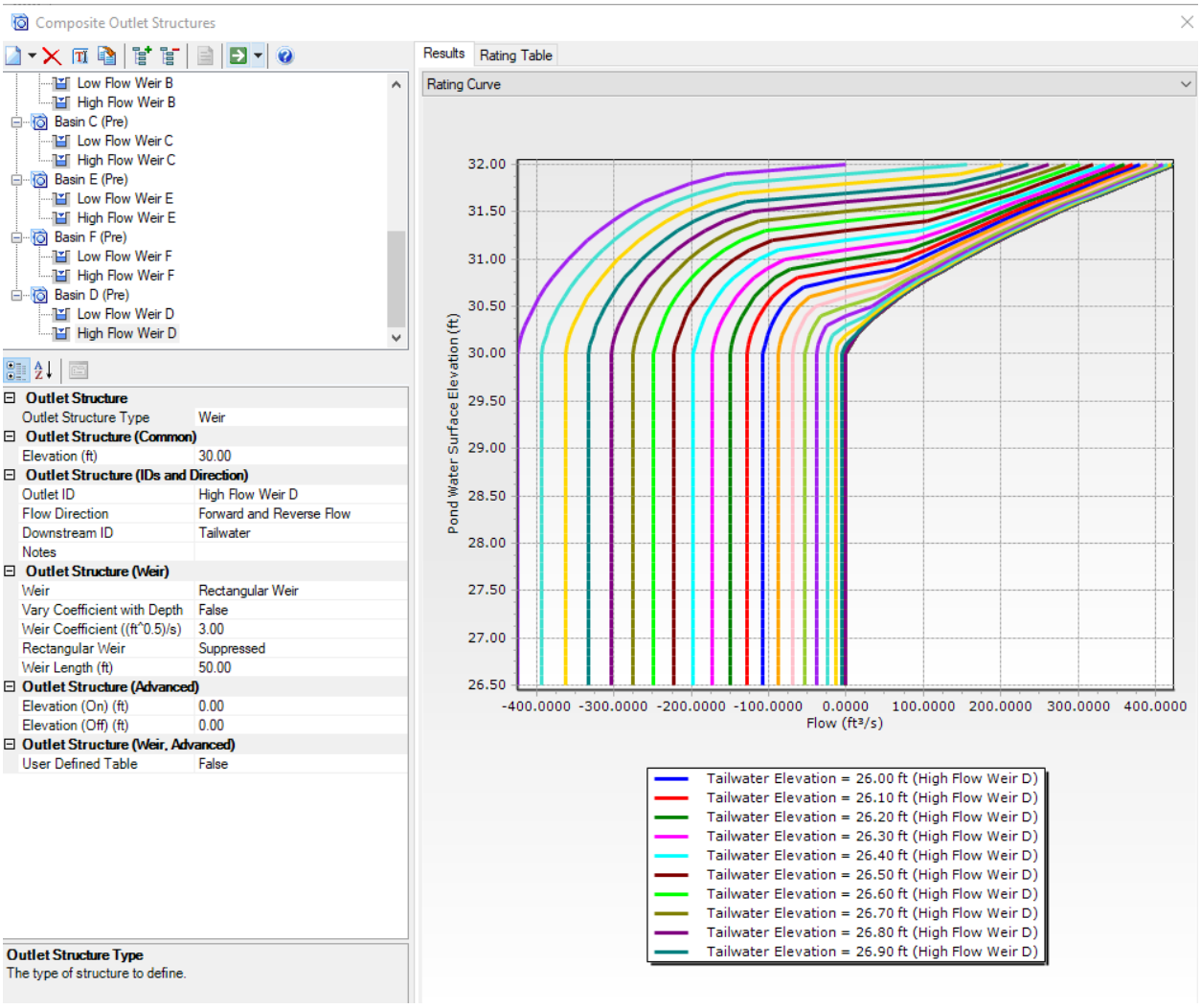

Composite Outlet Structures
Basin E
Riser E
Basin B (Pre)
Low Flow Weir B
High Flow Weir B
Basin C (Pre)
Low Flow Weir C
High Flow Weir C
Basin E (Pre)
Low Flow Weir E
High Flow Weir E
Basin F (Pre)
Low Flow Weir F
High Flow Weir F
<General>
ID 326
Label Basin E (Pre)
Notes
Headwater
Headwater Type Use Pond for Headwater Range
Pond Basin E (Pre)
Minimum (Headwater) (ft) 52.50
Increment (Headwater) (ft) 0.50
Maximum (Headwater) (ft) 62.00
Spot Elevations (Headwater) <Collection: 0 items>
Tailwater
Tailwater Type Interconnected Ponds
Interconnected Pond Type Use Pond/Outfall for Tailwater Range
Pond/Outfall ID Basin E
Minimum (Tailwater) (ft) 52.00
Maximum (Tailwater) (ft) 62.00
Increment (Tailwater) (ft) 0.10
Spot Elevations (Tailwater) <Collection: 0 items>
Store Elevation-Flow-Tailwat No
Outlet Structure (Convergence Tolerances)
Maximum Iterations 30
Headwater Tolerance (Minim 0.01
Headwater Tolerance (Maxin 0.50
Tailwater Tolerance (Minimu 0.01
Tailwater Tolerance (Maxim 0.50
Flow Tolerance (Minimum) (f 0.001
Flow Tolerance (Maximum) ( 10.000
ID
Unique identifier assigned to this element.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
62.00
61.00
60.00
59.00
58.00
57.00
56.00
55.00
54.00
53.00
52.00
-800.0000 -600.0000 -400.0000 -200.0000 0.0000 200.0000 400.0000 600.0000 800.0000
Flow (ft³/s)
Tailwater Elevation = 52.00 ft (Basin E (Pre))
Tailwater Elevation = 52.10 ft (Basin E (Pre))
Tailwater Elevation = 52.20 ft (Basin E (Pre))
Tailwater Elevation = 52.30 ft (Basin E (Pre))
Tailwater Elevation = 52.40 ft (Basin E (Pre))
Tailwater Elevation = 52.50 ft (Basin E (Pre))
Tailwater Elevation = 52.60 ft (Basin E (Pre))
Tailwater Elevation = 52.70 ft (Basin E (Pre))
Tailwater Elevation = 52.80 ft (Basin E (Pre))
Tailwater Elevation = 52.90 ft (Basin E (Pre))


Composite Outlet Structures
Basin E
Riser E
Basin B (Pre)
Low Flow Weir B
High Flow Weir B
Basin C (Pre)
Low Flow Weir C
High Flow Weir C
Basin E (Pre)
Low Flow Weir E
High Flow Weir E
Basin F (Pre)
Low Flow Weir F
High Flow Weir F
Outlet Structure
Outlet Structure Type Weir
Outlet Structure (Common)
Elevation (ft) 58.00
Outlet Structure (IDs and Direction)
Outlet ID Low Flow Weir E
Flow Direction Forward and Reverse Flow
Downstream ID Tailwater
Notes
Outlet Structure (Weir)
Weir Rectangular Weir
Vary Coefficient with Depth False
Weir Coefficient ((ft^0.5)/s) 3.00
Rectangular Weir Contracted
Weir Length (ft) 2.00
Outlet Structure (Advanced)
Elevation (On) (ft) 0.00
Elevation (Off) (ft) 0.00
Outlet Structure (Weir, Advanced)
User Defined Table False
Outlet Structure Type
The type of structure to define.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
62.00
61.00
60.00
59.00
58.00
57.00
56.00
55.00
54.00
53.00
52.00
-20.0000
-10.0000
0.0000
10.0000
20.0000
Flow (ft³/s)
Tailwater Elevation = 52.00 ft (Low Flow Weir E)
Tailwater Elevation = 52.10 ft (Low Flow Weir E)
Tailwater Elevation = 52.20 ft (Low Flow Weir E)
Tailwater Elevation = 52.30 ft (Low Flow Weir E)
Tailwater Elevation = 52.40 ft (Low Flow Weir E)
Tailwater Elevation = 52.50 ft (Low Flow Weir E)
Tailwater Elevation = 52.60 ft (Low Flow Weir E)
Tailwater Elevation = 52.70 ft (Low Flow Weir E)
Tailwater Elevation = 52.80 ft (Low Flow Weir E)
Tailwater Elevation = 52.90 ft (Low Flow Weir E)


Composite Outlet Structures
Basin E
Riser E
Basin B (Pre)
Low Flow Weir B
High Flow Weir B
Basin C (Pre)
Low Flow Weir C
High Flow Weir C
Basin E (Pre)
Low Flow Weir E
High Flow Weir E
Basin F (Pre)
Low Flow Weir F
High Flow Weir F
Outlet Structure
Outlet Structure Type Weir
Outlet Structure (Common)
Elevation (ft) 59.00
Outlet Structure (IDs and Direction)
Outlet ID High Flow Weir E
Flow Direction Forward and Reverse Flow
Downstream ID Tailwater
Notes
Outlet Structure (Weir)
Weir Rectangular Weir
Vary Coefficient with Depth False
Weir Coefficient ((ft^0.5)/s) 3.00
Rectangular Weir Suppressed
Weir Length (ft) 50.00
Outlet Structure (Advanced)
Elevation (On) (ft) 0.00
Elevation (Off) (ft) 0.00
Outlet Structure (Weir, Advanced)
User Defined Table False
Outlet Structure Type
The type of structure to define.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
62.00
61.00
60.00
59.00
58.00
57.00
56.00
55.00
54.00
53.00
52.00
-600.0000
-400.0000
-200.0000
0.0000
200.0000
400.0000
600.0000
Flow (ft³/s)
Tailwater Elevation = 52.00 ft (High Flow Weir E)
Tailwater Elevation = 52.10 ft (High Flow Weir E)
Tailwater Elevation = 52.20 ft (High Flow Weir E)
Tailwater Elevation = 52.30 ft (High Flow Weir E)
Tailwater Elevation = 52.40 ft (High Flow Weir E)
Tailwater Elevation = 52.50 ft (High Flow Weir E)
Tailwater Elevation = 52.60 ft (High Flow Weir E)
Tailwater Elevation = 52.70 ft (High Flow Weir E)
Tailwater Elevation = 52.80 ft (High Flow Weir E)
Tailwater Elevation = 52.90 ft (High Flow Weir E)


Composite Outlet Structures
Low Flow Weir B
High Flow Weir B
Basin C (Pre)
Low Flow Weir C
High Flow Weir C
Basin E (Pre)
Low Flow Weir E
High Flow Weir E
Basin F (Pre)
Low Flow Weir F
High Flow Weir F
Basin D (Pre)
Low Flow Weir D
High Flow Weir D
<General>
ID 331
Label Basin F (Pre)
Notes
Headwater
Headwater Type Use Pond for Headwater Range
Pond Basin F (Pre)
Minimum (Headwater) (ft) 56.50
Increment (Headwater) (ft) 0.50
Maximum (Headwater) (ft) 62.00
Spot Elevations (Headwater) <Collection: 0 items>
Tailwater
Tailwater Type Interconnected Ponds
Interconnected Pond Type Use Pond/Outfall for Tailwater Range
Pond/Outfall ID Basin F
Minimum (Tailwater) (ft) 56.00
Maximum (Tailwater) (ft) 62.00
Increment (Tailwater) (ft) 0.10
Spot Elevations (Tailwater) <Collection: 0 items>
Store Elevation-Flow-Tailwat No
Outlet Structure (Convergence Tolerances)
Maximum Iterations 30
Headwater Tolerance (Minim 0.01
Headwater Tolerance (Maxin 0.50
Tailwater Tolerance (Minimu 0.01
Tailwater Tolerance (Maximu 0.50
Flow Tolerance (Minimum) (f 0.001
Flow Tolerance (Maximum) ( 10.000
ID
Unique identifier assigned to this element.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
62.00
61.50
61.00
60.50
60.00
59.50
59.00
58.50
58.00
57.50
57.00
56.50
-400.0000
-200.0000
0.0000
200.0000
400.0000
Flow (ft³/s)
Tailwater Elevation = 56.00 ft (Basin F (Pre))
Tailwater Elevation = 56.10 ft (Basin F (Pre))
Tailwater Elevation = 56.20 ft (Basin F (Pre))
Tailwater Elevation = 56.30 ft (Basin F (Pre))
Tailwater Elevation = 56.40 ft (Basin F (Pre))
Tailwater Elevation = 56.50 ft (Basin F (Pre))
Tailwater Elevation = 56.60 ft (Basin F (Pre))
Tailwater Elevation = 56.70 ft (Basin F (Pre))
Tailwater Elevation = 56.80 ft (Basin F (Pre))
Tailwater Elevation = 56.90 ft (Basin F (Pre))


Composite Outlet Structures
Low Flow Weir B
High Flow Weir B
Basin C (Pre)
Low Flow Weir C
High Flow Weir C
Basin E (Pre)
Low Flow Weir E
High Flow Weir E
Basin F (Pre)
Low Flow Weir F
High Flow Weir F
Basin D (Pre)
Low Flow Weir D
High Flow Weir D
Outlet Structure
Outlet Structure Type Weir
Outlet Structure (Common)
Elevation (ft) 59.00
Outlet Structure (IDs and Direction)
Outlet ID Low Flow Weir F
Flow Direction Forward and Reverse Flow
Downstream ID Tailwater
Notes
Outlet Structure (Weir)
Weir Rectangular Weir
Vary Coefficient with Depth False
Weir Coefficient ((ft^0.5)/s) 3.00
Rectangular Weir Contracted
Weir Length (ft) 2.00
Outlet Structure (Advanced)
Elevation (On) (ft) 0.00
Elevation (Off) (ft) 0.00
Outlet Structure (Weir, Advanced)
User Defined Table False
Outlet Structure Type
The type of structure to define.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
62.00
61.50
61.00
60.50
60.00
59.50
59.00
58.50
58.00
57.50
57.00
56.50
-20.0000 -15.0000 -10.0000 -5.0000 0.0000 5.0000 10.0000 15.0000 20.0000
Flow (ft³/s)
Tailwater Elevation = 56.00 ft (Low Flow Weir F)
Tailwater Elevation = 56.10 ft (Low Flow Weir F)
Tailwater Elevation = 56.20 ft (Low Flow Weir F)
Tailwater Elevation = 56.30 ft (Low Flow Weir F)
Tailwater Elevation = 56.40 ft (Low Flow Weir F)
Tailwater Elevation = 56.50 ft (Low Flow Weir F)
Tailwater Elevation = 56.60 ft (Low Flow Weir F)
Tailwater Elevation = 56.70 ft (Low Flow Weir F)
Tailwater Elevation = 56.80 ft (Low Flow Weir F)
Tailwater Elevation = 56.90 ft (Low Flow Weir F)


Composite Outlet Structures
Low Flow Weir B
High Flow Weir B
Basin C (Pre)
Low Flow Weir C
High Flow Weir C
Basin E (Pre)
Low Flow Weir E
High Flow Weir E
Basin F (Pre)
Low Flow Weir F
High Flow Weir F
Basin D (Pre)
Low Flow Weir D
High Flow Weir D
Outlet Structure
Outlet Structure Type Weir
Outlet Structure (Common)
Elevation (ft) 30.00
Outlet Structure (IDs and Direction)
Outlet ID High Flow Weir D
Flow Direction Forward and Reverse Flow
Downstream ID Tailwater
Notes
Outlet Structure (Weir)
Weir Rectangular Weir
Vary Coefficient with Depth False
Weir Coefficient ((ft^0.5)/s) 3.00
Rectangular Weir Suppressed
Weir Length (ft) 50.00
Outlet Structure (Advanced)
Elevation (On) (ft) 0.00
Elevation (Off) (ft) 0.00
Outlet Structure (Weir, Advanced)
User Defined Table False
Outlet Structure Type
The type of structure to define.
Results
Rating Table
Rating Curve
Pond Water Surface Elevation (ft)
32.00
31.50
31.00
30.50
30.00
29.50
29.00
28.50
28.00
27.50
27.00
26.50
-400.0000 -300.0000 -200.0000 -100.0000 0.0000 100.0000 200.0000 300.0000 400.0000
Flow (ft³/s)
Tailwater Elevation = 26.00 ft (High Flow Weir D)
Tailwater Elevation = 26.10 ft (High Flow Weir D)
Tailwater Elevation = 26.20 ft (High Flow Weir D)
Tailwater Elevation = 26.30 ft (High Flow Weir D)
Tailwater Elevation = 26.40 ft (High Flow Weir D)
Tailwater Elevation = 26.50 ft (High Flow Weir D)
Tailwater Elevation = 26.60 ft (High Flow Weir D)
Tailwater Elevation = 26.70 ft (High Flow Weir D)
Tailwater Elevation = 26.80 ft (High Flow Weir D)
Tailwater Elevation = 26.90 ft (High Flow Weir D)

# Attachment N. Bioslope Calculations

**Bioslope Calculation**

$$\frac{LTIR * L * W}{C * SF} = Q_{Infiltration}$$

per ODOT's Hydraulics Manual Chapter 14 Appendix C

| Location | Main Access Road | NW Access Road | | |
|---|---|---|---|---|
| Designation | Bioslope B | Bioslope A | | |
| LTIR | 10 | 10 | in/hr | (Long-term infiltration rate of the ecology mix) |
| L | 371 | 165 | ft | (length of media filter drain (parallel to roadway) |
| W | 5 | 11 | ft | (width of the ecology mix bed) |
| C | 43200 | 43200 | (in/hr)/(ft/sec) | (conversion factor) |
| SF | 1 | 1 | | (safety factor) |
| Qinfiltration | 0.43 | 0.42 | cfs | (long-term infiltration capacity of the MFD) |
| Qhighway | 0.37 | 0.40 | | |
| CIA | 19620 | 20936 | sf | (threshold drainage area (contributing drainage area)) |
| CIA | 0.45 | 0.48 | ac | |
| Shoulder W | 8 | 8 | | |
| Filter Strip W | 3 | 3 | | |
| Overall W | 16 | 22 | | |

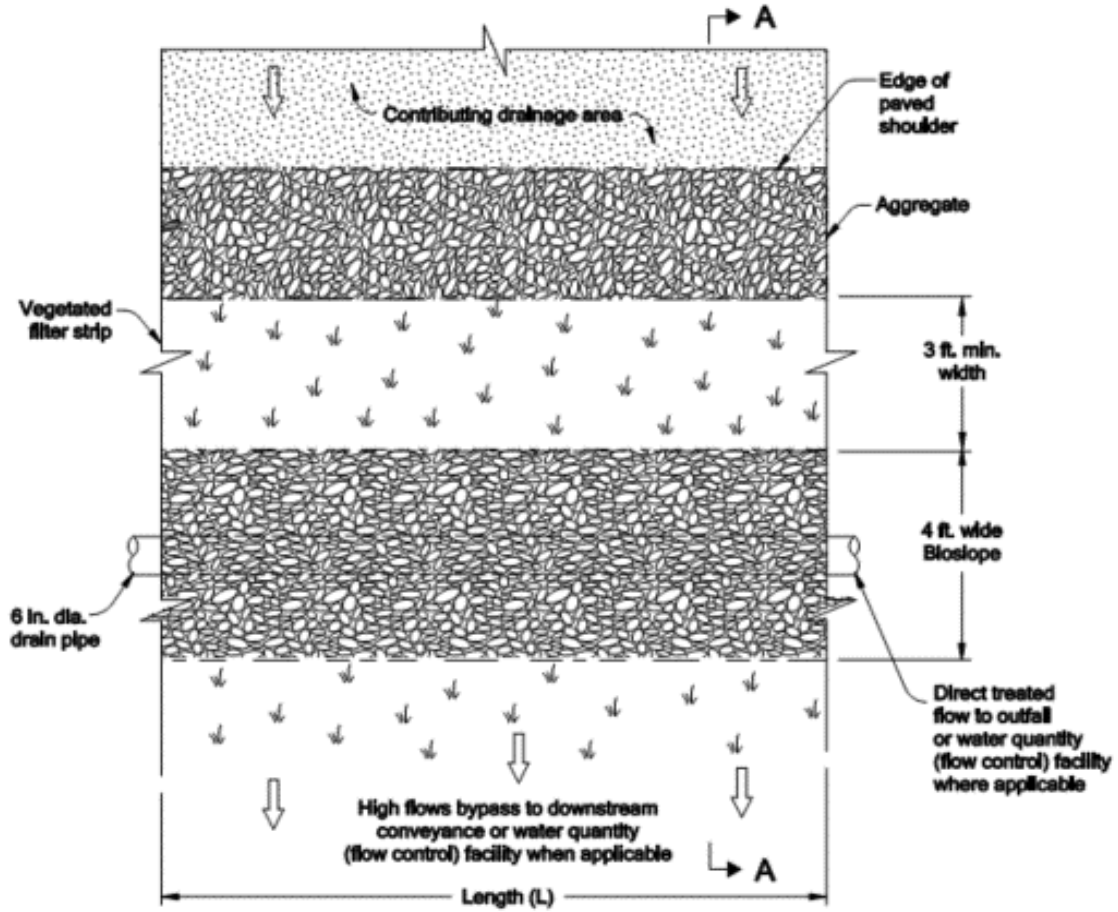
Long term infiltration capacity must be greater than the water quality peak flow.
The width of the bioslope ecology mix bed was increased until this condition is satisfied.
The minimum media filter strip ecology mix bed is 2 feet.

**Ecology Mix**

The ecology mix consists of the following materials:

| Amendment | Description | Quantity |
|---|---|---|
| **Aggregates** | 3/8" – No. 8 aggregate meeting the requirements of ODOT Standard Specifications Section 00680 | 3 cubic yards (c.y.) |
| **Perlite** | • Horticultural grade, free of any toxic materials. (Course Gradation)<br>• 0 – 29% passing No. 18 sieve<br>• 0 – 10% passing No. 30 sieve | 1 cubic yard per 3 cubic yards of aggregate |
| **Dolomite** | • Calcium magnesium carbonate – $CaMg(CO_3)_2$ (Ground)<br>• Agricultural grade, free of any toxic materials.<br>• 95 - 100% passing No. 8 sieve<br>• 0 -5% passing No. 16 sieve | 10 pounds per 1 c.y. of perlite |
| **Gypsum** | • Noncalcined, agricultural gypsum – $CaSO_4$-2($H_2O$) (hydrated calcium sulfate). (Ground or Peletized)<br>• Agricultural grade, free of any toxic materials<br>• 95 - 100% passing No. 8 sieve<br>• 0 – 5% passing No. 16 sieve | 1.5 pounds per 1 c.y. of perlite |

**Bioslope Detail per ODOT Hydraulics Manual**




PLAN VIEW
NTS

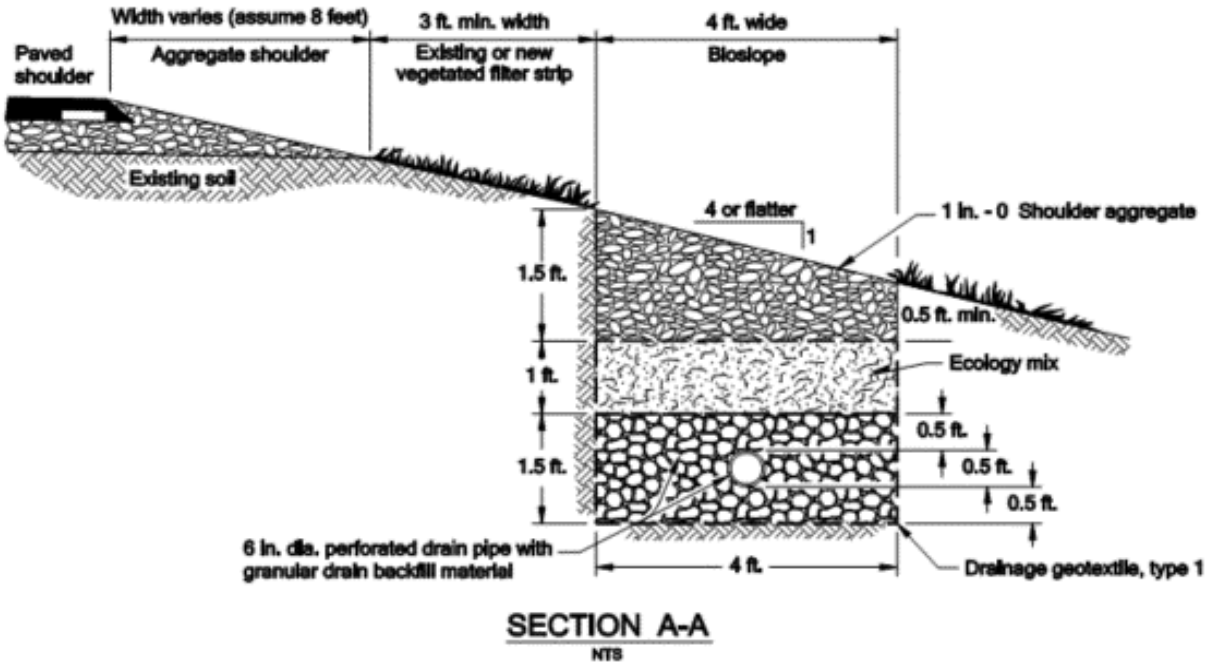



**Figure 6 Bioslope (4 foot wide)**

# Attachment O. Filter Strip Calculations

**Filter Strips Design**

| Location | Main Access Road Filter Strip | Secondary Access Road to South Dunes - North | Secondary Access Road to South Dunes - South | Old Jordan Cove Road to South Dunes | Comments |
|---|---|---|---|---|---|
| Designation | FS-A | FS-B | FS-B | FS-C | |
| Cf | 1.1 | 1.1 | 1.1 | 1.1 | Using Rational Method - ODOT Hydraulics Manual Chapter 7 Appendix F |
| C | 0.9 | 0.9 | 0.9 | 0.9 | Using Rational Method - ODOT Hydraulics Manual Chapter 7 Appendix F |
| Flow Path (ft) | 50 | 12 | 12 | 24 | Main access road flow path is 48' (3 - 12' lanes, 1 - 12' gravel shoulder, 1 - 2' asphalt shoulder |
| Lat. Slope of contributing imp. area (%) | 2 | 2 | 2 | 2 | From ODOT Hydraulics Manual Appendix B 3.1 (pg. 19) |
| Long. Slope of contributing imp. Area (%) | 5 | 5 | 5 | 5 | From ODOT Hydraulics Manual Appendix B 3.1 (pg. 19), (Same slope as road) |
| Lowest EL. Of strip | 20 | 16 | 16 | 16 | *EL of lowest point of filter strip should be at least 3' above seasonally high groundwater table or bedrock per ODOT Hydraulics Manual Appendix E |
| Seasonally high groundwater table | 13 | 13 | 13 | 13 | |
| Filter Strip Length (ft) | 1391 | 1745 | 1745 | 1250 | |
| Lat./Cross-section slope of filter strip (%) | 2 | 2 | 2 | 2 | ODOT Hydraulics Manual Ch. 14 App B |
| Long. Slope of filter strip (%) | 5 | 5 | 5 | 5 | ODOT Hydraulics Manual Ch. 14 App B (used minimum) |
| Filter Strip Width (ft) | 13 | 5 | 5 | 8 | ODOT Hydraulics Manual Ch. 14 App B (Table 1) |
| Setback from edge of pavement (or gravel road) (ft) | 12 | 12 | 12 | 12 | |

# Attachment P. Treatment Swales Calculations

**NW Access Road Entrance Swale**

| Designation | SW-A | |
|---|---|---|
| Manning's roughness coefficient (n) | 0.24 | ODOT Ch. 14 Appendix B |
| Design water depth (y), ft | 0.25 | ODOT Ch. 14 Appendix B |
| Swale slope (s), ft/ft | 0.005 | *0.5% is minimum per ODOT Ch. 14 Appendix B |
| Side slope (Z) | 4 | ODOT Ch. 14 Appendix B; 4:1 used in design; 3:1 near wetlands |
| Hydraulic Residence time in swale (min) | 9 | ODOT Ch. 14 Appendix B |
| Cf | 1.1 | Using Rational Method - ODOT Hydraulics Manual Chapter 7 Appendix F ( Table 2 Runoff Coefficient Adjustment Factors) |
| C | 0.95 | Using Rational Method - ODOT Hydraulics Manual Chapter 7 Appendix F |
| i | 2.32 | From Drainage Design - Jordan Cove Spreadsheet (using Tc and 25 yr design storm) |
| A, sf | 12,160 | |
| Tc, min | 12.21 | From Drainage Design spreadsheet |
| Q, cfs | 0.68 | Using Rational Method - ODOT Hydraulics Manual Chapter 7 Appendix F |
| Swale Bottom Width (B), ft | 15.61 | ODOT Ch. 14 Appendix B Section 2.2 (4 ft min) |
| Cross Sectional Area (A), sf | 4.15 | ODOT Ch. 14 Appendix B Section 2.2 |
| Average Velocity (V), ft/s | 0.16 | ODOT Ch. 14 Appendix B Section 2.2 |
| Swale flow path length (L)*, ft | 88.01 | ODOT Ch. 14 Appendix B Section 2.2 |
| Swale top width at the water quality depth (T), ft | 17.61 | ODOT Ch. 14 Appendix B Section 2.2 |

Porous pavers required in Oregon climate zone 1 per ODOT Ch. 14.B.2.1.

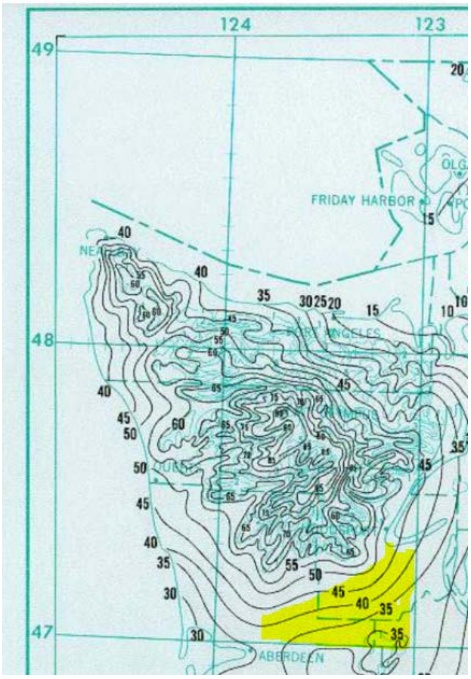
# Attachment Q. MGS Flood Results, StormFilter Calculations, Contech StormFilter Details, and TideFlex CheckMate Inline Check Valve Brochure

# CDS System Design Map

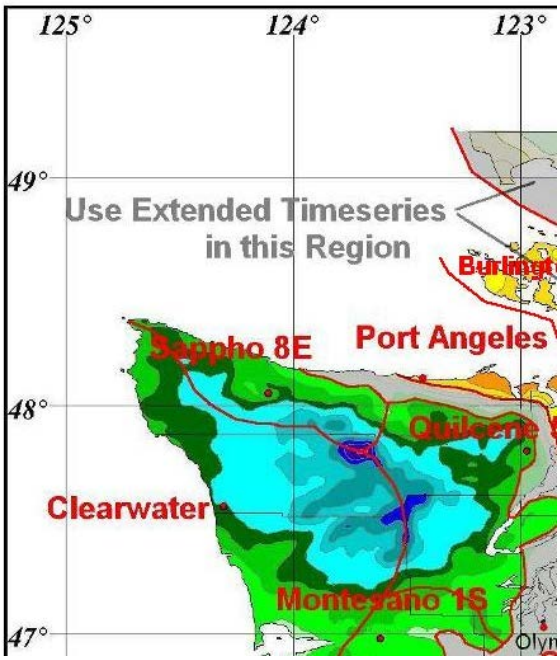
Link to Western Washington 2-year 24-hr Precipitation

Match a climate region in WW with a rainfall of 3.5 inches to model in MGSFlood for the CDS systems. (to find the Water Quality Flow Rate)

https://wrcc.dri.edu/Climate/precip_freq_map_show.php?simg=wa2y24.gif




This climate region has the same 2-year 24-hour rainfall.



## Inputs:

Used the Mean Annual Precipitation calculator

Project latitude: 46.9795 (based on region that receives same 2-year 24-hour rainfall)

Project Longitude: 123.6 (based on region that receives same 2-year 24-hour rainfall)

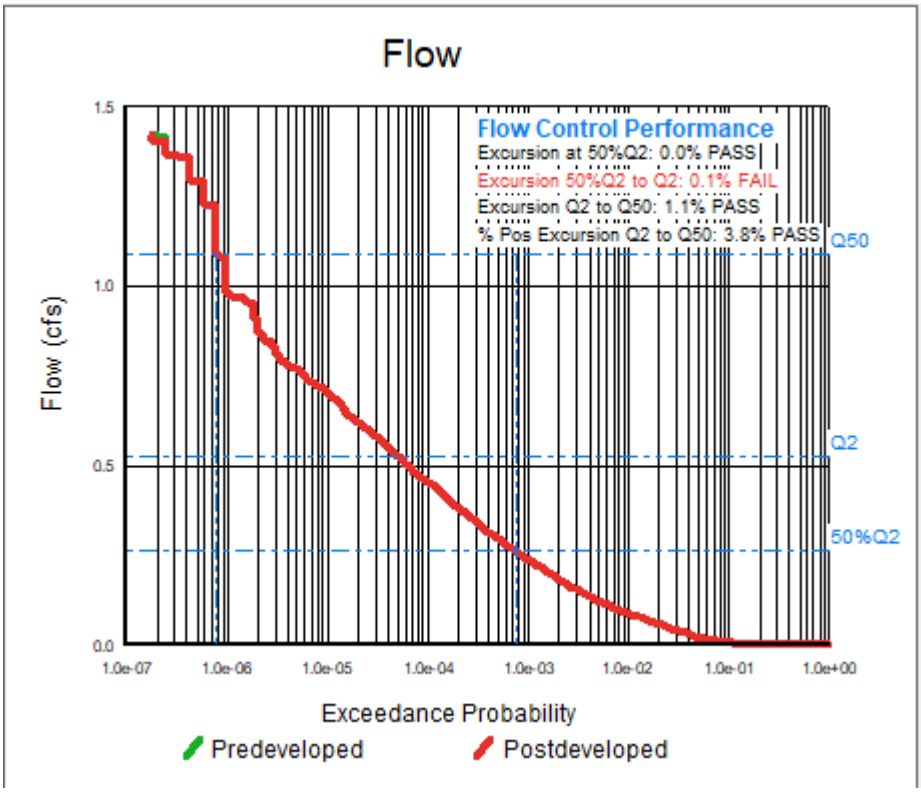
(MAP Computed, in) – 77.9

15-min time interval

Default Time Frame: 1939-2097

Default climate region when calculating MAP: Puget West 32 in MAP

## CF-A




**********Compliance Point Results **********

Scenario Predeveloped Compliance Subbasin: CF-A

Scenario Postdeveloped Compliance Subbasin: CF-A

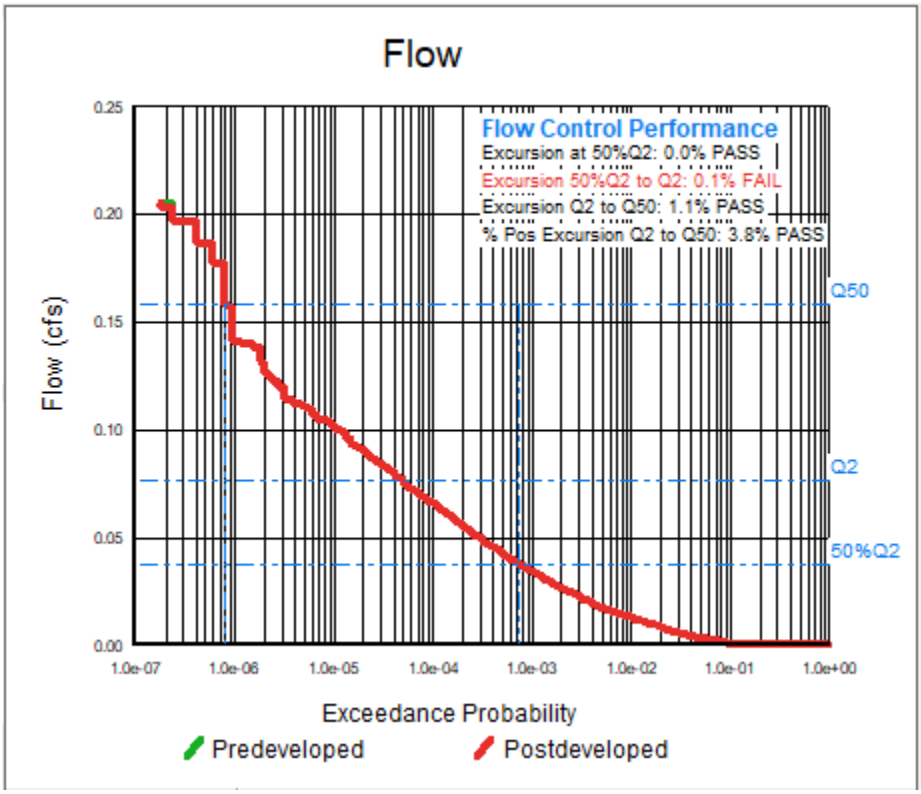
*** Point of Compliance Flow Frequency Data ***
Recurrence Interval Computed Using Gringorten Plotting Position

| Predevelopment Runoff | | Postdevelopment Runoff | |
|---|---|---|---|
| Tr (Years) | Discharge (cfs) | Tr (Years) | Discharge (cfs) |
| 2-Year | 0.529 | 2-Year | 0.529 |
| 5-Year | 0.695 | 5-Year | 0.695 |
| 10-Year | 0.780 | 10-Year | 0.780 |
| 25-Year | 0.961 | 25-Year | 0.961 |
| 50-Year | 1.092 | 50-Year | 1.092 |
| 100-Year | 1.357 | 100-Year | 1.357 |
| 200-Year | 1.401 | 200-Year | 1.401 |

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

**50%Q2 = 0.265 cfs (Assumed to be half of the 2-year flow.)**

## CF-B




**********Compliance Point Results **********

Scenario Predeveloped Compliance Subbasin: CF-B

Scenario Postdeveloped Compliance Subbasin: CF-B

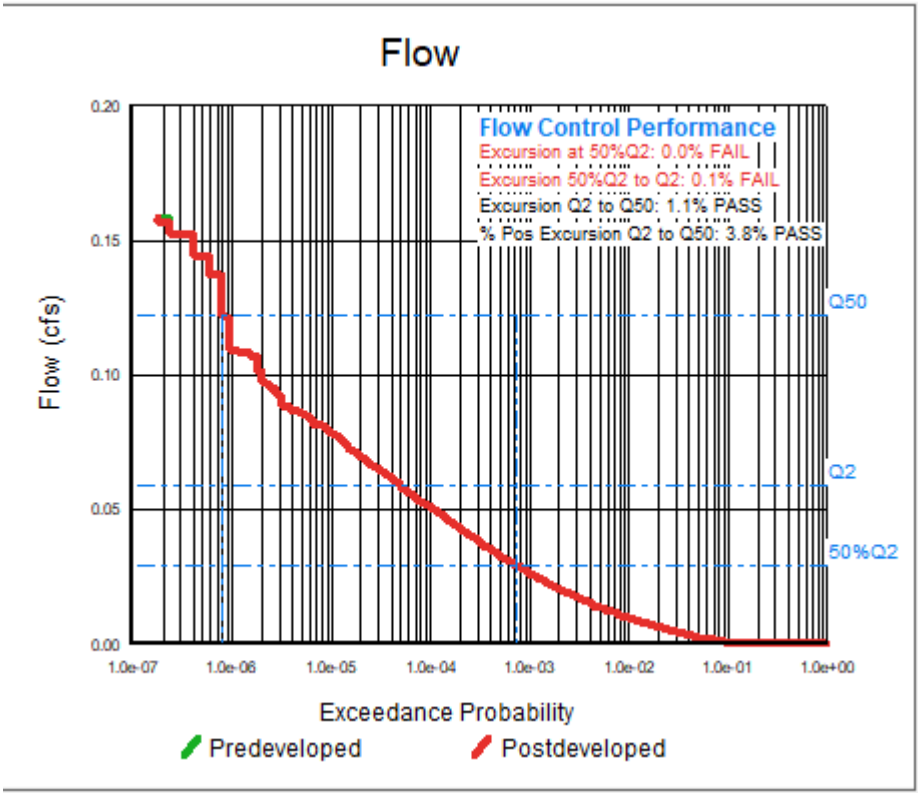
*** **Point of Compliance Flow Frequency Data** ***
Recurrence Interval Computed Using Gringorten Plotting Position

| Predevelopment Runoff | | Postdevelopment Runoff | |
|---|---|---|---|
| Tr (Years) | Discharge (cfs) | Tr (Years) | Discharge (cfs) |
| 2-Year | 7.655E-02 | 2-Year | 7.655E-02 |
| 5-Year | 0.101 | 5-Year | 0.101 |
| 10-Year | 0.113 | 10-Year | 0.113 |
| 25-Year | 0.139 | 25-Year | 0.139 |
| 50-Year | 0.158 | 50-Year | 0.158 |
| 100-Year | 0.196 | 100-Year | 0.196 |
| 200-Year | 0.203 | 200-Year | 0.203 |

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

**50%Q2 = 0.0383 cfs (Assumed to be half of the 2-year flow.)**

# CF-C




**********Compliance Point Results **********

Scenario Predeveloped Compliance Subbasin: CF-C

Scenario Postdeveloped Compliance Subbasin: CF-C

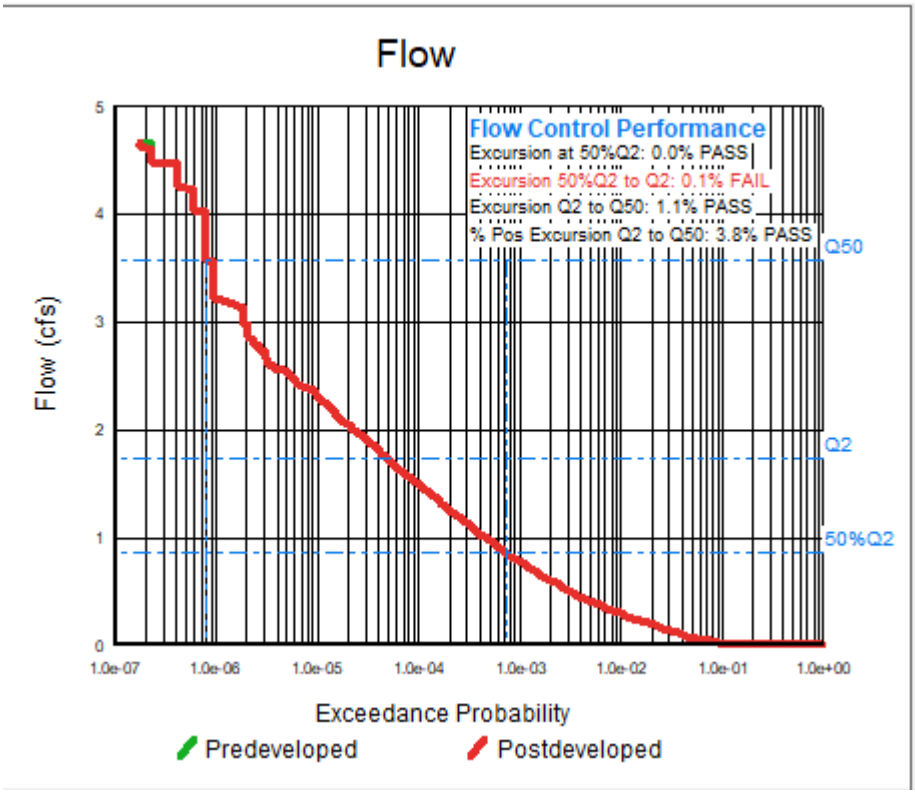
*** **Point of Compliance Flow Frequency Data** ***
Recurrence Interval Computed Using Gringorten Plotting Position

| Predevelopment Runoff | | Postdevelopment Runoff | |
|---|---|---|---|
| Tr (Years) | Discharge (cfs) | Tr (Years) | Discharge (cfs) |
| 2-Year | 5.915E-02 | 2-Year | 5.915E-02 |
| 5-Year | 7.773E-02 | 5-Year | 7.773E-02 |
| 10-Year | 8.729E-02 | 10-Year | 8.729E-02 |
| 25-Year | 0.107 | 25-Year | 0.107 |
| 50-Year | 0.122 | 50-Year | 0.122 |
| 100-Year | 0.152 | 100-Year | 0.152 |
| 200-Year | 0.157 | 200-Year | 0.157 |

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

**50%Q2 = 0.0296 cfs (Assumed to be half of the 2-year flow.)**

## CF-D




**********Compliance Point Results **********

Scenario Predeveloped Compliance Subbasin: CF-D

Scenario Postdeveloped Compliance Subbasin: CF-D

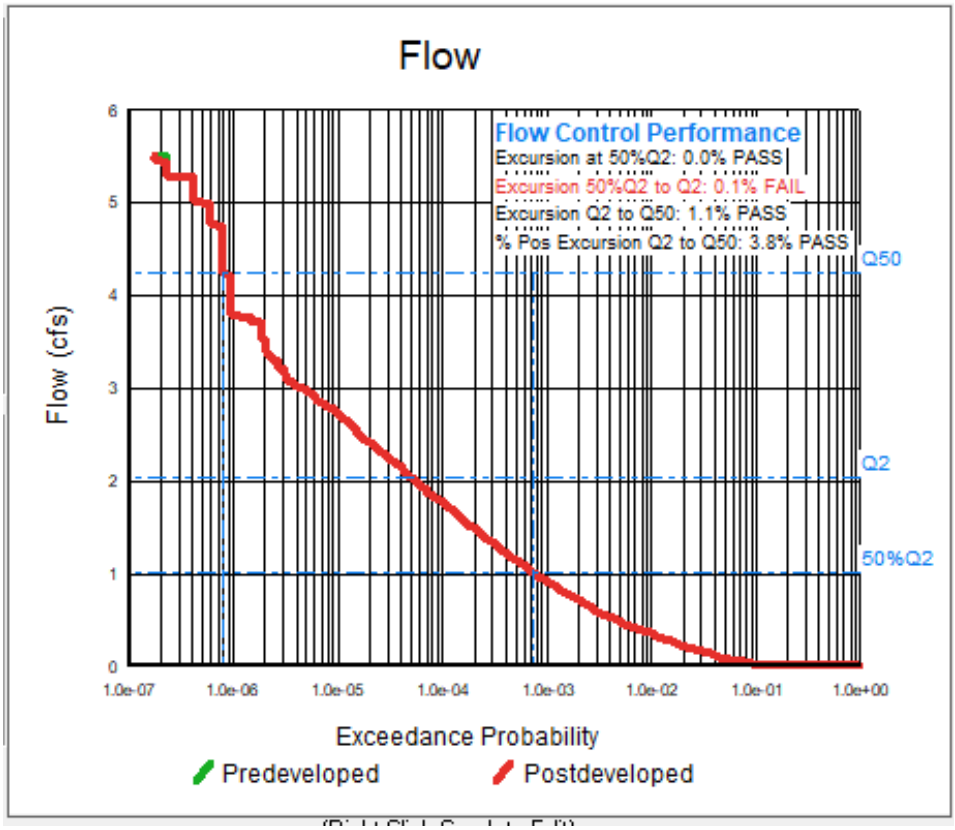
*** Point of Compliance Flow Frequency Data ***
Recurrence Interval Computed Using Gringorten Plotting Position

| Predevelopment Runoff | | Postdevelopment Runoff | |
|---|---|---|---|
| Tr (Years) | Discharge (cfs) | Tr (Years) | Discharge (cfs) |
| 2-Year | 1.740 | 2-Year | 1.740 |
| 5-Year | 2.286 | 5-Year | 2.286 |
| 10-Year | 2.567 | 10-Year | 2.567 |
| 25-Year | 3.160 | 25-Year | 3.160 |
| 50-Year | 3.591 | 50-Year | 3.591 |
| 100-Year | 4.465 | 100-Year | 4.465 |
| 200-Year | 4.609 | 200-Year | 4.609 |

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

**50%Q2 = 0.87 cfs (Assumed to be half of the 2-year flow.)**

## CF-E




**********Compliance Point Results **********

Scenario Predeveloped Compliance Subbasin: CF-E

Scenario Postdeveloped Compliance Subbasin: CF-E

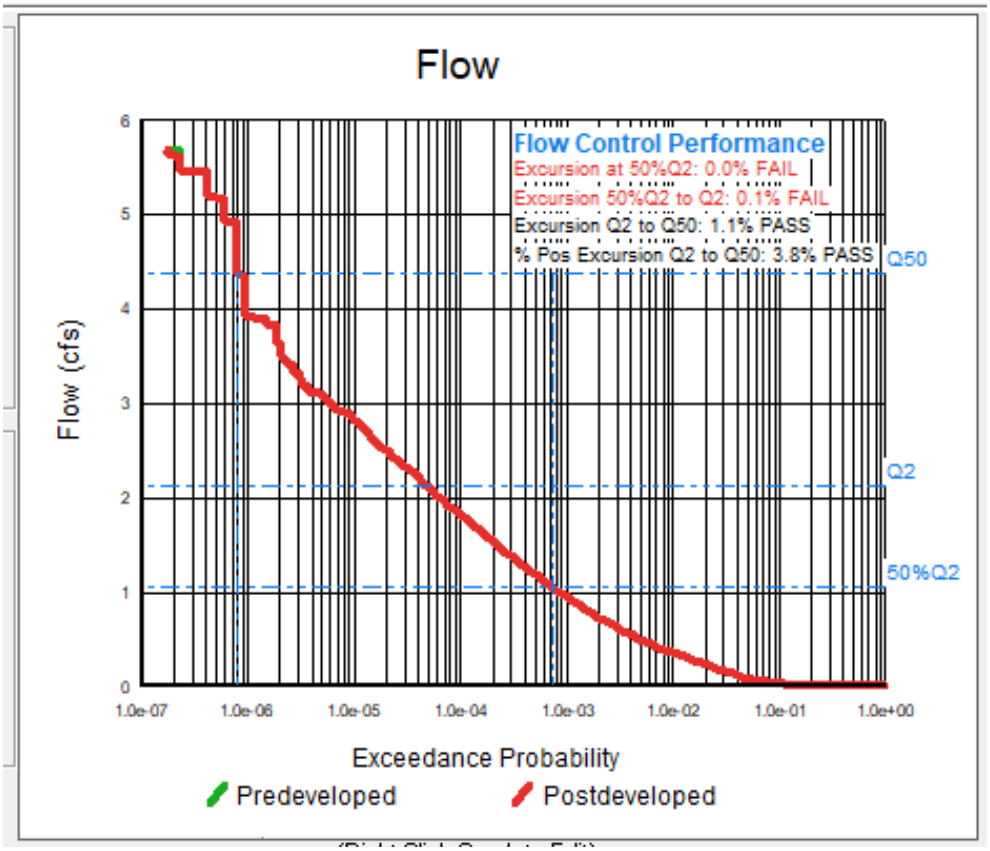
*** Point of Compliance Flow Frequency Data ***
Recurrence Interval Computed Using Gringorten Plotting Position

| Predevelopment Runoff | | Postdevelopment Runoff | |
|---|---|---|---|
| Tr (Years) | Discharge (cfs) | Tr (Years) | Discharge (cfs) |
| 2-Year | 2.053 | 2-Year | 2.053 |
| 5-Year | 2.698 | 5-Year | 2.698 |
| 10-Year | 3.029 | 10-Year | 3.029 |
| 25-Year | 3.729 | 25-Year | 3.729 |
| 50-Year | 4.237 | 50-Year | 4.237 |
| 100-Year | 5.268 | 100-Year | 5.268 |
| 200-Year | 5.438 | 200-Year | 5.438 |

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

**50%Q2 = 1.027 cfs (Assumed to be half of the 2-year flow.)**

## CF-F, G




**********Compliance Point Results **********

Scenario Predeveloped Compliance Subbasin: CF-FGHI

Scenario Postdeveloped Compliance Subbasin: CF-FGHI

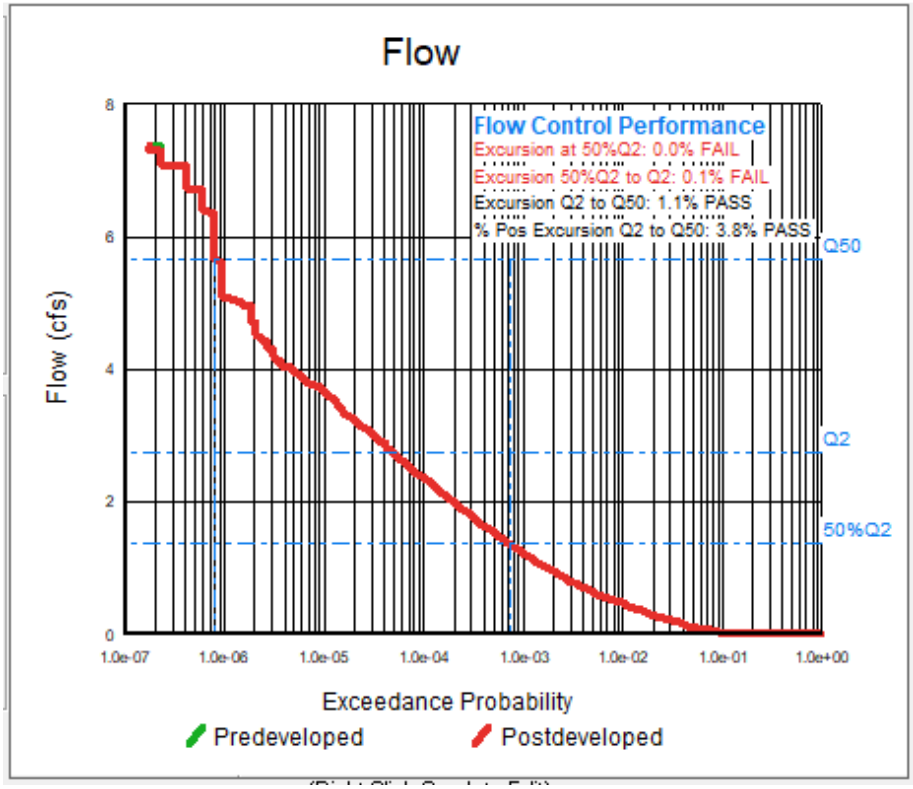
*** Point of Compliance Flow Frequency Data ***
Recurrence Interval Computed Using Gringorten Plotting Position

| Predevelopment Runoff | | Postdevelopment Runoff | |
|---|---|---|---|
| Tr (Years) | Discharge (cfs) | Tr (Years) | Discharge (cfs) |
| 2-Year | 2.122 | 2-Year | 2.122 |
| 5-Year | 2.789 | 5-Year | 2.789 |
| 10-Year | 3.132 | 10-Year | 3.132 |
| 25-Year | 3.855 | 25-Year | 3.855 |
| 50-Year | 4.381 | 50-Year | 4.381 |
| 100-Year | 5.447 | 100-Year | 5.447 |
| 200-Year | 5.623 | 200-Year | 5.623 |

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

**50%Q2 = 1.061 cfs (West Berth Combined) (Assumed to be half of the 2-year flow.)**
**50%Q2 = 0.53 cfs (Each Cartridge Filter) (Assumed to be half of the 2-year flow.)**

## Chamber A




**********Compliance Point Results **********

Scenario Predeveloped Compliance Subbasin: Chamber A

Scenario Postdeveloped Compliance Subbasin: Chamber A

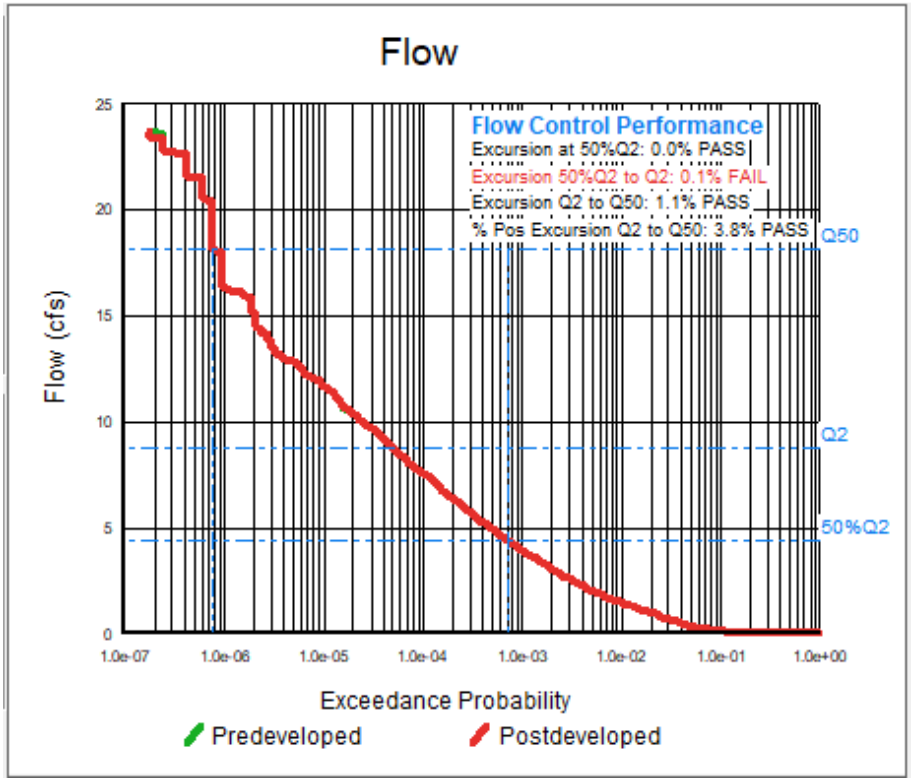
*** **Point of Compliance Flow Frequency Data** ***
Recurrence Interval Computed Using Gringorten Plotting Position

| Predevelopment Runoff | | Postdevelopment Runoff | |
|---|---|---|---|
| Tr (Years) | Discharge (cfs) | Tr (Years) | Discharge (cfs) |
| 2-Year | 2.749 | 2-Year | 2.749 |
| 5-Year | 3.612 | 5-Year | 3.612 |
| 10-Year | 4.056 | 10-Year | 4.056 |
| 25-Year | 4.993 | 25-Year | 4.993 |
| 50-Year | 5.673 | 50-Year | 5.673 |
| 100-Year | 7.054 | 100-Year | 7.054 |
| 200-Year | 7.282 | 200-Year | 7.282 |

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

**50%Q2 = 1.375 cfs (Assumed to be half of the 2-year flow.)**

## Chamber B




**********Compliance Point Results **********

Scenario Predeveloped Compliance Subbasin: Chamber B

Scenario Postdeveloped Compliance Subbasin: Chamber B

*** Point of Compliance Flow Frequency Data ***
Recurrence Interval Computed Using Gringorten Plotting Position

| Predevelopment Runoff | | Postdevelopment Runoff | |
|---|---|---|---|
| Tr (Years) | Discharge (cfs) | Tr (Years) | Discharge (cfs) |
| 2-Year | 8.817 | 2-Year | 8.817 |
| 5-Year | 11.587 | 5-Year | 11.587 |
| 10-Year | 13.011 | 10-Year | 13.011 |
| 25-Year | 16.016 | 25-Year | 16.016 |
| 50-Year | 18.198 | 50-Year | 18.198 |
| 100-Year | 22.628 | 100-Year | 22.628 |
| 200-Year | 23.357 | 200-Year | 23.357 |

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

**50%Q2 = 4.41 cfs (Assumed to be half of the 2-year flow.)**

**Cartridge Filter Sizing Calculation**

| Unit | Media | Area (ac) | Time of Concentration, Tc (min) | CN | I (in/hr) | Water Quality Flowrate (MGSFlood) (cfs) | Cartridge Height (in) | Treatment by Media Surface Area (gpm/ft2) | ZPG or MetalRx Cartridge Flow Rate (gpm/cartrige) | ZPG or MetalRx Flow Rate per Cartridge (cfs/ft2) | No. of Cartridges | Peak Diversion Vault? | Vault Size | Custom Vault Size | Max Cartridges Vault can Hold | Override Max Cartridges Vault can Hold | No. Vaults in Parallel |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CF-A | MetalRx | 1.52 | 5 | 98 | 3 | 0.265 | 18 | 1 | 7.5 | 0.017 | 16 | Yes | 8x11 | | 18 | | 1 |
| CF-B | MetalRx | 0.22 | 5 | 98 | 3 | 0.0383 | 27 | 1 | 11.25 | 0.025 | 2 | No | 6'-8" x 2'-0" | | 2 | | 1 |
| CF-C | MetalRx | 0.17 | 5 | 98 | 3 | 0.0296 | 27 | 1 | 11.25 | 0.025 | 2 | No | 6'-8" x 2'-0" | | 2 | | 1 |
| CF-D | ZPG | 5.0 | 5 | 98 | 3 | 0.87 | 18 | 1 | 7.5 | 0.017 | 53 | Yes | 8x24 | | 53 | | 1 |
| CF-E | ZPG | 5.9 | 5 | 98 | 3 | 1.027 | 18 | 1 | 7.5 | 0.017 | 62 | No | | 8x26 | | 62 | 1 |
| CF-F | ZPG | 3.05 | 5 | 98 | 3 | 0.531 | 27 | 1 | 11.25 | 0.025 | 22 | Yes | 8x14 | | 24 | | 1 |
| CF-G | ZPG | 3.05 | 5 | 98 | 3 | 0.531 | 27 | 1 | 11.25 | 0.025 | 22 | Yes | 8x14 | | 24 | | 1 |

April 2017

# GENERAL USE LEVEL DESIGNATION FOR BASIC (TSS) TREATMENT

**For**

**CONTECH Engineered Solutions**
**Stormwater Management StormFilter®**
**With ZPG Media at 1 gpm/sq ft media surface area**

**Ecology's Decision:**

**Based on the CONTECH Engineered Solutions' (CONTECH) application submissions, Ecology hereby issues a General Use Level Designation (GULD) for the Stormwater Management StormFilter® (StormFilter):**

1. **As a basic stormwater treatment practice for total suspended solids (TSS) removal,**
   - **Using ZPG™ media (zeolite/perlite/granular activated carbon), with the size distribution described below,**
   - **Sized at a hydraulic loading rate of 1 gpm/ft$^2$ of media surface area, per Table 1, and**
   - **Internal bypassing needs to be consistent with the design guidelines in CONTECH's current product design manual.**

**Table 1. StormFilter Design Flow Rates per Cartridge**

| Effective Cartridge Height (inches) | 12 | 18 | 27 |
|---|---|---|---|
| Cartridge Flow Rate (gpm/cartridge) | 5 | 7.5 | 11.3 |

2. **Ecology approves StormFilter systems containing ZPG™ media for treatment at the hydraulic loading rates shown in Table 1, and sized based on the water quality design flow rate for an off-line system. Contech designs their StormFilter systems to maintain treatment of the water quality design flow while routing excess flows around the treatment chamber during periods of peak bypass. The water quality design flow rates are calculated using the following procedures:**
   - **Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model.**

- **Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three methods described in Chapter 2.2.5 of the Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.**
- **Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.**

3. **This designation has no expiration date, but Ecology may amend or revoke it.**

**<u>Ecology's Conditions of Use</u>:**

**The StormFilter with ZPG media shall comply with the following conditions:**

1. **Design, install, operate, and maintain the StormFilter with ZPG media in accordance with applicable Contech Engineered Solutions manuals, documents, and the Ecology Decision.**

2. **Install StormFilter systems to bypass flows exceeding the water quality treatment rate. Additionally, high flows will not re-suspend captured sediments. Design StormFilter systems in accordance with the performance goals in Ecology's most recent Stormwater Manual and CONTECH's *Product Design Manual Version 4.1 (April 2006)*, or most current version, unless otherwise specified.**

3. **Owners must follow the design, pretreatment, land use application, and maintenance criteria in CONTECH's Design Manual.**

4. **Pretreatment of TSS and oil and grease may be necessary, and designers shall provide pre-treatment in accordance with the most current versions of the CONTECH's *Product Design Manual (April 2006)* or the applicable Ecology Stormwater Manual. Design pre-treatment using the performance criteria and pretreatment practices provided on Ecology's "Evaluation of Emerging Stormwater Treatment Technologies" website.**

5. **Maintenance: The required maintenance interval for stormwater treatment devices is often dependent upon the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of manufactured filter treatment device.**

   - **Typically, CONTECH designs StormFilter systems for a target filter media replacement interval of 12 months. Maintenance includes removing accumulated sediment from the vault, and replacing spent cartridges with recharged cartridges.**

- **Indications of the need for maintenance include effluent flow decreasing to below the design flow rate, as indicated by the scumline above the shoulder of the cartridge.**
- **Owners/operators must inspect StormFilter with ZPG media for a minimum of twelve months from the start of post-construction operation to determine site-specific maintenance schedules and requirements. You must conduct inspections monthly during the wet season, and every other month during the dry season. (According to the SWMMWW, the wet season in western Washington is October 1 to April 30. According to SWMMEW, the wet season in eastern Washington is October 1 to June 30). After the first year of operation, owners/operators must conduct inspections based on the findings during the first year of inspections.**
- **Conduct inspections by qualified personnel, follow manufacturer's guidelines, and use methods capable of determining either a decrease in treated effluent flowrate and/or a decrease in pollutant removal ability.**
- **When inspections are performed, the following findings typically serve as maintenance triggers:**
  - **Accumulated vault sediment depths exceed an average of 2 inches, or**
  - **Accumulated sediment depths on the tops of the cartridges exceed an average of 0.5 inches, or**
  - **Standing water remains in the vault between rain events, or**
  - **Bypass occurs during storms smaller than the design storm.**
- **Note: If excessive floatables (trash and debris) are present, perform a minor maintenance consisting of gross solids removal, not cartridge replacement.**

6. **CONTECH shall maintain readily available reports listed under "Application Documents" (above) as public, as well as the documentation submitted with its previous conditional use designation application. CONTECH shall provide links to this information from its corporate website, and make this information available upon request, at no cost and in a timely manner.**

7. **ZPG™ media used shall conform with the following specifications:**

- **Each cartridge contains a total of approximately 2.6 cubic feet of media. The ZPG™ cartridge consists of an outer layer of perlite that is approximately 1.3 cubic feet in volume and an inner layer, consisting of a mixture of 90% zeolite and 10% granular activated carbon, which is approximately 1.3 cubic feet in volume.**

- **Perlite Media: Perlite media shall be made of natural siliceous volcanic rock free of any debris or foreign matter. The expanded perlite shall**

**have a bulk density ranging from 6.5 to 8.5 lbs per cubic foot and particle sizes ranging from 0.09" (#8 mesh) to 0.38" (3/8" mesh).**

- **Zeolite Media: Zeolite media shall be made of naturally occurring clinoptilolite. The zeolite media shall have a bulk density ranging from 44 to 50 lbs per cubic foot and particle sizes ranging from 0.13" (#6 mesh) to 0.19" (#4 mesh). Additionally, the cation exchange capacity (CEC) of zeolite shall range from approximately 1.0 to 2.2 meq/g.**

- **Granular Activated Carbon: Granular activated carbon (GAC) shall be made of lignite coal that has been steam-activated. The GAC media shall have a bulk density ranging from 28 to 31 lbs per cubic foot and particle sizes ranging from a 0.09" (#8 mesh) to 0.19" (#4 mesh).**

**<u>Approved Alternate Configurations</u>**

**Peak Diversion StormFilter**

1. The Peak Diversion StormFilter allows for off-line bypass within the StormFilter structure. Design capture flows and peak flows enter the inlet bay which contains an internal weir. The internal weir allows design flows to enter the cartridge bay through a transfer hole located at the bottom of the inlet bay while the unit routs higher flows around the cartridge bay.
2. To select the size of the Peak Diversion StormFilter unit, the designer must determine the number of cartridges required and size of the standard StormFilter using the site-specific water quality design flow and the **StormFilter Design Flow Rates per Cartridge** as described above.
3. New owners may not install the Peak Diversion StormFilter at an elevation or in a location where backwatering may occur.

**Applicant:** Contech Engineered Solutions

**Applicant's Address:** 11835 NE Glenn Widing Dr.
Portland, OR 97220

**Application Documents:**

The applicant's master report, titled, "The Stormwater Management StormFilter Basic Treatment Application for General Use Level Designation in Washington", Stormwater Management, Inc., November 1, 2004, includes the following reports:

- (Public) *Evaluation of the Stormwater Management StormFilter Treatment System: Data Validation Report and Summary of the Technical Evaluation Engineering Report (TEER) by Stormwater Management Inc*., October 29, 2004 Ecology's technology assessment protocol requires the applicant to hire an independent consultant to complete the following work:

1. Complete the data validation report.
2. Prepare a TEER summary, including a testing summary and conclusions compared with the supplier's performance claims.
3. Provide a recommendation of the appropriate technology use level.
4. Work with Ecology to post recommend relevant information on Ecology's website.
5. Provide additional testing recommendations, if needed."
6. This report, authored by Dr. Gary Minton, Ph. D., P.E., Resource Planning Associates, satisfies the Ecology requirement.

- (Public) "Performance of the Stormwater Management StormFilter Relative to the Washington State Department of Ecology Performance Goals for Basic Treatment," is a summary of StormFilter performance that strictly adheres to the criteria listed in the Guidance for Evaluating Emerging Stormwater Treatment Technologies, Technology Assessment Protocol – Ecology (TAPE).
- "Heritage Marketplace Field Evaluation: Stormwater Management StormFilter with ZPG™ Media," is a report showing all of the information collected at Site A as stated in the SMI Quality Assurance Project Plan (QAPP). This document contains detailed information regarding each storm event collected at this site, and it provided a detailed overview of the data and project.
- "Lake Stevens Field Evaluation: Stormwater Management StormFilter with ZPG™ Media," is a report that corresponds to Site E as stated in the SMI QAPP. This document contains detailed information regarding each storm collected at this site, and includes a detailed overview of the data and project.
- (Public) "Evaluation of the Stormwater Management StormFilter for the removal of SIL-CO-SIL 106, a standardized silica product: ZPG™ at 7.5 GPM" is a report that describes laboratory testing at full design flow.
- "Factors Other Than Treatment Performance."
- "State of Washington Installations."
- "Peak Diversion StormFilter" is a technical document demonstrating the Peak Diversion StormFilter system complies with the Stormwater Management Manual for Western Washington Volume V Section 4.5.1.

Above-listed documents noted as "public" are available by contacting CONTECH.

**Applicant's Use Level Request:**

That Ecology grant a General Use Level Designation for Basic Treatment for the StormFilter using ZPG™ media (zeolite/perlite/granular activated carbon) at a hydraulic loading rate of 1 gpm/ft$^2$ of media surface area in accordance with Ecology's 2011 *Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE)*.

**Applicant's Performance Claim:**

The combined data from the two field sites reported in the TER (Heritage Marketplace and Lake Stevens) indicate that the performance of a StormFilter system configured for inline bypass with ZPG™ media and a hydraulic loading rate of 1 gpm/ft$^2$ of media surface area meets Ecology performance goals for Basic Treatment.

**Ecology's Recommendations:**

Based on the weight of the evidence and using its best professional judgment, Ecology finds that:

- StormFilter, using ZPG™ media and operating at a hydraulic loading rate of no more than 1 gpm/ft$^2$ of media surface area, is expected to provide effective stormwater treatment achieving Ecology's Basic Treatment (TSS removal) performance goals. Contech demonstrated this is through field and laboratory testing performed in accordance with the approved protocol. StormFilter is deemed satisfactory with respect to factors other than treatment performance (e.g., maintenance; see the protocol's Appendix B for complete list).

**Findings of Fact:**

- Influent TSS concentrations and particle size distributions were generally within the range of what Ecology considers "typical" for western Washington (silt-to-silt loam).
- Contech sampled thirty-two (32) storm events at two sites for storms from April 2003 to March 2004, of which Contech deemed twenty-two (22) as "qualified" and were therefore included in the data analysis set.
- Statistical analysis of these 22 storm events verifies the data set's adequacy.
- Analyzing all 22 qualifying events, the average influent and effluent concentrations and aggregate pollutant load reduction are 114 mg/L, 25 mg/L, and 82%, respectively.
- Analyzing all 22 qualifying events based on the *estimated average* flow rate during the event (versus the *measured peak* flow rate), and more heavily weighting those events near the design rate (versus events either far above or well below the design rate) does not significantly affect the reported results.
- For the 7 qualifying events with influent TSS concentrations greater than 100 mg/L, the average influent and effluent concentrations and aggregate pollutant load reduction are 241 mg/L, 34 mg/L, and 89%, respectively. If we exclude the 2 of 7 events that exceed the maximum 300 mg/L specified in Ecology's guidelines, the average influent and effluent concentrations and aggregate pollutant load reduction are 158 mg/L, 35 mg/L, and 78%, respectively.
- For the 15 qualifying events with influent TSS concentrations less than 100 mg/L, the average influent and effluent concentrations and aggregate pollutant load reduction are 55 mg/L, 20 mg/L, and 61%, respectively. If the 6 of 15 events that fall below the minimum 33 mg/L TSS specified in Ecology's guidelines are excluded, the average

influent and effluent concentrations and aggregate pollutant load reduction are 78 mg/L, 26 mg/L, and 67%, respectively.

- For the 8 qualifying events with peak discharge exceeding design flow (ranging from 120 to 257% of the design rate), results ranged from 52% to 96% TSS removal, with an average of 72%.
- Due to the characteristics of the hydrographs, the field results generally reflect flows below (ranging between 20 and 60 percent of) the tested facilities' design rate. During these sub-design flow rate periods, some of the cartridges operate at or near their *individual* full design flow rate (generally between 4 and 7.5 GPM for an 18" cartridge effective height) because their float valves have opened. Float valves remain closed on the remaining cartridges, which operate at their base "trickle" rate of 1 to 1.5 GPM.
- Laboratory testing using U.S. Silica's Sil-Co-Sil 106 fine silica product showed an average 87% TSS removal for testing at 7.5 GPM per cartridge (100% design flow rate).
- Other relevant testing at I-5 Lake Union, Greenville Yards (New Jersey), and Ski Run Marina (Lake Tahoe) facilities shows consistent TSS removals in the 75 to 85% range. *Note that the evaluators operated the I-5 Lake Union at 50%, 100%, and 125% of design flow*.
- SMI's application included a satisfactory "Factors other than treatment performance" discussion.

*Note: Ecology's 80% TSS removal goal applies to 100 mg/l and greater influent TSS. Below 100 mg/L influent TSS, the goal is 20 mg/L effluent TSS.*

**Technology Description:**

The Stormwater Management StormFilter® (StormFilter), a flow-through stormwater filtration system, improves the quality of stormwater runoff from the urban environment by removing pollutants. The StormFilter can treat runoff from a wide variety of sites including, but not limited to: retail and commercial development, residential streets, urban roadways, freeways, and industrial sites such as shipyards, foundries, etc.

**Operation:**

The StormFilter is typically comprised of a vault that houses rechargeable, media-filled, filter cartridges. Various media may be used, but this designation covers only the zeolite-perlite-granulated activated carbon (ZPG™) medium. Stormwater from storm drains percolates through these media-filled cartridges, which trap particulates and may remove pollutants such as dissolved metals, nutrients, and hydrocarbons. During the filtering process, the StormFilter system also removes surface scum and floating oil and grease. Once filtered through the media, the treated stormwater is directed to a collection pipe or discharged to an open channel drainage way.

This document includes a bypass schematic for flow rates exceeding the water quality design flow rate on page 8.

**StormFilter Configurations:**

Contech offers the StormFilter in multiple configurations: precast, high flow, catch basin, curb inlet, linear, volume, corrugated metal pipe, drywell, and CON/Span form. Most configurations use pre-manufactured units to ease the design and installation process. Systems may be either uncovered or covered underground units.

The typical precast StormFilter unit is composed of three sections: the energy dissipater, the filtration bay, and the outlet sump. As Stormwater enters the inlet of the StormFilter vault through the inlet pipe, piping directs stormwater through the energy dissipater into the filtration bay where treatment will take place. Once in the filtration bay, the stormwater ponds and percolates horizontally through the media contained in the StormFilter cartridges. After passing through the media, the treated water in each cartridge collects in the cartridge's center tube from where piping directs it into the outlet sump by a High Flow Conduit under-drain manifold. The treated water in the outlet sump discharges through the single outlet pipe to a collection pipe or to an open channel drainage way. In some applications where you anticipate heavy grit loads, pretreatment by settling may be necessary.

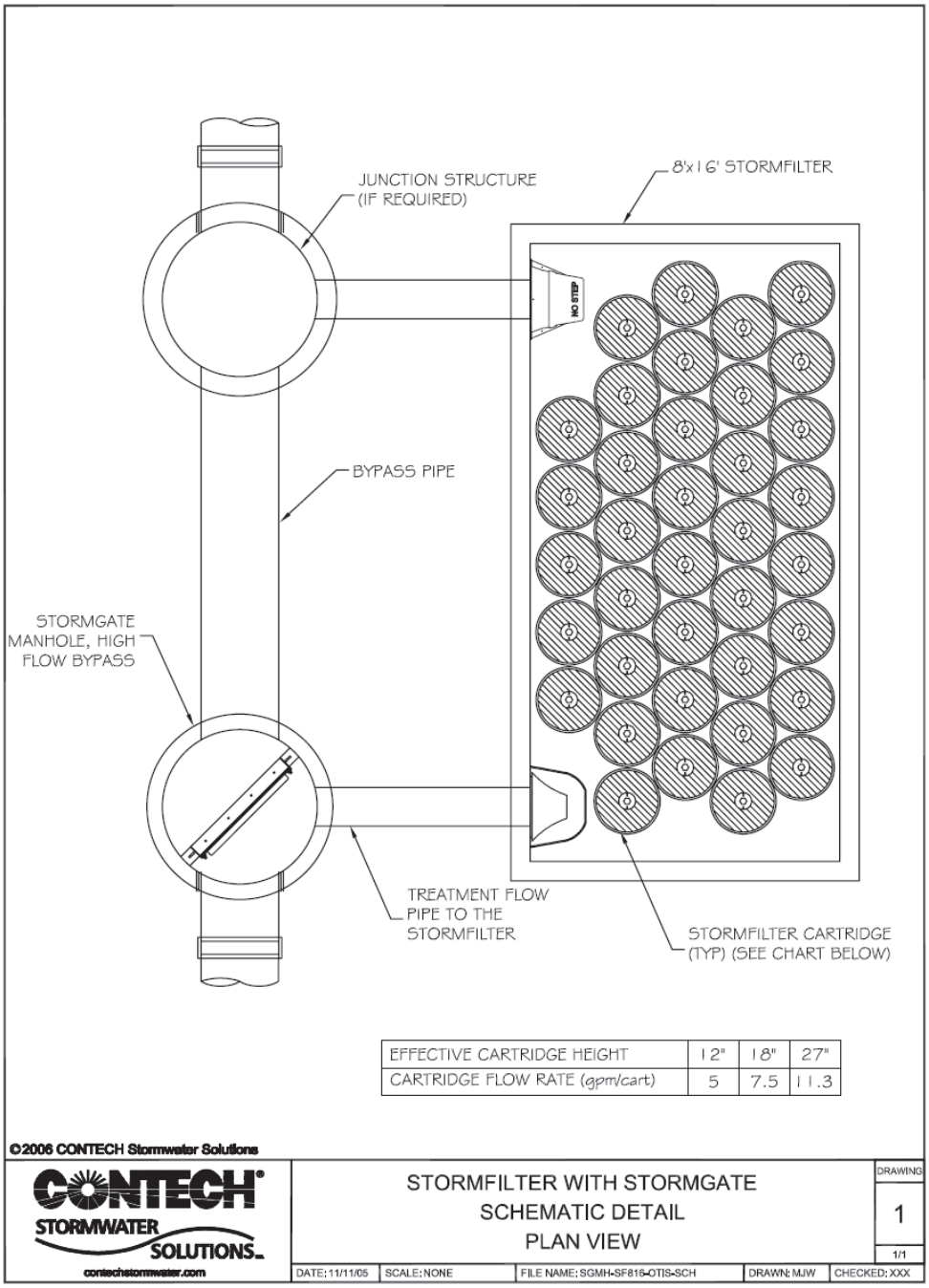



**Figure 1. Stormwater Management StormFilter Configuration with Bypass**

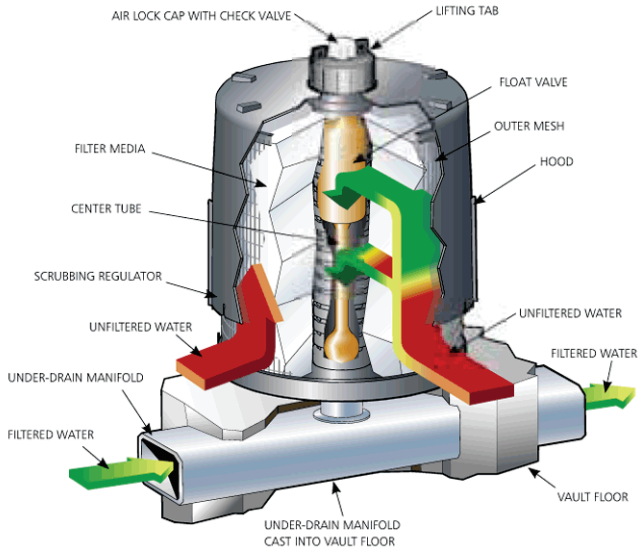



**Figure 2. The StormFilter Cartridge**

## Cartridge Operation:

As the water level in the filtration bay begins to rise, stormwater enters the StormFilter cartridge. Stormwater in the cartridge percolates horizontally through the filter media and passes into the cartridge's center tube, where the float in the cartridge is in a closed (downward) position. As the water level in the filtration bay continues to rise, more water passes through the filter media and into the cartridge's center tube. Water displaces the air in the cartridge and it purges from beneath the filter hood through the one-way check valve located in the cap. Once water fills the center tube there is enough buoyant force on the float to open the float valve and allow the treated water to flow into the under-drain manifold. As the treated water drains, it tries to pull in air behind it. This causes the check valve to close, initiating a siphon that draws polluted water throughout the full surface area and volume of the filter. Thus, water filters through the entire filter cartridge throughout the duration of the storm, regardless of the water surface elevation in the filtration bay. This continues until the water surface elevation drops to the elevation of the scrubbing regulators. At this point, the siphon begins to break and air quickly flows beneath the hood through the scrubbing regulators, causing energetic bubbling between the inner surface of the hood and the outer surface of the filter. This bubbling agitates and cleans the surface of the filter, releasing accumulated sediments on the surface, flushing them from beneath the hood, and allowing them to settle to the vault floor.

## Adjustable cartridge flow rate:

Inherent to the design of the StormFilter is the ability to control the individual cartridge flow rate with an orifice-control disc placed at the base of the cartridge. Depending on the treatment requirements and on the pollutant characteristics of the influent stream as

specified in the CONTECH *Product Design Manual*, operators may adjust the flow rate through the filter cartridges. By decreasing the flow rate through the filter cartridges, the influent contact time with the media is increased and the water velocity through the system is decreased, thus increasing both the level of treatment and the solids removal efficiencies of the filters, respectively (de Ridder, 2002).

**Recommended research and development:**

Ecology encourages CONTECH to pursue continuous improvements to the StormFilter. To that end, CONTECH recommends the following actions:

- Determine, through laboratory testing, the relationship between accumulated solids and flow rate through the cartridge containing the ZPG™ media. **Completed 11/05.**
- Determine the system's capabilities to meet Ecology's enhanced, phosphorus, and oil treatment goals.
- Develop easy-to-implement methods of determining that a StormFilter facility requires maintenance (cleaning and filter replacement).

**Contact Information:**

Applicant Contact: Jeremiah Lehman
Contech Engineered Solutions
11835 NE Glenn Widing Drive
Portland, OR, 97220
503-258-3136
jlehman@conteches.com

Applicant Web link http://www.conteches.com/

Ecology web link: http://www.ecy.wa.gov/programs/wq/stormwater/newtech/index.html

Ecology Contact: Douglas C. Howie, P.E.
Department of Ecology
Water Quality Program
(360) 407-6444
douglas.howie@ecy.wa.gov

**Revision History**

| **Date** | **Revision** |
|---|---|
| Jan 2005 | Original Use Level Designation |
| Dec 2007 | Revision |
| May 2012 | Maintenance requirements updated |
| November 2012 | Design Storm and Maintenance requirements updated |
| January 2013 | Updated format to match Ecology standard format |
| September 2014 | Added Peak Diversion StormFilter Alternate Configuration |
| November 2016 | Revised Contech contact information |
| April 2017 | Revised sizing language to note sizing based on Off-line calculations |

April 2017

# CONDITIONAL USE LEVEL DESIGNATION FOR BASIC (TSS) AND DISSOVLED METALS (ENHANCED) TREATMENT

**For**

**CONTECH Engineered Solutions**

**Stormwater Management StormFilter®**

**with MetalRx™ media**

**Ecology's Decision:**

**Based on Contech Engineered Solutions application, Ecology hereby issues conditional use level designation (CULD) for the Stormwater Management StormFilter® using MetalRx™ media cartridges:**

1. **Conditional Use Level Designation (CULD) for Basic Treatment (total suspended solids) and for Dissolved Metals ("Enhanced") treatment.**
   - **Sized at a hydraulic loading rate of no greater than 1 gallon per minute (gpm) per square foot (sq ft.) of media surface, per Table 1.**
   - **Using Contech's MetalRx media. Specifications for the media shall match the specifications provided by the manufacturer and approved by Ecology.**

**Table 1. StormFilter design flow rates for 18-inch diameter cartridges with MetalRx media, operating at 1 gpm/sq ft.**

| Effective cartridge height (in) | Cartridge flow rate (gpm/cartridge) |
|---|---|
| 12 | 5 |
| 18 | 7.5 |
| 27 | 11.25 |

2. **Ecology approves StormFilter systems containing MetalRx media for treatment at the hydraulic loading rates shown in Table 1, to achieve the maximum water quality design flow rate. The water quality design flow rates are calculated using the following procedures:**

- **Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model.**
- **Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three methods described in Chapter 2.2.5 of the Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.**
- **Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.**

3. **The use level designation expires on July 1, 2019 unless Ecology extends the date, and is subject to the conditions specified below.**

**<u>Ecology's Conditions of Use:</u>**

**StormFilter systems containing MetalRx media shall comply with the following conditions:**

1. **Design, assemble, install, operate, and maintain StormFilter systems containing MetalRx media in accordance with applicable Contech Engineered Solutions manuals, documents and the Ecology Decision.**
2. **Use sediment-loading capacity, in conjunction with the water quality design flow rate, to determine the target maintenance interval.**
3. **Install StormFilter systems in such a manner that you bypass flows exceeding the water quality treatment rate or you will not re-suspend captured sediments.**
4. **Contech Engineered Solutions commits to submitting a QAPP for Ecology review and approval by October 1, 2014 that meets the TAPE requirements for attaining a GULD for basic and dissolved metals treatment.**
5. **Contech Engineered Solutions shall complete all required testing and submit a TER for Ecology review by January 1, 2019.**
6. **Contech Engineered Solutions may request Ecology to grant deadline or expiration date extensions, upon showing cause for such extensions.**
7. **This CULD approval allows up to ten (10) installations of StormFilter systems containing MetalRx media within the State of Washington for development and redevelopment projects (as defined by the Stormwater Management Manual Western Washington). The limit of ten sites applies to the total number of installations; whether for basic or for dissolved metals (enhanced) treatment.**
8. **Maintenance: The required maintenance interval for stormwater treatment devices is often dependent upon the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of manufactured filter treatment device**
   - **Typically, CONTECH designs StormFilter systems for a target filter media replacement interval of 12 months. Maintenance includes removing accumulated sediment from the vault, and replacing spent cartridges with recharged cartridges.**

- **Indications of the need for maintenance included the effluent flow decreasing to below the design flow rate, as indicated by the scumline above the shoulder of the cartridge.**
- **Owners/operators must inspect StormFilter with MetalRx for a minimum of twelve months from the start of post-construction operation to determine site-specific maintenance schedules and requirements. You must conduct inspections monthly during the wet season, and every other month during the dry season. (According to the SWMMWW, the wet season in western Washington is October 1 to April 30. According to SWMMEW, the wet season in eastern Washington is October 1 to June 30). After the first year of operation, owners/operators must conduct inspections based on the findings during the first year of inspections.**
- **Conduct inspections by qualified personnel, follow manufacturer's guidelines, and you must use methods capable of determining either a decrease in treated effluent flowrate and/or a decrease in pollutant removal ability.**
- **When inspections are performed, the following findings typically serve as maintenance triggers:**
  - **Accumulated vault sediment depths exceed an average of 2 inches, or**
  - **Accumulated sediment depths on the tops of the cartridges exceed an average of 0.5 inches, or**
  - **Standing water remains in the vault between rain events, or**
  - **Bypass during storms smaller than the design storm.**
- **Note: If excessive floatables (trash and debris) are present, perform a minor maintenance consisting of gross solids removal, not cartridge replacement.**

9. **Discharges from the StormFilter systems containing MetalRx media shall not cause or contribute to water quality standards violations in receiving waters.**

| | |
|---|---|
| **Applicant:** | CONTECH Engineered Solutions |
| **Applicant's Address:** | 11835 NE Glenn Widing Dr.<br>Portland, OR 97220 |

**Application Documents:**

- August 27, 2012 letter from CONTECH Engineered Solutions requesting a CULD from Washington State Department of Ecology.
- Application and supporting documentation. Stormwater Management StormFilter® MetalRx™ at a Specific Flow Rate of 1 gpm/ft$^2$.

- Volume 1 – Technology Description
    - Appendix A – Specifications
    - Appendix B – Schematics
    - Appendix C – Operations & Maintenance
  - Volume 2 - MetalRx™ at 1 gpm/ft$^2$
    - Lab testing
    - Field Testing
    - Appendix A – Site Report
    - Appendix B – Statistics
    - QAPP

**Applicant's Use Level Request:**

- General use level designation as a basic (TSS) and dissolved metals treatment device in accordance with Ecology's 2012 Stormwater Management Manual for Western Washington and Technology Assessment Protocol – Ecology (TAPE January 2011 Revision).

**Applicant's Performance Claims:**

Based on results from laboratory and field-testing, the applicant claims:

- The Stormwater Management StormFilter with MetalRx media operating at 1 gpm/ft$^2$ removes greater than 80% suspended solids for influent concentrations greater than 100 mg/L, 60% dissolved zinc for influent concentrations greater than 20 ug/L, and 30% dissolved copper for influent concentrations greater than 5 ug/L.

**Recommendations:**

Ecology finds that:

- CONTECH Engineered Solutions qualifies for the opportunity to demonstrate, through field-testing in the Pacific Northwest, whether the StormFilter system with MetalRx media can attain Ecology's basic and dissolved metals treatment goals.

**Findings of Fact:**

*Laboratory testing*

- Since 1992, CSF® leaf, XFCSF™, and MetalRx media have been widely tested to investigate their pollutant removal capabilities for stormwater.
- In one laboratory study, Stormwater Management tested a single cartridge with XFCSF media for TSS, copper, and zinc removal using synthetic stormwater. Test flow rate was 6.5 gpm (slightly lower than the 7.5 gpm that corresponds to a loading of 1 gpm/ft$^2$). Contech made synthetic stormwater using zinc and copper salts and sandy loam (USDA) or sandy organic (USCS) sediment. Eight (8) of 14 test runs had TSS concentrations within the TAPE assessment range. These influent TSS concentrations ranged from 22 to 68 mg/L, and TSS removal was between 89 and 95 percent. Two (2) of 14 test runs had influent dissolved zinc in the TAPE assessment range, with a removal of 78-80 percent (influent concentrations 0.155, 0.185 mg/L). The remaining twelve (12) runs had much higher dissolved zinc influent concentrations, with removals ranging from 93 to 98

percent. The influent dissolved copper concentrations for all runs were higher than the TAPE assessment range of 0.005 to 0.02 mg/L. Influent dissolved copper ranged from 0.024 mg/L to 17.0 mg/L. Dissolved copper removal ranged from 15 to 97 percent (average of 65 percent).

*Field testing*

- Contech conducted monitoring of a StormFilter system using a blend of perlite and MetalRx media treating runoff from a 2.3-acre parking lot. Influent TSS concentration ranged from 22 to 71 mg/L. Discrete TSS removal efficiency ranged from 68 to 78 percent (5 storm events). Removal efficiency for influent dissolved zinc in the range of 19 to 60 ug/L ranged from 41 to 77 percent, with an average of 63 percent (6 storm events). Dissolved copper removal for a single event was 22 percent (influent 3.33 ug/L; effluent 2.59 ug/L).
- Contech conducted monitoring of a large-scale StormFilter system using MetalRx media treating runoff from 152 acres of airport runoff (roads, parking lots, roofs, taxiways, landscaping). The StormFilter system is downstream of a detention pond; therefore; influent TSS concentrations for all monitored events were lower than the lower end of the TAPE assessment range (<20 mg/L). Dissolved zinc removal ranged from 47 to 80 percent for influent concentrations from 30 to 52 ug/L. Average dissolved zinc removal was 68 percent (11 events). Dissolved copper removal ranged from -3 to 50 percent for influent concentrations from 7.7 to 18 ug/L. Average dissolved copper removal was 32.3 percent (11 events).
- Contech conducted monitoring of a StormFilter system using XFCSF media treating runoff from a 1-acre galvanized metal roof. The XFCSF media is similar to MetalRx media, except that XFCSF media comprises slightly larger gradation of media pellets. Contech did not monitor TSS removal for this study. Influent dissolved zinc concentrations were all higher than the upper end of the TAPE assessment range (> 300 ug/L), and ranged from 389 to 11,600 ug/L. Dissolved zinc removal ranged from 25 to 90 percent, with an average removal of 64 percent (12 events). Influent dissolved copper ranged from 2.1 to 18.2 ug/L. Dissolved copper removal ranged from 27 to 76 percent, with an average removal of 55 percent.

**Other StormFilter system MetalRx media matters to be addressed by the company:**

1. Test the system under normal operating conditions, such that pollutants partially fill the settling basin. Results obtained for “clean” systems may not be representative of typical performance.
2. Conduct field-testing at sites that are indicative of the treatment goals.
3. Conduct testing to obtain information about maintenance requirements in order to come up with a maintenance cycle.
4. Conduct loading tests on the filter to determine maximum treatment life of the system.

**Technology Description:** Download at: http://www.conteches.com/Products/Stormwater-Management/Treatment/Stormwater-Management-StormFilter.aspx

**Contact Information:**

Applicant: Jeremiah Lehman
Contech Engineered Solutions
11835 NE Glenn Widing Drive
Portland, OR, 97220
503-258-3136
jlehman@conteches.com

Applicant website: www.conteches.com

Ecology web link: http://www.ecy.wa.gov/programs/wq/stormwater/newtech/index.html

Ecology: Douglas C. Howie, P.E.
Water Quality Program
(360) 407-6444
douglas.howie@ecy.wa.gov

**Revision History**

| Date | Revision |
|---|---|
| November 7, 2012 | Original Draft use-level-designation document: CULD for basic and dissolved metals (enhanced). |
| November 2016 | Revised Contech contact information |
| April 2017 | Revised TER submittal and Expiration dates |

**Attachments**

August 27, 2012 letter from Contech Engineered Solutions.

CONTECH
ENGINEERED SOLUTIONS

Contech Engineered Solutions LLC
11835 NE Glenn Widing Dr.
Portland, OR 97220
Phone: (800) 548-4667

August 27, 2012

Doug Howie
Water Quality Section
Washington State Department of Ecology
300 Desmond Drive
Lacey, WA 98503

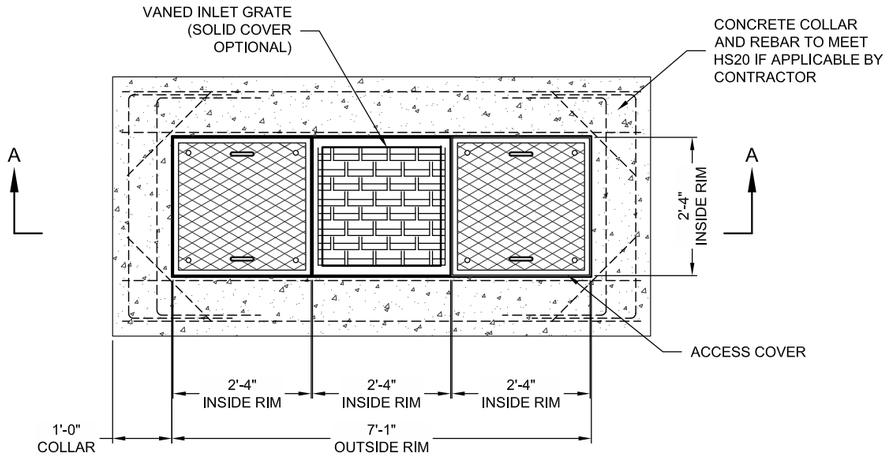
**Subject: Stormwater Management StormFilter® with MetalRx™ Request for CULD**

Dear Mr. Howie,

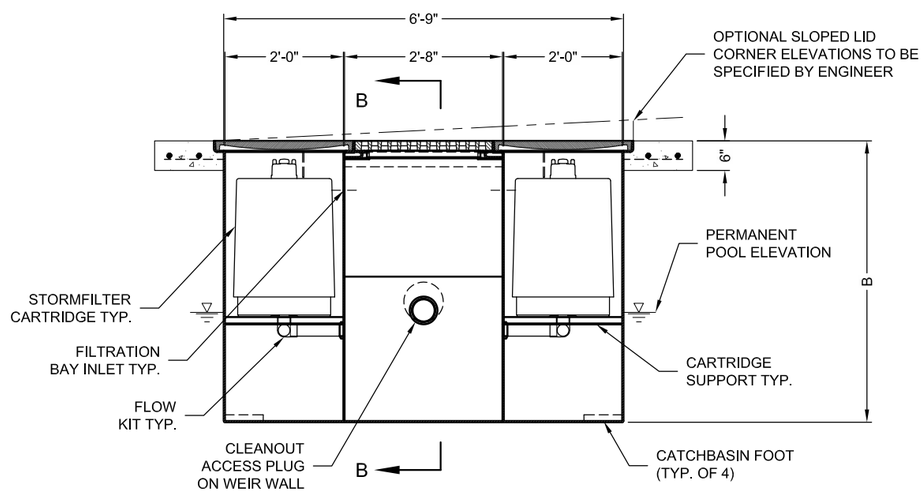
CONTECH would like to request a Conditional Use Level Designation (CULD) for the Stormwater Management StormFilter® (StormFilter) with MetalRx™ media operating at a specific flow rate of 1.0 gpm/ft$^2$. Ecology indicated in a May 9, 2012 letter entitled "TAPE 2011 Submittal for Contech StormFilter with MetalRx media (1gpm/ft$^2$)" that it would consider the application for a CULD provided that Contech commit to monitor. Contech will commit to finding a site that can satisfy Ecology's dissolved metals concentrations and providing a Quality Assurance Project Plan (per TAPE 2011) to Ecology within 2 years of issuing a CULD.

Sincerely,

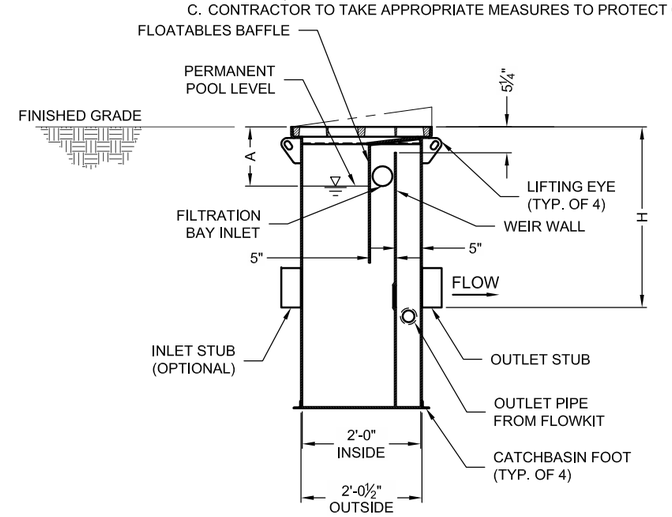
Sean Darcy
Regional Regulatory Manager
CONTECH Engineered Solutions




## PLAN VIEW




## SECTION A-A




## SECTION B-B

## STORMFILTER STEEL CATCHBASIN DESIGN NOTES

STORMFILTER TREATMENT CAPACITY IS A FUNCTION OF THE CARTRIDGE SELECTION AND THE NUMBER OF CARTRIDGES. 2 CARTRIDGE CATCHBASIN HAS A MAXIMUM OF TWO CARTRIDGES. SYSTEM IS SHOWN WITH A 27" CARTRIDGE, AND IS ALSO AVAILABLE WITH AN 18" CARTRIDGE. STORMFILTER CATCHBASIN CONFIGURATIONS ARE AVAILABLE WITH A DRY INLET BAY FOR VECTOR CONTROL.
PEAK HYDRAULIC CAPACITY PER TABLE BELOW. IF THE SITE CONDITIONS EXCEED PEAK HYDRAULIC CAPACITY, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

CARTRIDGE SELECTION

| CARTRIDGE HEIGHT | 27" | | | 18" | | | 18" DEEP | | |
|---|---|---|---|---|---|---|---|---|---|
| RECOMMENDED HYDRAULIC DROP (H) | 3.05' | | | 2.3' | | | 3.3' | | |
| SPECIFIC FLOW RATE (gpm/sf) | 2 gpm/sf | 1.67* gpm/sf | 1 gpm/sf | 2 gpm/sf | 1.67* gpm/sf | 1 gpm/sf | 2 gpm/sf | 1.67* gpm/sf | 1 gpm/sf |
| CARTRIDGE FLOW RATE (gpm) | 22.5 | 18.79 | 11.25 | 15 | 12.53 | 7.5 | 15 | 12.53 | 7.5 |
| PEAK HYDRAULIC CAPACITY | 1.0 | | | 1.0 | | | 1.8 | | |
| INLET PERMANENT POOL LEVEL (A) | 1'-0" | | | 1'-0" | | | 2'-0" | | |
| OVERALL STRUCTURE HEIGHT (B) | 4'-9" | | | 3'-9" | | | 4'-9" | | |

* 1.67 gpm/sf SPECIFIC FLOW RATE IS APPROVED WITH PHOSPHOSORB® (PSORB) MEDIA ONLY

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STORMFILTER CATCHBASIN STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. WWW.CONTECHES.COM
3. STORMFILTER CATCHBASIN WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
4. INLET SHOULD NOT BE LOWER THAN OUTLET. INLET (IF APPLICABLE) AND OUTLET PIPING TO BE SPECIFIED BY ENGINEER AND PROVIDED BY CONTRACTOR.
5. MANUFACTURER TO APPLY A SURFACE BEAD WELD IN THE SHAPE OF THE LETTER "O" ABOVE THE OUTLET PIPE STUB ON THE EXTERIOR SURFACE OF THE STEEL SFCB.
6. STORMFILTER CATCHBASIN EQUIPPED WITH 4 INCH (APPROXIMATE) LONG STUBS FOR INLET (IF APPLICABLE) AND OUTLET PIPING. STANDARD OUTLET STUB IS 8 INCHES IN DIAMETER. MAXIMUM OUTLET STUB IS 15 INCHES IN DIAMETER. CONNECTION TO COLLECTION PIPING CAN BE MADE USING FLEXIBLE COUPLING BY CONTRACTOR.
7. STEEL STRUCTURE TO BE MANUFACTURED OF 1/4 INCH STEEL PLATE. CASTINGS SHALL MEET AASHTO M306 LOAD RATING. TO MEET HS20 LOAD RATING ON STRUCTURE, A CONCRETE COLLAR IS REQUIRED. WHEN REQUIRED, CONCRETE COLLAR WITH #4 REINFORCING BARS TO BE PROVIDED BY CONTRACTOR.
8. FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. RADIAL MEDIA DEPTH SHALL BE 7-INCHES. FILTER MEDIA CONTACT TIME SHALL BE AT LEAST 38 SECONDS.
9. SPECIFIC FLOW RATE IS EQUAL TO THE FILTER TREATMENT CAPACITY (gpm) DIVIDED BY THE FILTER CONTACT SURFACE AREA (sq ft).

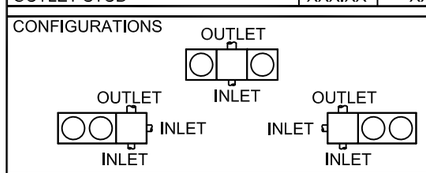
INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CATCHBASIN (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.

## 2-CARTRIDGE DEEP CATCHBASIN STORMFILTER DATA

| | |
|---|---|
| STRUCTURE ID | XXX |
| WATER QUALITY FLOW RATE (cfs) | X.XX |
| PEAK FLOW RATE (<1.8 cfs) | X.XX |
| RETURN PERIOD OF PEAK FLOW (yrs) | XXX |
| CARTRIDGE FLOW RATE (gpm) | XX |
| MEDIA TYPE (PERLITE, ZPG, PSORB) | XXXXX |
| RIM ELEVATION | XXX.XX' |

| PIPE DATA: | I.E. | DIAMETER |
|---|---|---|
| INLET STUB | XXX.XX' | XX" |
| OUTLET STUB | XXX.XX' | XX" |

CONFIGURATIONS




| | |
|---|---|
| SLOPED LID | YES\NO |
| SOLID COVER | YES\NO |

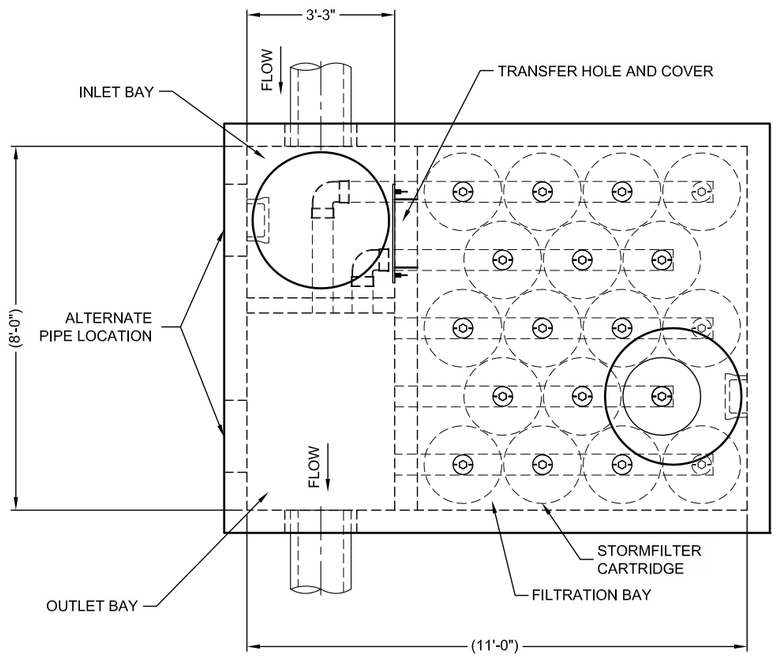
NOTES/SPECIAL REQUIREMENTS:

The Stormwater Management StormFilter®
THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING: U.S. PATENTS: 5,322,628; 5,524,670; 5,707,527; 5,865,157; 6,027,639; 6,649,046; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

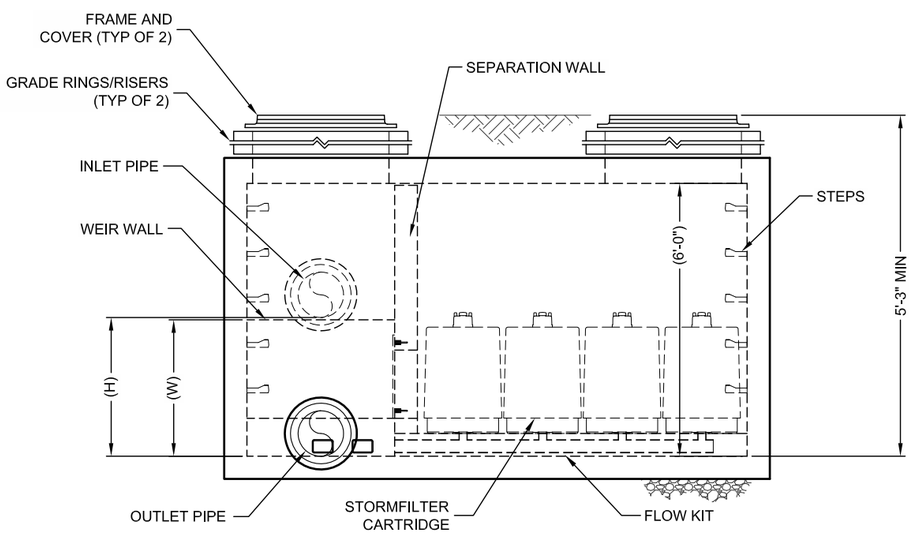
CONTECH® ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-526-3999 513-645-7000 513-645-7993 FAX

2 CARTRIDGE CATCHBASIN
STORMFILTER
STANDARD DETAIL

K:\COMMON\CAD\TREATMENT\10 STORMFILTER\40 STANDARD DRAWINGS\SFCB\SFCB-S\DWG\SFCB2-OTL.DWG 7/8/2016 2:45 PM




**PLAN**




**ELEVATION**

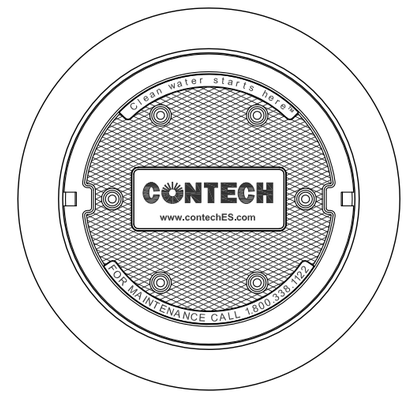
The Stormwater Management StormFilter®

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING: U.S. PATENTS: 5,322,629; 5,324,579; 5,707,527; 5,985,157; 6,027,639; 6,045,046; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

## STORMFILTER DESIGN TABLE

- THE 8' x 11' PEAK DIVERSION STORMFILTER TREATMENT CAPACITY VARIES BY CARTRIDGE COUNT AND LOCALLY APPROVED SURFACE AREA SPECIFIC FLOW RATE. PEAK CONVEYANCE CAPACITY TO BE DETERMINED BY ENGINEER OF RECORD.
- THE PEAK DIVERSION STORMFILTER IS AVAILABLE IN A LEFT INLET (AS SHOWN) OR RIGHT INLET CONFIGURATION.
- ALL PARTS AND INTERNAL ASSEMBLY PROVIDED BY CONTECH UNLESS OTHERWISE NOTED.

| CARTRIDGE HEIGHT | 27" | | 18" | | LOW DROP | |
|---|---|---|---|---|---|---|
| SYSTEM HYDRAULIC DROP (H - REQ'D. MIN.) | 3.05' | | 2.3' | | 1.8' | |
| HEIGHT OF WEIR (W) | 3.00' | | 2.25' | | 1.75' | |
| TREATMENT BY MEDIA SURFACE AREA | 2 gpm/ft² | 1 gpm/ft² | 2 gpm/ft² | 1 gpm/ft² | 2 gpm/ft² | 1 gpm/ft² |
| CARTRIDGE FLOW RATE (gpm) | 22.5 | 11.25 | 15 | 7.5 | 10 | 5 |




**FRAME AND COVER**
(DIAMETER VARIES)
N.T.S.

## SITE SPECIFIC DATA REQUIREMENTS

| | |
|---|---|
| STRUCTURE ID | * |
| WATER QUALITY FLOW RATE (cfs) | * |
| PEAK FLOW RATE (cfs) | * |
| RETURN PERIOD OF PEAK FLOW (yrs) | * |
| # OF CARTRIDGES REQUIRED | * |
| CARTRIDGE FLOW RATE | * |
| MEDIA TYPE (CSF, PERLITE, ZPG) | * |

| PIPE DATA: | I.E. | MATERIAL | DIAMETER |
|---|---|---|---|
| INLET PIPE | * | * | * |
| OUTLET PIPE | * | * | * |

| | |
|---|---|
| INLET BAY RIM ELEVATION | * |
| FILTER BAY RIM ELEVATION | * |

| ANTI-FLOTATION BALLAST | WIDTH | HEIGHT |
|---|---|---|
| | * | * |

NOTES/SPECIAL REQUIREMENTS:

PERFORMANCE SPECIFICATION

FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. **RADIAL MEDIA DEPTH SHALL BE 7-INCHES**. FILTER MEDIA CONTACT TIME SHALL BE AT LEAST **37 SECONDS**.
SPECIFIC FLOW RATE SHALL BE **2 GPM/SF (MAXIMUM)**. SPECIFIC FLOW RATE IS THE MEASURE OF THE FLOW (GPM) DIVIDED BY THE MEDIA SURFACE CONTACT AREA (SF). MEDIA VOLUMETRIC FLOW RATE SHALL BE **6 GPM/CF OF MEDIA (MAXIMUM).**

GENERAL NOTES

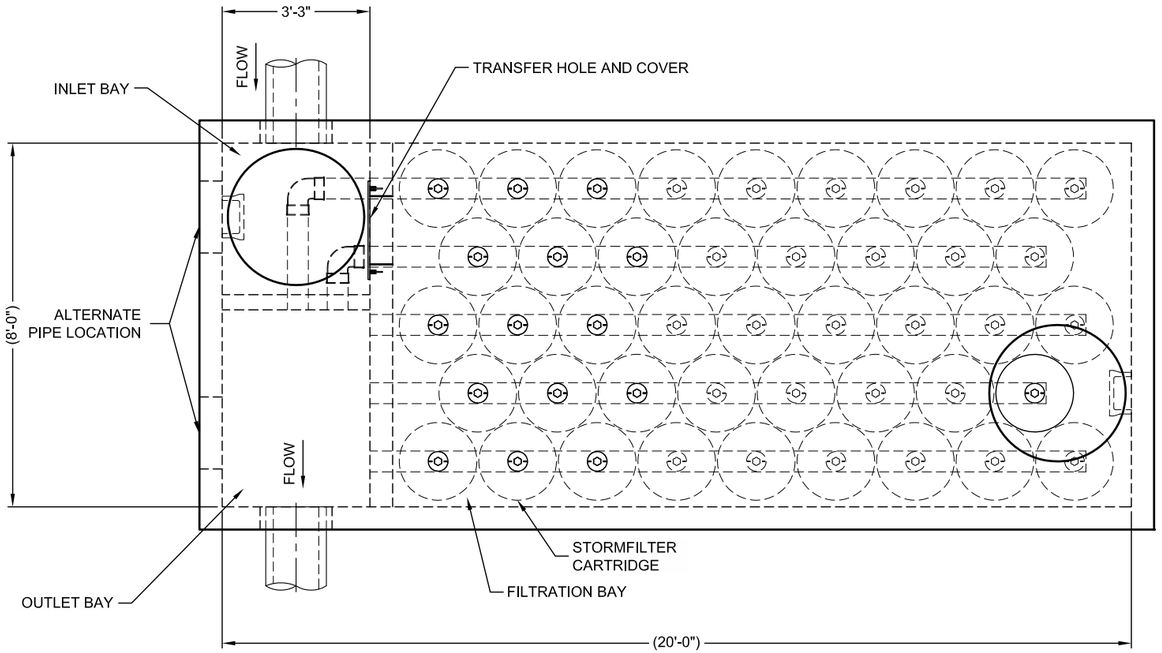
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH REPRESENTATIVE. www.ContechES.com
4. STORMFILTER WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
5. STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 5' AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO.

INSTALLATION NOTES

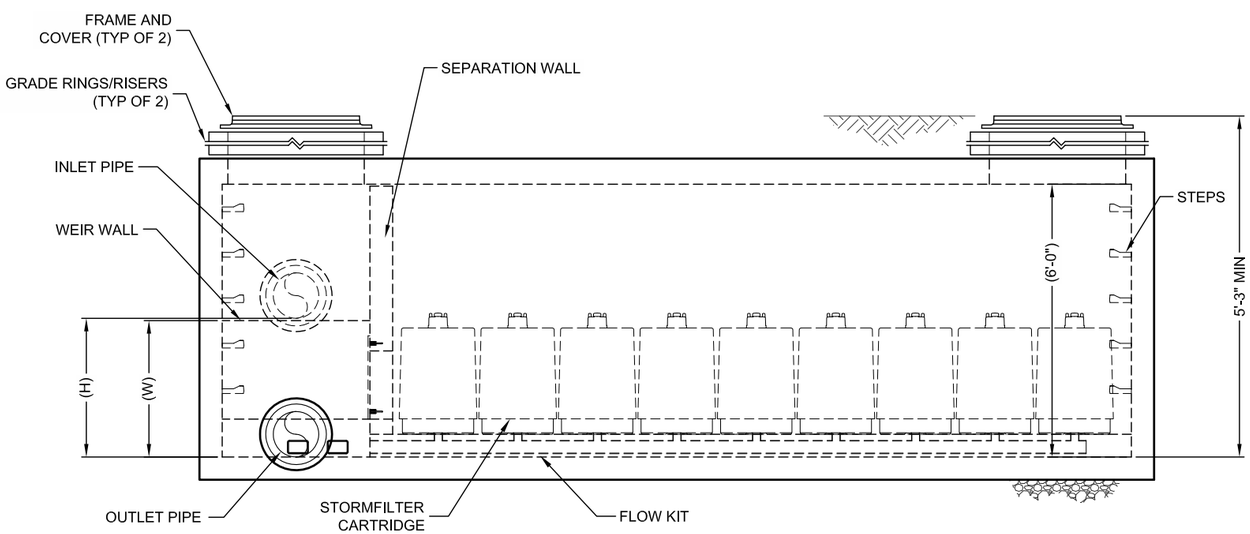
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STORMFILTER STRUCTURE (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL SECTIONS AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH OUTLET PIPE INVERT WITH OUTLET BAY FLOOR.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.
F. CONTRACTOR TO REMOVE THE TRANSFER HOLE COVER WHEN THE SYSTEM IS BROUGHT ONLINE.

CONTECH®
ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

THE STORMWATER MANAGEMENT STORMFILTER
8' x 11' PEAK DIVERSION STORMFILTER
STANDARD DETAIL




## PLAN

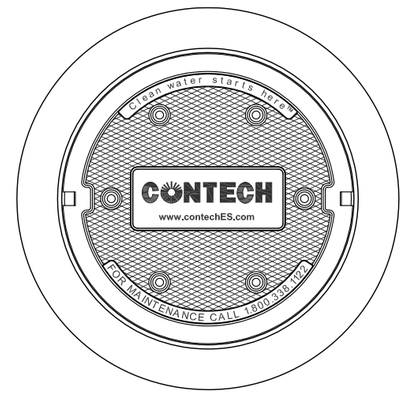



## ELEVATION

## STORMFILTER DESIGN TABLE

- THE 8' x 20' PEAK DIVERSION STORMFILTER TREATMENT CAPACITY VARIES BY CARTRIDGE COUNT AND LOCALLY APPROVED SURFACE AREA SPECIFIC FLOW RATE. PEAK CONVEYANCE CAPACITY TO BE DETERMINED BY ENGINEER OF RECORD.
- THE PEAK DIVERSION STORMFILTER IS AVAILABLE IN A LEFT INLET (AS SHOWN) OR RIGHT INLET CONFIGURATION.
- ALL PARTS AND INTERNAL ASSEMBLY PROVIDED BY CONTECH UNLESS OTHERWISE NOTED.

| CARTRIDGE HEIGHT | 27" | | 18" | | LOW DROP | |
|---|---|---|---|---|---|---|
| SYSTEM HYDRAULIC DROP (H - REQ'D. MIN.) | 3.05' | | 2.3' | | 1.8' | |
| HEIGHT OF WEIR (W) | 3.00' | | 2.25' | | 1.75' | |
| TREATMENT BY MEDIA SURFACE AREA | 2 gpm/ft² | 1 gpm/ft² | 2 gpm/ft² | 1 gpm/ft² | 2 gpm/ft² | 1 gpm/ft² |
| CARTRIDGE FLOW RATE (gpm) | 22.5 | 11.25 | 15 | 7.5 | 10 | 5 |




## FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

## SITE SPECIFIC DATA REQUIREMENTS

| | |
|---|---|
| STRUCTURE ID | * |
| WATER QUALITY FLOW RATE (cfs) | * |
| PEAK FLOW RATE (cfs) | * |
| RETURN PERIOD OF PEAK FLOW (yrs) | * |
| # OF CARTRIDGES REQUIRED | * |
| CARTRIDGE FLOW RATE | * |
| MEDIA TYPE (CSF, PERLITE, ZPG) | * |

| PIPE DATA: | I.E. | MATERIAL | DIAMETER |
|---|---|---|---|
| INLET PIPE | * | * | * |
| OUTLET PIPE | * | * | * |

| | |
|---|---|
| INLET BAY RIM ELEVATION | * |
| FILTER BAY RIM ELEVATION | * |

| ANTI-FLOTATION BALLAST | WIDTH | HEIGHT |
|---|---|---|
| | * | * |

NOTES/SPECIAL REQUIREMENTS:

PERFORMANCE SPECIFICATION

FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. **RADIAL MEDIA DEPTH SHALL BE 7-INCHES**. FILTER MEDIA CONTACT TIME SHALL BE AT LEAST **37 SECONDS**.
SPECIFIC FLOW RATE SHALL BE **2 GPM/SF (MAXIMUM)**. SPECIFIC FLOW RATE IS THE MEASURE OF THE FLOW (GPM) DIVIDED BY THE MEDIA SURFACE CONTACT AREA (SF). MEDIA VOLUMETRIC FLOW RATE SHALL BE **6 GPM/CF OF MEDIA (MAXIMUM).**

GENERAL NOTES

1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH REPRESENTATIVE. www.ContechES.com
4. STORMFILTER WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
5. STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 5' AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO.

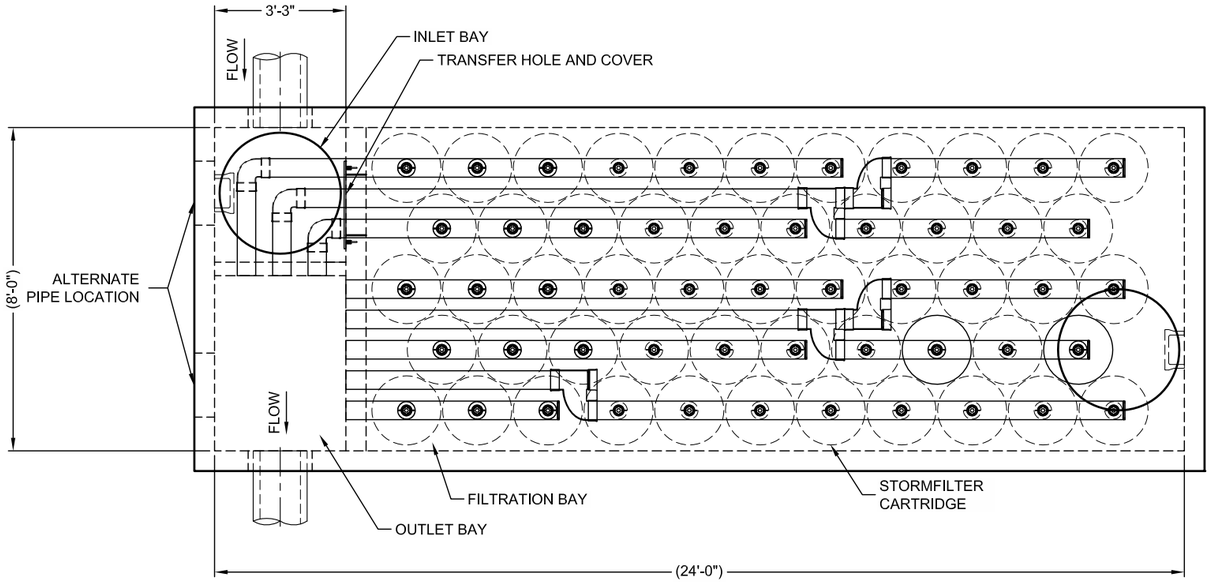
INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STORMFILTER STRUCTURE (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL SECTIONS AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH OUTLET PIPE INVERT WITH OUTLET BAY FLOOR.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.
F. CONTRACTOR TO REMOVE THE TRANSFER HOLE COVER WHEN THE SYSTEM IS BROUGHT ONLINE.

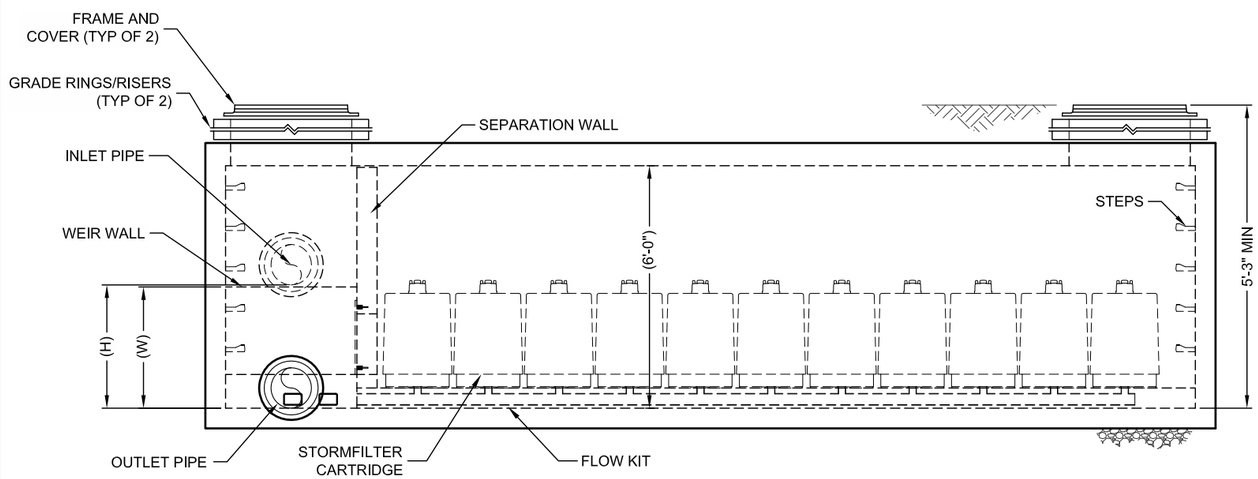
The Stormwater Management StormFilter®
THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,322,629; 5,324,579; 5,707,527; 5,985,157; 6,027,639; 6,045,046; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

CONTECH® ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

THE STORMWATER MANAGEMENT STORMFILTER
8' x 20' PEAK DIVERSION STORMFILTER
STANDARD DETAIL




**PLAN**

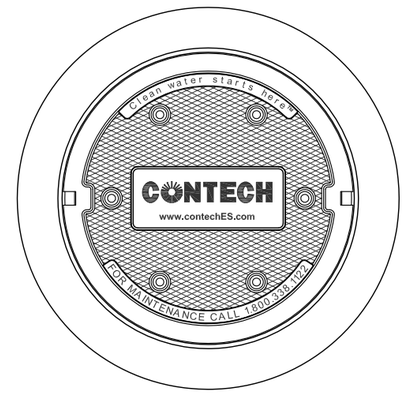



**ELEVATION**

## STORMFILTER DESIGN TABLE

- THE 8' x 24' PEAK DIVERSION STORMFILTER TREATMENT CAPACITY VARIES BY CARTRIDGE COUNT AND LOCALLY APPROVED SURFACE AREA SPECIFIC FLOW RATE. PEAK CONVEYANCE CAPACITY TO BE DETERMINED BY ENGINEER OF RECORD.
- THE PEAK DIVERSION STORMFILTER IS AVAILABLE IN A LEFT INLET (AS SHOWN) OR RIGHT INLET CONFIGURATION.
- ALL PARTS AND INTERNAL ASSEMBLY PROVIDED BY CONTECH UNLESS OTHERWISE NOTED.

| CARTRIDGE HEIGHT | 27" | | 18" | | LOW DROP | |
|---|---|---|---|---|---|---|
| SYSTEM HYDRAULIC DROP (H - REQ'D. MIN.) | 3.05' | | 2.3' | | 1.8' | |
| HEIGHT OF WEIR (W) | 3.00' | | 2.25' | | 1.75' | |
| TREATMENT BY MEDIA SURFACE AREA | 2 gpm/ft² | 1 gpm/ft² | 2 gpm/ft² | 1 gpm/ft² | 2 gpm/ft² | 1 gpm/ft² |
| CARTRIDGE FLOW RATE (gpm) | 22.5 | 11.25 | 15 | 7.5 | 10 | 5 |




**FRAME AND COVER**
(DIAMETER VARIES)
N.T.S.

## SITE SPECIFIC DATA REQUIREMENTS

| | |
|---|---|
| STRUCTURE ID | * |
| WATER QUALITY FLOW RATE (cfs) | * |
| PEAK FLOW RATE (cfs) | * |
| RETURN PERIOD OF PEAK FLOW (yrs) | * |
| # OF CARTRIDGES REQUIRED | * |
| CARTRIDGE FLOW RATE | * |
| MEDIA TYPE (CSF, PERLITE, ZPG) | * |

| PIPE DATA: | I.E. | MATERIAL | DIAMETER |
|---|---|---|---|
| INLET PIPE | * | * | * |
| OUTLET PIPE | * | * | * |

| | |
|---|---|
| INLET BAY RIM ELEVATION | * |
| FILTER BAY RIM ELEVATION | * |

| ANTI-FLOTATION BALLAST | WIDTH | HEIGHT |
|---|---|---|
| | * | * |

NOTES/SPECIAL REQUIREMENTS:

PERFORMANCE SPECIFICATION

FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. **RADIAL MEDIA DEPTH SHALL BE 7-INCHES**. FILTER MEDIA CONTACT TIME SHALL BE AT LEAST **37 SECONDS**. SPECIFIC FLOW RATE SHALL BE **2 GPM/SF (MAXIMUM)**. SPECIFIC FLOW RATE IS THE MEASURE OF THE FLOW (GPM) DIVIDED BY THE MEDIA SURFACE CONTACT AREA (SF). MEDIA VOLUMETRIC FLOW RATE SHALL BE **6 GPM/CF OF MEDIA (MAXIMUM).**

GENERAL NOTES

1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH REPRESENTATIVE. www.ContechES.com
4. STORMFILTER WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
5. STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 5' AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO.

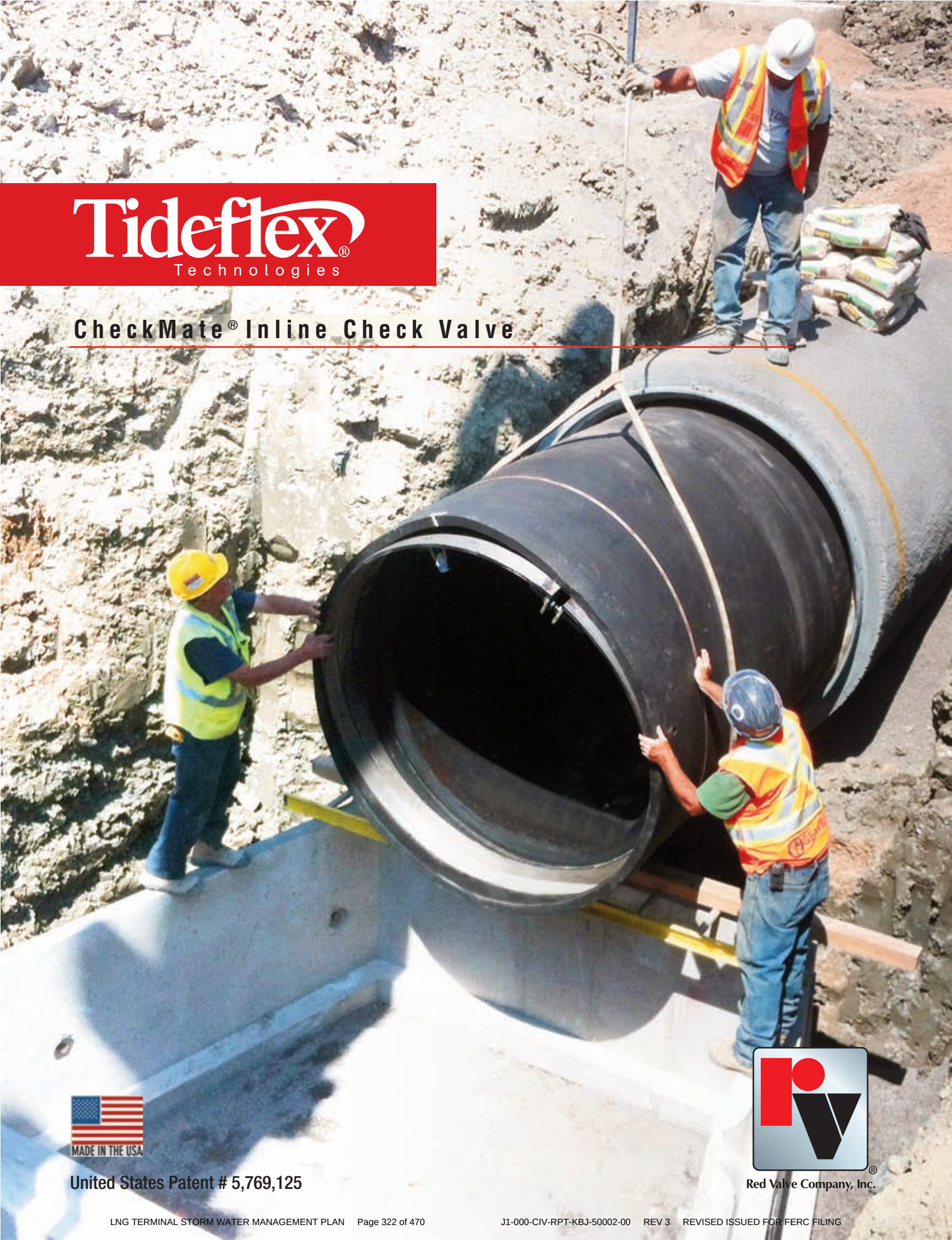
INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STORMFILTER STRUCTURE (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL SECTIONS AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH OUTLET PIPE INVERT WITH OUTLET BAY FLOOR.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.
F. CONTRACTOR TO REMOVE THE TRANSFER HOLE COVER WHEN THE SYSTEM IS BROUGHT ONLINE.

The Stormwater Management StormFilter®
THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING: U.S. PATENTS: 5,322,629; 5,524,576; 5,707,527; 5,985,157; 6,027,639; 6,045,048; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

CONTECH® ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

THE STORMWATER MANAGEMENT STORMFILTER
8' x 24' PEAK DIVERSION STORMFILTER
STANDARD DETAIL



Tideflex® Technologies

# CheckMate® Inline Check Valve

MADE IN THE USA

United States Patent # 5,769,125

Red Valve Company, Inc.®

# CheckMate®: Your Final Move to Eliminate Backflow!

# CHECKMATE® VALVE

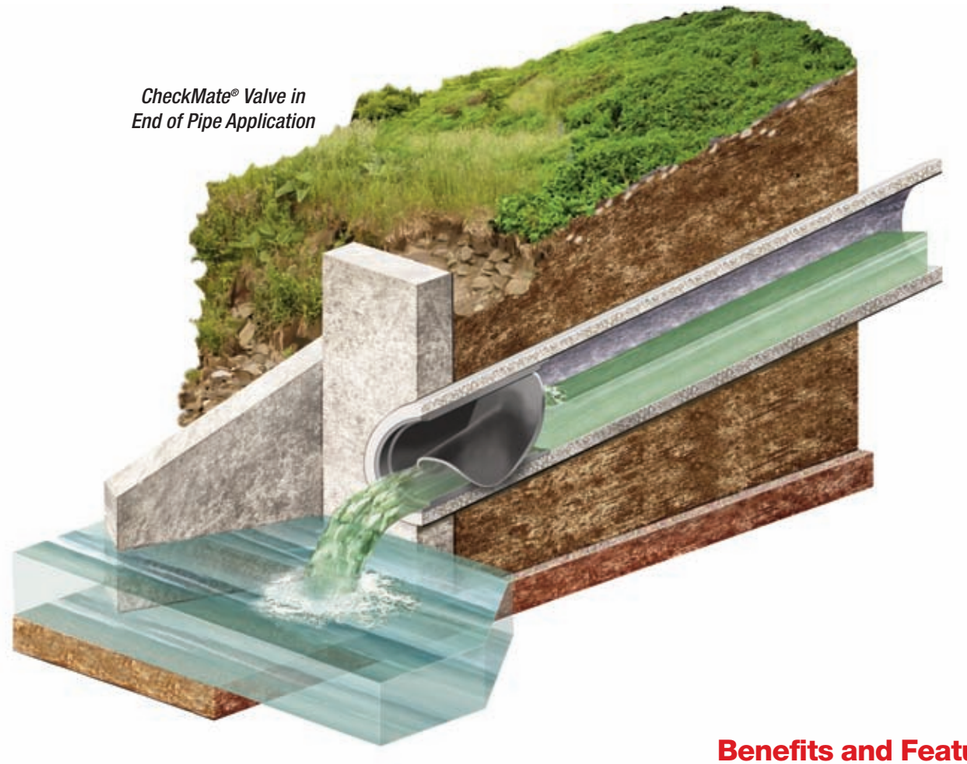
*Designed for Inline Service*

## Dependable Backflow Prevention

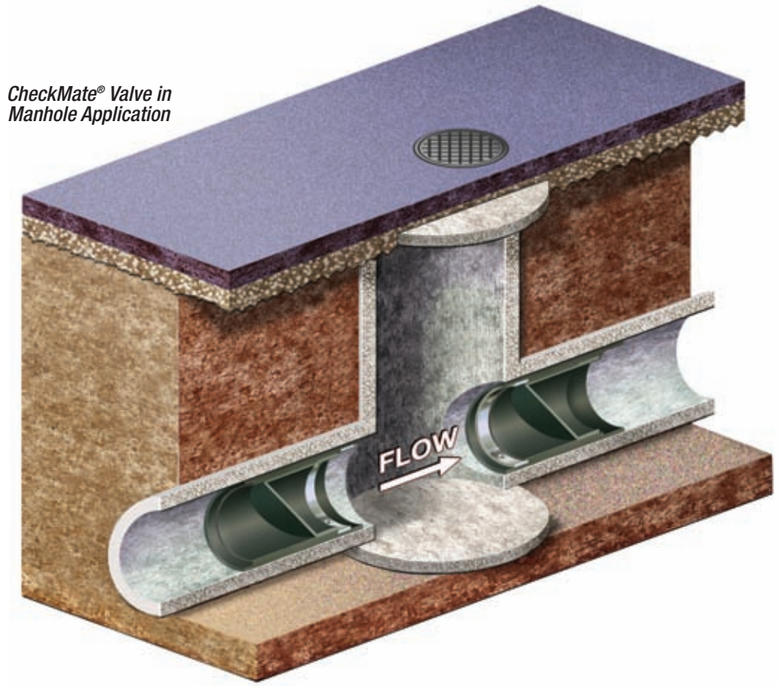
The CheckMate® Inline Check Valve is the valve of choice for both municipal and industrial applications - including stormwater, wastewater, highway run-off, CSO, SSO and flood control. CheckMate® Valves prevent unwanted backflow that can cause surcharging and flooding.

CheckMate® Inline Check Valves have become the specified solution for residential and commercial areas where complete, dependable backflow prevention is necessary. The CheckMate® is not simply a molded part. Rather it is hand-fabricated, utilizing various natural and synthetic elastomers and fabric ply reinforcement to create a unibody construction. There are no mechanical parts or fasteners to catch debris, corrode, or fail, making the CheckMate® maintenance-free. With seven elastomers to select from, the CheckMate® can be custom engineered to resist chemicals, grease and oils typically found in stormwater, wastewater and industrial applications.

The CheckMate® Valve boasts extremely low headloss, allowing for near 100% flow capacity. Its inherent design makes it the most user-friendly inline check valve on the market today. From the upstream or downstream end of the pipe, simply insert the valve into position and clamp it into place. Typically no modification to the pipe or structure is required to install the CheckMate®. Because the CheckMate® is recessed inside of the pipe, additional permitting is not required. The result is savings in both installation time and operational cost.



*CheckMate® Valve in End of Pipe Application*



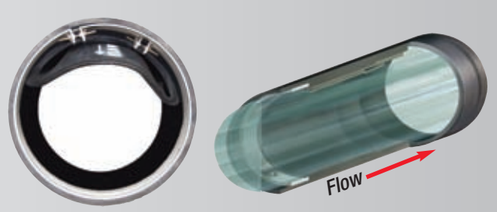

*CheckMate® Valve in Manhole Application*

The valve can successfully withstand severe winter freezes, typhoons, hurricanes and flooding. The CheckMate® also minimizes damage to wetlands, beaches and residential areas, eliminates hydraulic surges to wastewater treatment plants and saves municipalities millions of dollars in maintenance and treatment costs.

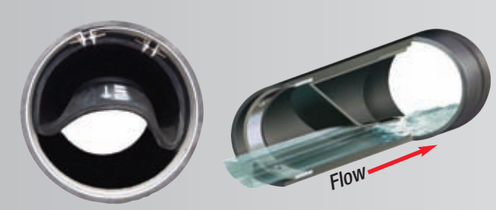
## Benefits and Features of CheckMate®:

- Extremely Low Headloss
- No Moving Mechanical Parts to Corrode, Catch Debris or Fail
- Heavy Duty Elastomer Unibody Construction
- Quick and Easy Installation
- Seals Around Debris
- Operates on Differential Pressure, Totally Passive
- Virtually No Maintenance
- Self-draining, 1" of Cracking Pressure
- Silent, Non-slamming
- Available in Sizes 3" (75 mm) to 78" (1950 mm)
- Extensive Independent Hydraulic Testing

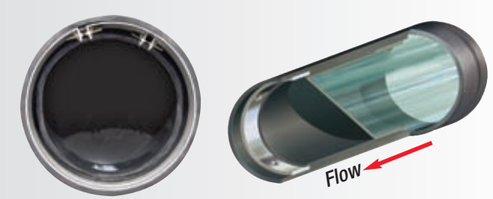
For an animated demonstration of the CheckMate® in operation, please visit: **http://www.tideflex.com/checkmate.**




**FULLY OPEN**




**FLOWING**




**FULLY CLOSED**

# CheckMate® Applications: Simply Versatile!

*48" CheckMate® installed in a storm sewer drain to stop backflow from flooding a residential area.*

## Residential and Municipal Sewers

CheckMate® Inline Check Valves have become a frequently specified solution for residential and municipal areas where complete, dependable backflow prevention is necessary. The CheckMate® Valve's maintenance-free, passive operation provides years of trouble-free service.

## CSO, SSO and Outfalls

CheckMate® Valves are used for interceptor, manhole and outfall pipelines because they maximize pipeline storage and capacity while preventing water from backflowing into a sewage treatment plant. The CheckMate® Valve's innovative inline design allows it to be easily installed without modifications to structures.

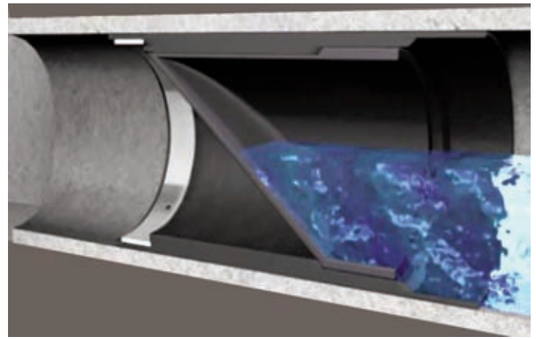
## Stormwater, MS4, Highway Run-off and Site Drainage

CheckMate® Inline Check Valves are the valve of choice for both municipalities and commercial property owners to prevent costly flood damage and to maximize system storage. The CheckMate's® low cracking pressure and headloss provide rapid drainage.

## Flow Equalization Basins, Pump Stations and Effluent Discharge

CheckMate® Valves provide backflow prevention in between basins and also protect pumps and capital equipment. The CheckMate's® low headloss characteristics maximize flow efficiency.

*24" CheckMate® is easily installed in a municipal sewer.*



*The CheckMate's® rugged unibody construction prevents backflow.*

*48" CheckMate® installed at the Freedom Tower for stormwater drainage.*



# CHECKMATE® VALVE

*Designed for Inline Service*

*48" CheckMate® Valve replacing a faulty flapgate in a CSO application.*

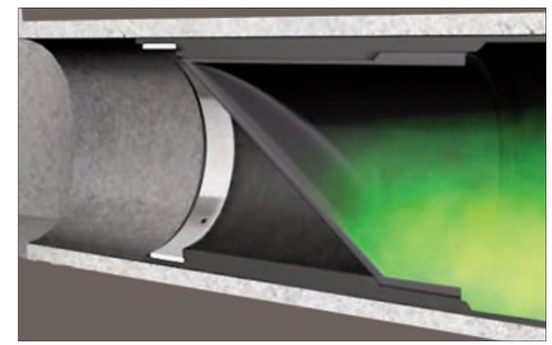
## Odor Control

CheckMate® Inline Check Valves prevent sewer systems' offending odors from escaping, while still allowing water to discharge when needed. The CheckMate® Valve is designed to eliminate the backflow of unwanted methane and hydrogen sulfide gases that typically result in complaints about odor from the general public.

## Levees, Marinas and Wetlands

In low lying areas where headloss is at a premium, CheckMate® Valves efficiently drain with the added benefit of providing absolute backflow prevention.

*The CheckMate® is also easily installed by hand.*



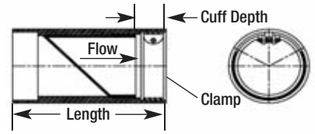
*The CheckMate® provides odor control.*

## Independent Hydraulic Testing

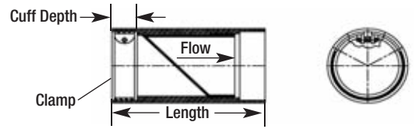
CheckMate® Inline Check Valves are independently tested to determine their hydraulic characteristics in both free and submerged discharge applications. Red Valve's published hydraulic data is validated through this independent testing.

# CheckMate® Configurations and Custom Designs

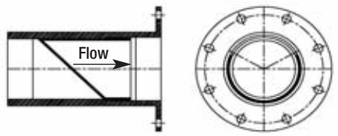
## Downstream Clamp



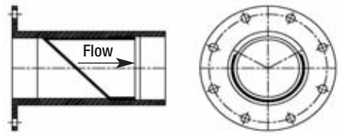

## Upstream Clamp



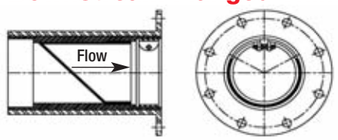

## Downstream Flanged



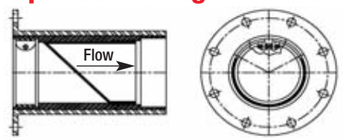

## Upstream Flanged




## Downstream Flanged Thimble Insert




## Upstream Flanged Thimble Insert




CheckMates® can be made for any pipe I.D.
Built to fit in sizes from 3" to 78".

Flange shape and bolt pattern can be customized.
Flangeless thimble inserts are available.

**CHECKMATE® VALVE**

| | NOMINAL PIPE SIZE I.D. | | OVERALL LENGTH* | | NUMBER OF CLAMPS | CUFF DEPTH | | BACK PRESSURE RATING** | | WEIGHT | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Inches | Millimeters | Inches | Millimeters | | Inches | Millimeters | Feet | Meters | lbs | Kg |
| Low Pressure | 3 | 75 | 5.1 | 130 | 1 | 1.5 | 38 | 5 | 1.5 | 1.5 | 0.7 |
| | 4 | 100 | 7.9 | 201 | 1 | 1.5 | 38 | 5 | 1.5 | 1.5 | 0.7 |
| Standard Pressure | 3 | 75 | 5.1 | 130 | 1 | 1.5 | 38 | 85 | 26.0 | 3 | 1.4 |
| | 4 | 100 | 7.9 | 201 | 1 | 1.5 | 38 | 85 | 26.0 | 3 | 1.5 |
| | 5 | 125 | 9.5 | 241 | 1 | 1.5 | 38 | 83 | 25.3 | 4 | 2 |
| | 6 | 150 | 11.0 | 279 | 1 | 2.0 | 51 | 83 | 25.3 | 9 | 4 |
| | 7 | 175 | 12.8 | 325 | 1 | 2.0 | 51 | 79 | 24.1 | 11 | 5 |
| | 8 | 200 | 15.2 | 386 | 1 | 2.0 | 51 | 79 | 24.1 | 13 | 6 |
| | 9 | 225 | 15.4 | 391 | 1 | 2.0 | 51 | 75 | 22.9 | 17 | 8 |
| | 10 | 250 | 16.1 | 409 | 1 | 2.0 | 51 | 71 | 21.6 | 20 | 10 |
| | 12 | 300 | 19.8 | 503 | 1 | 2.0 | 51 | 68 | 20.1 | 37 | 17 |
| | 14 | 350 | 25.8 | 655 | 1 | 4.0 | 102 | 64 | 20.0 | 110 | 50 |
| | 16 | 400 | 28.6 | 726 | 1 | 4.0 | 102 | 60 | 18.3 | 133 | 52 |
| | 18 | 450 | 31.0 | 787 | 1 | 4.0 | 102 | 56 | 17.1 | 143 | 65 |
| | 20 | 500 | 42.1 | 1069 | 2 | 8.0 | 203 | 53 | 16.2 | 223 | 102 |
| | 24 | 600 | 47.5 | 1207 | 2 | 8.0 | 203 | 45 | 13.7 | 304 | 137 |
| | 30 | 750 | 54.9 | 1395 | 2 | 8.0 | 203 | 38 | 11.6 | 500 | 227 |
| | 36 | 900 | 62.3 | 1582 | 2 | 8.0 | 203 | 30 | 9.1 | 828 | 376 |
| | 42 | 1050 | 70.6 | 1793 | 2 | 8.0 | 203 | 26 | 7.9 | 1423 | 646 |
| | 48 | 1200 | 79.0 | 2007 | 2 | 8.0 | 203 | 23 | 7.0 | 1801 | 817 |
| | 54 | 1350 | 86.4 | 2195 | 2 | 8.0 | 203 | 17 | 5.2 | 2700 | 1225 |
| | 60 | 1500 | 96.8 | 2459 | 2 | 9.0 | 229 | 15 | 4.6 | 3315 | 1504 |
| | 72 | 1800 | 119.0 | 3023 | 3 | 12.0 | 305 | 13 | 4.0 | 6100 | 2767 |
| | 78 | 1950 | 119.0 | 3023 | 3 | 12.0 | 305 | 13 | 4.0 | 7000 | 3176 |

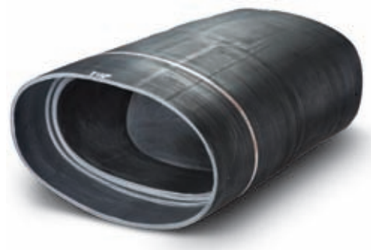
*Shorter lengths available.

**Back pressure measured from pipe invert.
Higher back pressure ratings available. Consult factory.

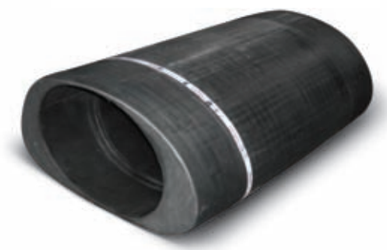


# CHECKMATE® VALVE

*Designed for Inline Service*



*Elliptical Pipe CheckMate®*



*Arch Pipe CheckMate®*

*Rectangular Pipe CheckMate®*

## Elliptical, Arch and Rectangular Pipes

Elliptical, arch and rectangular pipes for drainage and flood prevention projects have become popular, particularly in high water table areas with shallow surface gradients. CheckMate® Inline Check Valves are the perfect solution for backflow prevention in elliptical, arch and rectangular pipes.

## Rubber Flanged

Rubber Flanged CheckMate® Valves can be manufactured with an integral rubber upstream or downstream flange. The flanged CheckMate® gets inserted into the host pipe then can be bolted to a mating flange or anchored to a concrete headwall. The flange can be circular with standard drilling; or circular, square or rectangular with custom flange drilling. The valve is supplied with retaining rings for mounting.

## Thimble Inserts

A CheckMate® Thimble Insert is a CheckMate® Valve that is factory-installed, clamped, and pinned into flanged or plain end pipe. The thimble insert assembly can either be inserted into the I.D. of the host pipe, or can be mounted to a mating flange or concrete headwall and extend beyond the pipe. Plain end thimble inserts are inserted into the host pipe and non-shrink grout is placed between the thimble insert O.D. and host pipe I.D. to form the seal.

*Upstream Flanged CheckMate®*

*CheckMate® Thimble Insert*

# The best choice for the toughest applications.

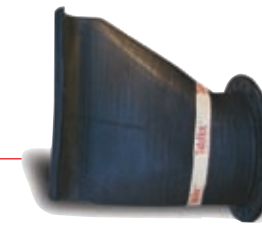
**In addition to the Checkmate® Inline Check Valve, Tideflex® Technologies offers a complete line of check valves.**

## TF-1 CHECK VALVES

The Tideflex® TF-1 Curved Bill Check Valve is designed with enhanced sealing to improve headloss. The improved TF-1 design allows the valve to handle long-term water weight while maintaining structural integrity. The spine is at a greater vertical angle, making it able to withstand the cantilever effect when water is flowing through the valve. The TF-1 is constructed of rubber, making it immune to rust, corrosion and weathering.

## SERIES 35-1 CHECK VALVES

The flat-bottom Series 35-1 features an integral rubber flange, allowing them to be mounted to flanged outfall pipes or directly to headwalls where the pipe is flush. The flange size drilling conforms to ANSI B16.10, Class 150#, or can be constructed with DIN, 2632 and other standards. The Series 35-1 Check Valve is furnished complete with steel or stainless steel backup rings for installation.



## SERIES 39 CHECK VALVES

The Tideflex® Series 39 Inline Check Valve features a fabric-reinforced elastomer check sleeve housed in a cast iron body with ANSI 125/150 flanges, allowing for easy installation into any piping system. The valve's operation is silent, non-slamming and maintenance free. Sliding, rotating, swinging and plunging parts are completely eliminated. The body is equipped with flush ports and a clean-out port and can be epoxy coated.

Tideflex® Technologies

600 N. Bell Ave.
Carnegie, PA 15106

PHONE:
412/279-0044

FAX:
412/279-7878

www.tideflex.com



The information presented in this catalog is provided in good faith. Red Valve Company, Inc. and Tideflex® Technologies reserves the right to modify or improve its design specifications without notice and does not imply any guarantee or warranty for any of its products from reliance upon the information contained herein. All orders are subject to Red Valve Company, Inc. and Tideflex® Technologies' standard terms and warranty and are subject to final acceptance by Red Valve Company, Inc. and Tideflex® Technologies.

Viton is a registered trademark of DuPont Dow Elastomers. Hypalon is a registered trademark of DuPont Performance Elastomers. Tideflex, Red Valve, and the Red Valve "rv" logo are registered trademarks of the Red Valve Company, Inc.

© 2009 Red Valve Company.
All rights reserved.

RECYCLABLE PAPER



CMCV 060515

# Attachment R. Contech CDS Pretreatment Calculations and Details

**CDS Pretreatment Selections**

| Structural Control | CDS Number | MGS Flood 50% Q2 (cfs) | Contech CDS Model | Max CDS Water Quality Flow (cfs) | Inflow Pipe Size(s) | Outflow Pipe Size(s) | Online/Offline? | Comments |
|---|---|---|---|---|---|---|---|---|
| CF-A | CDS-118 | 0.26 | CDS 2015-4 | 0.7 | 24" | 24" | Online | |
| CF-D | CDS-56 | 0.87 | CDS 2020-5 | 1.1 | - | 30" | Online | |
| CF-E | CDS-126 | 1.03 | CDS 2020-5 | 1.1 | - | 30" | Online | |
| CF-F,G | CDS-183, CDS-193 | 1.06 | CDS 2020-5 | 1.1 | 2 x 18" | 24" | Online | |
| Chamber A | CDS-124 | 1.37 | CDS 3020-6 | 2 | 48" | 48" | Online | Larger than minimum CDS 2025-5 due to 48" inflow and outflow pipe. |
| Chamber B | CDS-77 | 4.41 | CDS 4030-8 | 9 | 48" | 48" | Online | |

Notes: 1) Contech CDS System
2) TAPE GULD for Pretreatment

WASHINGTON STATE DEPARTMENT OF ECOLOGY

**August 2018**

# GENERAL USE LEVEL DESIGNATION FOR PRETREATMENT (TSS)

## For

## CONTECH Engineered Solutions CDS® System

**Ecology's Decision:**

**Based on the CONTECH Engineered Solutions (CONTECH) application submissions for the CDS® System, Ecology hereby issues the following use designations for the CDS storm water treatment system:**

1. **General Use Level Designation (GULD) for pretreatment use, as defined in Ecology's 2011 *Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE)* Table 2, (a) ahead of infiltration treatment, or (b) to protect and extend the maintenance cycle of a basic, enhanced, or phosphorus treatment device (e.g., sand or media filter). This GULD applies to 2,400 micron screen CDS® units sized per the table below.**

2. **The following table shows flowrates associated with various CDS models:**

| | | CDS Model | Water Quality Flow cfs | Water Quality Flow L/s |
|---|---|---|---|---|
| Precast** | Inline or Offline | CDS 2015-4 | 0.7 | 19.8 |
| | | CDS 2015-5 | 0.7 | 19.8 |
| | | CDS 2020-5 | 1.1 | 31.2 |
| | | CDS2025-5 | 1.6 | 45.3 |
| | | CDS3020-6 | 2 | 56.6 |
| | | CDS3030-6 | 3 | 85.0 |
| | | CDS3035-6 | 3.8 | 106.2 |
| | | CDS4030-8 | 4.5 | 127.4 |
| | | CDS4040-8 | 6 | 169.9 |
| | | CDS4045-8 | 7.5 | 212.4 |
| | | CDS5640-10 | 9 | 254.9 |
| | | CDS5653-10 | 14 | 396.5 |
| | | CDS5668-10 | 19 | 538.1 |
| | | CDS5678-10 | 25 | 7.08 |
| Prec ast* | Offline Only | CDS3030-V | 3 | 85 |
| | | CDS4030-7 | 4.5 | 127.4 |
| | | CDS4040-7 | 6 | 169.9 |

| | | | | |
|---|---|---|---|---|
| | | CDS4045-7 | 7.5 | 212.4 |
| | | CDS5640-8 | 9 | 254.9 |
| | | CDS5653-8 | 14 | 396.5 |
| | | CDS5668-8 | 19 | 538.1 |
| | | CDS5678-8 | 25 | 708 |
| | | CDS5042 | 9 | 254.9 |
| | | CDS5050 | 11 | 311.5 |
| | | CDS7070 | 26 | 736.3 |
| | | CDS10060 | 30 | 849.6 |
| | | CDS10080 | 50 | 1416 |
| | | CDS100100 | 64 | 1812.5 |
| Cast In Place | | CDS150134-22 | 148 | 4191.4 |
| | | CDS200164-26 | 270 | 7646.6 |
| | | CDS240160-32 | 300 | 8496.2 |

***Specially Designed CDS Units may be approved by Ecology on a on a site-by-site basis.**
****Contact Contech for updated model numbers if PMIU, PMSU, PSW, PSWC are specified.**

3. **The water quality design flow rates are calculated using the following procedures:**

   - **Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model.**

   - **Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three methods described in Chapter 2.2.5 of the Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.**

   - **Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.**

4. **The pretreatment GULD has no expiration date; however, Ecology may amend or revoke the designation.**

5. **All designations are subject to the conditions specified below.**

6. **Properly designed and operated CDS systems may also have applicability in other situations (example: low-head situations such as bridges or ferry docks), for TSS where, on a case-by-case basis, it is found to be infeasible or impracticable to use any other approved practice. Jurisdictions covered under the Phase I or II municipal stormwater permits should use variance/exception procedures and criteria as required by their NPDES permit.**

7. **Ecology finds that the CDS, sized according to the table above, could also provide water quality benefits in retrofit situations.**

**<u>Ecology's Conditions of Use:</u>**

**<u>CDS systems shall comply with these conditions:</u>**

1. **Design, assemble, install, operate, and maintain CDS Systems in accordance with Contech's applicable manuals and documents and the Ecology decision and conditions specified herein. Ecology recommends use of the inspection and maintenance schedule included as Attachment 1.**

2. **Maintenance: The required inspection/maintenance interval for stormwater treatment devices is often dependent upon the efficiency of the device and the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of manufactured treatment device.**
   - **Owners/operators must inspect the CDS™ System for a minimum of twelve months from the start of post-construction operation to determine site-specific maintenance schedules and requirements. You must conduct inspections monthly during the wet season, and every other month during the dry season. (According to SWMMWW, the wet season for western Washington is October 1 to April 30. According to SWMMEW, the wet season in eastern Washington is October 1 to June 30). After the first year of operation, owners/operators must conduct inspections based on the findings during the first year of inspections.**
   - **Conduct inspections by qualified personnel, follow manufacturer's guidelines, and use methods capable of determining either a decrease in treated effluent flow rate and/or a decrease in pollutant removal ability.**

3. **Discharges from the CDS System shall not cause or contribute to water quality standards violations in receiving waters.**

**Applicant:** Contech Engineered Solutions

**Applicant's Address:** 11835 NE Glen Widing Drive
Portland, OR 97220

**Application Documents:**

- Contech Stormwater Solutions Application to: Washington State Department of Ecology Water Quality Program for General Use Level Designation – Pretreatment Applications and Conditional Use Level Designation – Oil Treatment of the Continuous Deflective Separation (CDS™) Technology (June 2007)

- Strynchuk, Royal, and England, *The Use of a CDS Unit for Sediment Control in Brevard County*.

- Walker, Allison, Wong, and Wootton, *Removal of Suspended Solids and Associated Pollutants by a CDS Gross Pollutant Trap*, Cooperative Research Centre for Catchment Hydrology, Report 99/2, February 1999

- Allison, Walker, Chiew, O'Neill, McMahon, *From Roads to Rivers Gross Pollutant Removal from Urban Waterways*, Cooperative Research Centre for Catchment Hydrology, Report 98/6, May 1998

**Applicant's Use Level Request:**

- General use level designation as a pretreatment device and conditional use level designation as an oil and grease device in accordance with Ecology's *Stormwater Management Manual for Western Washington.*

**Applicant's Performance Claims:**

Based on laboratory trials, the CDS™ System will achieve 50% removal of total suspended solids with $d_{50}$ of 50-µm and 80% removal of total suspended solids with $d_{50}$ of 125-µm at 100% design flowrate with typical influent concentration of 200-mg/L.

**Ecology's Recommendation:**

Ecology finds that:

- The CDS™ system, sized per the table above, should provide, at a minimum, equivalent performance to a presettling basin as defined in the most recent *Stormwater Management Manual for Western Washington, Volume V, Chapter 6*.

**Findings of Fact:**

1. Laboratory testing was completed on a CDS 2020 unit equipped with 2400-µm screen using OK-110 sand ($d_{50}$ of 106-µm) at flowrates ranging from 100 to 125% of the design flowrate (1.1 cfs) with a target influent of 200 mg/L. Laboratory results for the OK-110 sand showed removal rates from about 65% to 99% removal with 80% removal occurring near 70% of the design flowrate.
2. Laboratory testing was completed on a CDS 2020 unit equipped with 2400-µm screen using "UF" sediment ($d_{50}$ of 20 to 30-µm) at flowrates ranging from 100 to 125% of the design flowrate (1.1 cfs) with a target influent of 200 mg/L. Laboratory results for the "UF" sediment showed removal rates from about 42% to 94% removal with 80% removal occurring at 5% of the design flowrate.

3. Laboratory testing was completed on a CDS 2020 unit equipped with 4700-µm screen using OK-110 sand ($d_{50}$ of 106-µm) at flowrates ranging from 100 to 125% of the design flowrate (1.1 cfs) with a target influent of 200 mg/L. Laboratory results for the OK-110 sand showed removal rates from about 45% to 99% removal with an average removal of 83.1%.
4. Laboratory testing was completed on a CDS 2020 unit equipped with 4700-µm screen using "UF" sediment ($d_{50}$ of 20 to 30-µm) at flowrates ranging from 100 to 125% of the design flowrate (1.1 cfs) with a target influent of 200 mg/L. Laboratory results for the "UF" sediment showed removal rates from about 39% to 88% removal with an average removal of 56.1%.
5. Contech completed laboratory testing on a CDS2020 unit using motor oil at flowrates ranging from 25% to 75% of the design flowrate (1.1 cfs) with influents ranging from 7 to 47 mg/L. Laboratory results showed removal rates from 27% to 92% removal. A spill test was also run at 10% of the design flowrate with an influent of 82,000 mg/L with an average percent capture of 94.5%
6. Independent parties in California, Florida, and Australia completed various field studies. Field studies showed the potential for the unit to remove oils and grease and total suspended solids, and capture 100% gross solids greater than the aperture size of the screen under treatment flow rate.
7. CDS Technology has been widely accepted with over 6,200 installations in the United States and Canada. There are over 1,380 installations in Washington and Oregon.

**Technology Description:**

Engineers can download a technology description from the company's website. www.conteches.com

**Recommended Research and Development:**

Ecology encourages Contech to pursue continuous improvements to the CDS system. To that end, Ecology makes the following recommendations:

1. Conduct testing to quantify the flowrate at which resuspension occurs.
2. Conduct testing on various sized CDS units to verify the sizing technique is appropriate.
3. Test the system under normal operating conditions, pollutants partially filling the swirl concentrator. Results obtained for "clean" systems may not be representative of typical performance.

**Contact Information:**

Applicant Contact: Jeremiah Lehman
Contech Engineered Solutions
(503) 258-3136
jlehman@conteches.com

Applicant website: http://www.conteches.com/

Ecology web link: http://www.ecy.wa.gov/programs/wq/stormwater/newtech/index.html

Ecology: Douglas C. Howie. P.E.
Department of Ecology
Water Quality Program
(360) 407-6444
douglas.howie@ecy.wa.gov

**Revision History**

| Date | Revision |
|---|---|
| July 2008 | Original use-level-designation document |
| February 2010 | Reinstate Contech's Oil Control PULD |
| August 2012 | Revised design storm criteria, revised oil control QAPP, TER, and Expiration dates |
| December 2012 | Revised Contech Engineered Solutions Contact Information; Added QAPP for Oil Treatment |
| May 2013 | Revised model numbers in Attachment 1 |
| April 2014 | Revised Due dates for QAPP and TER and changed Expiration date |
| August 2014 | Revised Due dates for QAPP and TER and changed Expiration date |
| July 2016 | Updated Oil Control PULD to a CULD based on preliminary field monitoring results |
| November 2016 | Revised Contech Contact person |
| August 2018 | Removed CULD for Oil from document |

# Attachment 1
# CDS Stormwater Treatment Unit Checklist

| Frequency | Drainage System Feature | Problem | Conditions to Check For | Recommended Action | Date Inspected* | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | J | F | M | A | M | J | J | A | S | O | N | D |
| M & S | Inlet Chamber | Accumulation of trash, debris and sediment | Trash blocking inlet throat opening & sediment accumulation exceeds 2 inches | Remove trash, debris, and sediments. Inlet throat opening should not be blocked by any materials. | | | | | | | | | | | | |
| A | Screen | Blockage/Damage | Biological growth on the surface of the screen; broken screen or loose screen | Powerwash screen to clean the surface and Contact CSS for screen repair (broken or loose) | | | | | | | | | | | | |
| M | Separation Chamber | Trash and floatable debris accumulation | Excessive trash and floatable debris accumulation on the surface in separation chamber | Remove trash or other floatable debris in separation chamber to minimum level | | | | | | | | | | | | |
| A | Oil Baffle** | Damaged | Baffles corroding, cracking, warping, and/or showing signs of failure as determined by maintenance/inspection person. | Baffles repaired or replaced to design specifications. | | | | | | | | | | | | |
| M & S | Oil sorbent** | Consumed | Change of color in sorbents (fresh sorbents typically appears to be white or light yellow) | Remove spent oil sorbent and replace with new sorbent | | | | | | | | | | | | |
| M | Sediment Depth in the Sump | Sediment accumulation | Sediment accumulation exceeds 75-85% sump depth (varies depending on the Model, see attached Table) | Sediment in sump should be removed using vactor truck. | | | | | | | | | | | | |
| M | Sediment Depth behind the screen | Sediment accumulation | Sediment accumulation exceeds 2 inches behind the screen | Sediment behind the screen should be removed using vactor truck. | | | | | | | | | | | | |

| Frequency | Drainage System Feature | Problem | Conditions to Check For | Recommended Action | Date Inspected* | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | J | F | M | A | M | J | J | A | S | O | N | D |
| M | Access Cover (MH, Grate, cleanout) | Access cover Damaged/ Not working | One maintenance person cannot remove lid after applying 80 pounds of lift, corrosion of deformation of cover. | Cover repaired to proper working specifications or replaced. | | | | | | | | | | | | |
| A | Inlet and Outlet Piping | Damaged Piping/Leaking | Any part of the pipes are crushed or damaged due to corrosion and/or settlement. | Pipe repaired or replaced. | | | | | | | | | | | | |
| A | Concrete Structure | Concrete structure (MH or diversion vault) has cracks in wall, bottom, and damage to frame and/or top slab. | Cracks wider than ½ inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the structure is not structurally sound. | Structure repaired so that no cracks exist wider than 0.25 inch at the joint of inlet/outlet pipe. | | | | | | | | | | | | |
| A | Access Ladder | Ladder rungs unsafe | Maintenance person judges that ladder is unsafe due to missing rungs, misalignment, rust, or cracks. Ladder must be fixed or secured immediately. | Ladder meets design standards and allows maintenance persons safe access. | | | | | | | | | | | | |

*Note dates when maintenance was performed and type of maintenance performed in notes section below.
**May not be present on all units.

(M) Monthly from November through April.
(A) Once in late summer (preferable September)
(S) After any major storm (use 1-inch in 24 hours as a guideline).

If you are unsure whether a problem exists, please contact a Professional Engineer.

Notes:

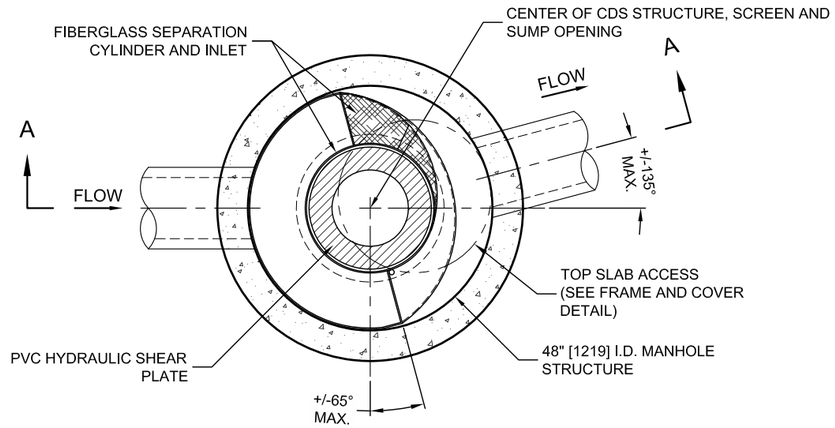
Maintenance of CDS stormwater treatment unit typically does not require confined space entry. Visual inspections should be performed above ground. If entry is required, it should be performed by qualified personnel.

Refer to CDS Unit Operation & Maintenance Guideline for maintenance details. Typically the CDS unit needs to be inspected before and after the rainfall seasons (November to April), after any major storms (>1-inch within 24 hour) and in the event of chemical spills.

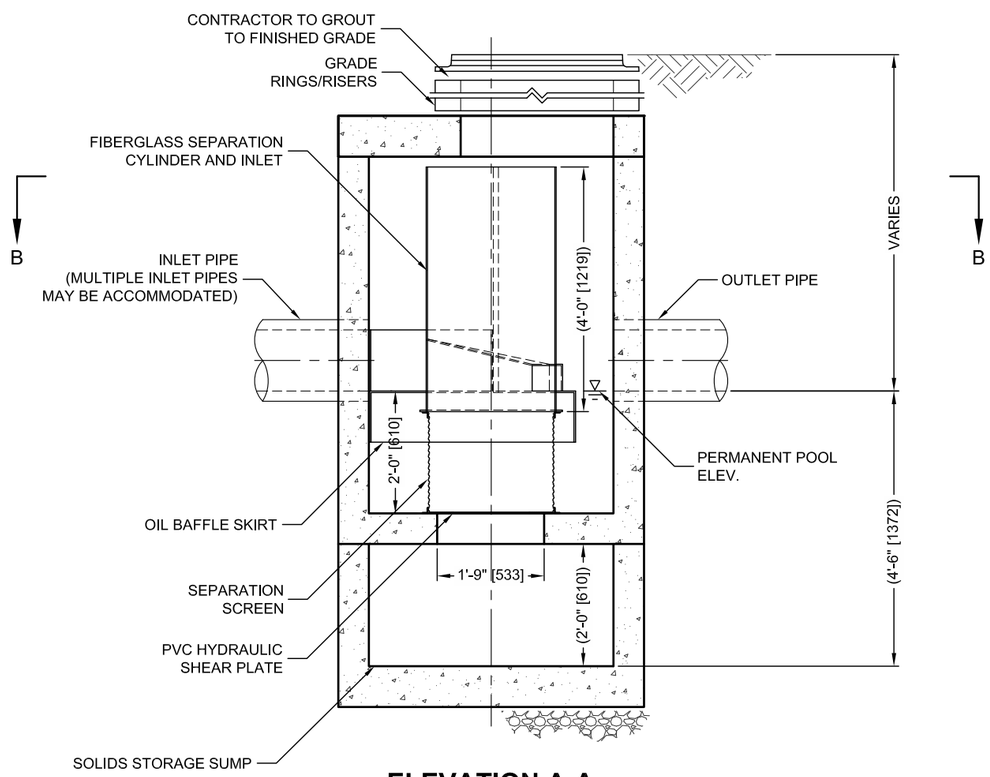
Contact Contech Engineered Solutions (CSS) (800-548-4667) if there is any damage to the internal components of CDS Unit.

### CDS Maintenance Indicators and Sediment Storage Capacities

| CDS Model | Diameter | | Distance from Water Surface to Top of Sediment Pile | | Sediment Storage Capacity | |
|---|---|---|---|---|---|---|
| | ft | m | ft | m | $yd^3$ | $m^3$ |
| CDS2015 | 5 | 1.5 | 3.0 | 0.9 | 1.3 | 1.0 |
| CDS2020 | 5 | 1.5 | 3.5 | 1.1 | 1.3 | 1.0 |
| CDS2025 | 5 | 1.5 | 4.0 | 1.2 | 1.3 | 1.0 |
| CDS3020 | 6 | 1.8 | 4.0 | 1.2 | 2.1 | 1.6 |
| CDS3030 | 6 | 1.8 | 4.6 | 1.4 | 2.1 | 1.6 |
| CDS3035 | 6 | 1.8 | 5.0 | 1.5 | 2.1 | 1.6 |
| CDS4030 | 8 | 2.4 | 4.6 | 1.4 | 5.6 | 4.3 |
| CDS4040 | 8 | 2.4 | 5.7 | 1.7 | 5.6 | 4.3 |
| CDS4045 | 8 | 2.4 | 6.2 | 1.9 | 5.6 | 4.3 |




**PLAN VIEW B-B**
N.T.S.



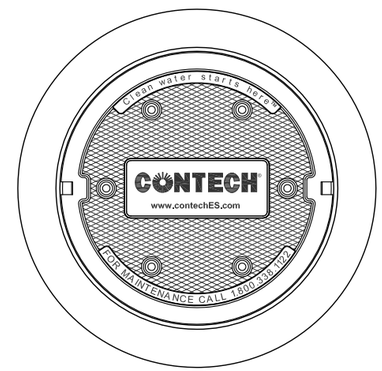

**ELEVATION A-A**
N.T.S.

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,788,848; 6,641,720; 6,511,588; 6,581,782; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

## CDS2015-4-C DESIGN NOTES

THE STANDARD CDS2015-4-C CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

| CONFIGURATION DESCRIPTION |
|---|
| GRATED INLET ONLY (NO INLET PIPE) |
| GRATED INLET WITH INLET PIPE OR PIPES |
| CURB INLET ONLY (NO INLET PIPE) |
| CURB INLET WITH INLET PIPE OR PIPES |
| SEPARATE OIL BAFFLE (SINGLE INLET PIPE REQUIRED FOR THIS CONFIGURATION) |
| SEDIMENT WEIR FOR NJDEP / NJCAT CONFORMING UNITS |




**FRAME AND COVER**
(DIAMETER VARIES)
N.T.S.

## SITE SPECIFIC DATA REQUIREMENTS

| | | | |
|---|---|---|---|
| STRUCTURE ID | | | |
| WATER QUALITY FLOW RATE (CFS OR L/s) | | | * |
| PEAK FLOW RATE (CFS OR L/s) | | | * |
| RETURN PERIOD OF PEAK FLOW (YRS) | | | * |
| SCREEN APERTURE (2400 OR 4700) | | | * |
| PIPE DATA: | I.E. | MATERIAL | DIAMETER |
| INLET PIPE 1 | * | * | * |
| INLET PIPE 2 | * | * | * |
| OUTLET PIPE | * | * | * |
| RIM ELEVATION | | | * |
| ANTI-FLOTATION BALLAST | WIDTH | HEIGHT | |
| | * | * | |

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

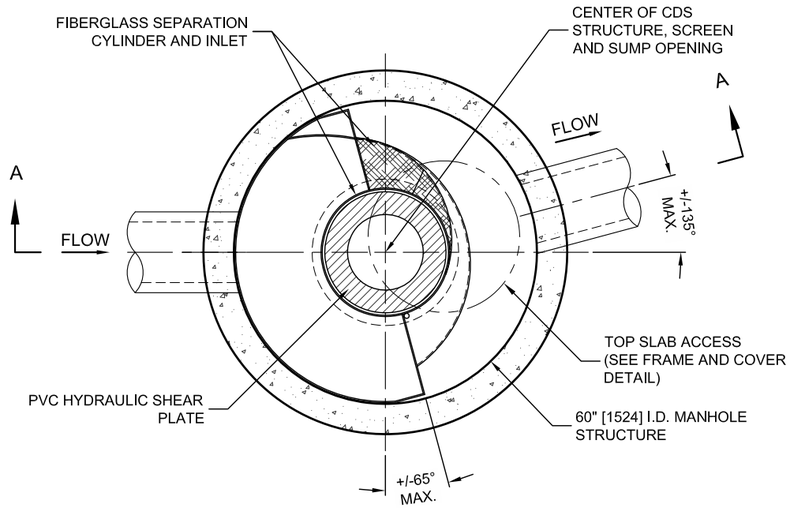
GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.contechES.com
4. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE SHALL MEET AASHTO HS20 AND CASTINGS SHALL MEET HS20 (AASHTO M 306) LOAD RATING, ASSUMING GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION.
6. PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.

INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO ADD JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS, AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

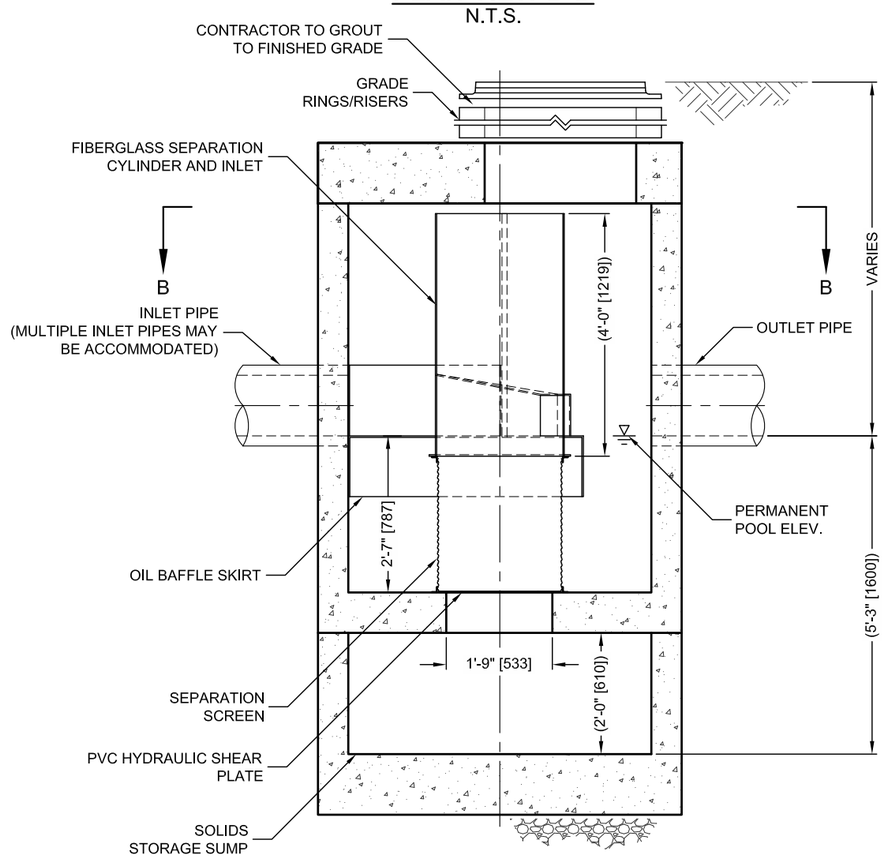
CONTECH®
ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CDS2015-4-C
INLINE CDS
STANDARD DETAIL

C:\USERS\SCHLACHTERH\DESKTOP\CDS DETAILS 180 MICRON SIZING\ACAD\CDS2015-4-C-DTL.DWG 5/19/2014 5:16 PM




## PLAN VIEW B-B
N.T.S.



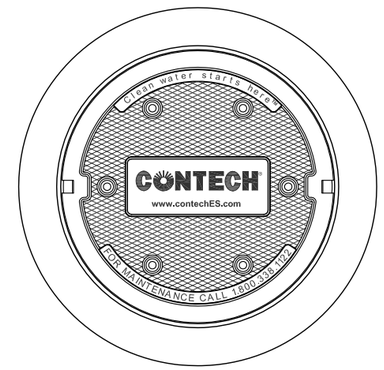

## ELEVATION A-A
N.T.S.

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,788,846; 6,641,720; 6,511,598; 6,581,782; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

## CDS2020-5-C DESIGN NOTES

THE STANDARD CDS2020-5-C CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

| CONFIGURATION DESCRIPTION |
|---|
| GRATED INLET ONLY (NO INLET PIPE) |
| GRATED INLET WITH INLET PIPE OR PIPES |
| CURB INLET ONLY (NO INLET PIPE) |
| CURB INLET WITH INLET PIPE OR PIPES |
| SEPARATE OIL BAFFLE (SINGLE INLET PIPE REQUIRED FOR THIS CONFIGURATION) |
| SEDIMENT WEIR FOR NJDEP / NJCAT CONFORMING UNITS |




## FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

## SITE SPECIFIC DATA REQUIREMENTS

| | |
|---|---|
| STRUCTURE ID | |
| WATER QUALITY FLOW RATE (CFS OR L/s) | * |
| PEAK FLOW RATE (CFS OR L/s) | * |
| RETURN PERIOD OF PEAK FLOW (YRS) | * |
| SCREEN APERTURE (2400 OR 4700) | * |

| PIPE DATA: | I.E. | MATERIAL | DIAMETER |
|---|---|---|---|
| INLET PIPE 1 | * | * | * |
| INLET PIPE 2 | * | * | * |
| OUTLET PIPE | * | * | * |

| | |
|---|---|
| RIM ELEVATION | * |

| ANTI-FLOTATION BALLAST | WIDTH | HEIGHT |
|---|---|---|
| | * | * |

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

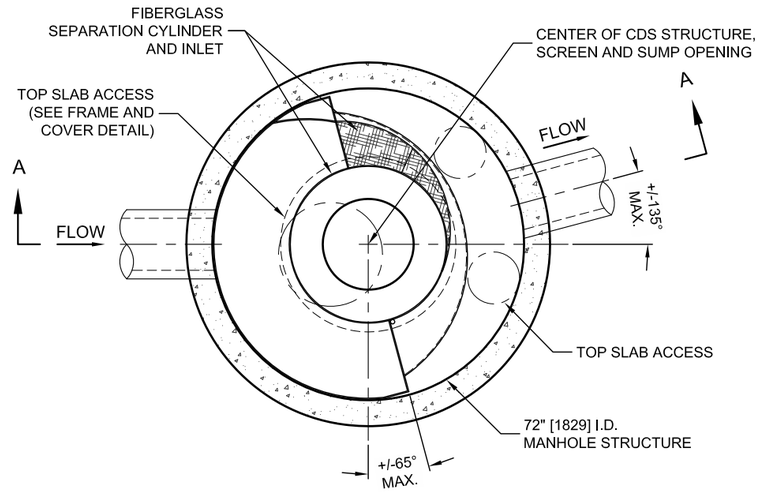
GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.contechES.com
4. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE SHALL MEET AASHTO HS20 AND CASTINGS SHALL MEET HS20 (AASHTO M 306) LOAD RATING, ASSUMING GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION.
6. PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.

INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO ADD JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS, AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

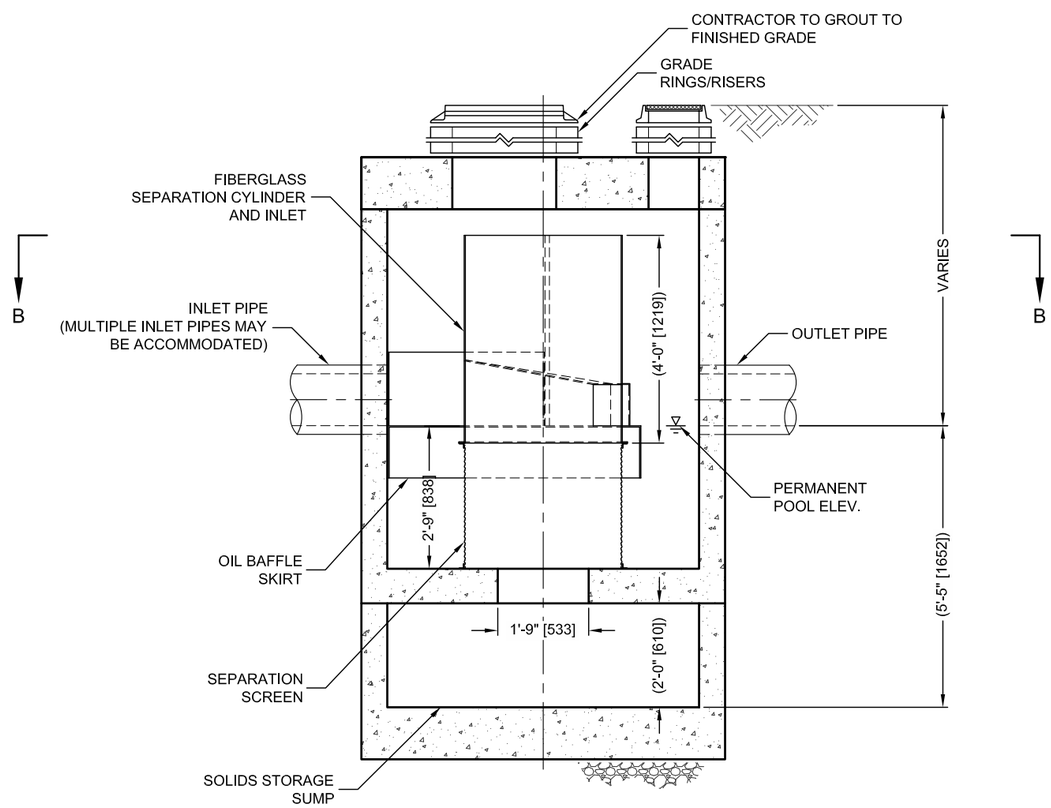
CONTECH®
ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CDS2020-5-C
INLINE CDS
STANDARD DETAIL

C:\USERS\SCHLACHTERH\DESKTOP\CDS DETAILS 180 MICRON SIZING\ACAD\CDS2020-5-C-DTL.DWG 5/19/2014 5:19 PM




## PLAN VIEW B-B
N.T.S.



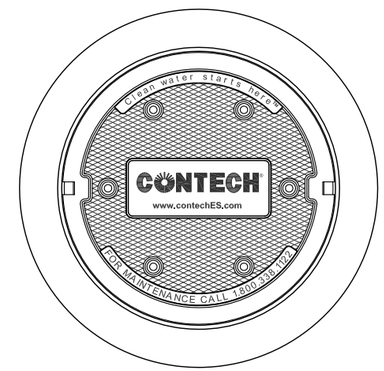

## ELEVATION A-A
N.T.S.

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,788,846; 6,641,720; 6,511,598; 6,581,782; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

## CDS3020-6-C DESIGN NOTES

THE STANDARD CDS3020-6-C CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

| CONFIGURATION DESCRIPTION |
|---|
| GRATED INLET ONLY (NO INLET PIPE) |
| GRATED INLET WITH INLET PIPE OR PIPES |
| CURB INLET ONLY (NO INLET PIPE) |
| CURB INLET WITH INLET PIPE OR PIPES |
| SEPARATE OIL BAFFLE (SINGLE INLET PIPE REQUIRED FOR THIS CONFIGURATION) |
| SEDIMENT WEIR FOR NJDEP / NJCAT CONFORMING UNITS |




## FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

## SITE SPECIFIC DATA REQUIREMENTS

| | |
|---|---|
| STRUCTURE ID | |
| WATER QUALITY FLOW RATE (CFS OR L/s) | * |
| PEAK FLOW RATE (CFS OR L/s) | * |
| RETURN PERIOD OF PEAK FLOW (YRS) | * |
| SCREEN APERTURE (2400 OR 4700) | * |

| PIPE DATA: | I.E. | MATERIAL | DIAMETER |
|---|---|---|---|
| INLET PIPE 1 | * | * | * |
| INLET PIPE 2 | * | * | * |
| OUTLET PIPE | * | * | * |

| | |
|---|---|
| RIM ELEVATION | * |

| ANTI-FLOTATION BALLAST | WIDTH | HEIGHT |
|---|---|---|
| | * | * |

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

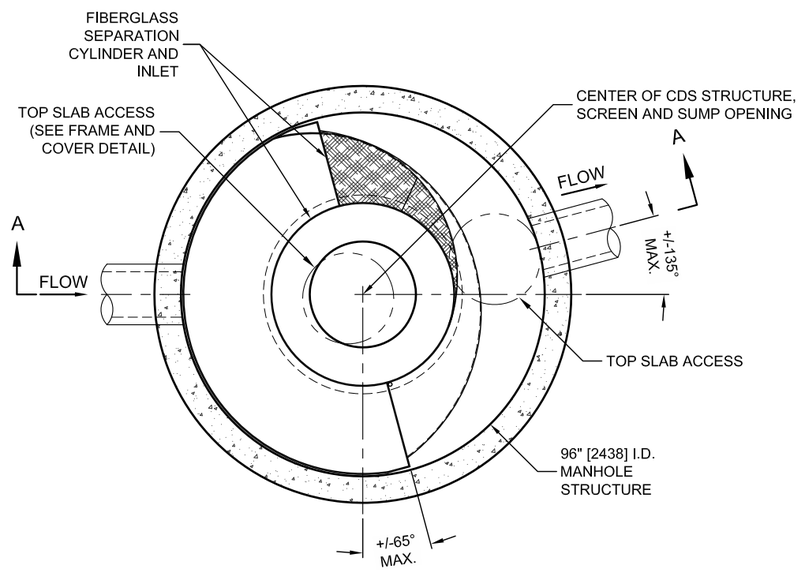
GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.contechES.com
4. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE SHALL MEET AASHTO HS20 AND CASTINGS SHALL MEET HS20 (AASHTO M 306) LOAD RATING, ASSUMING GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION.
6. PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.

INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO ADD JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS, AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

CONTECH®
ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

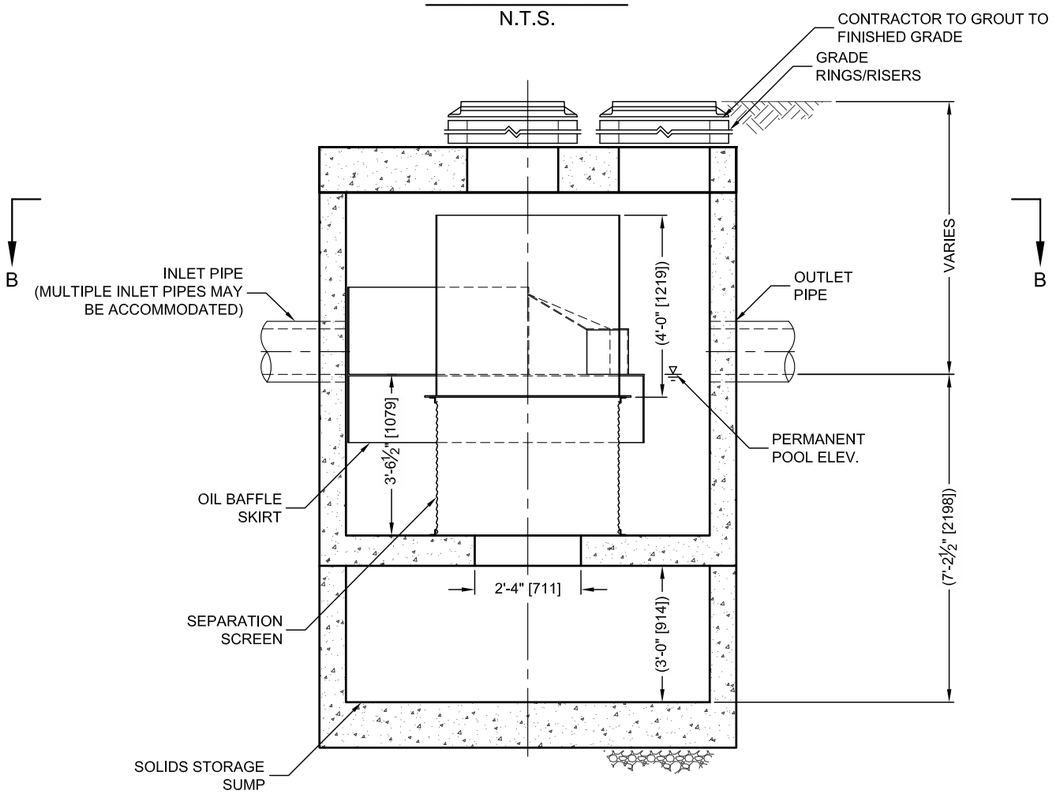
CDS3020-6-C
INLINE CDS
STANDARD DETAIL

C:\USERS\SCHLACHTERH\DESKTOP\CDS DETAILS 180 MICRON SIZING\ACAD\CDS3020-6-C-DTL.DWG 5/19/2014 5:21 PM




## PLAN VIEW B-B

N.T.S.




## ELEVATION A-A

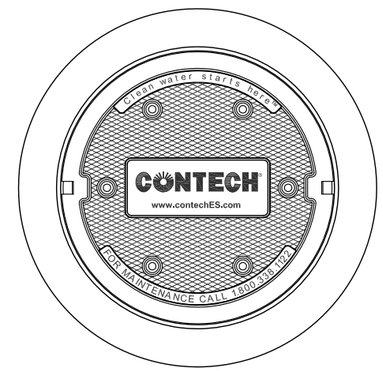
N.T.S.

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,788,846; 6,641,720; 6,511,595; 6,581,782; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

## CDS4030-8-C DESIGN NOTES

THE STANDARD CDS4030-8-C CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

| CONFIGURATION DESCRIPTION |
|---|
| GRATED INLET ONLY (NO INLET PIPE) |
| GRATED INLET WITH INLET PIPE OR PIPES |
| CURB INLET ONLY (NO INLET PIPE) |
| CURB INLET WITH INLET PIPE OR PIPES |
| SEPARATE OIL BAFFLE (SINGLE INLET PIPE REQUIRED FOR THIS CONFIGURATION) |
| SEDIMENT WEIR FOR NJDEP / NJCAT CONFORMING UNITS |




## FRAME AND COVER

(DIAMETER VARIES)

N.T.S.

## SITE SPECIFIC DATA REQUIREMENTS

| | | | |
|---|---|---|---|
| STRUCTURE ID | | | |
| WATER QUALITY FLOW RATE (CFS OR L/s) | | | * |
| PEAK FLOW RATE (CFS OR L/s) | | | * |
| RETURN PERIOD OF PEAK FLOW (YRS) | | | * |
| SCREEN APERTURE (2400 OR 4700) | | | * |
| PIPE DATA: | I.E. | MATERIAL | DIAMETER |
| INLET PIPE 1 | * | * | * |
| INLET PIPE 2 | * | * | * |
| OUTLET PIPE | * | * | * |
| RIM ELEVATION | | | * |
| ANTI-FLOTATION BALLAST | WIDTH | HEIGHT | |
| | * | * | |

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

GENERAL NOTES

1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECHENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.contechES.com
4. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE SHALL MEET AASHTO HS20 AND CASTINGS SHALL MEET HS20 (AASHTO M 306) LOAD RATING, ASSUMING GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION.
6. PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO ADD JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS, AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

CONTECH ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

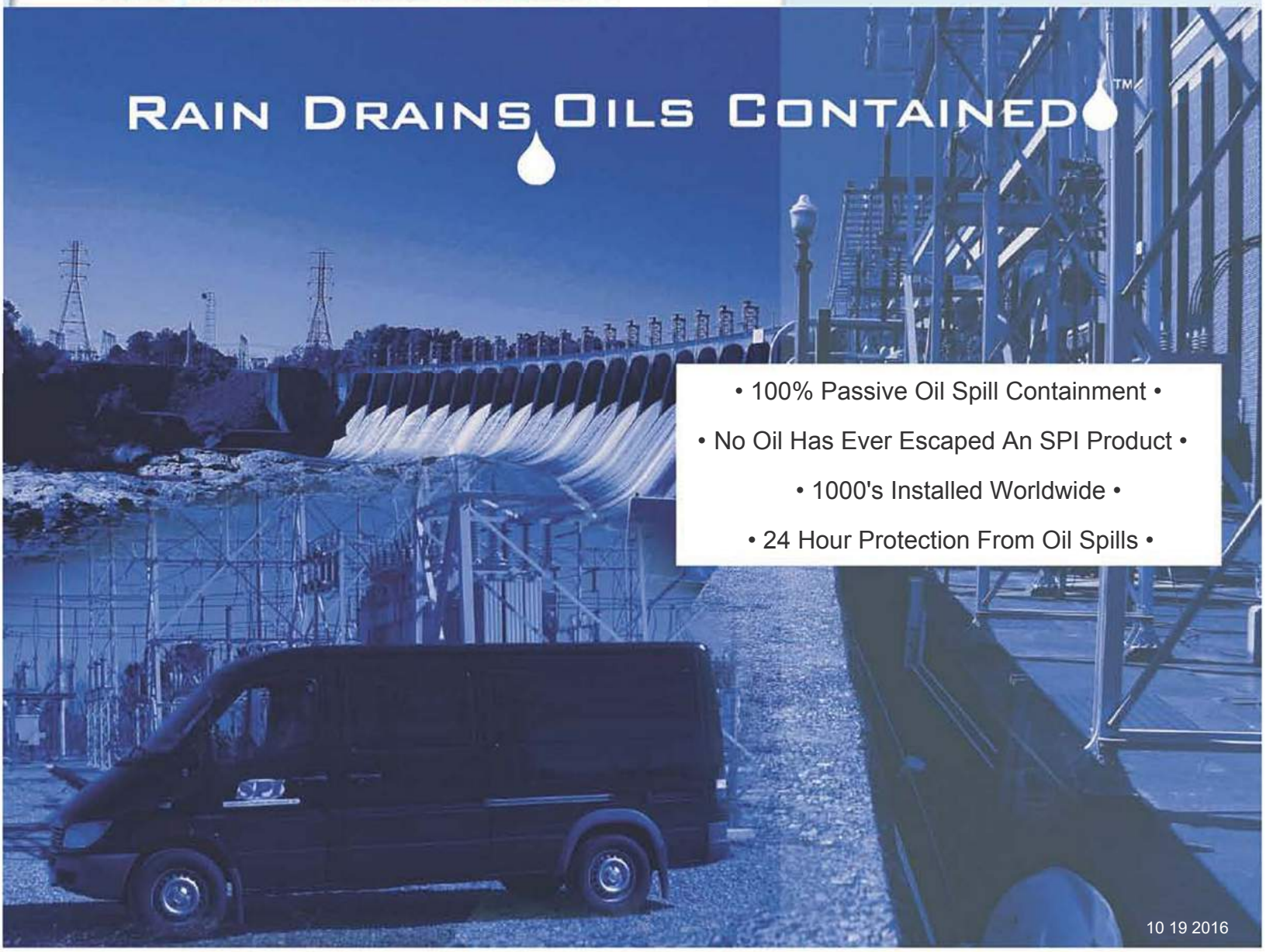
CDS4030-8-C
INLINE CDS
STANDARD DETAIL

C:\USERS\SCHLACHTERH\DESKTOP\CDS DETAILS 180 MICRON SIZING\ACAD\CDS4030-8-C-DTL.DWG 5/19/2014 5:34 PM

# Attachment S. Solidification Products International Petro-Barrier – Product Information Booklet, Application Drawings, and Laboratory Testing

Solidification Products International

# Product Information Booklet



# TABLE OF CONTENTS

Product Overview……..…….....3-4

How Technology Works……..…….……....5-6

**Petro-Plug®** …….....7-8

**Petro-Plug®** Vault Installation…….....9

**Petro-Pipe®** …….....10-12

**Petro-Pipe®** Flow Testing …….…….....…….....……13-14

4" **Petro-Pipe®** & FR3 **Petro-Pipe®**.....15-16

**Petro-Pipe®** Installations……....…….....17-18

Transformer Explosion… ..... 19-20

**SPI Petro-Barrier™** Design & Installation……..…….....21-28

Cold Weather & **SPI Petro-Barrier™** Application…….....29-30

Pre-Fab **SPI Petro-Barrier™** ..... 31-32

An Actual Oil Spill.....33

Portable Containment Berms……..…….....…34-38

Sealed Containment Liners…….....……..39-40

SPI **Oil Bond®**.....…….....….....41-43

SPI **WaterBond™**.....…….....……..44-45

SPI Storm Water Barriers.....46-47

*Solidification Products International*
P.O. Box 35, Northford, CT 06472
203-484-9494 Fax: 203-484-9492
www.oilbarriers.com

Dear Friend,

Founded in 1991, Solidification Products International SPI developed unique environmental products for industrial applications. We concentrated on oil and water absorbents for solidification of waste and oil spill clean-up products. In the late 1990's we took a proactive approach to stopping spills from escaping into and contaminating our waterways and wetlands.

We started the development of a containment system which allowed rainwater to drain and totally seal off an oil spill. Containment in the late 1990's was not required by law or by the Spill Prevention Control and Countermeasures Act, "SPCC", for many industries, only proactive companies utilized these products and systems, making them a standard in their containment plans. Many electric utilities were taking notice of SPI's technology and by 2000, our products and systems started to be installed. By 2002 we were installing in ten states and expanding nationally.

Over the years, thousands of our **Petro-Plug®, Petro-Pipes®,** and **SPI Petro-Barriers®** have been installed all over the world. To date, we have fourteen (14) US Patents with other US and Foreign Patents still pending. As you look through this booklet, you will see that SPI's products are capable of containing and stopping a devastating environmental oil spill.

The **SPI Petro-Barrier™, Petro-Pipe®, Petro-Plug®** and our latest addition, the SPI Portable Containment Systems, will provide all your containment needs. All of SPI's products have the ability to handle rainwater discharge while providing total *100% OIL-SPILL CONTAINMENT.*

Sincerely,
*Bill Gannon*

Bill Gannon
President

# Product Overview

SPI offers a whole lineup of products for use in State-of-the-Art Oil-Spill Containment Systems. Many materials can be used to pick up or absorb oil, but only SPI can offer materials of such unique performance and technical properties. In addition to effectively trapping hydrocarbons, SPIMedia chemically reacts to prevent any oil from ever being discharged from any of SPI's Spill Containment Systems and Products. In this Product Booklet, we concentrate on Spill Protection where SPI's products set a New Standard of Performance.

## PETRO-PLUG®

These plugs are designed to protect small floor drains in boiler rooms, garages, warehouses and underground vaults. Uncontaminated water will drain at approximately 6 quarts per minute with standard sized floor drains of diameter. The Petro-Plug® will plug up completely when an oil spill hits the inner media, thus sealing the drain. Once sealed, nothing will pass through the plug.

## SPI PETRO-PIPE®

These pipes are designed for areas with high water tables and poor drainage fields. Petro-Pipes® are constructed to allow passage of uncontaminated water and to seal upon contact with an oil spill. They are available in a variety of stock sizes according to drainage needs. The 6" **Petro-Pipe®** has a water drainage flow rate of 4 GPM based upon an optimum installation at a 25 degree angle. They are designed to be cast into concrete, asphalt or earthen berms. New **Petro-Pipe®** Inserts are easily replaced into a pre-cast flanged outer sleeve as needed. Stainless steel bolts and a gasket insure the integrity of the flanged joint seal.

## SPI PETRO-BARRIER™

These barriers are designed to handle the largest volumes of rainwater run off utilizing a vertical type installation where there is good drainage. Average storm water drain rates per barrier vary from a low of 8 GPM with the 12" diameter **SPI Petro-Barrier™**,to a maximum of 80 GPM with the 72" diameter **SPI Petro-Barrier™**. Typically, our **SPI Petro-Barriers** are 24" deep though custom applications are available. They are constructed with three types of media that filters out all Oil-Sheen while simultaneously allowing rainwater to drain through freely.

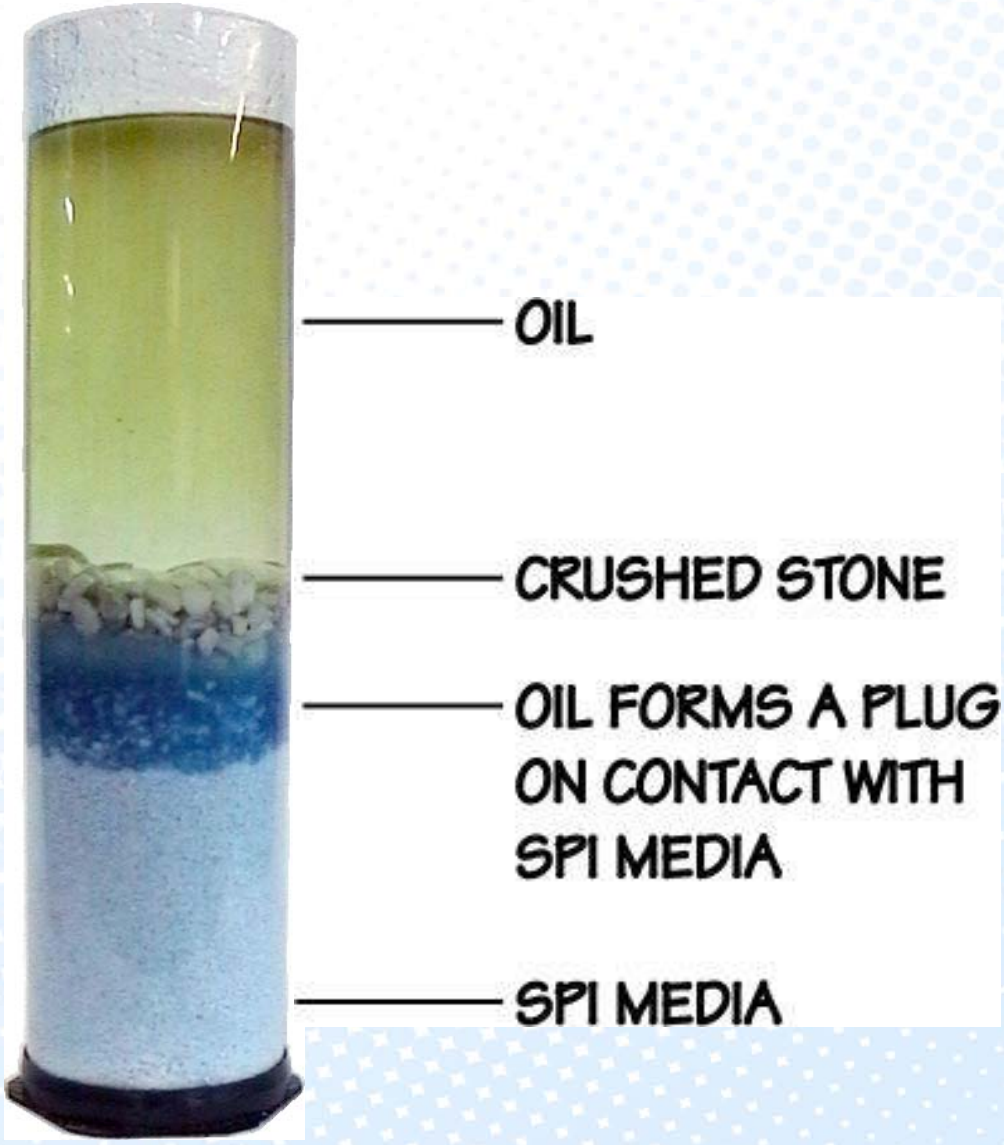
## SPI PORTABLE CONTAINMENTS BERMS

Designed for use around tanker trucks, transformers, generators and portable oil storage drums/containers. The portable containment berms are available in custom sizes. Berm walls are typically 8" to 12" tall. Collapsible, quick setup straps (interior or exterior) plus rigid angle supports provide firm support of the walls. The specialized material (XR5) is rated with a 10 year life under harsh ultraviolet light. Rainwater drains from the portable containment berms via built-in **Petro-Plugs®** and **Petro-Pipes®**. The system is designed for horizontal water drainage and will seal immediately upon any contact with oil.

| Product Info/Image | Mounting Position | Size | Primary Application | Suggested Maintenance | Dirt Filter Maintenance |
|---|---|---|---|---|---|
| Petro-Plug® | Vertical | 3" - 4" | Indoor Floor Drain | 1 - 5 years depending on use | as needed/Check Monthly |
| Petro-Pipe® PIFH-616 | 15° - 25° | 7" Flanged Housing<br>6" Flanged Petro-Pipe® | Outdoor oil containment areas | 3 - 5 years | Suggested Bi-Annually |
| Petro-Pipe® PI-616 | 15° - 25° | 6" Petro-Pipe®<br>2" to 6" male fitting | Outdoor oil containment areas | 3 - 5 years | Suggested Bi-Annually |
| Petro-Pipe® PIT-416 | 15° - 25° | 3.8" Outside Diameter<br>1.5" & 2" Male Fitting | Outdoor oil containment areas | Up to 3 years | Bi-Annually as needed |
| Petro-Barrier-Plug | Vertical | 12" Housing<br>11" Petro-Barrier-Plug | Outdoor oil containment areas | 5 years | Bi-Annually |
| Pre-Fab Petro-Barrier | Vertical | 18", 24", 36" | Outdoor oil containment areas | 5 years | Bi-Annually |
| Field Installed Petro-Barrier | Vertical | As required | Outdoor oil containment areas | 5 years | Bi-Annually |
| Pump-Thru-Barrier | Vertical | 24" | Outdoor oil containment areas | 5 years | As required |
| Filter Cannister and Basket | With Petro-Pipes | | Outdoor oil containment areas | Check monthly until a schedule can be determined | As required until schedule is determined. |

# How SPI Technology Works

**SPI Petro-Barriers™**, **Petro-Pipes®** and **Petro-Plugs®** are unique oil/water filters using patented technology that allows rain to drain while totally containing any oil spill. In the event of a major spill, the filter/ barrier will form a plug, preventing the oil from ever getting out into the environment. These products are used at electric utilities, oil companies, government agencies, petroleum storage tanks and other industrial facilities for applications in storm drains, containment sumps, floor drains and customized applications.




DISPLAY SHOWING THE OIL STOPPING CAPABILITIES OF THE SPI MEDIA.

# SPI Petro-Barrier™

The **SPI Petro-Barrier™** was designed to provide the most successful and cost effective solution for spill containment area storm water drainage, with virtually no maintenance. With more than 1500 installations, no oil has ever gotten past an **SPI Petro-Barrier**! Anyone with experience in this field is familiar with oil/ water separators, oil stop valves and oil sensing switches for pumps. In numerous situations these expensive, high maintenance methods have contributed to significant oil spills. Oil got past a separator, a stuck valve or a fouled oil switch. SPI Petro-Barriers™ offer the most fool-proof way to prevent oil from being discharged.

Briefly stated, a typical **SPI Petro-Barrier™** would be utilized as follows. In a spill containment area surrounding an oil storage vessel or oil-filled electrical transformer, everything on the ground is designed and created to be impervious to oil and water. The ground is sloped to drainage sumps where the **SPI PetroBarriers™** would be installed. After the drainage path and spill containment area have been completed, SPI fills the drainage sumps with the **SPI Petro-Barrier™** Media that allows water to pass while removing and locking up any oil. In a normal, non-spill operation an **SPI Petro-Barrier™** will last five (5) years. In the event of an oil spill, the barrier material will form a plug to prevent oil from getting out into the environment. In the event of a spill, the oil is contained within your spill containment area and can be reclaimed with pumps and filters. SPI will then remove the plugged material and refresh the barrier for a new 5-year clock of protection against an oil spill.

**SPI Petro-Barriers™** are all custom-designed and SPI-Installed for each individual site. A myriad of criteria and conditions including existing slope of land, percolation rates for under-drains, amount of rainfall and the size of the containment area all contribute to the overall system design. Large containment areas or installations in wet climates could require six or more sumps (barriers) whereas a small area in a low-rainfall climate might only need one or two. As a result, our extensive experience with this type of application is used to create the optimum design for each spill containment plan.

*-See drawings on next page-*

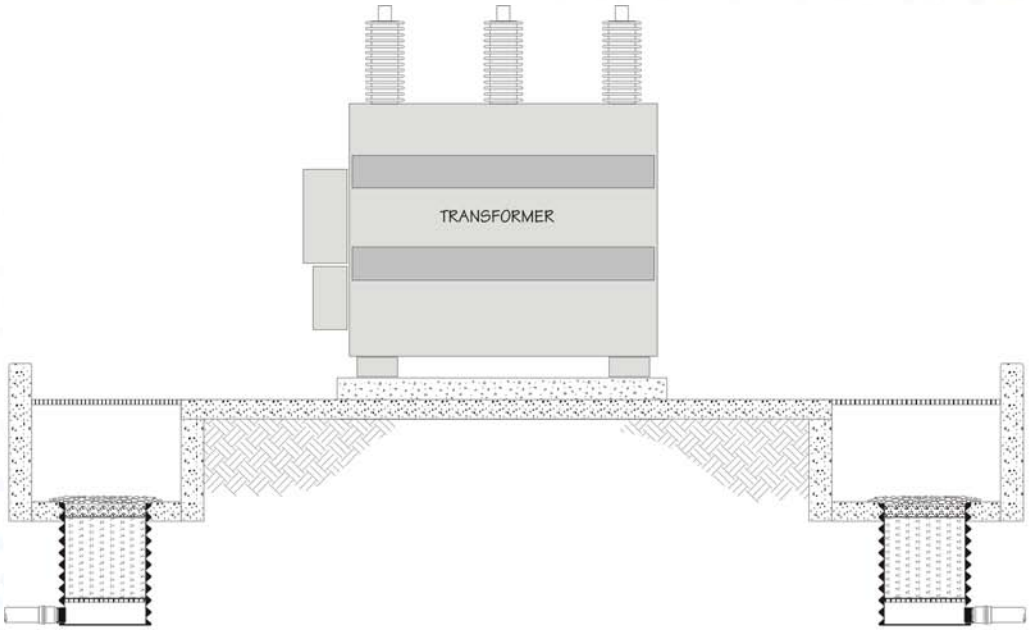



FIGURE 1 ELEVATION VIEW

NOTE: ALL SURFACES SLOPE TOWARDS BARRIER DRAINS FOR PROPER STORM WATER DISCHARGE.
CONTRACTOR TO PREPARE AREA AS SHOWN AND PROVIDE DRAINAGE HOLES FOR BARRIERS.
CONTAINMENT AREA SIZED TO HOLD FULL CONTENTS OF TRANSFORMER PLUS 10%-25% AS REQUIRED.

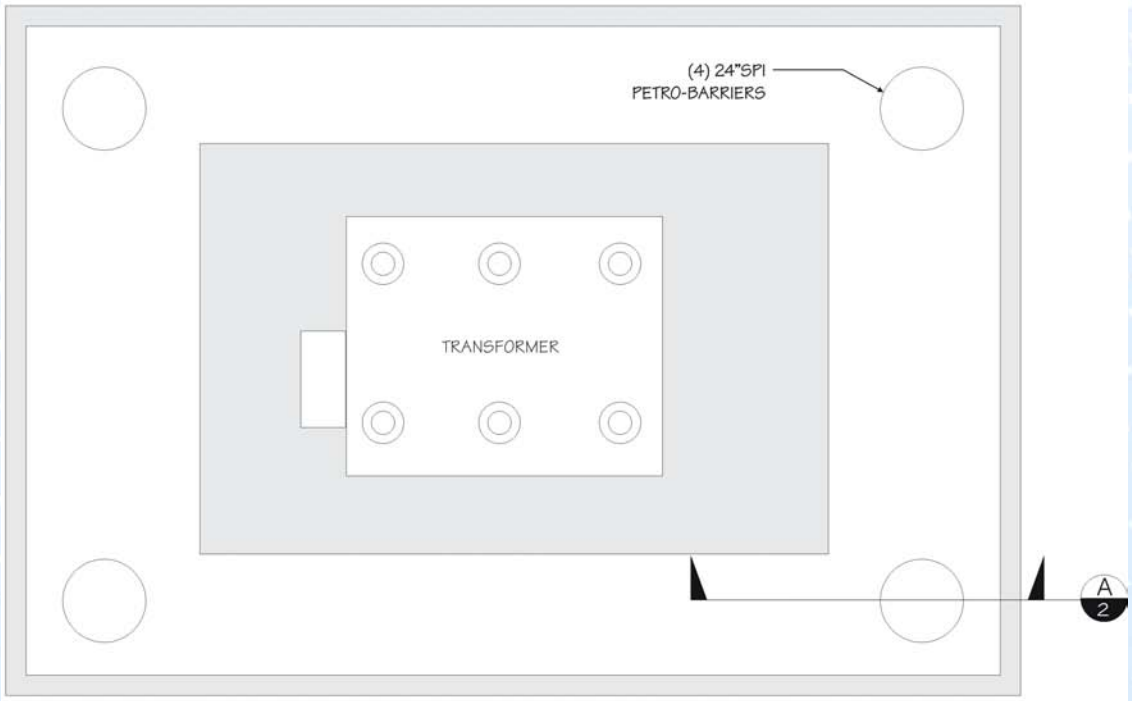



FIGURE 2 PLAN VIEW

# New Construction of Sub-Station Oil Containment Using SPI Petro-Barriers™

The construction was completed on this oil containment pad and SPI was called in to install four **SPI PetroBarriers™**, one in each corner. The new transformer will sit on the concrete pad surrounded by steel grating. All rainwater will flow into the pit along with any oil leaks or spills.

The steel grates are removed unveiling the pre-installed 18" HDPE pipe which becomes the housing for the **SPI Petro-Barrier™**. During construction a lot of dirt and debris is left on the floor of the containment area and SPI always vacuums and cleans the floor before the installation begins.

After the area is cleaned, Chris is busy installing the **SPI Petro-Barriers™**.

**SPI Petro-Barrier™** media is installed in the 18" sump.

The steel grating has been replaced. The **SPI Petro-Barrier™** can be seen on the floor of the oil containment area. The **SPI Petro-Barrier™** is covered with clean crushed stone.

The oil containment is complete and ready for delivery of the transformer.

# Retro-Fitting Existing Substation Storm Water Drains With SPI Petro-Barrier™

Five storm water drains are being retro fitted with **SPI Petro-Barriers™**. The storm drains are 10 feet deep and 24" in diameter. Confined entry is required for access into the drain.

Typically, SPI would install **SPI Petro-Barriers™** 28-30 inches down from the top. The storm drain sump was perforated with many holes to allow rain water to enter the drain 2 feet down from the top,so for total containment we installed the **SPI Petro-Barrier™** 5 to 6 feet deep.

Craig is lowered into a sump to start installing braces for grating to support the **SPI Petro- Barrier™** media.

Pete is watching the grating being installed by Craig six feet down in the storm drain.

Aluminum grating is used to support the **SPI Petro-Barrier™** Media.

This storm drain has some structural issues. Repairs need to be performed before the **SPI Petro-Barriers™** can be installed.

# Retro-Fit SPI Petro-Barriers™ in Sub-Station With Storm Drains

Sub-stations have walls on three sides with a cement curb in the front acting as containment with a door between transformer areas. There are storm drains in both areas to drain rain water.

Below, Glen installs an angle bracket to the sides of the storm drain.

A fiberglass grate is placed on top of the angle brackets.

The fiber glass is covered so no **SPI Petro-Barrier™** media will escape during and after installation.

The **SPI Petro-Barrier™** is complete; the media is in place and crushed stone is added to hold the pad in place. The iron gates are then placed on top.

# Weather Conditions WILL NOT slow down SPI

The day after a 22" snow fall with temperatures at 18°, Paul and Bill had numerous installations.

Cold and frigid but ready for an installation.

Two **SPI Petro-Barrier™** Sumps installed on this cold winter day.

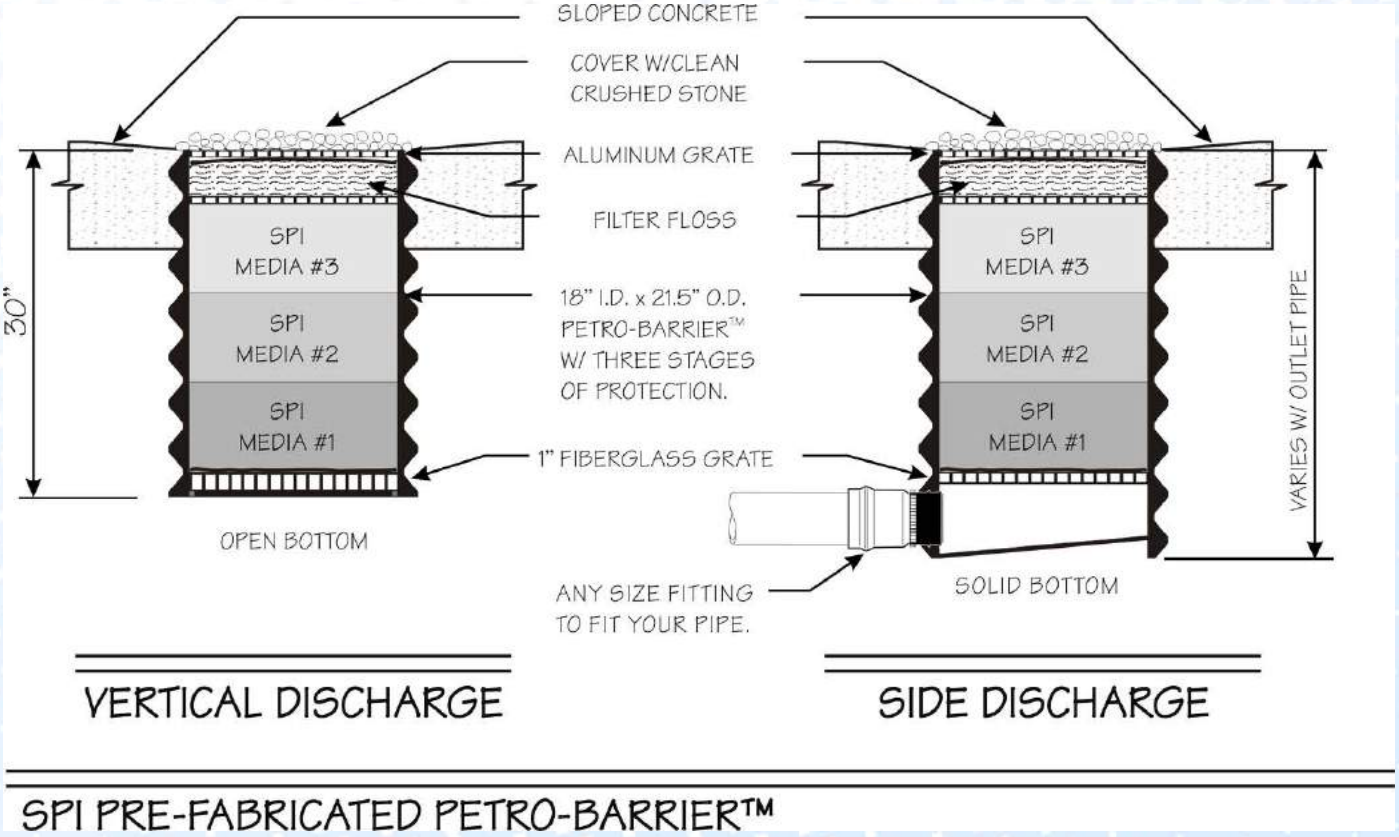
Paul looks happy this day is almost over.

# Pre-Fabricated SPI Petro-Barriers™ From 12” to 36” Diameter

Pre-Fabricated **SPI Petro-Barriers™** provide clients with all the benefits of having SPI personnel on hand to install the Barrier Media on-site, giving them the choice to install the system themselves or by contractors.

Pre-Fabricated **SPI Petro-Barriers™** provide the option to drain directly into the ground or to be piped offsite to another location. The Pre-Fabricated **SPI Petro-Barriers™** are preferred options for new construction sites, allowing proper placement during construction.

SPI works with your engineers, contractors and personnel to provide the proper installation and the best type Pre-Fabricated **SPI Petro-Barrier™** for your application.




SPI PRE-FABRICATED PETRO-BARRIER™

# Pre-Fabricated SPI Petro-Barrier™ Installation in Ontario, Canada, Winter 2007 For transformers using Cargill's FR3 Soy Based Transformer Oil.

For this new transformer, 2 - 18" x 36" tall SPI Petro-Barriers™ and 4- Pre-Fabricated **SPI Petro-Barriers™** are going to being installed.

The Pre-Fabricated **SPI Petro-Barriers™** are being installed as containment for two transformers. The two **SPI Petro-Barriers™** are being installed on each side of the containment pad.

Bill Gannon explains the installation and drainage to the engineer and contractor.

This is a view of half the containment area as the first two Pre-Fabricated **SPI Petro-Barriers™** are installed. The white pipes will be used to drain the **SPI Petro-Barriers™** from the containment area.

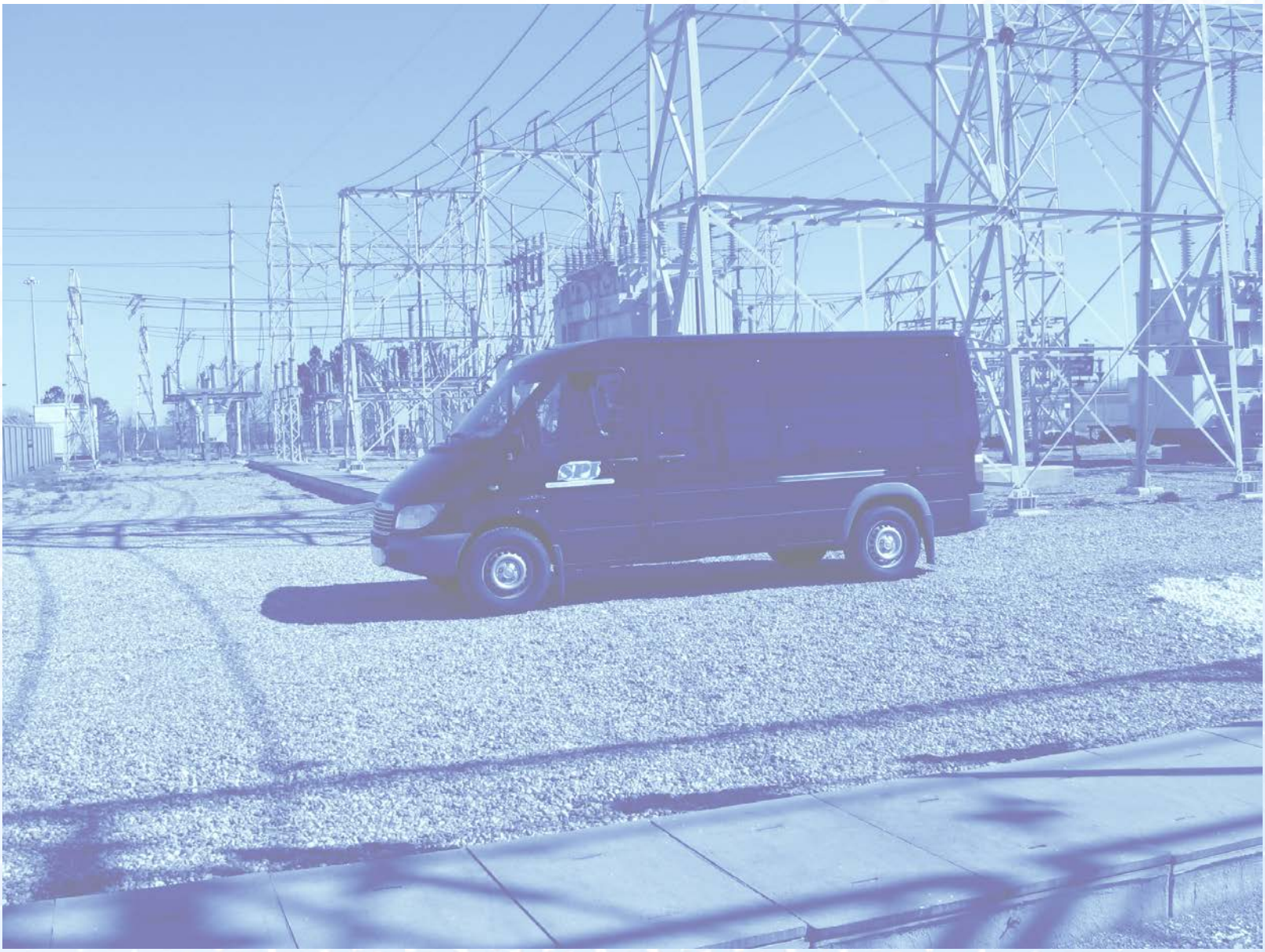
Construction is complete. The Pre-Fabricated **SPI Petro-Barriers™** were back filled with soil and crushed stone and then 6" of concrete was poured on the surface. The drainage is sloped toward the **SPI Petro-Barriers™.**

The drain lines direct the water to the holding pond for the power plant. After the installation, there have been many large rainfalls with no water back-up

# Actual 200 Gallon Oil Spill

The **SPI Petro-Barrier™** completely protected this NYC substation against an oil leak from the contained area. Eighteen months after installation, approximately 200 gallons of transformer oil leaked out of the mushroom on top of the transformer. All of the oil made its way to our Patented **SPI Petro-Barriers™** and as you can see, the oil stained the wall 2 inches up from the floor of the contained area. After the oil was cleaned-up, we cleaned up the remaining oil. The media that had reacted with the oil was removed and the sump was repacked with fresh media.

# *Solidification Products International*
# Application Drawings




**Petro-Plug®**

**Petro-Pipe®**

**SPI Petro-Barrier™**

Table of Contents Page

**Petro-Plug®** .....3 - 6

**SPI Petro-Barrier Plug®** .....7 - 12

**Petro-Pipe®** .....13 - 17

**Petro-Pipe® for Ball Valves** .....18 -20

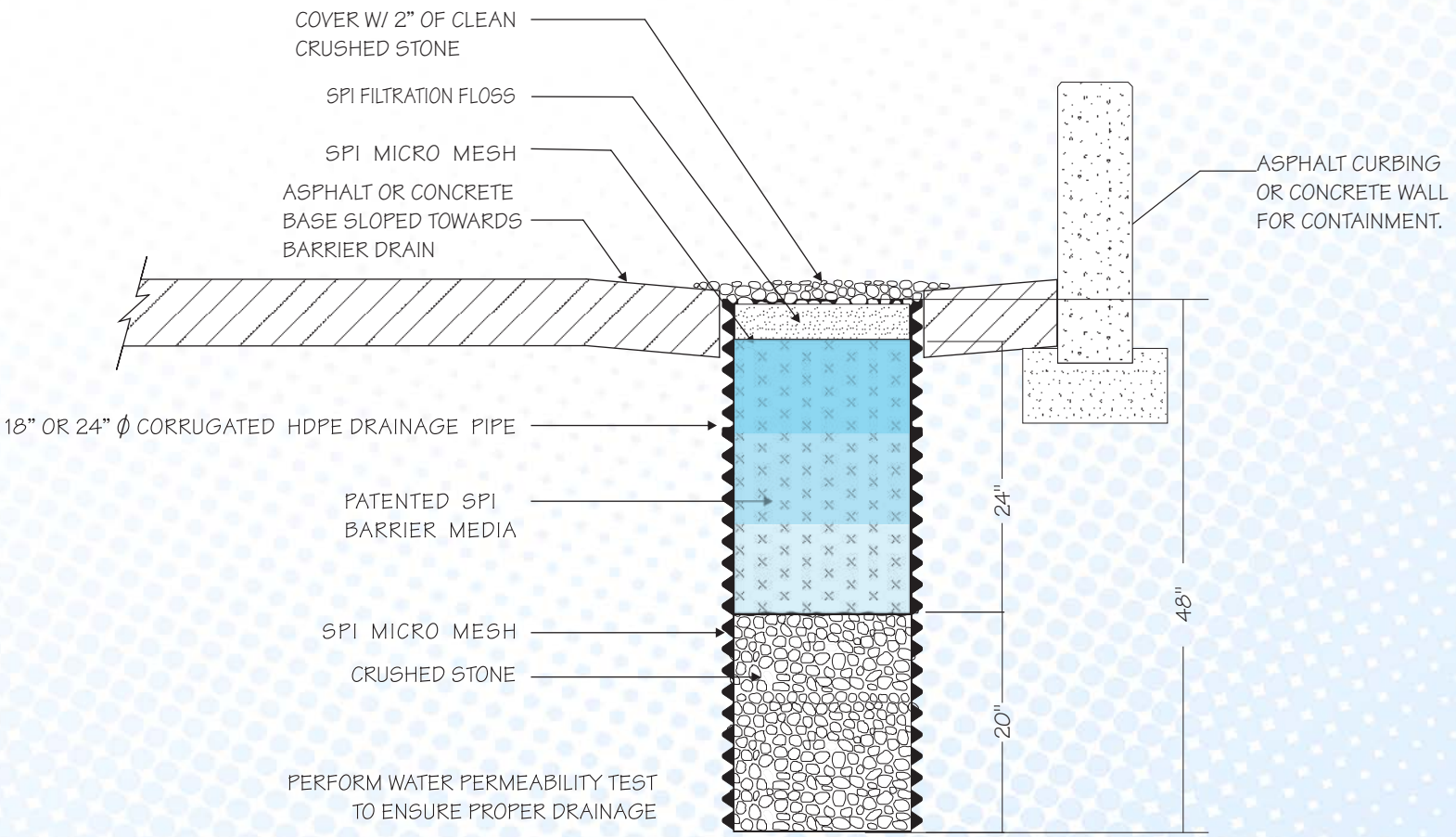
4" **Petro-Pipe®** .....21

**Petro-Pipe®** for FR3 Oil .....22

**SPI Petro-Barrier™** .....23- 35

**Pump-Thru-Barrier™** .....36 - 45

# SPI Petro-Barrier™ Applications for Oil Containment

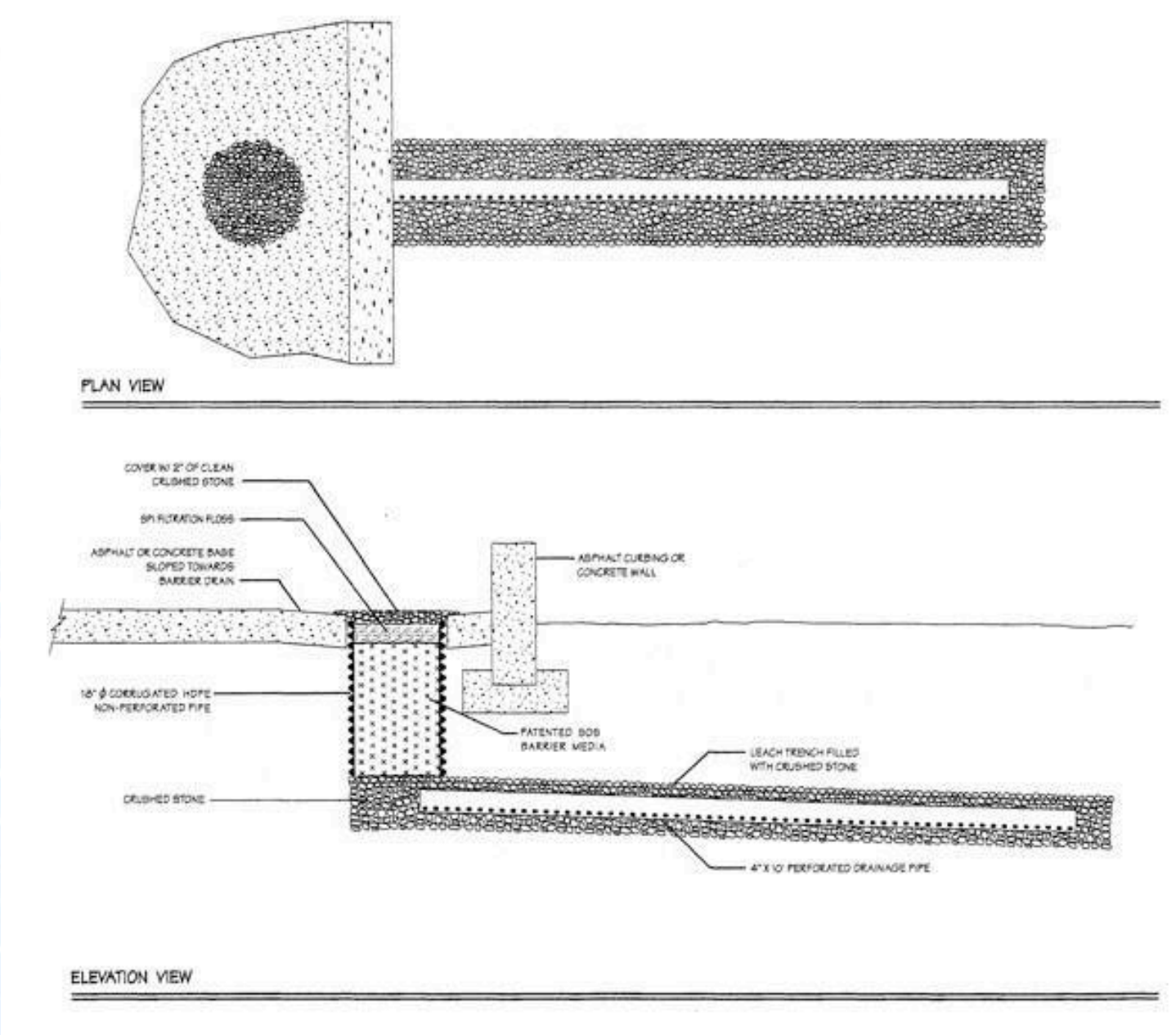



SPI PETRO-BARRIER™

**SPI Petro-Barriers™** have been installed in thousands of locations across North America since 1998. The original design of the **SPI Petro-Barrier™** in the above drawing creates a sump in the containment area that utilizes a corrugated HDPE pipe that may extend up to 48" deep. This is designed to discharge water directly into the ground. The bottom 20" is filled with crushed stone and can be perforated to allow the water to discharge through the sides as well as the bottom. The top 30" is non-perforated and the rainwater is filtered through the **SPI Petro-Barrier™** media, filtering any oil sheen to non-detectable levels. The top 4" are dirt and sheen filters that are replaceable to maintain performance of the **SPI Petro-Barrier™**. The **SPI Petro-Barriers™** are topped off with clean crushed stone and are available with steel grates and/or top hat filters.

# SPI Petro-Barriers™ are installed in a new Transformer Oil Containment Basin

This new sub-station has a moat-type containment area around the transformer. **SPI Petro-Barriers™** are used for rainwater drainage and to provide 100% oil containment.




This drawing shows an **SPI Petro-Barrier™** for draining rainwater from the surface of the oil containment area. It is similar to the first drawing, but a perforated drain pipe is installed underneath the **SPI Petro-Barrier™** covered with crushed stone allowing the rainwater to drain into the stone and dissipate into the ground. This allows for better drainage in poorly draining soil.

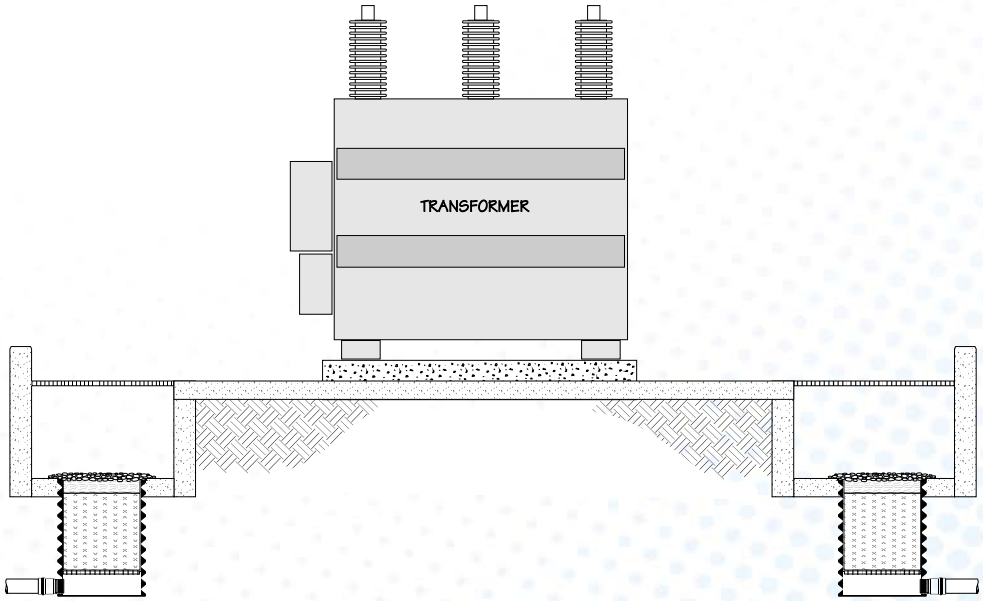



FIGURE 1 ELEVATION VIEW

NOTE: ALL SURFACES SLOPE TOWARDS BARRIER DRAINS FOR PROPER STORM WATER DISCHARGE.
CONTRACTOR TO PREPARE AREA AS SHOWN AND PROVIDE DRAINAGE HOLES FOR BARRIERS.
CONTAINMENT AREA SIZED TO HOLD FULL CONTENTS OF TRANSFORMER PLUS 10%-25% AS REQUIRED.

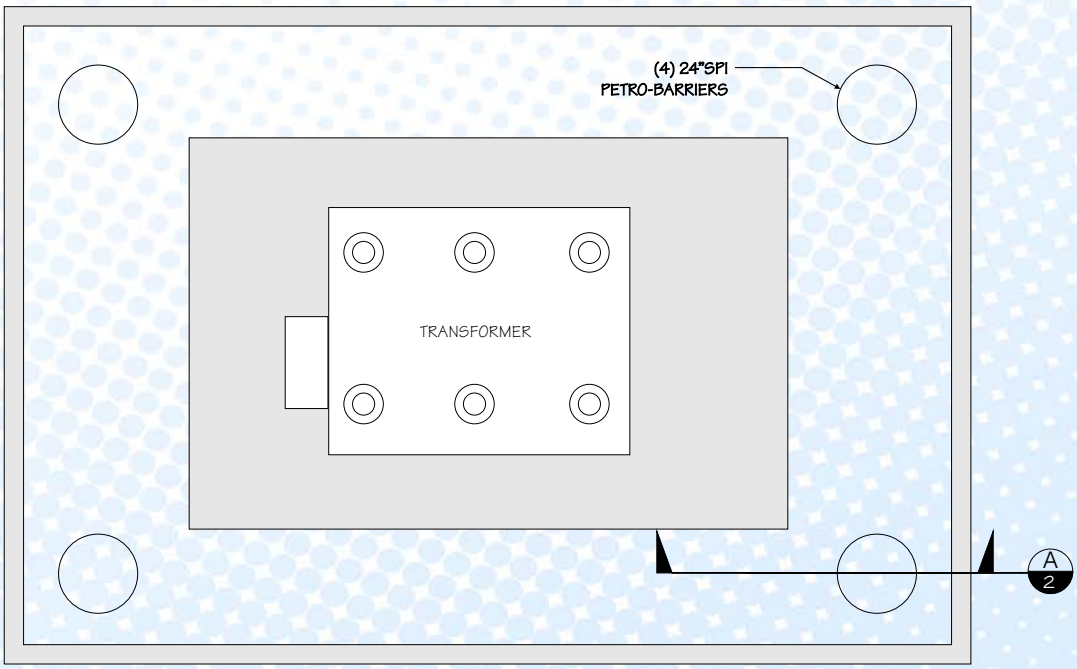
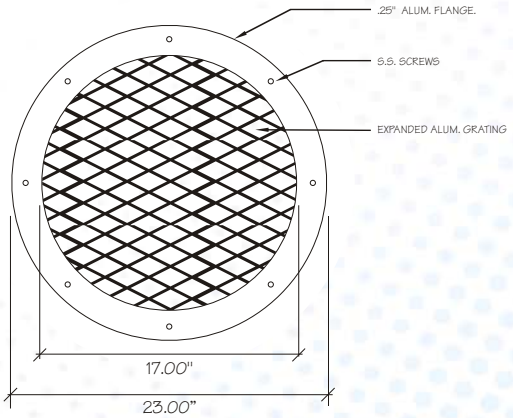


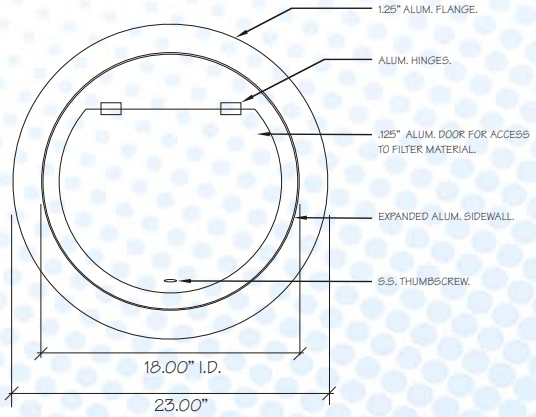

FIGURE 2 PLAN VIEW

This drawing displays a concrete moat system for oil containment. There are many different ways to configure both the moats and the **SPI Petro-Barriers™.** In this drawing the moat incorporates four **SPI Petro-Barriers™**, one in each corner. Steel grates are installed above to provide level walking and work areas around the transformer. This design could also use crushed stone in the containment pit with access to be provided for each **Petro-Barriers™**.

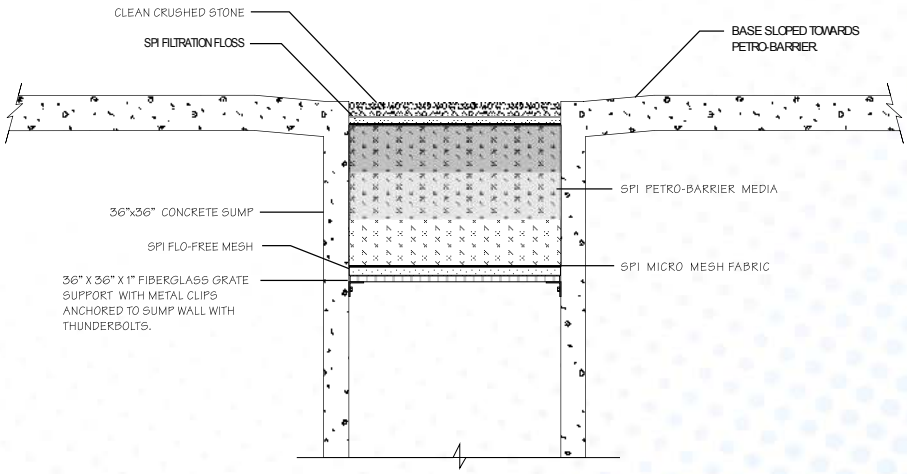
SPI Top Hat Filters are used with the **SPI Petro-Barriers™** for extra dirt and debris protection inside containment areas. The filters attach directly to the top of the **SPI Petro-Barrier™** and use dirt and debris filters that can be easily changed out throughout the useful life of the **SPI Petro-Barrier** media.




DETAIL 'A' / TOP VIEW OF PETRO-BARRIER PIPE

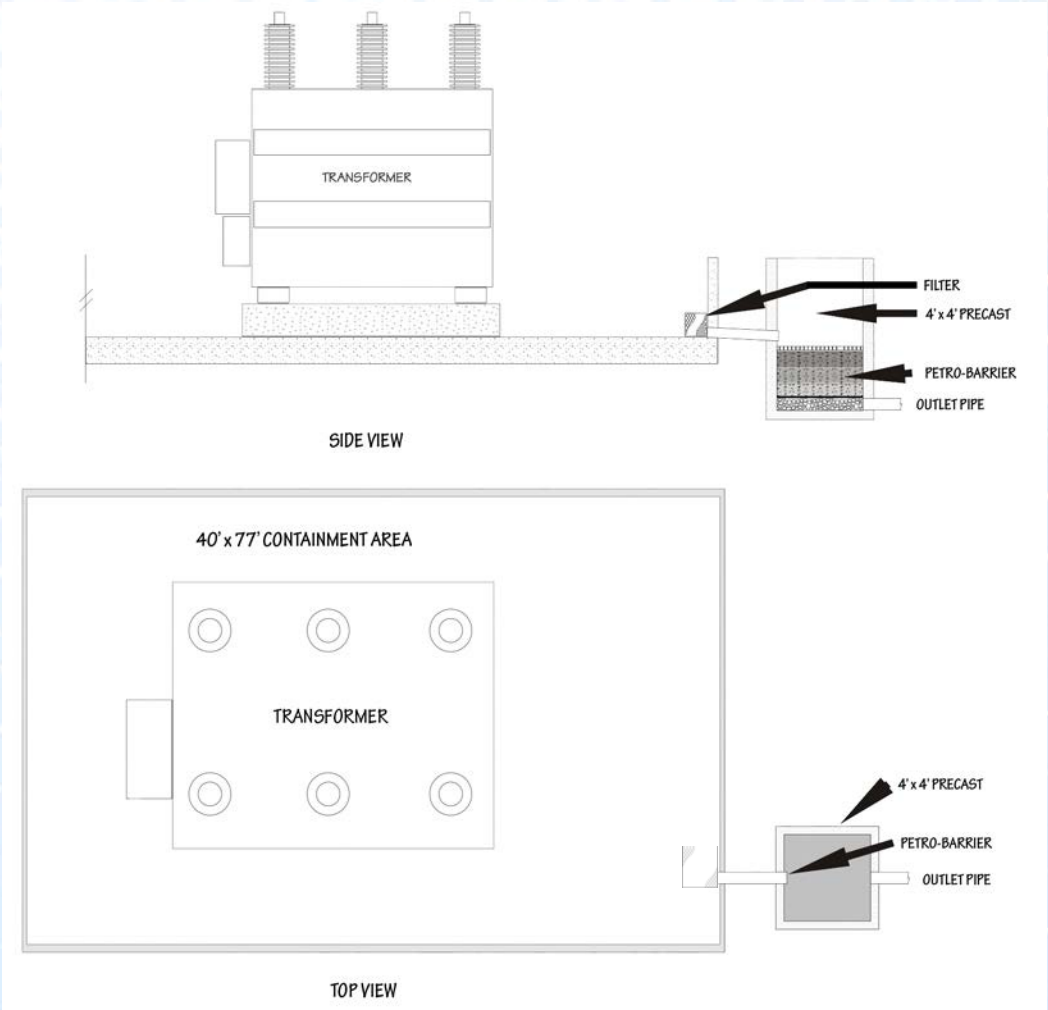


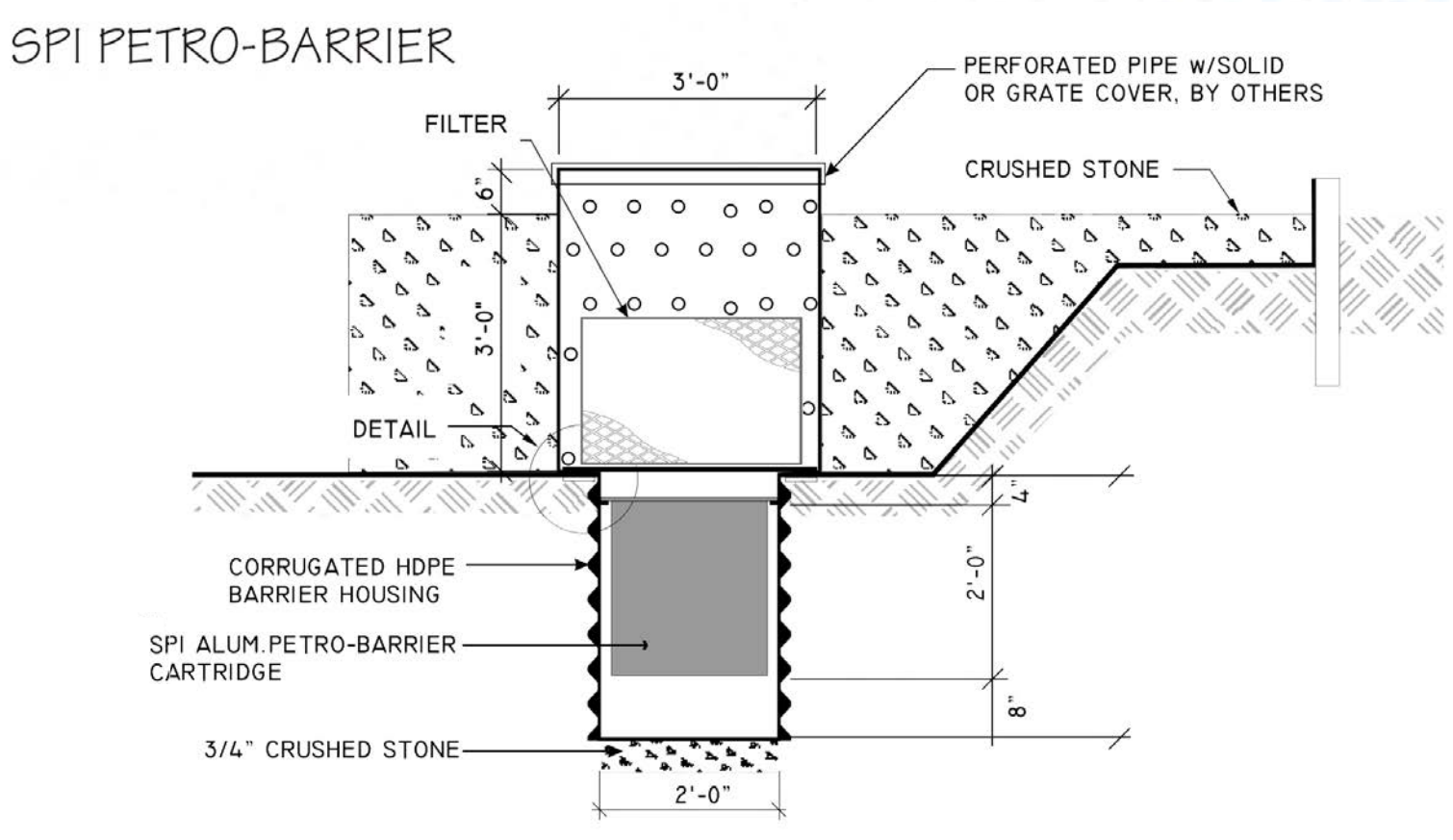

DETAIL 'B' / TOP VIEW OF PRE-FILTER BASKET




## SPI PETRO-BARRIER™

The top drawing shows an **SPI Petro-Barrier™** installed in an existing storm drain. Angle Irons are installed into the concrete walls of the storm drain and a support grate is then added. The **SPI Petro-Barrier™** is then installed directly into the drain. The lower drawing shows the **SPI Petro-Barrier™** installed outside the oil containment area. All water and potential oil is piped to a remote **SPI Petro-Barrier™**. When it rains the **SPI Petro-Barrier™** drains and in an oil spill seals off and provides 100% Oil Spill Containment.






Above is a diagram of a **SPI Petro-Barrier™** installed through a containment liner for drainage and oil spill containment. A flange is installed between the top of the liner and the HDPE **SPI Petro-Barrier™** Housing and the surrounding area is then backfilled with stone. The liner is set in place on the floor of the containment area and the 36" perforated access pipe is attached to the flange on the **SPI Petro-Barrier™** housing. The outside of the access pipe is then backfilled with clean crushed stone, when it rains the water will enter the access pipe through the perforations and drain through the **SPI Petro-Barrier™**. When all construction is complete the **SPI Petro-Barrier™** Cartridge is then lowered into the access pipe and housing pipe below the liner. It is then attached with screws and additional dirt filters are installed. A steel grate is installed for access from the top for maintenance and change outs.

# Custom SPI Petro-Barrier™ Installation

SPI removes Oil Stop Valves at several locations in the Philadelphia area for PECO. The valves were never maintained properly and completely non-functional. These were installed more than ten years before and SPI technology was used to replace the non-working valves. SPI cut out and removed the valves making way for the installation of the **SPI Petro-Barriers™**.

The Oil Stop Valve was sitting inside the concrete sump with a heater resting on the fiberglass grate to keep the stop valve from freezing in cold weather.

The heater was disconnected, removed and thrown out.

The Oil Stop valve was removed by cutting away all the connections. The Stop Valve Technology uses a float system that detects when oil is present. If the specific gravity changes with oil, the float moves and shuts off the system, but they fail quite often if not maintained regularly.

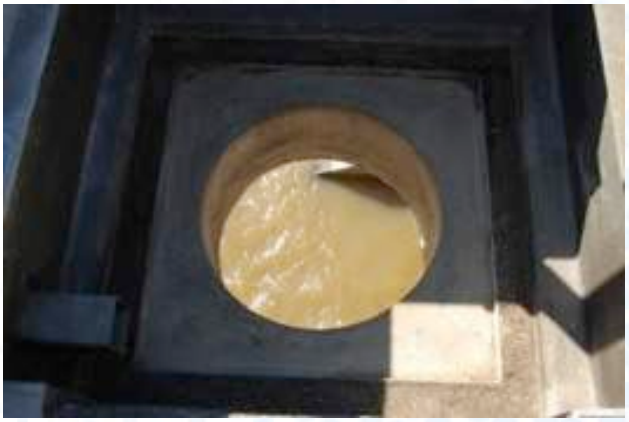
The valve was removed. Maintenance was mandatory on a regular basis to keep the valve in proper operation, but was never performed, causing the valve to malfunction all the time.

The existing drain vaults were then modified with angle iron supports and fiberglass grating as the support structure for the **SPI Petro-Barrier™**. Each **SPI Petro-Barrier™** was installed on-site with different medias for sheen removal and total oil spill containment. The **SPI Petro-Barriers™** are compressed into a filter cake (solid mass) and then they are topped with dirt and debris filters to keep the dirt out of the SPI media.

The **SPI Petro-Barriers™** had been installed for three years when PECO contracted SPI to perform a maintenance check and replace filters if required. There was a lot of accumulated grime under the grate, but the **SPI Petro-Barrier™** was still flowing with no problems. Due to the accumulation of dirt and debris, the filter matting was replaced and the **SPI Petro-Barriers™** are still working to this day, offering complete protection from oil sheen and a full scale spill.

# SPI Petro-Barrier™ Plugs are used to protect from an Oil Spill at this Hydro Facility

**SPI Petro-Barriers™** are installed at a hydro-dam. The **SPI Petro-Barriers™** drain from the deck with the oil filled equipment.



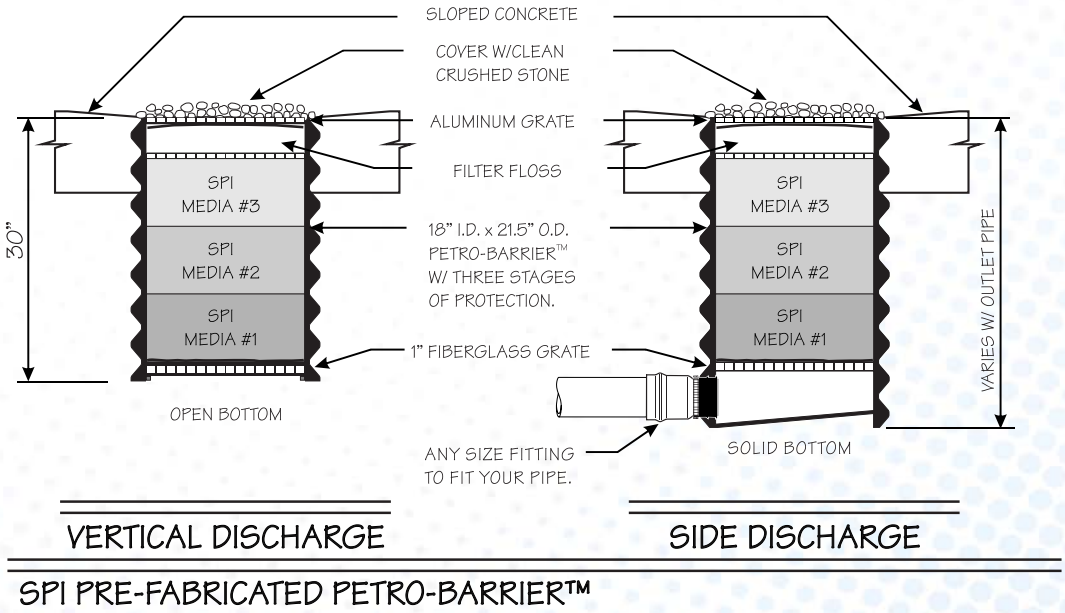
The **SPI Petro-Barrier™** mounting area is cleaned of dirt and debris.

The **SPI Petro-Barrier™** is lowered into the opening and the flange of the **SPI Petro-Barrier™** is glued to the concrete. The **SPI Petro-Barrier™** can be replaced by removing the screws on the housing and lifting out.

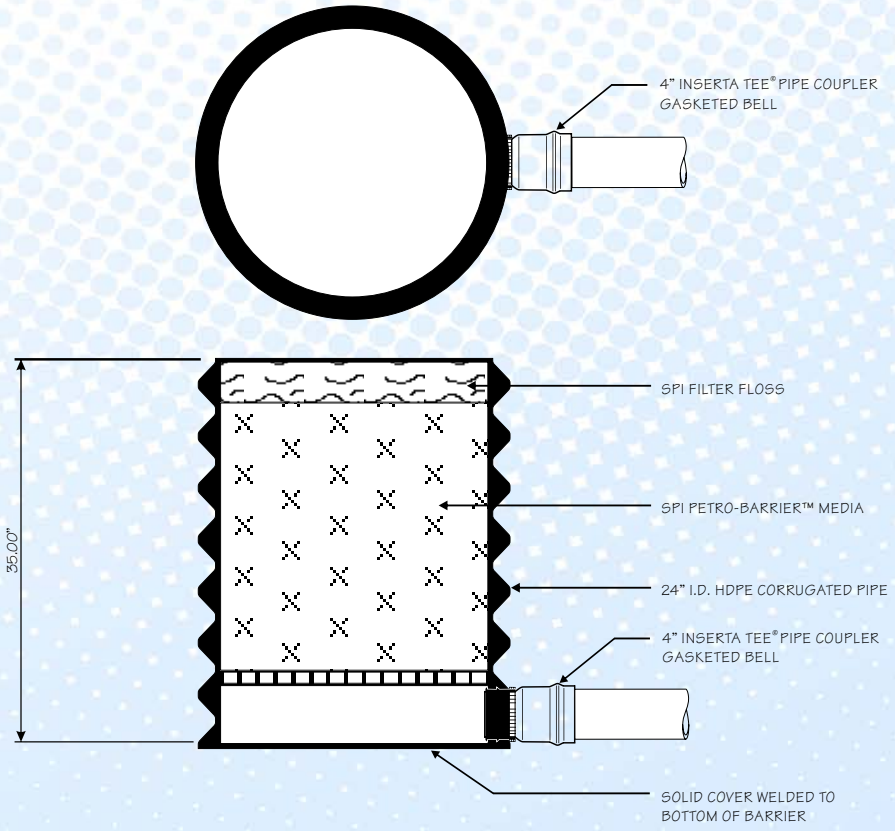
Prefilter canisters are attached to the **SPI Petro-Barriers™** to prevent dirt and debris from clogging the **SPI Petro-Barriers™**. The tops are hinged so maintenance can easily take place keeping the **SPI Petro-Barriers™** working properly.

The **SPI Petro-Barriers™** are in place providing 24/7 water drainage and 100% oil containment.

# Pre-Fab SPI Petro-Barrier™




Pre-Fabricated **SPI Petro-Barriers™** are sent directly from the SPI Factory to your facility for installation. They are made either for discharge directly into the ground or we provide a pipe connection to a dry well or open area. There are 3 medias in the **SPI Petro-Barriers™**. Number 3 is primarily for filtering oil sheen, #2 is a more active absorption media and #1 is the most active media. The different medias work together to provide 100% oil spill protection and non-detectable oil levels in discharge water.



# Pre-Fab SPI Petro-Barriers™ Installed in a New Oil Containment Basin

A New Transformer at a Power Plant is being installed and the Oil Spill Containment System is the top priority.

A Pre-Fabricated **SPI Petro-Barrier™** is shipped to a new oil containment site for installation.

Pre-Fabricated **SPI Petro-Barriers™** are shipped ready to install. Bill Gannon, of SPI, is explaining the different filters inside the **SPI Petro-Barrier™**. Each **SPI Petro-Barrier™** comes with covers that are not removed until the construction is finished and then the **SPI Petro-Barriers™** are installed. The concrete is sloped forward toward the **SPI Petro-Barriers™**.

## Solidification Products International Laboratory Testing

P.O. Box 35 NORTHFORD, CT, 06472
(203) 484-9494 *WWW.OILBARRIERS.COM*

# TABLE OF CONTENTS

| Pages | Product Info |
|---|---|
| 1 - 13 | Phoenix Lab Report |
| 14 - 21 | Chemir Lab Report |
| 22- 48 | Independant Lab Report |
| 49 - 50 | Environmental Equivalency Report |
| 51 - 83 | French Bureau Veritas Report |

# Phoenix Lab Report

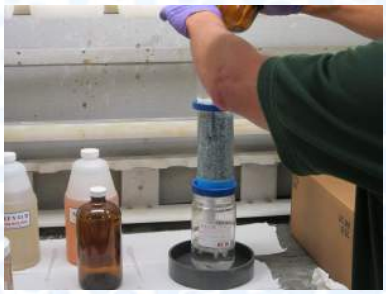
Providing how the test were performed.

This was an ongoing test for 18 months testing low levels of both transformer Oil and Diesel Fuel on the removal efficiencies of SPI's Oil Containment Technology.

Independant New York State Certified lab testing performed for region three of the New York D.E.C. (Department Of Environmental Conservation) and Con Edison Of New York.

Procedure

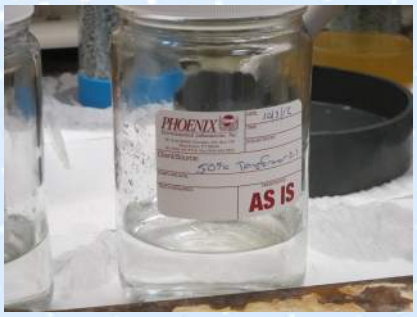
- Phoenix labs tested the media's discharge to see if there are any traces of oil in the water.



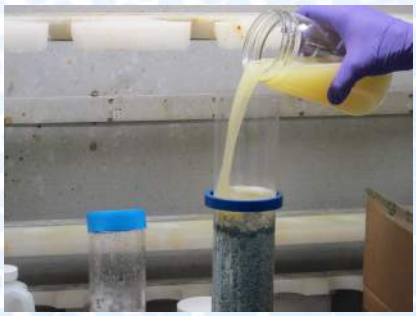
- First test was to add about 5 ml or 15 to 20 ppm of transformer oil to a glass of water and pour the water through the demo tube.

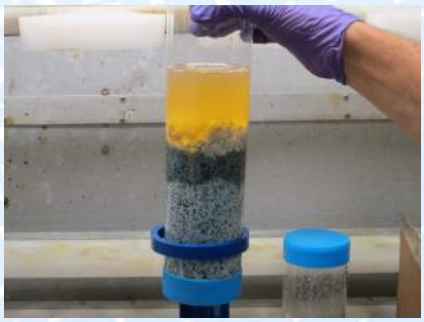
- The test was repeated but for Diesel fuel.

- The second test was to mix 50% transformer oil and 50% water and then it is poured through the media .



- Test 2 was repeated with 50% diesel fuel and 50% water





- Phoenix Labs then took the discharged water sample and gave an analysis report with results of the test.

PHOENIX
Environmental Laboratories, Inc.

Tuesday, October 09, 2012

Solidification Products
215 Village St
Northford, CT 06472

Project ID: TREATMENT EVALUATION SAMPLES
Sample IDs: BC78244 - BC78247

This laboratory is in compliance with the NELAC requirements of procedures used except where indicated.

This report contains results for the parameters tested, under the sampling conditions described on the Chain Of Custody, as received by the laboratory.

A scanned version of the COC form accompanies the analytical report and is an exact duplicate of the original.
If you have any questions concerning this testing, please do not hesitate to contact Phoenix Client Services at ext. 200.

Sincerely yours,

Phyllis Shiller
Laboratory Director

NELAC - #NY11301
CT Lab Registration #PH-0618
MA Lab Registration #MA-CT-007
ME Lab Registration #CT-007
NH Lab Registration #213693-A,B

NJ Lab Registration #CT-003
NY Lab Registration #11301
PA Lab Registration #68-03530
RI Lab Registration #63
VT Lab Registration #VT11301

587 East Middle Turnpike, P.O. Box 370, Manchester, CT 06040
Telephone (860) 645-1102 Fax (860) 645-0823

PHOENIX

Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

# Analysis Report

October 09, 2012

FOR: Solidification Products
215 Village St
Northford, CT 06472

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | WASTE WATER | Collected by: | | 10/03/12 | 13:10 |
| Location Code: | SOLPROD | Received by: | SW | 10/03/12 | 14:00 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBC78244
Phoenix ID: BC78244

Project ID: TREATMENT EVALUATION SAMPLES
Client ID: DIESEL SAMPLE

| Parameter | Result | RL/ PQL | Units | Date/Time | By | Reference |
|---|---|---|---|---|---|---|
| Extraction of CT ETPH | Completed | | | 10/03/12 | I/D | 3510/3520 |
| **TPH by GC (Extractable Products)** | | | | | | |
| Ext. Petroleum HC | ND | 0.078 | mg/L | 10/04/12 | JRB | CTETPH/8015D |
| Identification | ND | | mg/L | 10/04/12 | JRB | CTETPH/8015D |
| **QA/QC Surrogates** | | | | | | |
| % n-Pentacosane | 62 | | % | 10/04/12 | JRB | 50 - 150 % |

RL/PQL=Reporting/Pratical Quantitation Level ND=Not Detected BRL=Below Reporting Level

**Comments:**

If there are any questions regarding this data, please call Phoenix Client Services at extension 200.
This report must not be reproduced except in full as defined by the attached chain of custody.

**Phyllis Shiller, Laboratory Director**
**October 09, 2012**
**Reviewed and Released by: Johanna Harrington, Project Manager**

PHOENIX

Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

# Analysis Report

October 09, 2012

FOR: Solidification Products
215 Village St
Northford, CT 06472

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | WASTE WATER | Collected by: | | 10/03/12 | 13:15 |
| Location Code: | SOLPROD | Received by: | SW | 10/03/12 | 14:00 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBC78244
Phoenix ID: BC78245

Project ID: TREATMENT EVALUATION SAMPLES
Client ID: TRANSFORMER OIL

| Parameter | Result | RL/ PQL | Units | Date/Time | By | Reference |
|---|---|---|---|---|---|---|
| Extraction of CT ETPH | Completed | | | 10/03/12 | I/D | 3510/3520 |
| **TPH by GC (Extractable Products)** | | | | | | |
| Ext. Petroleum HC | ND | 0.078 | mg/L | 10/04/12 | JRB | CTETPH/8015D |
| Identification | ND | | mg/L | 10/04/12 | JRB | CTETPH/8015D |
| **QA/QC Surrogates** | | | | | | |
| % n-Pentacosane | 90 | | % | 10/04/12 | JRB | 50 - 150 % |

RL/PQL=Reporting/Pratical Quantitation Level ND=Not Detected BRL=Below Reporting Level

**Comments:**

If there are any questions regarding this data, please call Phoenix Client Services at extension 200.
This report must not be reproduced except in full as defined by the attached chain of custody.

**Phyllis Shiller, Laboratory Director**
**October 09, 2012**
**Reviewed and Released by: Johanna Harrington, Project Manager**

PHOENIX
Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

# Analysis Report

October 09, 2012

FOR: Solidification Products
215 Village St
Northford, CT 06472

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | WASTE WATER | Collected by: | | 10/03/12 | 13:30 |
| Location Code: | SOLPROD | Received by: | SW | 10/03/12 | 14:00 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBC78244
Phoenix ID: BC78246

Project ID: TREATMENT EVALUATION SAMPLES
Client ID: 50 PERCENT DIESEL/50 PERCENT WATER

| Parameter | Result | RL/ PQL | Units | Date/Time | By | Reference |
|---|---|---|---|---|---|---|
| Extraction of CT ETPH | Completed | | | 10/03/12 | I/D | 3510/3520 |
| **TPH by GC (Extractable Products)** | | | | | | |
| Ext. Petroleum HC | 1.9 | 0.25 | mg/L | 10/04/12 | JRB | CTETPH/8015D |
| Identification | ** | | mg/L | 10/04/12 | JRB | CTETPH/8015D |
| **QA/QC Surrogates** | | | | | | |
| % n-Pentacosane | 60 | | % | 10/04/12 | JRB | 50 - 150 % |

RL/PQL=Reporting/Pratical Quantitation Level ND=Not Detected BRL=Below Reporting Level

**Comments:**

**Petroleum hydrocarbon chromatogram contains a multicomponent hydrocarbon distribution in the range of C9 to C24. The sample was quantitated against a C9-C36 alkane hydrocarbon standard.

If there are any questions regarding this data, please call Phoenix Client Services at extension 200.
This report must not be reproduced except in full as defined by the attached chain of custody.

**Phyllis Shiller, Laboratory Director**
**October 09, 2012**
**Reviewed and Released by: Johanna Harrington, Project Manager**

PHOENIX

Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

# Analysis Report

October 09, 2012

FOR: Solidification Products
215 Village St
Northford, CT 06472

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | WASTE WATER | Collected by: | | 10/03/12 | 13:40 |
| Location Code: | SOLPROD | Received by: | SW | 10/03/12 | 14:00 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBC78244
Phoenix ID: BC78247

Project ID: TREATMENT EVALUATION SAMPLES
Client ID: 50 PERCENT TRANSFORMER OIL/50 PERCENT WATER

| Parameter | Result | RL/ PQL | Units | Date/Time | By | Reference |
|---|---|---|---|---|---|---|
| Extraction of CT ETPH | Completed | | | 10/03/12 | I/D | 3510/3520 |
| **TPH by GC (Extractable Products)** | | | | | | |
| Ext. Petroleum HC | 2.2 | 0.25 | mg/L | 10/04/12 | JRB | CTETPH/8015D |
| Identification | ** | | mg/L | 10/04/12 | JRB | CTETPH/8015D |
| **QA/QC Surrogates** | | | | | | |
| % n-Pentacosane | 65 | | % | 10/04/12 | JRB | 50 - 150 % |

RL/PQL=Reporting/Pratical Quantitation Level ND=Not Detected BRL=Below Reporting Level

**Comments:**

**Petroleum hydrocarbon chromatogram contains a multicomponent hydrocarbon distribution in the range of C10 to C24. The sample was quantitated against a C9-C36 alkane hydrocarbon standard.

If there are any questions regarding this data, please call Phoenix Client Services at extension 200.
This report must not be reproduced except in full as defined by the attached chain of custody.

**Phyllis Shiller, Laboratory Director**
**October 09, 2012**
**Reviewed and Released by: Johanna Harrington, Project Manager**

PHOENIX

Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

# QA/QC Report

October 09, 2012

## QA/QC Data

SDG I.D.: GBC78244

| Parameter | Blank | LCS % | LCSD % | LCS RPD | MS % | MSD % | MS RPD | % Rec Limits | % RPD Limits |
|---|---|---|---|---|---|---|---|---|---|
| QA/QC Batch 210758, QC Sample No: BC78245 (BC78244, BC78245, BC78246, BC78247) | | | | | | | | | |
| **TPH by GC (Extractable Products) - Waste Water** | | | | | | | | | |
| Ext. Petroleum HC | ND | 76 | 63 | 18.7 | | | | 50 - 150 | 20 |
| % n-Pentacosane | 54 | 70 | 57 | 20.5 | | | | 50 - 150 | 20 |

If there are any questions regarding this data, please call Phoenix Client Services at extension 200.

RPD - Relative Percent Difference
LCS - Laboratory Control Sample
LCSD - Laboratory Control Sample Duplicate
MS - Matrix Spike
MS Dup - Matrix Spike Duplicate
NC - No Criteria
Intf - Interference

Phyllis Shiller, Laboratory Director
October 09, 2012

Tuesday, October 09, 2012

Requested Criteria: None

State: CT

# Sample Criteria Exceedences Report

**GBC78244 - SOLPROD**



| SampNo | Acode | Phoenix Analyte | Criteria | Result | RL | Criteria | RL Criteria | Analysis Units |
|---|---|---|---|---|---|---|---|---|

*** No Data to Display ***

Phoenix Laboratories does not assume responsibility for the data contained in this report. It is provided as an additional tool to identify requested criteria exceedences. All efforts are made to ensure the accuracy of the data (obtained from appropriate agencies). A lack of exceedence information does not necessarily suggest conformance to the criteria. It is ultimately the site professional's responsibility to determine appropriate compliance.

Cooler: Yes ☐ No
Coolant: IPK ☑ ICE ☐ N ☐

# PHOENIX Environmental Laboratories, Inc.

## CHAIN OF CUSTODY RECORD

587 East Middle Turnpike, Manchester, CT 06040
Email: info@phoenixlabs.com Fax (860) 645-0823
**Client Services (860) 645-8726**

Temp 6 °C Pg 1 of 1

**Data Delivery:**
☐ Fax #:
☐ Email:

Customer: Solidification Products
Address: 215 Village Street
Middlefield, CT 06455

Project: Treatment Reduction Samples
Report to:
Invoice to:

Project P.O:
Phone #:
Fax #:

Sampler's Signature
Date: 10/3/12

**Client Sample - Information - Identification**

**Matrix Code:**
DW=Drinking Water GW=Ground Water SW=Surface Water WW=Waste Water
SE=Sediment SL=Sludge S=Soil/Solid W=Wipe O=Other

Analysis Request

| PHOENIX USE ONLY SAMPLE # | Customer Sample Identification | Sample Matrix | Date Sampled | Time Sampled | TPH |
|---|---|---|---|---|---|
| 78244 | Diesel Sample | WW | 10/3/12 | 13:10 | X |
| 78245 | Transformer oil | WW | 10/3/12 | 13:15 | X |
| 78246 | 50% Diesel/50% water | WW | 10/3/12 | 13:30 | X |
| 78247 | 50% Transformer/50% water | WW | 10/3/12 | 13:40 | X |

Soil VOA Vials [ ] methanol [ ] $H_2O$
GL Soil container ( ) oz
GL Soil container ( ) oz
40 ml VOA Vial [ ] As is [ ] HCl
GL Amber 1000ml [ ] As is [ ] $H_2SO_4$
PL As is [ ] 250ml [ ] 500ml [ ] 1000ml
PL $H_2SO_4$ [ ] 250ml [ ] 500ml
PL $HNO_3$ 250ml
PL NaOH 250ml
Bacteria Bottle

| Relinquished by: | Accepted by: | Date: | Time: |
|---|---|---|---|
| | | 10/3/12 | 14:00 |
| | | 10/3/12 | 14:00 |

Comments, Special Requirements or Regulations:

**Turnaround:**
☐ 1 Day*
☐ 2 Days*
☐ 3 Days*
☑ Standard
☐ Other
* SURCHARGE APPLIES

**RI**
☐ Direct Exposure (Residential)
☐ GW
☐ Other

**CT**
☐ RCP Cert
☐ GW Protection
☐ SW Protection
☐ GA Mobility
☐ GB Mobility
☐ Residential DEC
☐ I/C DEC
☐ Other

**MA**
☐ MCP Certification
☐ GW-1
☐ GW-2
☐ GW-3
☐ S-1
☐ S-2
☐ S-3
☐ MWRA eSMART
☐ Other

**Data Format**
☐ Excel
☐ PDF
☐ GIS/Key
☐ EQuIS
☐ Other

**Data Package**
☐ Tier II Checklist
☐ Full Data Package*
☐ Phoenix Std Report
☐ Other
* SURCHARGE APPLIES

State where samples were collected: _____

## Summary

SPI media had great results. The Phoenix Lab results came back non-detectable in both the 5ml. of transformer oil and diesel oil test. In the 50% transformer oil and 50% water test there were traces of transformer oil measured at 2.2 parts per million. In the 50% diesel oil and 50% water there were traces of oil measured at 1.9 parts per million.

CHEMIR

Analytical Services

# ANALYSIS REPORT

Prepared for:

**Mr. Pete Van Fossen**
**Solidification Products International**
Chemir Analytical Job #54186

**Monday, April 25, 2005**

Third Party Lab Testing performed for Florida D.E.P. (Department of Environmental Protection)
D.E.P. to be accepted on any oil containment system in the state of Florida.

CHEMIR

*Analytical Services*

25 April 2005

Mr. Pete Van Fossen Solidification
Products International 1437
Middletown Avenue Northford, CT
06472

Re: Performance Testing on Solidification Products International Multi-Component Sump Trap Assembly
P.O.#: Verbal
Chernir Analytical Job#: 54186

Dear Mr. Van Fossen:

Per your request and as outlined in our proposal, we have completed the testing of your media test tubes containing the multi-component sump trap assembly and the seven hydrocarbon samples. The results are summarized below.

## OBJECTIVE

The objective of the testing was to determine if the Solidification Products International multi-component sump trap assembly became impervious once a hydrocarbon was introduced. The testing was performed on the samples as indicated in the proposal.

## SUMMARY OF ANALYSIS CONCLUSIONS

Solidification Products International multi-component sump trap assembly performed as per specification, (CHART 5), becoming impervious once the hydrocarbon was introduced.

## SAMPLE LOG-IN

Seven tubes, each containing three layers (crushed stone, mesh, and SPI media - See CHART I) were submitted. Each tube was made of flexible plastic and each tube system comprised the multi-component sump trap assembly that was used for testing. These tubes were used in tandem with the following hydrocarbon samples. The hydrocarbon samples were chosen and provided by the client and given unique laboratory identification numbers. These lab numbers are listed below and CHART 2 is a picture of the tubes and products prior to testing.

The samples were logged as follows:

| SAMPLE DESCRIPTION | CHEMIR ANALYTICAL SAMPLE NUMBER |
|---|---|
| Transformer Oil | 550496 |
| #2 Heating Oil | 550497 |
| K-1 Kerosene | 550498 |
| Gasoline | 550499 |
| Diesel | 550500 |
| #6 Heating Oil | 550501 |
| Media Test Tube (7 each) | 550502 |
| Jet Fuel A | 550506 |

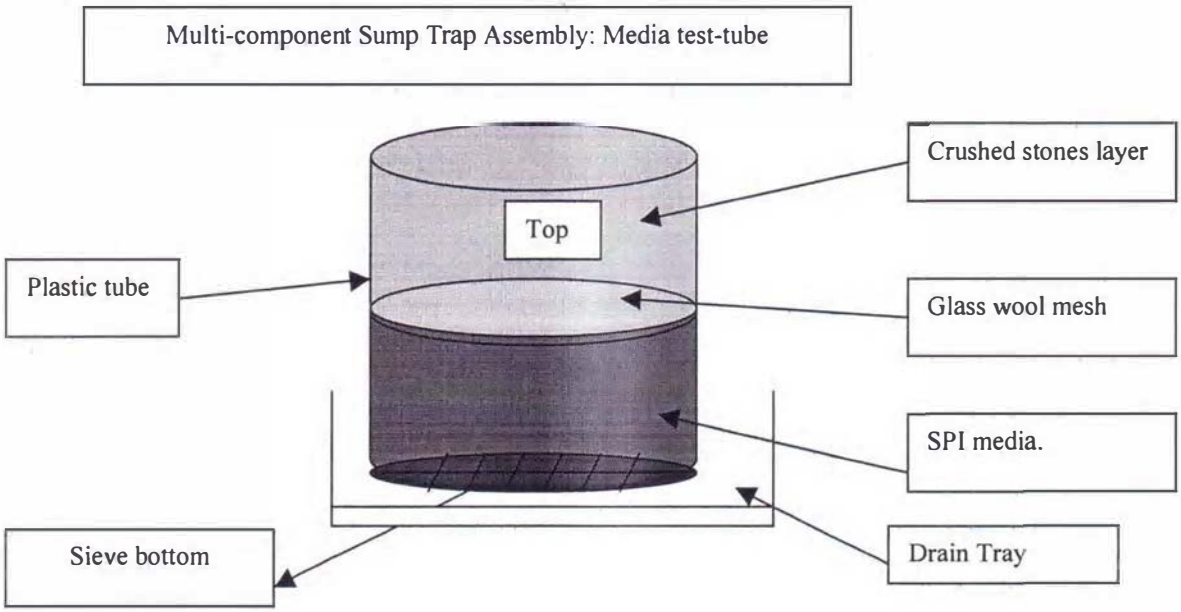
materials identification | method development | deformulation

ISO 9001 CERTIFIED
2672 Metro Blvd. | Maryland Heights, MO 63043 | 314.291.6620 *phone* | 314.291.6630 *facsimile* | www.chemir.com

## TESTING TUBES

***Solidification Products International Multi-Component Sump Trap Assembly***

Each multi-component sump trap assembly was comprised of a sieve-cap at the bottom with the SPI media (blue), mesh (glass wool like) and a bed of crushed stone from bottom to top. The drain tray was placed below the sieve end of the tube. This is depicted below and a photograph of the multi-component sump trap assembly is attached as CHART 3.




## TESTING METHOD

***Step One***
The seven tubes were placed onto a tray, with the bottom part emptying into a plastic containment. Approximately 500 mL ofwater was poured into the tubes confirming the flow ofthe system. All tubes allowed the water to permeate through the SPI media and into the containment. The containment was filled with water.

***Step Two***
200 mL ofeach type ofhydrocarbon was then poured into individual SPI multi-component sump trap assembly tubes. After the introduction ofhydrocarbons in each tube the flow stopped and the levels ofeach hydrocarbon was marked. This process occurred in approximately 30 seconds with each hydrocarbon. It was noted that each hydrocarbon permeated to different levels within the SPI media.

***Step Three***
Since the hydrocarbons were known to react with the plastic testing tube material the free standing hydrocarbons were decanted. The absorbed hydrocarbons within the SPI media still remained. An additional 200 mL ofwater was then poured into each tube (-4 hour duration) (See CHART 4). This was done to illustrate head pressure effects. The free standing hydrocarbon was removed to prevent the compromise ofthe plastic testing tubes.

***Step Four***
The tubes were left with 200 n;iL ofwater on top ofthe SP£ media that had absorbed the hydrocarbons and stopped flow.

## ANALYSIS DISCUSSION

The objective of the test was to test the theory that the SPI layer of media allows the flow of water until a hydrocarbon sample becomes present. Once in contact with the hydrocarbon sample, the SPI media layer becomes impervious to further flow trough it and does not allow the flow of hydrocarbon or water.
In summarizing the testing method, a known amount of water and then hydrocarbon sample was poured into the SPI multi-component sump trap assembly. The tube layers and drain containment were monitored to see if any hydrocarbon escaped through the tube and into the drain containment. If any hydrocarbon had escaped it would be visibly identifiable in the containment. Each hydrocarbon permeated to different levels within the SPI media (blue).

For each hydrocarbon tested, when placed in the multi-component sump trap assembly (tube), no hydrocarbon was observed to make it through to the containment drain.

## ANALYSIS CONCLUSION

For the experiment as performed, Solidification Products Internationals' multi-component sump trap assembly performed as designed, becoming impervious once the hydrocarbon was introduced. No hydrocarbon was observed to pass through the Solidification Products International multi-component sump trap.

## CHARTS

Enclosed please find the following CHARTS generated during the analysis.

| ENCLOSURE | DESCRIPTION |
|---|---|
| CHART 1 | Multi-component sump trap system with three layers (crushed stone, mesh, and SPI media). |
| CHART 2 | Tubes with the hydrocarbon sample to be tested. |
| CHART 3 | Set-up of the tubes with the hydrocarbon samples placed inside, marking of the level for each hydrocarbon and the drain tray. |
| CHART 4 | Tubes with hydrocarbon sample and an additional 200 mL of water with markings for the hydrocarbon and the water. |
| CHART 5 | Specification for SPI sump trap system. |
| CHART 6 | Laboratory affiliations and accreditation. |
| CHART 7 | Literature on laboratory. |

Sincerely,
**Chemir Analytical Services**

Ila Sharma, M.S., M.B.A.
Manager – Client Services

Christopher J. Andren
Director – Technical Services

Project Analyst: Nikolay Vassilev, B.S.
Analytical Chemist

CJA:gld/SolidificationProductsREV0405.doc

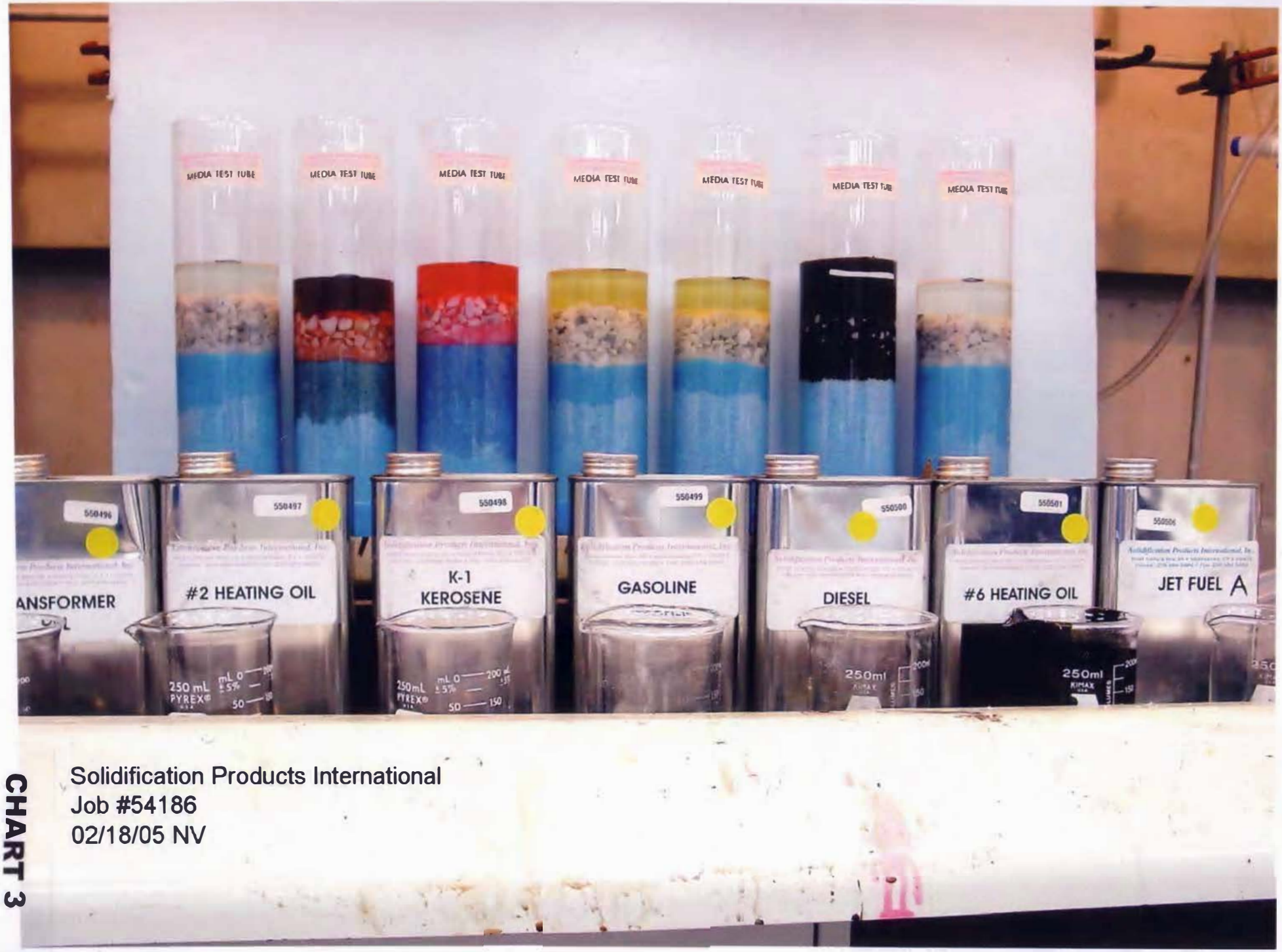
Enclosures

CHART 2

Solidification Products International
Job # 54186
02/18/05 NV

Solidification Products International
Job # 54186
02/18/05 NV

CHART 4




Solidification Products International
Job #54186
02/18/05 NV

CHART 3

# Department of
# Environmental Protection

Jeb Bush
Governor

Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Colleen M. Castil
Secretary

May 4, 2005

Mr. Peter Van Fossen
Solidification Products International, Inc.
1536 Rolling Meadow Drive
Valrico, Florida 33594

RE: The Petro-Barries™, Petro -Plug™, & Petro-Pipe™

Dear Mr. Fossen:

The Bureau of Petroleum Storage Systems has concluded its review of your request dated April 28, 2005 that was submitted for above referenced products.

Based upon the submitted third party documents, the use of the above referenced products are acceptable in the State of Florida for direct discharge of water from diked field areas as required in Rule 62-762-701(2)(c), Florida Administrative Code.

If you need additional information, please call Farid Moghadam at 850/245-8848.

Sincerely,

John P. Svec

John P. Svec, P.E.
Storage Tank Regulation Section

JPS/FGM/fm

CC: Districts and Local Tank Program Offices

"More Protection, Less Process"

RAIN DRAINS OILS CONTAINED™

Solidification Products International

## Independant Laboratory testing performed for Maine D.E.P. (Department of Environmental Protection) to Massachusetts standards

P.O. Box 35 NORTHFORD, CT, 06472
(203) 484-9494 *WWW.OILBARRIERS.COM*

PHOENIX
Environmental Laboratories, Inc.

Wednesday, October 23, 2013

Solidification Products
215 Village St
Northford, CT 06472

Project ID: TREATED FOR ME-DEP
Sample ID#s: BF52851 - BF52859

This laboratory is in compliance with the NELAC requirements of procedures used except where indicated.

This report contains results for the parameters tested, under the sampling conditions described on the Chain Of Custody, as received by the laboratory.

A scanned version of the COC form accompanies the analytical report and is an exact duplicate of the original.

If you have any questions concerning this testing, please do not hesitate to contact Phoenix Client Services at ext. 200.

Sincerely yours,

Phyllis Shiller
Laboratory Director

NELAC - #NY11301
CT Lab Registration #PH-0618
MA Lab Registration #MA-CT-007
ME Lab Registration #CT-007
NH Lab Registration #213693-A,B

NJ Lab Registration #CT-003
NY Lab Registration #11301
PA Lab Registration #68-03530
RI Lab Registration #63
VT Lab Registration #VT11301

587 East Middle Turnpike, P.O. Box 370, Manchester, CT 06040
Telephone (860) 645-1102 Fax (860) 645-0823

PHOENIX
Environmental Laboratories, Inc.

Wednesday, October 23, 2013

Solidification Products
215 Village St
Northford, CT 06472

Project ID: TREATED FOR ME-DEP
Sample ID#s: BF52851 - BF52859

This laboratory is in compliance with the NELAC requirements of procedures used except where indicated.

This report contains results for the parameters tested, under the sampling conditions described on the Chain Of Custody, as received by the laboratory.

A scanned version of the COC form accompanies the analytical report and is an exact duplicate of the original.

If you have any questions concerning this testing, please do not hesitate to contact Phoenix Client Services at ext. 200.

Sincerely yours,

Phyllis Shiller
Laboratory Director

NELAC - #NY11301
CT Lab Registration #PH-0618
MA Lab Registration #MA-CT-007
ME Lab Registration #CT-007
NH Lab Registration #213693-A,B
NJ Lab Registration #CT-003
NY Lab Registration #11301
PA Lab Registration #68-03530
RI Lab Registration #63
VT Lab Registration #VT11301

587 East Middle Turnpike, P.O. Box 370, Manchester, CT 06040
Telephone (860) 645-1102 Fax (860) 645-0823

PHOENIX

Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

# Analysis Report

October 23, 2013

FOR: Solidification Products
215 Village St
Northford, CT 06472

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | WASTE WATER | Collected by: | PHOENIX | 10/11/13 | 11:00 |
| Location Code: | SOLPROD | Received by: | SW | 10/11/13 | 13:00 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBF52851
Phoenix ID: BF52851

Project ID: TREATED FOR ME-DEP
Client ID: TRANSFORMER OIL/WATER

| Parameter | Result | RL/ PQL | Units | Date/Time | By | Reference |
|---|---|---|---|---|---|---|
| EPH Extraction | Completed | | | 10/15/13 | W/D | 3510 |
| MA Petroleum Hydrocarbon (EPH) | Completed | | | 10/17/13 | | MADEP EPH-04 |
| **MA EPH Aliphatic/Aromatic Ranges** | | | | | | |
| **C11-C22 Aromatic Hydrocarbons 1,2*** | 5900 | 100 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| **C19-C36 Aliphatic Hydrocarbons 1*** | 16000 | 100 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| **C9-C18 Aliphatic Hydrocarbons 1*** | 13000 | 100 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Total TPH 1* | 35000 | 100 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| **QA/QC Surrogates** | | | | | | |
| **% 1-chlorooctadecane (aliphatic)** | 61 | | % | 10/17/13 | BB | MAEPH 5/2004 |
| **% 2-Bromonaphthalene (Fractionation)** | 79 | | % | 10/17/13 | BB | MAEPH 5/2004 |
| **% 2-Fluorobiphenyl (Fractionation)** | 72 | | % | 10/17/13 | BB | MAEPH 5/2004 |
| % o-terphenyl (aromatic) | 74 | | % | 10/17/13 | BB | MAEPH 5/2004 |
| **EPH Diesel PAH Target Analytes** | | | | | | |
| 2-Methyl Naphthalene | <10 | 10 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Acenaphthene | <10 | 10 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Naphthalene | <10 | 10 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Phenanthrene | <10 | 10 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| **EPH Other PAH Target Analytes** | | | | | | |
| Acenapthylene | <10 | 10 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Anthracene | <10 | 10 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Benzo(a)anthracene | <10 | 10 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Benzo(a)pyrene | <10 | 10 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Benzo(b)fluoranthene | <10 | 10 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Benzo(ghi)perylene | <10 | 10 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Benzo(k)fluoranthene | <10 | 10 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Chrysene | <10 | 10 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |

Project ID: TREATED FOR ME-DEP

Client ID: TRANSFORMER OIL/WATER

Phoenix I.D.: BF52851

| Parameter | Result | RL/ PQL | Units | Date/Time | By | Reference |
|---|---|---|---|---|---|---|
| Dibenzo(a,h)anthracene | <10 | 10 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Fluoranthene | <10 | 10 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Fluorene | <10 | 10 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Indeno(1,2,3-cd)pyrene | <10 | 10 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Pyrene | <10 | 10 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |

RL/PQL=Reporting/Practical Quantitation Level ND=Not Detected BRL=Below Reporting Level

**Comments:**

MAEPH:
1* Hydrocarbon range data exclude concentrations of any surrogate(s) and/or internal standards eluting in that range.
2* C11-C12 Aromatic Hydrocarbons exclude the concentration of Target PAH analytes eluting in that range.

Sample was spiked with between 15 mg/L and 25 mg/l of Transformer Oil. This was to simulate an oil sheen.

If there are any questions regarding this data, please call Phoenix Client Services at extension 200.
This report must not be reproduced except in full as defined by the attached chain of custody.

**Phyllis Shiller, Laboratory Director**
**October 23, 2013**
**Reviewed and Released by: Greg Lawrence, Assistant Lab Director**

PHOENIX

Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

# Analysis Report

October 23, 2013

FOR: Solidification Products
215 Village St
Northford, CT 06472

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | WASTE WATER | Collected by: | PHOENIX | 10/11/13 | 11:00 |
| Location Code: | SOLPROD | Received by: | SW | 10/11/13 | 13:00 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBF52851
Phoenix ID: BF52852

Project ID: TREATED FOR ME-DEP
Client ID: DIESEL FUEL/WATER

| Parameter | Result | RL/ PQL | Units | Date/Time | By | Reference |
|---|---|---|---|---|---|---|
| EPH Extraction | Completed | | | 10/15/13 | W/D | 3510 |
| MA Petroleum Hydrocarbon (EPH) | Completed | | | 10/17/13 | | MADEP EPH-04 |
| **MA EPH Aliphatic/Aromatic Ranges** | | | | | | |
| **C11-C22 Aromatic Hydrocarbons 1,2*** | 740 | 500 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| **C19-C36 Aliphatic Hydrocarbons 1*** | 6600 | 500 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| **C9-C18 Aliphatic Hydrocarbons 1*** | 15000 | 500 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Total TPH 1* | 23000 | 500 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| **QA/QC Surrogates** | | | | | | |
| **% 1-chlorooctadecane (aliphatic)** | diluted out | | % | 10/17/13 | BB | MAEPH 5/2004 |
| **% 2-Bromonaphthalene (Fractionation)** | diluted out | | % | 10/17/13 | BB | MAEPH 5/2004 |
| **% 2-Fluorobiphenyl (Fractionation)** | diluted out | | % | 10/17/13 | BB | MAEPH 5/2004 |
| % o-terphenyl (aromatic) | diluted out | | % | 10/17/13 | BB | MAEPH 5/2004 |
| **EPH Diesel PAH Target Analytes** | | | | | | |
| 2-Methyl Naphthalene | <50 | 50 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Acenaphthene | <50 | 50 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Naphthalene | <50 | 50 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Phenanthrene | <50 | 50 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| **EPH Other PAH Target Analytes** | | | | | | |
| Acenapthylene | <50 | 50 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Anthracene | <50 | 50 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Benzo(a)anthracene | <50 | 50 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Benzo(a)pyrene | <50 | 50 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Benzo(b)fluoranthene | <50 | 50 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Benzo(ghi)perylene | <50 | 50 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Benzo(k)fluoranthene | <50 | 50 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Chrysene | <50 | 50 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |

Project ID: TREATED FOR ME-DEP
Client ID: DIESEL FUEL/WATER

Phoenix I.D.: BF52852

| Parameter | Result | RL/ PQL | Units | Date/Time | By | Reference |
|---|---|---|---|---|---|---|
| Dibenzo(a,h)anthracene | <50 | 50 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Fluoranthene | <50 | 50 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Fluorene | <50 | 50 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Indeno(1,2,3-cd)pyrene | <50 | 50 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |
| Pyrene | <50 | 50 | ug/L | 10/17/13 | BB | MAEPH 5/2004 |

RL/PQL=Reporting/Practical Quantitation Level ND=Not Detected BRL=Below Reporting Level

**Comments:**

MAEPH:
1* Hydrocarbon range data exclude concentrations of any surrogate(s) and/or internal standards eluting in that range.
2* C11-C12 Aromatic Hydrocarbons exclude the concentration of Target PAH analytes eluting in that range.

Sample was spiked with between 15 mg/L and 25 mg/l of Diesel Fuel. This was to simulate an oil sheen.

If there are any questions regarding this data, please call Phoenix Client Services at extension 200.
This report must not be reproduced except in full as defined by the attached chain of custody.

**Phyllis Shiller, Laboratory Director**
**October 23, 2013**
**Reviewed and Released by: Greg Lawrence, Assistant Lab Director**

PHOENIX

Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

# Analysis Report

October 23, 2013

FOR: Solidification Products
215 Village St
Northford, CT 06472

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | WASTE WATER | Collected by: | PHOENIX | 10/11/13 | 11:00 |
| Location Code: | SOLPROD | Received by: | SW | 10/11/13 | 13:00 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBF52851
Phoenix ID: BF52853

Project ID: TREATED FOR ME-DEP
Client ID: TRANSFORMER OIL/WATER TREATED

| Parameter | Result | RL/ PQL | Units | Date/Time | By | Reference |
|---|---|---|---|---|---|---|
| EPH Extraction | Completed | | | 10/15/13 | W/D | 3510 |
| MA Petroleum Hydrocarbon (EPH) | Completed | | | 10/15/13 | | MADEP EPH-04 |
| **MA EPH Aliphatic/Aromatic Ranges** | | | | | | |
| **C11-C22 Aromatic Hydrocarbons 1,2*** | <100 | 100 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| **C19-C36 Aliphatic Hydrocarbons 1*** | <100 | 100 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| **C9-C18 Aliphatic Hydrocarbons 1*** | <100 | 100 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Total TPH 1* | <100 | 100 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| **QA/QC Surrogates** | | | | | | |
| **% 1-chlorooctadecane (aliphatic)** | 68 | | % | 10/15/13 | BB | MAEPH 5/2004 |
| **% 2-Bromonaphthalene (Fractionation)** | 90 | | % | 10/15/13 | BB | MAEPH 5/2004 |
| **% 2-Fluorobiphenyl (Fractionation)** | 68 | | % | 10/15/13 | BB | MAEPH 5/2004 |
| % o-terphenyl (aromatic) | 93 | | % | 10/15/13 | BB | MAEPH 5/2004 |
| **EPH Diesel PAH Target Analytes** | | | | | | |
| 2-Methyl Naphthalene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Acenaphthene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Naphthalene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Phenanthrene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| **EPH Other PAH Target Analytes** | | | | | | |
| Acenapthylene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Anthracene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Benzo(a)anthracene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Benzo(a)pyrene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Benzo(b)fluoranthene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Benzo(ghi)perylene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Benzo(k)fluoranthene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Chrysene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |

Project ID: TREATED FOR ME-DEP

Phoenix I.D.: BF52853

Client ID: TRANSFORMER OIL/WATER TREATED

| Parameter | Result | RL/ PQL | Units | Date/Time | By | Reference |
|---|---|---|---|---|---|---|
| Dibenzo(a,h)anthracene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Fluoranthene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Fluorene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Indeno(1,2,3-cd)pyrene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Pyrene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |

RL/PQL=Reporting/Practical Quantitation Level ND=Not Detected BRL=Below Reporting Level

**Comments:**

MAEPH:
1* Hydrocarbon range data exclude concentrations of any surrogate(s) and/or internal standards eluting in that range.
2* C11-C12 Aromatic Hydrocarbons exclude the concentration of Target PAH analytes eluting in that range.

Sample was spiked with between 15 mg/L and 25 mg/l of Transformer Oil. This was to simulate an oil sheen.

If there are any questions regarding this data, please call Phoenix Client Services at extension 200.
This report must not be reproduced except in full as defined by the attached chain of custody.

**Phyllis Shiller, Laboratory Director**
**October 23, 2013**
**Reviewed and Released by: Greg Lawrence, Assistant Lab Director**

PHOENIX

Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

# Analysis Report

October 23, 2013

FOR: Solidification Products
215 Village St
Northford, CT 06472

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | WASTE WATER | Collected by: | PHOENIX | 10/11/13 | 11:00 |
| Location Code: | SOLPROD | Received by: | SW | 10/11/13 | 13:00 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBF52851
Phoenix ID: BF52854

Project ID: TREATED FOR ME-DEP
Client ID: TRANSFORMER OIL/WATER TREATED DUP

| Parameter | Result | RL/ PQL | Units | Date/Time | By | Reference |
|---|---|---|---|---|---|---|
| EPH Extraction | Completed | | | 10/15/13 | W/D | 3510 |
| MA Petroleum Hydrocarbon (EPH) | Completed | | | 10/15/13 | | MADEP EPH-04 |
| **MA EPH Aliphatic/Aromatic Ranges** | | | | | | |
| **C11-C22 Aromatic Hydrocarbons 1,2*** | <100 | 100 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| **C19-C36 Aliphatic Hydrocarbons 1*** | <100 | 100 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| **C9-C18 Aliphatic Hydrocarbons 1*** | <100 | 100 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Total TPH 1* | <100 | 100 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| **QA/QC Surrogates** | | | | | | |
| **% 1-chlorooctadecane (aliphatic)** | 63 | | % | 10/15/13 | BB | MAEPH 5/2004 |
| **% 2-Bromonaphthalene (Fractionation)** | 80 | | % | 10/15/13 | BB | MAEPH 5/2004 |
| **% 2-Fluorobiphenyl (Fractionation)** | 64 | | % | 10/15/13 | BB | MAEPH 5/2004 |
| % o-terphenyl (aromatic) | 83 | | % | 10/15/13 | BB | MAEPH 5/2004 |
| **EPH Diesel PAH Target Analytes** | | | | | | |
| 2-Methyl Naphthalene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Acenaphthene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Naphthalene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Phenanthrene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| **EPH Other PAH Target Analytes** | | | | | | |
| Acenapthylene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Anthracene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Benzo(a)anthracene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Benzo(a)pyrene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Benzo(b)fluoranthene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Benzo(ghi)perylene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Benzo(k)fluoranthene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Chrysene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |

Project ID: TREATED FOR ME-DEP

Phoenix I.D.: BF52854

Client ID: TRANSFORMER OIL/WATER TREATED DUP

| Parameter | Result | RL/ PQL | Units | Date/Time | By | Reference |
|---|---|---|---|---|---|---|
| Dibenzo(a,h)anthracene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Fluoranthene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Fluorene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Indeno(1,2,3-cd)pyrene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Pyrene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |

RL/PQL=Reporting/Practical Quantitation Level ND=Not Detected BRL=Below Reporting Level

**Comments:**

MAEPH:
1* Hydrocarbon range data exclude concentrations of any surrogate(s) and/or internal standards eluting in that range.
2* C11-C12 Aromatic Hydrocarbons exclude the concentration of Target PAH analytes eluting in that range.

Sample was spiked with between 15 mg/L and 25 mg/l of Transformer Oil. This was to simulate an oil sheen.

If there are any questions regarding this data, please call Phoenix Client Services at extension 200.
This report must not be reproduced except in full as defined by the attached chain of custody.

**Phyllis Shiller, Laboratory Director**
**October 23, 2013**
**Reviewed and Released by: Greg Lawrence, Assistant Lab Director**

PHOENIX

Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

# Analysis Report

October 23, 2013

FOR: Solidification Products
215 Village St
Northford, CT 06472

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | WASTE WATER | Collected by: | PHOENIX | 10/11/13 | 11:00 |
| Location Code: | SOLPROD | Received by: | SW | 10/11/13 | 13:00 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBF52851
Phoenix ID: BF52855

Project ID: TREATED FOR ME-DEP
Client ID: DIESEL FUEL/WATER TREATED

| Parameter | Result | RL/ PQL | Units | Date/Time | By | Reference |
|---|---|---|---|---|---|---|
| EPH Extraction | Completed | | | 10/15/13 | W/D | 3510 |
| MA Petroleum Hydrocarbon (EPH) | Completed | | | 10/15/13 | | MADEP EPH-04 |
| **MA EPH Aliphatic/Aromatic Ranges** | | | | | | |
| **C11-C22 Aromatic Hydrocarbons 1,2*** | <100 | 100 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| **C19-C36 Aliphatic Hydrocarbons 1*** | <100 | 100 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| **C9-C18 Aliphatic Hydrocarbons 1*** | <100 | 100 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Total TPH 1* | <100 | 100 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| **QA/QC Surrogates** | | | | | | |
| **% 1-chlorooctadecane (aliphatic)** | 57 | | % | 10/15/13 | BB | MAEPH 5/2004 |
| **% 2-Bromonaphthalene (Fractionation)** | 75 | | % | 10/15/13 | BB | MAEPH 5/2004 |
| **% 2-Fluorobiphenyl (Fractionation)** | 58 | | % | 10/15/13 | BB | MAEPH 5/2004 |
| % o-terphenyl (aromatic) | 79 | | % | 10/15/13 | BB | MAEPH 5/2004 |
| **EPH Diesel PAH Target Analytes** | | | | | | |
| 2-Methyl Naphthalene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Acenaphthene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Naphthalene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Phenanthrene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| **EPH Other PAH Target Analytes** | | | | | | |
| Acenapthylene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Anthracene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Benzo(a)anthracene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Benzo(a)pyrene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Benzo(b)fluoranthene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Benzo(ghi)perylene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Benzo(k)fluoranthene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Chrysene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |

Project ID: TREATED FOR ME-DEP

Client ID: DIESEL FUEL/WATER TREATED

Phoenix I.D.: BF52855

| Parameter | Result | RL/ PQL | Units | Date/Time | By | Reference |
|---|---|---|---|---|---|---|
| Dibenzo(a,h)anthracene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Fluoranthene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Fluorene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Indeno(1,2,3-cd)pyrene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Pyrene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |

RL/PQL=Reporting/Practical Quantitation Level ND=Not Detected BRL=Below Reporting Level

**Comments:**

MAEPH:
1* Hydrocarbon range data exclude concentrations of any surrogate(s) and/or internal standards eluting in that range.
2* C11-C12 Aromatic Hydrocarbons exclude the concentration of Target PAH analytes eluting in that range.

Sample was spiked with between 15 mg/L and 25 mg/l of Diesel Fuel. This was to simulate an oil sheen.

If there are any questions regarding this data, please call Phoenix Client Services at extension 200.
This report must not be reproduced except in full as defined by the attached chain of custody.

**Phyllis Shiller, Laboratory Director**
**October 23, 2013**
**Reviewed and Released by: Greg Lawrence, Assistant Lab Director**

PHOENIX

Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

# Analysis Report

October 23, 2013

FOR: Solidification Products
215 Village St
Northford, CT 06472

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | WASTE WATER | Collected by: | PHOENIX | 10/11/13 | 11:00 |
| Location Code: | SOLPROD | Received by: | SW | 10/11/13 | 13:00 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBF52851
Phoenix ID: BF52856

Project ID: TREATED FOR ME-DEP
Client ID: DIESEL FUEL/WATER TREATED DUP

| Parameter | Result | RL/ PQL | Units | Date/Time | By | Reference |
|---|---|---|---|---|---|---|
| EPH Extraction | Completed | | | 10/15/13 | W/D | 3510 |
| MA Petroleum Hydrocarbon (EPH) | Completed | | | 10/15/13 | | MADEP EPH-04 |
| **MA EPH Aliphatic/Aromatic Ranges** | | | | | | |
| **C11-C22 Aromatic Hydrocarbons 1,2*** | <100 | 100 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| **C19-C36 Aliphatic Hydrocarbons 1*** | <100 | 100 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| **C9-C18 Aliphatic Hydrocarbons 1*** | <100 | 100 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Total TPH 1* | <100 | 100 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| **QA/QC Surrogates** | | | | | | |
| **% 1-chlorooctadecane (aliphatic)** | 59 | | % | 10/15/13 | BB | MAEPH 5/2004 |
| **% 2-Bromonaphthalene (Fractionation)** | 77 | | % | 10/15/13 | BB | MAEPH 5/2004 |
| **% 2-Fluorobiphenyl (Fractionation)** | 59 | | % | 10/15/13 | BB | MAEPH 5/2004 |
| % o-terphenyl (aromatic) | 85 | | % | 10/15/13 | BB | MAEPH 5/2004 |
| **EPH Diesel PAH Target Analytes** | | | | | | |
| 2-Methyl Naphthalene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Acenaphthene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Naphthalene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Phenanthrene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| **EPH Other PAH Target Analytes** | | | | | | |
| Acenapthylene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Anthracene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Benzo(a)anthracene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Benzo(a)pyrene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Benzo(b)fluoranthene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Benzo(ghi)perylene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Benzo(k)fluoranthene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Chrysene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |

Project ID: TREATED FOR ME-DEP

Phoenix I.D.: BF52856

Client ID: DIESEL FUEL/WATER TREATED DUP

| Parameter | Result | RL/ PQL | Units | Date/Time | By | Reference |
|---|---|---|---|---|---|---|
| Dibenzo(a,h)anthracene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Fluoranthene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Fluorene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Indeno(1,2,3-cd)pyrene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |
| Pyrene | <10 | 10 | ug/L | 10/15/13 | BB | MAEPH 5/2004 |

RL/PQL=Reporting/Practical Quantitation Level ND=Not Detected BRL=Below Reporting Level

**Comments:**

MAEPH:
1* Hydrocarbon range data exclude concentrations of any surrogate(s) and/or internal standards eluting in that range.
2* C11-C12 Aromatic Hydrocarbons exclude the concentration of Target PAH analytes eluting in that range.

Sample was spiked with between 15 mg/L and 25 mg/l of Diesel Fuel. This was to simulate an oil sheen.

If there are any questions regarding this data, please call Phoenix Client Services at extension 200.
This report must not be reproduced except in full as defined by the attached chain of custody.

**Phyllis Shiller, Laboratory Director**
**October 23, 2013**
**Reviewed and Released by: Greg Lawrence, Assistant Lab Director**

PHOENIX

Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

# Analysis Report

October 23, 2013

FOR: Solidification Products
215 Village St
Northford, CT 06472

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | WASTE WATER | Collected by: | PHOENIX | 10/11/13 | 11:00 |
| Location Code: | SOLPROD | Received by: | SW | 10/11/13 | 13:00 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBF52851
Phoenix ID: BF52857

Project ID: TREATED FOR ME-DEP
Client ID: PCB WATER TREATED

| Parameter | Result | RL/ PQL | Units | Date/Time | By | Reference |
|---|---|---|---|---|---|---|
| PCB Extraction | Completed | | | 10/14/13 | L/T | SW3510C |
| **Polychlorinated Biphenyls** | | | | | | |
| PCB-1016 | ND | 0.56 | ug/L | 10/16/13 | AW | E608 |
| PCB-1221 | ND | 0.56 | ug/L | 10/16/13 | AW | E608 |
| PCB-1232 | ND | 0.56 | ug/L | 10/16/13 | AW | E608 |
| PCB-1242 | ND | 0.56 | ug/L | 10/16/13 | AW | E608 |
| PCB-1248 | ND | 0.56 | ug/L | 10/16/13 | AW | E608 |
| PCB-1254 | ND | 0.56 | ug/L | 10/16/13 | AW | E608 |
| PCB-1260 | ND | 0.56 | ug/L | 10/16/13 | AW | E608 |
| PCB-1262 | ND | 0.56 | ug/L | 10/16/13 | AW | E608 |
| PCB-1268 | ND | 0.56 | ug/L | 10/16/13 | AW | E608 |
| **QA/QC Surrogates** | | | | | | |
| % DCBP | 75 | | % | 10/16/13 | AW | 30 - 150 % |
| % TCMX | 92 | | % | 10/16/13 | AW | 30 - 150 % |

Project ID: TREATED FOR ME-DEP

Client ID: PCB WATER TREATED

Phoenix I.D.: BF52857

| Parameter | Result | RL/ PQL | Units | Date/Time | By | Reference |
|---|---|---|---|---|---|---|

RL/PQL=Reporting/Practical Quantitation Level ND=Not Detected BRL=Below Reporting Level

**Comments:**

The sample was spiked with 1 ml of oil that had a concentration of 35.6 mg/kg of Aroclor 1248.

If there are any questions regarding this data, please call Phoenix Client Services at extension 200.
This report must not be reproduced except in full as defined by the attached chain of custody.

**Phyllis Shiller, Laboratory Director**

**October 23, 2013**

**Reviewed and Released by: Greg Lawrence, Assistant Lab Director**

PHOENIX

Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

# Analysis Report

October 23, 2013

FOR: Solidification Products
215 Village St
Northford, CT 06472

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | WASTE WATER | Collected by: | PHOENIX | 10/11/13 | 11:00 |
| Location Code: | SOLPROD | Received by: | SW | 10/11/13 | 13:00 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBF52851
Phoenix ID: BF52858

Project ID: TREATED FOR ME-DEP
Client ID: PCB WATER TREATED DUP

| Parameter | Result | RL/ PQL | Units | Date/Time | By | Reference |
|---|---|---|---|---|---|---|
| PCB Extraction | Completed | | | 10/14/13 | L/T | SW3510C |
| **Polychlorinated Biphenyls** | | | | | | |
| PCB-1016 | ND | 0.56 | ug/L | 10/16/13 | AW | E608 |
| PCB-1221 | ND | 0.56 | ug/L | 10/16/13 | AW | E608 |
| PCB-1232 | ND | 0.56 | ug/L | 10/16/13 | AW | E608 |
| PCB-1242 | ND | 0.56 | ug/L | 10/16/13 | AW | E608 |
| PCB-1248 | ND | 0.56 | ug/L | 10/16/13 | AW | E608 |
| PCB-1254 | ND | 0.56 | ug/L | 10/16/13 | AW | E608 |
| PCB-1260 | ND | 0.56 | ug/L | 10/16/13 | AW | E608 |
| PCB-1262 | ND | 0.56 | ug/L | 10/16/13 | AW | E608 |
| PCB-1268 | ND | 0.56 | ug/L | 10/16/13 | AW | E608 |
| **QA/QC Surrogates** | | | | | | |
| % DCBP | 84 | | % | 10/16/13 | AW | 30 - 150 % |
| % TCMX | 105 | | % | 10/16/13 | AW | 30 - 150 % |

Project ID: TREATED FOR ME-DEP

Client ID: PCB WATER TREATED DUP

Phoenix I.D.: BF52858

| Parameter | Result | RL/ PQL | Units | Date/Time | By | Reference |
|---|---|---|---|---|---|---|

RL/PQL=Reporting/Practical Quantitation Level ND=Not Detected BRL=Below Reporting Level

**Comments:**

The sample was spiked with 1 ml of oil that had a concentration of 35.6 mg/kg of Aroclor 1248.

If there are any questions regarding this data, please call Phoenix Client Services at extension 200.
This report must not be reproduced except in full as defined by the attached chain of custody.

**Phyllis Shiller, Laboratory Director**

**October 23, 2013**

**Reviewed and Released by: Greg Lawrence, Assistant Lab Director**

PHOENIX

Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

# Analysis Report

October 23, 2013

FOR: Solidification Products
215 Village St
Northford, CT 06472

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | WASTE WATER | Collected by: | PHOENIX | 10/11/13 | 11:00 |
| Location Code: | SOLPROD | Received by: | SW | 10/11/13 | 13:00 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBF52851
Phoenix ID: BF52859

Project ID: TREATED FOR ME-DEP
Client ID: PCB WATER TREATED TRIPLICATE

| Parameter | Result | RL/ PQL | Units | Date/Time | By | Reference |
|---|---|---|---|---|---|---|
| PCB Extraction | Completed | | | 10/14/13 | L/T | SW3510C |
| **Polychlorinated Biphenyls** | | | | | | |
| PCB-1016 | ND | 0.67 | ug/L | 10/16/13 | AW | E608 |
| PCB-1221 | ND | 0.67 | ug/L | 10/16/13 | AW | E608 |
| PCB-1232 | ND | 0.67 | ug/L | 10/16/13 | AW | E608 |
| PCB-1242 | ND | 0.67 | ug/L | 10/16/13 | AW | E608 |
| PCB-1248 | ND | 0.67 | ug/L | 10/16/13 | AW | E608 |
| PCB-1254 | ND | 0.67 | ug/L | 10/16/13 | AW | E608 |
| PCB-1260 | ND | 0.67 | ug/L | 10/16/13 | AW | E608 |
| PCB-1262 | ND | 0.67 | ug/L | 10/16/13 | AW | E608 |
| PCB-1268 | ND | 0.67 | ug/L | 10/16/13 | AW | E608 |
| **QA/QC Surrogates** | | | | | | |
| % DCBP | 71 | | % | 10/16/13 | AW | 30 - 150 % |
| % TCMX | 103 | | % | 10/16/13 | AW | 30 - 150 % |

Project ID: TREATED FOR ME-DEP

Phoenix I.D.: BF52859

Client ID: PCB WATER TREATED TRIPLICATE

| Parameter | Result | RL/ PQL | Units | Date/Time | By | Reference |
|---|---|---|---|---|---|---|

RL/PQL=Reporting/Practical Quantitation Level ND=Not Detected BRL=Below Reporting Level

**Comments:**

The sample was spiked with 1 ml of oil that had a concentration of 35.6 mg/kg of Aroclor 1248.

If there are any questions regarding this data, please call Phoenix Client Services at extension 200.
This report must not be reproduced except in full as defined by the attached chain of custody.

**Phyllis Shiller, Laboratory Director**
**October 23, 2013**
**Reviewed and Released by: Greg Lawrence, Assistant Lab Director**

PHOENIX

# QA/QC Report

October 23, 2013

Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

SDG I.D.: GBF52851

## QA/QC Data

| Parameter | Blank | LCS % | LCSD % | LCS RPD | MS % | MSD % | MS RPD | % Rec Limits | % RPD Limits |
|---|---|---|---|---|---|---|---|---|---|
| QA/QC Batch 256829, QC Sample No: BF52606 (BF52857, BF52858, BF52859) | | | | | | | | | |
| **Polychlorinated Biphenyls - Waste Water** | | | | | | | | | |
| PCB-1016 | ND | 105 | 111 | 5.6 | | | | 40 - 140 | 20 |
| PCB-1221 | ND | | | | | | | 40 - 140 | 20 |
| PCB-1232 | ND | | | | | | | 40 - 140 | 20 |
| PCB-1242 | ND | | | | | | | 40 - 140 | 20 |
| PCB-1248 | ND | | | | | | | 40 - 140 | 20 |
| PCB-1254 | ND | | | | | | | 40 - 140 | 20 |
| PCB-1260 | ND | 105 | 114 | 8.2 | | | | 40 - 140 | 20 |
| PCB-1262 | ND | | | | | | | 40 - 140 | 20 |
| PCB-1268 | ND | | | | | | | 40 - 140 | 20 |
| % DCBP (Surrogate Rec) | 77 | 70 | 79 | 12.1 | | | | 30 - 150 | 20 |
| % TCMX (Surrogate Rec) | 85 | 97 | 100 | 3.0 | | | | 30 - 150 | 20 |
| Comment: | | | | | | | | | |
| A LCS and LCS Duplicate were performed instead of a matrix spike and matrix spike duplicate. | | | | | | | | | |
| QA/QC Batch 257045, QC Sample No: BF52851 (BF52851, BF52852, BF52853, BF52854, BF52855, BF52856) | | | | | | | | | |
| **MAEPH - Waste Water** | | | | | | | | | |
| Acenaphthylene - Water | ND | 59 | 63 | 6.6 | | | | 40 - 140 | 20 |
| Anthracene - Water | ND | 71 | 74 | 4.1 | | | | 40 - 140 | 20 |
| Benzo(a)anthracene - Water | ND | 80 | 82 | 2.5 | | | | 40 - 140 | 20 |
| Benzo(a)pyrene - Water | ND | 79 | 79 | 0.0 | | | | 40 - 140 | 20 |
| Benzo(b)fluoranthene - Water | ND | 80 | 80 | 0.0 | | | | 40 - 140 | 20 |
| Benzo(ghi)perylene - Water | ND | 75 | 77 | 2.6 | | | | 40 - 140 | 20 |
| Benzo(k)fluoranthene - Water | ND | 80 | 80 | 0.0 | | | | 40 - 140 | 20 |
| C11-C22 Aromatic Hydrocarbons - Wate | ND | 72 | 75 | 4.1 | | | | 40 - 140 | 20 |
| C19-C36 Aliphatic Hydrocarbons - Wate | ND | 75 | 70 | 6.9 | | | | 40 - 140 | 20 |
| C9-C18 Aliphatic Hydrocarbons - Water | ND | 41 | 42 | 2.4 | | | | 40 - 140 | 20 |
| Chrysene - Water | ND | 77 | 78 | 1.3 | | | | 40 - 140 | 20 |
| Dibenz(a,h)anthracene - Water | ND | 77 | 79 | 2.6 | | | | 40 - 140 | 20 |
| Fluoranthene - Water | ND | 77 | 80 | 3.8 | | | | 40 - 140 | 20 |
| Fluorene - Water | ND | 70 | 74 | 5.6 | | | | 40 - 140 | 20 |
| Indeno(1,2,3-cd)pyrene - Water | ND | 77 | 79 | 2.6 | | | | 40 - 140 | 20 |
| Pyrene - Water | ND | 85 | 92 | 7.9 | | | | 40 - 140 | 20 |
| % 2-Methylnaphthalene BT - Water | | 0 | 0 | NC | | | | 0 - 5 | |
| % Naphthalene BT - Water | | 0 | 0 | NC | | | | 0 - 5 | |
| %2-Bromonaphthalene (surr) - Water | 75 | 66 | 70 | 5.9 | | | | 40 - 140 | 20 |
| %2-Flurobiphenyl (surr) - Water | 76 | 67 | 72 | 7.2 | | | | 40 - 140 | 20 |
| %o-COD (surr) - Water | 51 | 58 | 49 | 16.8 | | | | 40 - 140 | 20 |
| %o-Terphenyl (surr) - Water | 66 | 61 | 64 | 4.8 | | | | 40 - 140 | 20 |
| Comment: | | | | | | | | | |
| Additional EPH fractionation criteria: Breakthrough criteria (BT) is 0 to 5% | | | | | | | | | |

# QA/QC Data

SDG I.D.: GBF52851

| Parameter | Blank | LCS % | LCSD % | LCS RPD | MS % | MSD % | MS RPD | % Rec Limits | % RPD Limits |
|---|---|---|---|---|---|---|---|---|---|

If there are any questions regarding this data, please call Phoenix Client Services at extension 200.

RPD - Relative Percent Difference
LCS - Laboratory Control Sample
LCSD - Laboratory Control Sample Duplicate
MS - Matrix Spike
MS Dup - Matrix Spike Duplicate
NC - No Criteria
Intf - Interference

Phyllis Shiller, Laboratory Director
October 23, 2013

Wednesday, October 23, 2013

Requested Criteria: None

State: CT

# Sample Criteria Exceedences Report

## GBF52851 - SOLPROD



| SampNo | Acode | Phoenix Analyte | Criteria | Result | RL | Criteria | RL Criteria | Analysis Units |
|---|---|---|---|---|---|---|---|---|

*** No Data to Display ***

Phoenix Laboratories does not assume responsibility for the data contained in this report. It is provided as an additional tool to identify requested criteria exceedences. All efforts are made to ensure the accuracy of the data (obtained from appropriate agencies). A lack of exceedence information does not necessarily suggest conformance to the criteria. It is ultimately the site professional's responsibility to determine appropriate compliance.

Wednesday, October 23, 2013

PHOENIX

# EPH Fractionation Standard

**SDG I.D.:** GBF52851

**Effective Date(s):** 01/09/13 - 01/09/14 **Analyst:**

| AS # | TV | #1 | #2 | #3 | #4 | Avg | % Rec | % RSD | Rec Limits | RSD Limits |
|---|---|---|---|---|---|---|---|---|---|---|
| Naphthalene | 10 | 6.79 | 7.06 | 7.12 | 6.83 | 6.95 | 69.5 | 2.4 | 40-140 | 20 |
| 2-Methylnaphthalene | 10 | 6.68 | 7.12 | 7.27 | 6.96 | 7.01 | 70.1 | 3.6 | 40-140 | 20 |
| Acenaphthalene | 10 | 7.17 | 7.70 | 8.16 | 7.41 | 7.61 | 76.1 | 5.6 | 40-140 | 20 |
| Acenaphthene | 10 | 8.02 | 8.43 | 8.81 | 8.14 | 8.35 | 83.5 | 4.2 | 40-140 | 20 |
| Fluorene | 10 | 7.96 | 8.64 | 8.78 | 8.23 | 8.40 | 84.0 | 4.5 | 40-140 | 20 |
| Phenanthrene | 10 | 8.85 | 9.37 | 9.59 | 9.02 | 9.21 | 92.1 | 3.6 | 40-140 | 20 |
| Anthracene | 10 | 14.10 | 15.20 | 15.40 | 14.50 | 14.80 | 148.0 | 4.1 | 40-140 | 20 |
| Fluoranthene | 10 | 10.10 | 10.20 | 10.40 | 10.20 | 10.23 | 102.3 | 1.2 | 40-140 | 20 |
| Pyrene | 10 | 9.60 | 10.10 | 10.50 | 10.00 | 10.05 | 100.5 | 3.7 | 40-140 | 20 |
| Benzo(a)anthracene | 10 | 10.10 | 10.40 | 10.60 | 10.40 | 10.38 | 103.8 | 2.0 | 40-140 | 20 |
| Chrysene | 10 | 9.88 | 10.10 | 10.60 | 10.20 | 10.20 | 102.0 | 3.0 | 40-140 | 20 |
| Benzo(b)fluoranthene | 10 | 9.95 | 9.66 | 11.40 | 10.60 | 10.40 | 104.0 | 7.4 | 40-140 | 20 |
| Benzo(k)fluoranthene | 10 | 9.57 | 10.00 | 9.35 | 9.23 | 9.54 | 95.4 | 3.6 | 40-140 | 20 |
| Benzo(a)pyrene | 10 | 9.07 | 9.15 | 9.78 | 9.27 | 9.32 | 93.2 | 3.4 | 40-140 | 20 |
| Indeno(123cd)pyrene | 10 | 9.10 | 9.54 | 10.00 | 9.88 | 9.63 | 96.3 | 4.2 | 40-140 | 20 |
| Dibenz(ah)anthracene | 10 | 9.80 | 9.70 | 10.30 | 9.54 | 9.84 | 98.4 | 3.3 | 40-140 | 20 |
| Benzo(ghi)perylene | 10 | 9.60 | 9.70 | 10.20 | 9.75 | 9.81 | 98.1 | 2.7 | 40-140 | 20 |
| Nonane c9 | 10 | 3.68 | 3.80 | 3.91 | 3.61 | 3.75 | 37.5 | 3.5 | 25-140 | 20 |
| Decane c10 | 10 | 5.16 | 5.46 | 6.04 | 5.15 | 5.45 | 54.5 | 7.7 | 40-140 | 20 |
| Dodecane c12 | 10 | 6.12 | 6.50 | 6.31 | 6.25 | 6.30 | 63.0 | 2.5 | 40-140 | 20 |
| Tetradecane c14 | 10 | 7.48 | 7.92 | 8.40 | 7.76 | 7.89 | 78.9 | 4.9 | 40-140 | 20 |
| Hexadecane c16 | 10 | 8.69 | 9.23 | 9.86 | 9.10 | 9.22 | 92.2 | 5.3 | 40-140 | 20 |
| Octadecane c18 | 10 | 9.92 | 10.70 | 11.10 | 10.80 | 10.63 | 106.3 | 4.7 | 40-140 | 20 |
| Eicosane c20 | 10 | 10.00 | 10.90 | 11.20 | 10.80 | 10.73 | 107.3 | 4.8 | 40-140 | 20 |
| Henecosane c21 | 10 | 9.82 | 10.90 | 11.20 | 10.70 | 10.66 | 106.6 | 0.6 | 40-140 | 20 |
| Docosane c22 | 10 | 10.10 | 11.20 | 11.50 | 10.90 | 10.93 | 109.3 | 5.5 | 40-140 | 20 |
| Tetracosane c24 | 10 | 10.10 | 11.30 | 11.50 | 10.90 | 10.95 | 109.5 | 5.7 | 40-140 | 20 |
| Hexacosane c26 | 10 | 9.92 | 11.10 | 11.40 | 10.70 | 10.78 | 107.8 | 6.0 | 40-140 | 20 |
| Octacosane c28 | 10 | 9.46 | 10.70 | 11.00 | 10.30 | 10.37 | 103.7 | 6.4 | 40-140 | 20 |
| Tricotane c30 | 10 | 9.24 | 10.60 | 10.80 | 10.20 | 10.21 | 102.1 | 6.8 | 40-140 | 20 |
| Dotriacontane c32 | 10 | 8.68 | 9.88 | 10.20 | 9.51 | 9.57 | 95.7 | 0.7 | 40-140 | 20 |

PHOENIX

# EPH Fractionation Standard

**SDG I.D.:** GBF52851

**Effective Date(s):** 01/09/13 - 01/09/14 **Analyst:**

| AS # | TV | #1 | #2 | #3 | #4 | Avg | % Rec | % RSD | Rec Limits | RSD Limits |
|---|---|---|---|---|---|---|---|---|---|---|
| Tetratriacontane c34 | 10 | 8.44 | 9.84 | 10.10 | 9.65 | 9.51 | 95.1 | 0.7 | 40-140 | 20 |
| Hexatriacontane c36 | 10 | 7.70 | 8.96 | 9.35 | 8.80 | 8.70 | 87.0 | 8.1 | 40-140 | 20 |
| Octatriacontane c38 | 10 | 6.56 | 7.98 | 8.20 | 7.97 | 7.68 | 76.8 | 0.8 | 40-140 | 20 |
| Tetracontane c40 | 10 | 6.52 | 7.39 | 7.63 | 7.60 | 7.29 | 72.9 | 0.5 | 40-140 | 20 |
| c9-c12 Aliphatic | 30 | 14.90 | 15.70 | 10.00 | 14.90 | 13.88 | 46.3 | 2.6 | 25-140 | 20 |
| c12-c16 Aliphatic | 20 | 16.10 | 17.10 | 18.20 | 16.80 | 17.05 | 85.3 | 0.9 | 40-140 | 20 |
| c16-c21 Aliphatic | 30 | 29.80 | 32.40 | 33.50 | 32.40 | 32.03 | 106.8 | 1.6 | 40-140 | 20 |
| c21-c40 Aliphatic | 100 | 88.40 | 101.00 | 103.00 | 97.90 | 97.58 | 97.6 | 6.5 | 40-140 | 20 |

Cooler: Yes ☐ No ☐
Coolant: IPK ☐ ICE ☐ No ☐
Temp °C Pg of

# CHAIN OF CUSTODY RECORD

**PHOENIX** Environmental Laboratories, Inc.

587 East Middle Turnpike, P.O. Box 370, Manchester, CT 06040
Email: info@phoenixlabs.com Fax (860) 645-0823
**Client Services (860) 645-8726**

**Contact Options:**
☐ Fax:
☐ Phone:
☐ Email:

Customer: Solidification Products
Address: 215 Village Street
Deerfield, CT 06472

Project: Treated Produced Fr ME-DEP
Report to: William Gannon
Invoice to: William Gannon

Project P.O:

***This section MUST be completed with Bottle Quantities.***

Sampler's Signature: [signature] Date: 10/11/13

**Client Sample - Information - Identification**

**Matrix Code:**
**DW**=Drinking Water **GW**=Ground Water **SW**=Surface Water **WW**=Waste Water
**RW**=Raw Water **SE**=Sediment **SL**=Sludge **S**=Soil **SD**=Solid **W**=Wipe
**OIL**=Oil **B**=Bulk **L**=Liquid

Analysis Request

| PHOENIX USE ONLY SAMPLE # | Customer Sample Identification | Sample Matrix | Date Sampled | Time Sampled | EPH with Targets | PCBs | | | | | | | | | | | Soil VOA Vials [ ] methanol [ ] H2O | GL Soil container (32) oz | GL Soil container ( ) oz | 40 ml VOA Vial [ ] As is [ ] HCl | GL Amber 1000ml [ ] As is [ ] H2SO4 | PL As is [ ] 250ml [ ] 500ml [ ] 1000ml | PL H2SO4 [ ] 250ml [ ] 500ml | PL HNO3 250ml | PL NaOH 250ml | Bacteria Bottle |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Transformer oil/Water | WW | 10/11/13 | 11:00 | X | | | | | 528 | 51 | | | | | | | 2 | | | | | | | | |
| | Diesel Fuel/Water | | | | X | | | | | 528 | 52 | | | | | | | 2 | | | | | | | | |
| | Transformer oil/Water Treated | | | | X | | | | | 528 | 53 | | | | | | | 2 | | | | | | | | |
| | Transformer oil/Water Treated Dup | | | | X | | | | | 528 | 54 | | | | | | | 2 | | | | | | | | |
| | Diesel Fuel/Water Treated | | | | X | | | | | 528 | 55 | | | | | | | 2 | | | | | | | | |
| | Diesel Fuel/Water Treated Dup | | | | X | | | | | 528 | 56 | | | | | | | 2 | | | | | | | | |
| | PCB Water Treated | | | | X | X | | | | 528 | 57 | | | | | | | 1 | | | | | | | | |
| | PCB Water Treated Dup | | | | X | X | | | | 528 | 58 | | | | | | | 1 | | | | | | | | |
| | PCB Water Treated Triplicate | | | | X | X | | | | 528 | 59 | | | | | | | 1 | | | | | | | | |

| Relinquished by: | Accepted by: | Date: | Time: |
|---|---|---|---|
| [signature] | [signature] | 10/11/13 | 1300 |

**Comments, Special Requirements or Regulations:**

**Turnaround:**
☐ 1 Day*
☐ 2 Days*
☐ 3 Days*
☑ Standard
☐ Other
* SURCHARGE APPLIES

**RI**
☐ Direct Exposure (Residential)
☐ GW
☐ Other

**CT**
☐ RCP Cert
☐ GW Protection
☐ SW Protection
☐ GA Mobility
☐ GB Mobility
☐ Residential DEC
☐ I/C DEC
☐ Other

**MA**
☐ MCP Certification
☐ GW-1
☐ GW-2
☐ GW-3
☐ S-1
☐ S-2
☐ S-3
☐ MWRA eSMART
☐ Other

**State where samples were collected:** _____

**Data Format**
☐ Excel
☐ PDF
☐ GIS/Key
☐ EQuIS
☐ Other

**Data Package**
☐ Tier II Checklist
☐ Full Data Package*
☐ Phoenix Std Report
☐ Other

* SURCHARGE APPLIES

ERA
A Waters Company

GBF52851

# DataPacK™

Lot No. 06046
Aroclor 1248 Low level

# PCBs in Oil

Catalog No. 826

## Certification

| Parameter | Certified Value | Performance Acceptance Limits™ |
|---|---|---|
| | mg/Kg | mg/Kg |
| Aroclor 1016 | < 10 | |
| Aroclor 1221 | < 10 | |
| Aroclor 1232 | < 10 | |
| Aroclor 1242 | < 10 | |
| Aroclor 1248 | 35.6 | 11.5 - 47.0 |
| Aroclor 1254 | < 10 | |
| Aroclor 1260 | < 10 | |

## Analytical Verification

| Parameter | Certified Value | Mean Recovery | | n | NIST SRM Number |
|---|---|---|---|---|---|
| | mg/Kg | mg/Kg | % | | |
| Aroclor 1016 | < 10 | | | | NIST SRM 3075 |
| Aroclor 1221 | < 10 | | | | NIST SRM not available |
| Aroclor 1232 | < 10 | | | | NIST SRM 3076 |
| Aroclor 1242 | < 10 | | | | NIST SRM 3077 |
| Aroclor 1248 | 35.6 | 34.1 | 95.7% | 3 | NIST SRM 3078 |
| Aroclor 1254 | < 10 | | | | NIST SRM 3079 |
| Aroclor 1260 | < 10 | | | | NIST SRM 3080 |

The **Certified Values** are the actual 'made-to' concentrations confirmed by ERA analytical verification.

The **Performance Acceptance Limits (PALs™)** are based on actual historical data collected in ERA's Proficiency Testing program. The **PALs™** reflect any inherent biases in the methods used to establish the limits and closely approximate a 95% confidence interval of the performance that experienced laboratories should achieve using accepted environmental methods. Use these **PALs™** to realistically evaluate your performance against your peers.

The **Analytical Verification** data was generated by ERA, solely. In addition, where NIST Standard Reference Materials (SRMs) are available, each analyte has been analytically traced to the NIST SRM listed.

Please call ERA at 1-800-372-0122 if you have any questions or need technical assistance.

# Environmental Equivalency Document for U.S. E.P.A. S.P.C.C. Regional Inspectors

# Chapter 3 Environmental Equivalence

## 3.1 Introduction

The environmental equivalence provision, contained in §112.7(a)(2), allows for deviations from specific requirements of the SPCC rule, as long as the alternative measures provide equivalent environmental protection. The environmental equivalence provision is a key mechanism of the performance-based SPCC rule. This flexibility enables owners and operators of facilities to achieve environmental protection in a manner that fits the facility's unique circumstances. It also allows owners and operators to adopt more protective industry practices and technologies for their facilities as they become available.

***The US EPA Has Approved SPI's Patented Technology as Mentioned Here in its SPCC Handbook Which Is Distributed to All of Its Compliance Officers.**

**Please Review The Excerpt Taken Directly from Page 3-24 of the SPCC Environmental Equivalence Handbook.**

In cases where operational procedures are used as environmentally equivalent alternatives to SPCC requirements, the Plan must state the reasons for nonconformance and describe in detail the alternative methods and how the approach will achieve equivalent environmental protection (§112.7(a)(2)). The description should provide the details of how the procedures are implemented at the facility, including specific information on the steps involved in each activity, required equipment, personnel training, and records that need to be maintained to document and verify implementation. Records kept as part of usual and customary business practices are acceptable forms of documentation, but should be referenced in the Plan and available for an inspector's review during an inspection. These records must be maintained at the facility for a period of three years (§112.7(e)). Certain industry standards (for example, API Standards 570 and 653) may specify that records be maintained for more than three years. If a Plan indicates conformance with a standard that requires longer retention of inspection records, then the owner/operator should follow the longer recordkeeping requirement of the standard.

The two examples in *Figure 3-2* and *Figure 3-3* illustrate documentation of environmentally equivalent measures in hypothetical SPCC Plans. The first example in *Figure 3-2* shows *insufficient* documentation, illustrating a Plan description that simply notes the use of an alternative measure without supporting descriptions. Specifically, the example in *Figure 3-2* does not provide sufficient detail to ascertain whether the approach provides environmentally equivalent protection – it does not describe how environmental equivalence is achieved and what procedures are implemented to ensure that the measure performs as intended. The second example in *Figure 3-3* provides a sufficient level of detail to allow an EPA inspector to understand what the facility is doing to meet the objectives of the SPCC rule with regard to the given provision, and to verify implementation of the measure(s) in the field.

**Figure 3-2: Example 1: Insufficient Documentation of Environmentally Equivalent Protection for Drainage of Diked Areas (§112.8(b)(1) and §112.8(b)(2)).**

**Facility Drainage – 40 CFR 112.8(b)(1) and 40 CFR 112.8(b)(2)**

The dike structure in Area A is equipped with a [TRADEMARK] drain shutoff system and therefore does not require employee supervision during draining. This provides an environmentally equivalent method of compliance with the drainage requirement.

**Figure 3-3: Example 2: Sufficient Documentation of Environmentally Equivalent Protection for Drainage of Diked Areas (§112.8(b)(1) and §112.8(b)(2)).**[78]

**Facility Drainage – 40 CFR 112.8(b)(1) and 40 CFR 112.8(b)(2)**

The dike in Area A contains three transformers (see list of equipment and oil storage capacity in the Plan). The dike is equipped with a [TRADEMARK] drain shutoff system specifically engineered to prevent any oil from escaping the containment structure while allowing water to flow through the valve housing during normal conditions. The system uses hydrophobic and oleophilic material to block the flow of all fluids once it detects the presence of oil. The oil type stored in the containment area has been confirmed by the manufacturer to activate the oil-blocking mechanism and the mechanism ensures that any discharge from the containment structure will not cause a discharge as described in §112.1(b). Attached in an appendix to the Plan are efficacy testing results supplied by the manufacturer of [TRADEMARK].

Further documentation of the performance of this system and the manufacturer's suggested replacement interval are maintained as an appendix to this Plan. This method deviates from the rule requirement to drain dikes under direct visual supervision using valves of manual, open-and-closed design. Employee supervision is not required under regular operating conditions to drain uncontaminated rainwater that has accumulated in the dike, which will reduce manpower and resources necessary to implement the SPCC Plan. Therefore, we are implementing this system which is environmentally equivalent because it will only drain rainwater when oil is not present.

The manufacturer's maintenance and inspection requirements are maintained at the facility. In accordance with those recommendations, the diked area is inspected monthly by facility personnel as part of the scheduled inspection of bulk storage tanks, as per the checklist presented in Appendix A. This inspection includes looking for accumulation of water and presence of oil within the diked area, and examining, and replacing, as warranted, the silt filter and [TRADEMARK] elements. Facility personnel also examine the system, and replace components as needed, within 48 hours of any rainfall greater than 3 inches. Replacement of the silt filter and/or other elements of the [TRADEMARK] system are noted on the monthly inspection sheets, which are maintained at the facility for three years.

All maintenance is performed following the manufacturer's specifications. Maintenance requirements are covered in the employee training program.

In the event that the filter clogs and storm water accumulates within the diked area, facility personnel will follow required procedures for dike drainage as follows:

1) Inspect the retained rainwater to ensure that it does not contain oil (to avoid a discharge to *[Insert Name of Waterbody]* or adjoining shorelines which is the nearest navigable water to the facility);

2) Open the bypass valve, allow drainage, and reseal the valve; and

3) Record event in log.

[78] This is a hypothetical example for illustrative purposes only. The use of environmental equivalence is a site-specific determination certified by a PE in accordance with good engineering practice. EPA does not endorse this specific example as a means of environmental equivalence. If a system that uses hydrophobic and oleophilic material is used at a facility, the inspector should pay close attention to manufacturers' data supporting the assertion the system is effective to prevent a discharge as described in § 112.1(b) and PE's site-specific considerations for the use of this technology at the facility. Follow-up action by the EPA inspector may include requesting additional information from the facility owner or operator on the implementation of the equivalent measure.

**Independent testing performed in France to verify US standards for European use.**

Solidification Products International
Testing performed by the
Bureau Veritas in France

**BUREAU VERITAS**

**8 avenue Jacques Cartier**
**44807 SAINT HERBLAIN**
**Tél: 02 72 64 47 01– Fax : 02 40 92 48 97**
**francois.villain@fr.bureauveritas.com**

# RAPPORT D'ESSAIS */ TEST RESULTS*

## Lors de tests d'hydrocarbures sur système de filtration PETRO-PIPE®

*from hydrocarbons test measurement on filtration systems PETRO-PIPE*

## ANALYSES PHYSICO-CHIMIQUES */ Chemical analysis*

Référence rapport : 003606/276643/1/1/1-Rév.1-FV/CA

C

A l'attention de : Samuel BOURSEUL

| *Lieu d'intervention/**Location of the test*** | *Adresse d'envoi du rapport/**Direction to send report*** |
|---|---|
| **Adresse : Confidentiel**<br>**En FRANCE** | **SANERGRID**<br>**34 Av Des Champs Elysées**<br>**75008 PARIS** |

Intervention du 12/03/2015

Intervenant : François VILLAIN

Accompagnateur : Samuel BOURSEUL de SANERGRID

Ce rapport comporte 8 pages dont 1 annexe non paginée

***This report has 8 pages and 1 annexe***

| **Version** | **0** | **1** | **2** |
|---|---|---|---|
| **Date du rapport** | 17/04/2015 | 06/05/2015 | - |
| **Emetteur** | François VILLAIN | François VILLAIN | - |
| **Signature** | | | - |

La reproduction de ce rapport d'essai n'est autorisée que sous sa forme intégrale / ***Coping this report is only authorized if it is done from the complete French original report.***

# SOMMAIRE/ *SUMMARY*

1. **CONDITIONS GENERALES D'INTERVENTION**/*conditions of the test*.....3

2. **SYNTHESE ET RESULTATS DE LA MISSION** / *synthesis and results of the test* .....4

3. **CONCLUSION** / *Conclusions* .....7

**ANNEXE - RESULTATS DU LABORATOIRE** / *annex and laboratory results*.....8

# SUIVI DU DOCUMENT

| Révision | Commentaires |
|---|---|
| 0 | Première émission du document/ ***First publication of the document*** |
| X | |

## 1. CONDITIONS GENERALES D'INTERVENTION/*General conditions of the test*

Le but de ces essais est de vérifier l'efficacité de filtration de différents filtres SPI de technologie PETRO-PIPE® de type PETRO-PIT™ 410 et le PETRO-PIPE®-616. ***The aim of this test is to verify the filtration efficiency of the rainwater filters SPI technology PETRO-PIPE® range PETRO-PIT™ 410 and PETRO-PIPE®-616***

Lors de chaque essai, nous avons réalisé un mélange à partir de 14 litres d'eau pure et d'une quantité de produit hydrocarburé différente pour chaque essai. ***During each test, we have measured concentrations of 14 litters of pure water mix with a certain quantity of different hydrocarbons products.***

Pour l'ensemble des essais, nous avons prélevé un premier échantillon dans le bac d'entrée, puis nous avons saturé le filtre avant de prélever un échantillon dans le bac de sortie. / ***For all the tests, we have measured the concentration of hydrocarbons with a sample upstream of the filter, and then we saturated and blocked the filter in order to take sample of water downstream of filter and measured hydrocarbons concentration***

Les échantillons sont envoyés par glacière dans le laboratoire EUROFINS à Maxéville (Accréditation COFRAC n°1-0685). ***The samples has been sent in a special briefcase to the laboratory EUROFINS in Maxéville (laboratory accredited by COFRAC number 1-0685 : official national French laboratory accreditation)***

## 2. SYNTHESE ET RESULTATS DE LA MISSION / *Synthesis and results of the tests*

### 1. Essai sur filtre PETRO-PIPE® PIT 410 / *Test on PETRO-PIPE® PIT 410*

| | | | |
|---|---|---|---|
| **Coordonnées de l'installation** / *test place* | | **Test réalisé en laboratoire client** / *customer's facilities* | |
| **Prélèvement effectué par Bureau Veritas** / *samples made by Bureau Veritas* | | **Préleveur :** | François VILLAIN |
| **Référence et localisation du point/** *reference and localization of the samples:* | | **Mesure réalisée en amont et en aval d'un banc d'essai** / *measure upstream and downstream the filter.* | |
| **Date et Heure** | **Type de filtre** / *filter reference:* | **Modalités de prélèvement** / *sampling method* | **Aspect de l'eau** / *aspects of the water* |
| 12/03/15 *Morning* | **PETRO-PIPE® PIT 410** | instantané (échantillon unique) / *unique sample* | Coloré/color : en amont du filtre, Limpide : en sortie du filtre /***upstream the filter. Clear downstream the filter*** |
| | | **Etat du point/*condition of the sample*** | **Odeur/***smell* |
| | | Point propre/*clean measurement* | d'hydrocarbure (sur la partie amont)/***only upstream the filter*** |

**Résultats d'analyses des eaux en entrée et en sortie du filtre, avec changement de filtre lors de chaque essai.** *I water tests results upstream and downstream the filter, with new filter for each test*.

| Concentration en hydrocarbure (C10-C40)/hydrocarbon concentration [1] | | | | |
|---|---|---|---|---|
| **Essai**/*test* | **Eau en amont (mg/l)**/ *water tank upstream* | **Type de mélange**/*type of hydrocarbons* | **Eau en aval**/*water downstream* ***(mg/l)*** | **Rendement d'épuration**/ *filtration rate* |
| *1* | *< 0.1* | *Eau pure /pure water* | *< 0.1* | *100%* |
| *2* | *986* | *1 l of Diesel in 14l pure water* | *< 0.1* | *100%* |
| *3* | *3760* | *1l used hydraulic oil in 14l pure water* | *< 0.1* | *100%* |
| *4* | *92.4* [2] | *½ l transformer mineral oil in 14l pure water* | *< 0.1* | *100%* |

[1] Analyses sous traitées/ ***analysis subconctracted to COFRAC homologated Laboratory.*** Se référer aux PV d'analyses joints en annexe du présent rapport pour obtenir la liste des analyses réalisées sous accréditation COFRAC par le laboratoire. /***please refer to test results in the annex of this document***

[2] Suite à une suspicion d'erreur analytique, la concentration indiquée correspond à celle de l'essai n°5 qui est identique (même huile et même concentration de départ).

[2] ***due to analytics mistakes the concetration rate of this upstream sample corespond to the upstream sample from test N°5 hereafter, since concentration was the same in the upstream water tank.***

BUREAU VERITAS

## 2. Essai sur filtre PETRO-PIPE® PI 616/*test on filter PETRO-PIPE® PI 616*

| | | |
|---|---|---|
| **Coordonnées de l'installation** / *test place* | **Test réalisé en laboratoire client** / *customer's facilities* | |
| **Prélèvement effectué par Bureau Veritas** / *samples made by Bureau Veritas* | **Préleveur :** | François VILLAIN |
| **Référence et localisation du point/** *reference and localization of the samples:* | **Mesure réalisée en amont et en aval d'un banc d'essai** / measure upstream and downstream the filter. | |

| | **Date et Heure** | **Type de filtre** / *filter reference:* | **Modalités de prélèvement** / *sampling method* | **Aspect de l'eau** / *aspects of the water* |
|---|---|---|---|---|
| | Le 12/03/15 *afternoon* | **PETRO-PIPE® PI 616** | instantané (échantillon unique) / ***unique sample*** | Coloré/color : en amont du filtre, Limpide : en sortie du filtre /***upstream the filter. Clear downstream the filter*** |
| | | | **Etat du point**/*condition of the sample* | **Odeur**/*smell* |
| | | | Point propre/***clean measurement*** | d'hydrocarbure (sur la partie amont)/***only upstream the filter*** |

**Résultats d'analyses des eaux en entrée et en sortie du filtre, avec même filtre pour les deux essais.** / *water tests results upstream and downstream the filter, with same filter for both test.*

| Concentration en hydrocarbure (C10-C40)/ *Ihydrocarbon concentration*[1] | | | | |
|---|---|---|---|---|
| **Essai**/*test* | **Eau en amont (mg/l)**/ *water tank upstream* | **Type de mélange/type of hydrocarbons** | **Eau en aval**/*water downstream* ***(mg/l)*** | **Rendement d'épuration**/ *filtration rate* |
| *5* | *92.4* | *600 ml of oil transformers in 14l pure water* | *< 0.1* | *100%* |
| *6* | *1090* | *3l diesel in14l pure water* | *< 0.1* | *100%* |

[1] Analyses sous traitées/ ***analysis subconctracted to COFRAC homologated Laboratory.*** Se référer aux PV d'analyses joints en annexe du présent rapport pour obtenir la liste des analyses réalisées sous accréditation COFRAC par le laboratoire. /***please refer to test results in the annex of this document***

## 3. CONCLUSION

Les tests réalisés le 12 mars 2015 sur les filtres SPI de technologie PETRO-PIPE® type PETRO-PIT™ 410 et le PETRO-PIPE®-616 ont montrés une absence de détection d'hydrocarbures par le laboratoire sur l'eau de sortie des filtres (taux d'hydrocarbures en sortie inférieurs à 0,1 ppm).

***Test realized the 12 mars 2015 on SPI filters technology PETRO-PIPE® range PETRO-PIT™ 410 and PETRO-PIPE®-616 have shown an absence of hydrocarbons downstream the filters hydrocarbons concentration below 0,1 ppm)***

# ANNEXE

## RESULTATS DU LABORATOIRE

**Cette annexe comporte 24 pages non numérotées**

eurofins | Hydrologie

**BUREAU VERITAS SA**
**Monsieur François VILLAIN**
314 boulevard marcel paul
bp 20162
44802 SAINT HERBLAIN

# RAPPORT D'ANALYSE

N° de rapport d'analyse : AR-15-IX-028746-01 Version du : 19/03/2015 Page 1/2

Référence commande : 1510003606 15 344
Référence dossier : AFFAIRE N° 2776443/1/1

Echantillon N° : 15M013724-007 Référence échantillon : 7
Matrice : Eau de rejet / Eau résiduaire
Date de prélèvement : 13/03/2015 Date de réception : 14/03/2015 07:34:26
Début d'analyse (1) : 17/03/2015
Préleveur : VILLAIN François (CLIENT) - BVFVI -
Commune :

Observations :
L'heure de prélèvement n'étant pas renseignée, les délais de mise en analyse ont été calculés à partir d'une heure de prélèvement fixée par défaut à midi.

| Conservation de vos échantillons | |
|---|---|
| Les échantillons seront conservés sous conditions contrôlées pendant 2 semaines après validation des échantillons. Sans avis contraire, ils seront détruits après cette période sans aucune communication de notre part. Si vous désirez que les échantillons soient conservés plus longtemps, veuillez retourner ce document signé au plus tard une semaine avant la date d'issue. | |
| Conservation Supplémentaire : | |
| Nom : | Signature : |
| Date : | |

**Eurofins IPL Est**
**Rue Lucien Cuenot site Saint Jacques II BP 51005 54521 Maxeville cedex**
**Tél 03 83 50 36 00 - fax 03 83 56 84 22 - site web : www.eurofins.fr/env**
**SAS au capital de 10 249 470 € RCS Nancy 756 800 090 Siret 756 800 090 00257 TVA FR 46 756 800 090**

ACCREDITATION
N° 1- 0685
Site de Maxéville
Portée disponible sur
www.cofrac.fr

cofrac ESSAIS

eurofins | Hydrologie

N° de rapport d'analyse : AR-15-IX-028746-01 Version du : 19/03/2015 Page 2/2

## Hydrocarbures

| | (4) | Résultat (2) | Unité | Incertitude | Limites Qualité (3) | Réf. Qualité (3) |
|---|---|---|---|---|---|---|
| IX578 : **Indice Hydrocarbures (C10-C40)** Prestation réalisée par le laboratoire de Maxéville<br>NF EN ISO/IEC 17025:2005 COFRAC 1-0685<br>*NF EN ISO 9377-2 - Extraction L/L - GC / FID* | * | 0.3 | mg/l | | | |

(1) La date de début d'analyse correspond à la date de lancement d'une séquence analytique.
(2) Les résultats précédés du signe < correspondent aux limites de quantification. Ces limites de quantification sont de la responsabilité du laboratoire et peuvent être dépendantes de la matrice de l'échantillon.
**(3)** Valeurs données en référence à la règlementation en vigueur selon le ca
- Code de la Santé publique pour les analyses effectuées sur les eaux de consommation, de loisirs, les eaux conditionnées, les eaux thermales
- Arrêté du 1er février 2010 relatif à la surveillance des légionelles dans les réseaux de distribution d'eau chaude sanitaire
- Arrêté du 14 décembre 2013 relatif aux installations relevant du régime de la déclaration ou de l'enregistrement au titre de la rubrique n°2921 pour le suivi obligatoire de la concentration en *L. pneumophila* et/ou la surveillance des substances polluantes dans les eaux

Pour déclarer ou non la conformité aux limites ou références de qualité, il n'a pas été tenu compte de l'incertitude associée au résultat.
(4) Les résultats non conformes aux limites ou références de qualité sont signalé par un rond noir.

Les résultats ne se rapportent qu'à cet échantillon. Ce document comporte 2 page(s). La reproduction de ce document n'est autorisée que sous la forme de fac similé photographique intégral.

Seules certaines prestations rapportées dans ce document sont couvertes par l'accréditation. Elles sont identifiées par le symbole *.

Laboratoire agréé pour la réalisation de prélèvements et des analyses terrains et des analyses des paramètres du contrôle sanitaire des eaux - portée détaillée de l'agrément disponible sur demande.
Analyses effectuées par un laboratoire agréé par le ministère chargé de l'environnement dans les conditions de l'arrêté du 27 Octobre 2011.
Tous les éléments de traçabilité, ainsi que les incertitudes de mesure, sont disponibles sur demande.
Pour les résultats issus d'une sous-traitance, les rapports émis par des laboratoires accrédités sont disponibles sur demande.

AMOUR

Mahmoud Amour
Coordinateur de Projets Clients

**Eurofins IPL Est**
**Rue Lucien Cuenot site Saint Jacques II BP 51005 54521 Maxeville cedex**
**Tél 03 83 50 36 00 - fax 03 83 56 84 22 - site web : www.eurofins.fr/env**
**SAS au capital de 10 249 470 € RCS Nancy 756 800 090 Siret 756 800 090 00257 TVA FR 46 756 800 090**

ACCREDITATION
N° 1- 0685
Site de Maxéville
Portée disponible sur
www.cofrac.fr

cofrac ESSAIS

eurofins | Hydrologie

**BUREAU VERITAS SA**
**Monsieur François VILLAIN**
314 boulevard marcel paul
bp 20162
44802 SAINT HERBLAIN

# RAPPORT D'ANALYSE

N° de rapport d'analyse : AR-15-IX-028747-01 Version du : 19/03/2015 Page 1/2

Référence commande : 1510003606 15 344
Référence dossier : AFFAIRE N° 2776443/1/1

Echantillon N° : 15M013724-008 Référence échantillon : 8
Matrice : Eau de rejet / Eau résiduaire
Date de prélèvement : 13/03/2015 Date de réception : 14/03/2015 07:34:33
Début d'analyse (1) : 17/03/2015
Préleveur : VILLAIN François (CLIENT) - BVFVI -
Commune :

Observations :
L'heure de prélèvement n'étant pas renseignée, les délais de mise en analyse ont été calculés à partir d'une heure de prélèvement fixée par défaut à midi.

| Conservation de vos échantillons | |
|---|---|
| Les échantillons seront conservés sous conditions contrôlées pendant 2 semaines après validation des échantillons. Sans avis contraire, ils seront détruits après cette période sans aucune communication de notre part. Si vous désirez que les échantillons soient conservés plus longtemps, veuillez retourner ce document signé au plus tard une semaine avant la date d'issue. | |
| Conservation Supplémentaire : | |
| Nom : | Signature : |
| Date : | |

**Eurofins IPL Est**
**Rue Lucien Cuenot site Saint Jacques II BP 51005 54521 Maxeville cedex**
**Tél 03 83 50 36 00 - fax 03 83 56 84 22 - site web : www.eurofins.fr/env**
**SAS au capital de 10 249 470 € RCS Nancy 756 800 090 Siret 756 800 090 00257 TVA FR 46 756 800 090**

ACCREDITATION
N° 1- 0685
Site de Maxéville
Portée disponible sur
www.cofrac.fr

cofrac ESSAIS

eurofins | Hydrologie

N° de rapport d'analyse : AR-15-IX-028747-01 Version du : 19/03/2015 Page 2/2

## Hydrocarbures

| | (4) | Résultat (2) | Unité | Incertitude | Limites Qualité (3) | Réf. Qualité (3) |
|---|---|---|---|---|---|---|
| IX578 : **Indice Hydrocarbures (C10-C40)** Prestation réalisée par le laboratoire de Maxévill<br>NF EN ISO/IEC 17025:2005 COFRAC 1-0685<br>*NF EN ISO 9377-2 - Extraction L/L - GC / FID* | * | <0.1 | mg/l | | | |

(1) La date de début d'analyse correspond à la date de lancement d'une séquence analytique.
(2) Les résultats précédés du signe < correspondent aux limites de quantification. Ces limites de quantification sont de la responsabilité du laboratoire et peuvent être dépendantes de la matrice de l'échantillon.
**(3)** Valeurs données en référence à la règlementation en vigueur selon le ca
- Code de la Santé publique pour les analyses effectuées sur les eaux de consommation, de loisirs, les eaux conditionnées, les eaux thermales
- Arrêté du 1er février 2010 relatif à la surveillance des légionelles dans les réseaux de distribution d'eau chaude sanitaire
- Arrêté du 14 décembre 2013 relatif aux installations relevant du régime de la déclaration ou de l'enregistrement au titre de la rubrique n°2921 pour le suivi obligatoire de la concentration en *L. pneumophila* et/ou la surveillance des substances polluantes dans les eaux

Pour déclarer ou non la conformité aux limites ou références de qualité, il n'a pas été tenu compte de l'incertitude associée au résultat.
(4) Les résultats non conformes aux limites ou références de qualité sont signalé par un rond noir.

Les résultats ne se rapportent qu'à cet échantillon. Ce document comporte 2 page(s). La reproduction de ce document n'est autorisée que sous la forme de fac similé photographique intégral.

Seules certaines prestations rapportées dans ce document sont couvertes par l'accréditation. Elles sont identifiées par le symbole *.

Laboratoire agréé pour la réalisation de prélèvements et des analyses terrains et des analyses des paramètres du contrôle sanitaire des eaux - portée détaillée de l'agrément disponible sur demande.
Analyses effectuées par un laboratoire agréé par le ministère chargé de l'environnement dans les conditions de l'arrêté du 27 Octobre 2011.
Tous les éléments de traçabilité, ainsi que les incertitudes de mesure, sont disponibles sur demande.
Pour les résultats issus d'une sous-traitance, les rapports émis par des laboratoires accrédités sont disponibles sur demande.

AMOUR

Mahmoud Amour
Coordinateur de Projets Clients

**Eurofins IPL Est**
**Rue Lucien Cuenot site Saint Jacques II BP 51005 54521 Maxeville cedex**
**Tél 03 83 50 36 00 - fax 03 83 56 84 22 - site web : www.eurofins.fr/env**
**SAS au capital de 10 249 470 € RCS Nancy 756 800 090 Siret 756 800 090 00257 TVA FR 46 756 800 090**

ACCREDITATION
N° 1- 0685
Site de Maxéville
Portée disponible sur
www.cofrac.fr

cofrac ESSAIS

eurofins | Hydrologie

**BUREAU VERITAS SA**
**Monsieur François VILLAIN**
314 boulevard marcel paul
bp 20162
44802 SAINT HERBLAIN

# RAPPORT D'ANALYSE

N° de rapport d'analyse : AR-15-IX-028748-01 Version du : 19/03/2015 Page 1/2

Référence commande : 1510003606 15 344
Référence dossier : AFFAIRE N° 2776443/1/1

Echantillon N° : 15M013724-010 Référence échantillon : 10
Matrice : Eau de rejet / Eau résiduaire
Date de prélèvement : 13/03/2015 Date de réception : 14/03/2015 07:34:47
Début d'analyse (1) : 17/03/2015
Préleveur : VILLAIN François (CLIENT) - BVFVI -
Commune :

Observations :
L'heure de prélèvement n'étant pas renseignée, les délais de mise en analyse ont été calculés à partir d'une heure de prélèvement fixée par défaut à midi.

| Conservation de vos échantillons | |
|---|---|
| Les échantillons seront conservés sous conditions contrôlées pendant 2 semaines après validation des échantillons. Sans avis contraire, ils seront détruits après cette période sans aucune communication de notre part. Si vous désirez que les échantillons soient conservés plus longtemps, veuillez retourner ce document signé au plus tard une semaine avant la date d'issue. | |
| Conservation Supplémentaire : | |
| Nom : | Signature : |
| Date : | |

**Eurofins IPL Est**
**Rue Lucien Cuenot site Saint Jacques II BP 51005 54521 Maxeville cedex**
**Tél 03 83 50 36 00 - fax 03 83 56 84 22 - site web : www.eurofins.fr/env**
**SAS au capital de 10 249 470 € RCS Nancy 756 800 090 Siret 756 800 090 00257 TVA FR 46 756 800 090**

ACCREDITATION
N° 1- 0685
Site de Maxéville
Portée disponible sur
www.cofrac.fr

cofrac ESSAIS

eurofins | Hydrologie

N° de rapport d'analyse : AR-15-IX-028748-01 Version du : 19/03/2015 Page 2/2

## Hydrocarbures

| | (4) | Résultat (2) | Unité | Incertitude | Limites Qualité (3) | Réf. Qualité (3) |
|---|---|---|---|---|---|---|
| IX578 : **Indice Hydrocarbures (C10-C40)** Prestation réalisée par le laboratoire de Maxévill<br>NF EN ISO/IEC 17025:2005 COFRAC 1-0685<br>*NF EN ISO 9377-2 - Extraction L/L - GC / FID* | * | <0.1 | mg/l | | | |

(1) La date de début d'analyse correspond à la date de lancement d'une séquence analytique.
(2) Les résultats précédés du signe < correspondent aux limites de quantification. Ces limites de quantification sont de la responsabilité du laboratoire et peuvent être dépendantes de la matrice de l'échantillon.
**(3)** Valeurs données en référence à la règlementation en vigueur selon le ca
- Code de la Santé publique pour les analyses effectuées sur les eaux de consommation, de loisirs, les eaux conditionnées, les eaux thermales
- Arrêté du 1er février 2010 relatif à la surveillance des légionelles dans les réseaux de distribution d'eau chaude sanitaire
- Arrêté du 14 décembre 2013 relatif aux installations relevant du régime de la déclaration ou de l'enregistrement au titre de la rubrique n°2921 pour le suivi obligatoire de la concentration en *L. pneumophila* et/ou la surveillance des substances polluantes dans les eaux

Pour déclarer ou non la conformité aux limites ou références de qualité, il n'a pas été tenu compte de l'incertitude associée au résultat.
(4) Les résultats non conformes aux limites ou références de qualité sont signalé par un rond noir.

Les résultats ne se rapportent qu'à cet échantillon. Ce document comporte 2 page(s). La reproduction de ce document n'est autorisée que sous la forme de fac similé photographique intégral.

Seules certaines prestations rapportées dans ce document sont couvertes par l'accréditation. Elles sont identifiées par le symbole *.

Laboratoire agréé pour la réalisation de prélèvements et des analyses terrains et des analyses des paramètres du contrôle sanitaire des eaux - portée détaillée de l'agrément disponible sur demande.
Analyses effectuées par un laboratoire agréé par le ministère chargé de l'environnement dans les conditions de l'arrêté du 27 Octobre 2011.
Tous les éléments de traçabilité, ainsi que les incertitudes de mesure, sont disponibles sur demande.
Pour les résultats issus d'une sous-traitance, les rapports émis par des laboratoires accrédités sont disponibles sur demande.

AMOUR

Mahmoud Amour
Coordinateur de Projets Clients

**Eurofins IPL Est**
**Rue Lucien Cuenot site Saint Jacques II BP 51005 54521 Maxeville cedex**
**Tél 03 83 50 36 00 - fax 03 83 56 84 22 - site web : www.eurofins.fr/env**
**SAS au capital de 10 249 470 € RCS Nancy 756 800 090 Siret 756 800 090 00257 TVA FR 46 756 800 090**

ACCREDITATION
N° 1- 0685
Site de Maxéville
Portée disponible sur
www.cofrac.fr

cofrac ESSAIS

eurofins | Hydrologie

**BUREAU VERITAS SA**
**Monsieur François VILLAIN**
314 boulevard marcel paul
bp 20162
44802 SAINT HERBLAIN

# RAPPORT D'ANALYSE

N° de rapport d'analyse : AR-15-IX-028749-01 Version du : 19/03/2015 Page 1/2

Référence commande : 1510003606 15 344
Référence dossier : AFFAIRE N° 2776443/1/1

Echantillon N° : 15M013724-012 Référence échantillon : 12
Matrice : Eau de rejet / Eau résiduaire
Date de prélèvement : 13/03/2015 Date de réception : 14/03/2015 07:34:59
Début d'analyse (1) : 17/03/2015
Préleveur : VILLAIN François (CLIENT) - BVFVI -
Commune :

Observations :
L'heure de prélèvement n'étant pas renseignée, les délais de mise en analyse ont été calculés à partir d'une heure de prélèvement fixée par défaut à midi.

| Conservation de vos échantillons | |
|---|---|
| Les échantillons seront conservés sous conditions contrôlées pendant 2 semaines après validation des échantillons. Sans avis contraire, ils seront détruits après cette période sans aucune communication de notre part. Si vous désirez que les échantillons soient conservés plus longtemps, veuillez retourner ce document signé au plus tard une semaine avant la date d'issue. | |
| Conservation Supplémentaire : | |
| Nom : | Signature : |
| Date : | |

**Eurofins IPL Est**
**Rue Lucien Cuenot site Saint Jacques II BP 51005 54521 Maxeville cedex**
**Tél 03 83 50 36 00 - fax 03 83 56 84 22 - site web : www.eurofins.fr/env**
**SAS au capital de 10 249 470 € RCS Nancy 756 800 090 Siret 756 800 090 00257 TVA FR 46 756 800 090**

ACCREDITATION
N° 1- 0685
Site de Maxéville
Portée disponible sur
www.cofrac.fr

cofrac ESSAIS

eurofins | Hydrologie

N° de rapport d'analyse : AR-15-IX-028749-01 Version du : 19/03/2015 Page 2/2

## Hydrocarbures

| | (4) | Résultat (2) | Unité | Incertitude | Limites Qualité (3) | Réf. Qualité (3) |
|---|---|---|---|---|---|---|
| IX578 : **Indice Hydrocarbures (C10-C40)** Prestation réalisée par le laboratoire de Maxéville<br>NF EN ISO/IEC 17025:2005 COFRAC 1-0685<br>*NF EN ISO 9377-2 - Extraction L/L - GC / FID* | * | <0.1 | mg/l | | | |

(1) La date de début d'analyse correspond à la date de lancement d'une séquence analytique.
(2) Les résultats précédés du signe < correspondent aux limites de quantification. Ces limites de quantification sont de la responsabilité du laboratoire et peuvent être dépendantes de la matrice de l'échantillon.
**(3)** Valeurs données en référence à la règlementation en vigueur selon le ca
- Code de la Santé publique pour les analyses effectuées sur les eaux de consommation, de loisirs, les eaux conditionnées, les eaux thermales
- Arrêté du 1er février 2010 relatif à la surveillance des légionelles dans les réseaux de distribution d'eau chaude sanitaire
- Arrêté du 14 décembre 2013 relatif aux installations relevant du régime de la déclaration ou de l'enregistrement au titre de la rubrique n°2921 pour le suivi obligatoire de la concentration en *L. pneumophila* et/ou la surveillance des substances polluantes dans les eaux

Pour déclarer ou non la conformité aux limites ou références de qualité, il n'a pas été tenu compte de l'incertitude associée au résultat.
(4) Les résultats non conformes aux limites ou références de qualité sont signalé par un rond noir.

Les résultats ne se rapportent qu'à cet échantillon. Ce document comporte 2 page(s). La reproduction de ce document n'est autorisée que sous la forme de fac similé photographique intégral.

Seules certaines prestations rapportées dans ce document sont couvertes par l'accréditation. Elles sont identifiées par le symbole *.

Laboratoire agréé pour la réalisation de prélèvements et des analyses terrains et des analyses des paramètres du contrôle sanitaire des eaux - portée détaillée de l'agrément disponible sur demande.
Analyses effectuées par un laboratoire agréé par le ministère chargé de l'environnement dans les conditions de l'arrêté du 27 Octobre 2011.
Tous les éléments de traçabilité, ainsi que les incertitudes de mesure, sont disponibles sur demande.
Pour les résultats issus d'une sous-traitance, les rapports émis par des laboratoires accrédités sont disponibles sur demande.

AMOUR

Mahmoud Amour
Coordinateur de Projets Clients

**Eurofins IPL Est**
**Rue Lucien Cuenot site Saint Jacques II BP 51005 54521 Maxeville cedex**
**Tél 03 83 50 36 00 - fax 03 83 56 84 22 - site web : www.eurofins.fr/env**
**SAS au capital de 10 249 470 € RCS Nancy 756 800 090 Siret 756 800 090 00257 TVA FR 46 756 800 090**

ACCREDITATION
N° 1- 0685
Site de Maxéville
Portée disponible sur
www.cofrac.fr

cofrac ESSAIS

eurofins | Hydrologie

**BUREAU VERITAS SA**
**Monsieur François VILLAIN**
314 boulevard marcel paul
bp 20162
44802 SAINT HERBLAIN

# RAPPORT D'ANALYSE

N° de rapport d'analyse : AR-15-IX-029105-01 Version du : 20/03/2015 Page 1/2

Référence commande : 1510003606 15 344
Référence dossier : AFFAIRE N° 2776443/1/1

Echantillon N° : 15M013724-001 Référence échantillon : 1
Matrice : Eau de rejet / Eau résiduaire
Date de prélèvement : 13/03/2015 Date de réception : 14/03/2015 07:33:44
Début d'analyse (1) : 17/03/2015
Préleveur : VILLAIN François (CLIENT) - BVFVI -
Commune :

Observations :
L'heure de prélèvement n'étant pas renseignée, les délais de mise en analyse ont été calculés à partir d'une heure de prélèvement fixée par défaut à midi.

| Conservation de vos échantillons | |
|---|---|
| Les échantillons seront conservés sous conditions contrôlées pendant 2 semaines après validation des échantillons. Sans avis contraire, ils seront détruits après cette période sans aucune communication de notre part. Si vous désirez que les échantillons soient conservés plus longtemps, veuillez retourner ce document signé au plus tard une semaine avant la date d'issue. | |
| Conservation Supplémentaire : | |
| Nom : | Signature : |
| Date : | |

**Eurofins IPL Est**
**Rue Lucien Cuenot site Saint Jacques II BP 51005 54521 Maxeville cedex**
**Tél 03 83 50 36 00 - fax 03 83 56 84 22 - site web : www.eurofins.fr/env**
**SAS au capital de 10 249 470 € RCS Nancy 756 800 090 Siret 756 800 090 00257 TVA FR 46 756 800 090**

ACCREDITATION
N° 1- 0685
Site de Maxéville
Portée disponible sur
www.cofrac.fr

cofrac ESSAIS

eurofins | Hydrologie

N° de rapport d'analyse : AR-15-IX-029105-01 Version du : 20/03/2015 Page 2/2

## Hydrocarbures

| | (4) | Résultat (2) | Unité | Incertitude | Limites Qualité (3) | Réf. Qualité (3) |
|---|---|---|---|---|---|---|
| IX578 : **Indice Hydrocarbures (C10-C40)** Prestation réalisée par le laboratoire de Maxéville<br>NF EN ISO/IEC 17025:2005 COFRAC 1-0685<br>*NF EN ISO 9377-2 - Extraction L/L - GC / FID* | * | <0.1 | mg/l | | | |

(1) La date de début d'analyse correspond à la date de lancement d'une séquence analytique.
(2) Les résultats précédés du signe < correspondent aux limites de quantification. Ces limites de quantification sont de la responsabilité du laboratoire et peuvent être dépendantes de la matrice de l'échantillon.
**(3)** Valeurs données en référence à la règlementation en vigueur selon le ca
- Code de la Santé publique pour les analyses effectuées sur les eaux de consommation, de loisirs, les eaux conditionnées, les eaux thermales
- Arrêté du 1er février 2010 relatif à la surveillance des légionelles dans les réseaux de distribution d'eau chaude sanitaire
- Arrêté du 14 décembre 2013 relatif aux installations relevant du régime de la déclaration ou de l'enregistrement au titre de la rubrique n°2921 pour le suivi obligatoire de la concentration en *L. pneumophila* et/ou la surveillance des substances polluantes dans les eaux

Pour déclarer ou non la conformité aux limites ou références de qualité, il n'a pas été tenu compte de l'incertitude associée au résultat.
(4) Les résultats non conformes aux limites ou références de qualité sont signalé par un rond noir.

Les résultats ne se rapportent qu'à cet échantillon. Ce document comporte 2 page(s). La reproduction de ce document n'est autorisée que sous la forme de fac similé photographique intégral.

Seules certaines prestations rapportées dans ce document sont couvertes par l'accréditation. Elles sont identifiées par le symbole *.

Laboratoire agréé pour la réalisation de prélèvements et des analyses terrains et des analyses des paramètres du contrôle sanitaire des eaux - portée détaillée de l'agrément disponible sur demande.
Analyses effectuées par un laboratoire agréé par le ministère chargé de l'environnement dans les conditions de l'arrêté du 27 Octobre 2011.
Tous les éléments de traçabilité, ainsi que les incertitudes de mesure, sont disponibles sur demande.
Pour les résultats issus d'une sous-traitance, les rapports émis par des laboratoires accrédités sont disponibles sur demande.

Julie Herbé
Coordinateur de Projets Clients

**Eurofins IPL Est**
**Rue Lucien Cuenot site Saint Jacques II BP 51005 54521 Maxeville cedex**
**Tél 03 83 50 36 00 - fax 03 83 56 84 22 - site web : www.eurofins.fr/env**
**SAS au capital de 10 249 470 € RCS Nancy 756 800 090 Siret 756 800 090 00257 TVA FR 46 756 800 090**

ACCREDITATION
N° 1- 0685
Site de Maxéville
Portée disponible sur
www.cofrac.fr

cofrac ESSAIS

eurofins | Hydrologie

**BUREAU VERITAS SA**
**Monsieur François VILLAIN**
314 boulevard marcel paul
bp 20162
44802 SAINT HERBLAIN

# RAPPORT D'ANALYSE

N° de rapport d'analyse : AR-15-IX-029106-01 Version du : 20/03/2015 Page 1/2

Référence commande : 1510003606 15 344
Référence dossier : AFFAIRE N° 2776443/1/1

Echantillon N° : 15M013724-003 Référence échantillon : 3
Matrice : Eau de rejet / Eau résiduaire
Date de prélèvement : 13/03/2015 Date de réception : 14/03/2015 07:33:55
Début d'analyse (1) : 17/03/2015
Préleveur : VILLAIN François (CLIENT) - BVFVI -
Commune :

Observations :
L'heure de prélèvement n'étant pas renseignée, les délais de mise en analyse ont été calculés à partir d'une heure de prélèvement fixée par défaut à midi.

| Conservation de vos échantillons | |
|---|---|
| Les échantillons seront conservés sous conditions contrôlées pendant 2 semaines après validation des échantillons. Sans avis contraire, ils seront détruits après cette période sans aucune communication de notre part. Si vous désirez que les échantillons soient conservés plus longtemps, veuillez retourner ce document signé au plus tard une semaine avant la date d'issue. | |
| Conservation Supplémentaire : | |
| Nom : | Signature : |
| Date : | |

**Eurofins IPL Est**
**Rue Lucien Cuenot site Saint Jacques II BP 51005 54521 Maxeville cedex**
**Tél 03 83 50 36 00 - fax 03 83 56 84 22 - site web : www.eurofins.fr/env**
**SAS au capital de 10 249 470 € RCS Nancy 756 800 090 Siret 756 800 090 00257 TVA FR 46 756 800 090**

ACCREDITATION
N° 1- 0685
Site de Maxéville
Portée disponible sur
www.cofrac.fr

cofrac ESSAIS

eurofins | Hydrologie

N° de rapport d'analyse : AR-15-IX-029106-01 Version du : 20/03/2015 Page 2/2

| Hydrocarbures | (4) | Résultat (2) | Unité | Incertitude | Limites Qualité (3) | Réf. Qualité (3) |
|---|---|---|---|---|---|---|
| IX578 : **Indice Hydrocarbures (C10-C40)** Prestation réalisée par le laboratoire de Maxéville<br>NF EN ISO/IEC 17025:2005 COFRAC 1-0685<br>*NF EN ISO 9377-2 - Extraction L/L - GC / FID* | * | 986 | mg/l | | | |

(1) La date de début d'analyse correspond à la date de lancement d'une séquence analytique.
(2) Les résultats précédés du signe < correspondent aux limites de quantification. Ces limites de quantification sont de la responsabilité du laboratoire et peuvent être dépendantes de la matrice de l'échantillon.
**(3)** Valeurs données en référence à la règlementation en vigueur selon le ca
- Code de la Santé publique pour les analyses effectuées sur les eaux de consommation, de loisirs, les eaux conditionnées, les eaux thermales
- Arrêté du 1er février 2010 relatif à la surveillance des légionelles dans les réseaux de distribution d'eau chaude sanitaire
- Arrêté du 14 décembre 2013 relatif aux installations relevant du régime de la déclaration ou de l'enregistrement au titre de la rubrique n°2921 pour le suivi obligatoire de la concentration en *L. pneumophila* et/ou la surveillance des substances polluantes dans les eaux

Pour déclarer ou non la conformité aux limites ou références de qualité, il n'a pas été tenu compte de l'incertitude associée au résultat.
(4) Les résultats non conformes aux limites ou références de qualité sont signalé par un rond noir.

Les résultats ne se rapportent qu'à cet échantillon. Ce document comporte 2 page(s). La reproduction de ce document n'est autorisée que sous la forme de fac similé photographique intégral.

Seules certaines prestations rapportées dans ce document sont couvertes par l'accréditation. Elles sont identifiées par le symbole *.

Laboratoire agréé pour la réalisation de prélèvements et des analyses terrains et des analyses des paramètres du contrôle sanitaire des eaux - portée détaillée de l'agrément disponible sur demande.
Analyses effectuées par un laboratoire agréé par le ministère chargé de l'environnement dans les conditions de l'arrêté du 27 Octobre 2011.
Tous les éléments de traçabilité, ainsi que les incertitudes de mesure, sont disponibles sur demande.
Pour les résultats issus d'une sous-traitance, les rapports émis par des laboratoires accrédités sont disponibles sur demande.

Julie Herbé
Coordinateur de Projets Clients

**Eurofins IPL Est**
**Rue Lucien Cuenot site Saint Jacques II BP 51005 54521 Maxeville cedex**
**Tél 03 83 50 36 00 - fax 03 83 56 84 22 - site web : www.eurofins.fr/env**
**SAS au capital de 10 249 470 € RCS Nancy 756 800 090 Siret 756 800 090 00257 TVA FR 46 756 800 090**

ACCREDITATION
N° 1- 0685
Site de Maxéville
Portée disponible sur
www.cofrac.fr

cofrac ESSAIS

eurofins | Hydrologie

**BUREAU VERITAS SA**
**Monsieur François VILLAIN**
314 boulevard marcel paul
bp 20162
44802 SAINT HERBLAIN

# RAPPORT D'ANALYSE

N° de rapport d'analyse : AR-15-IX-029107-01 Version du : 20/03/2015 Page 1/2

Référence commande : 1510003606 15 344
Référence dossier : AFFAIRE N° 2776443/1/1

Echantillon N° : 15M013724-005 Référence échantillon : 5
Matrice : Eau de rejet / Eau résiduaire
Date de prélèvement : 13/03/2015 Date de réception : 14/03/2015 07:34:15
Début d'analyse (1) : 17/03/2015
Préleveur : VILLAIN François (CLIENT) - BVFVI -
Commune :

Observations :
L'heure de prélèvement n'étant pas renseignée, les délais de mise en analyse ont été calculés à partir d'une heure de prélèvement fixée par défaut à midi.

| Conservation de vos échantillons | |
|---|---|
| Les échantillons seront conservés sous conditions contrôlées pendant 2 semaines après validation des échantillons. Sans avis contraire, ils seront détruits après cette période sans aucune communication de notre part. Si vous désirez que les échantillons soient conservés plus longtemps, veuillez retourner ce document signé au plus tard une semaine avant la date d'issue. | |
| Conservation Supplémentaire : | |
| Nom : | Signature : |
| Date : | |

**Eurofins IPL Est**
**Rue Lucien Cuenot site Saint Jacques II BP 51005 54521 Maxeville cedex**
**Tél 03 83 50 36 00 - fax 03 83 56 84 22 - site web : www.eurofins.fr/env**
**SAS au capital de 10 249 470 € RCS Nancy 756 800 090 Siret 756 800 090 00257 TVA FR 46 756 800 090**

ACCREDITATION
N° 1- 0685
Site de Maxéville
Portée disponible sur
www.cofrac.fr

cofrac ESSAIS

eurofins | Hydrologie

N° de rapport d'analyse : AR-15-IX-029107-01 Version du : 20/03/2015 Page 2/2

## Hydrocarbures

| | | (4) | Résultat (2) | Unité | Incertitude | Limites Qualité (3) | Réf. Qualité (3) |
|---|---|---|---|---|---|---|---|
| IX578 : **Indice Hydrocarbures (C10-C40)** Prestation réalisée par le laboratoire de Maxévill<br>NF EN ISO/IEC 17025:2005 COFRAC 1-0685<br>*NF EN ISO 9377-2 - Extraction L/L - GC / FID* | | * | 3760 | mg/l | | | |

(1) La date de début d'analyse correspond à la date de lancement d'une séquence analytique.
(2) Les résultats précédés du signe < correspondent aux limites de quantification. Ces limites de quantification sont de la responsabilité du laboratoire et peuvent être dépendantes de la matrice de l'échantillon.
**(3)** Valeurs données en référence à la règlementation en vigueur selon le ca
- Code de la Santé publique pour les analyses effectuées sur les eaux de consommation, de loisirs, les eaux conditionnées, les eaux thermales
- Arrêté du 1er février 2010 relatif à la surveillance des légionelles dans les réseaux de distribution d'eau chaude sanitaire
- Arrêté du 14 décembre 2013 relatif aux installations relevant du régime de la déclaration ou de l'enregistrement au titre de la rubrique n°2921 pour le suivi obligatoire de la concentration en *L. pneumophila* et/ou la surveillance des substances polluantes dans les eaux

Pour déclarer ou non la conformité aux limites ou références de qualité, il n'a pas été tenu compte de l'incertitude associée au résultat.
(4) Les résultats non conformes aux limites ou références de qualité sont signalé par un rond noir.

Les résultats ne se rapportent qu'à cet échantillon. Ce document comporte 2 page(s). La reproduction de ce document n'est autorisée que sous la forme de fac similé photographique intégral.

Seules certaines prestations rapportées dans ce document sont couvertes par l'accréditation. Elles sont identifiées par le symbole *.

Laboratoire agréé pour la réalisation de prélèvements et des analyses terrains et des analyses des paramètres du contrôle sanitaire des eaux - portée détaillée de l'agrément disponible sur demande.
Analyses effectuées par un laboratoire agréé par le ministère chargé de l'environnement dans les conditions de l'arrêté du 27 Octobre 2011.
Tous les éléments de traçabilité, ainsi que les incertitudes de mesure, sont disponibles sur demande.
Pour les résultats issus d'une sous-traitance, les rapports émis par des laboratoires accrédités sont disponibles sur demande.

Julie Herbé
Coordinateur de Projets Clients

**Eurofins IPL Est**
**Rue Lucien Cuenot site Saint Jacques II BP 51005 54521 Maxeville cedex**
**Tél 03 83 50 36 00 - fax 03 83 56 84 22 - site web : www.eurofins.fr/env**
**SAS au capital de 10 249 470 € RCS Nancy 756 800 090 Siret 756 800 090 00257 TVA FR 46 756 800 090**

ACCREDITATION
N° 1- 0685
Site de Maxéville
Portée disponible sur
www.cofrac.fr

cofrac ESSAIS

eurofins | Hydrologie

**BUREAU VERITAS SA**
**Monsieur François VILLAIN**
314 boulevard marcel paul
bp 20162
44802 SAINT HERBLAIN

# RAPPORT D'ANALYSE

N° de rapport d'analyse : AR-15-IX-029108-01 Version du : 20/03/2015 Page 1/2

Référence commande : 1510003606 15 344
Référence dossier : AFFAIRE N° 2776443/1/1

Echantillon N° : 15M013724-009 Référence échantillon : 9
Matrice : Eau de rejet / Eau résiduaire
Date de prélèvement : 13/03/2015 Date de réception : 14/03/2015 07:34:39
Début d'analyse (1) : 17/03/2015
Préleveur : VILLAIN François (CLIENT) - BVFVI -
Commune :

Observations :
L'heure de prélèvement n'étant pas renseignée, les délais de mise en analyse ont été calculés à partir d'une heure de prélèvement fixée par défaut à midi.

| Conservation de vos échantillons | |
|---|---|
| Les échantillons seront conservés sous conditions contrôlées pendant 2 semaines après validation des échantillons. Sans avis contraire, ils seront détruits après cette période sans aucune communication de notre part. Si vous désirez que les échantillons soient conservés plus longtemps, veuillez retourner ce document signé au plus tard une semaine avant la date d'issue. | |
| Conservation Supplémentaire : | |
| Nom : | Signature : |
| Date : | |

**Eurofins IPL Est**
**Rue Lucien Cuenot site Saint Jacques II BP 51005 54521 Maxeville cedex**
**Tél 03 83 50 36 00 - fax 03 83 56 84 22 - site web : www.eurofins.fr/env**
**SAS au capital de 10 249 470 € RCS Nancy 756 800 090 Siret 756 800 090 00257 TVA FR 46 756 800 090**

ACCREDITATION
N° 1- 0685
Site de Maxéville
Portée disponible sur
www.cofrac.fr

cofrac ESSAIS

eurofins | Hydrologie

N° de rapport d'analyse : AR-15-IX-029108-01 Version du : 20/03/2015 Page 2/2

## Hydrocarbures

| | | (4) | Résultat (2) | Unité | Incertitude | Limites Qualité (3) | Réf. Qualité (3) |
|---|---|---|---|---|---|---|---|
| IX578 : **Indice Hydrocarbures (C10-C40)** Prestation réalisée par le laboratoire de Maxéville<br>NF EN ISO/IEC 17025:2005 COFRAC 1-0685<br>*NF EN ISO 9377-2 - Extraction L/L - GC / FID* | | * | 92.4 | mg/l | | | |

(1) La date de début d'analyse correspond à la date de lancement d'une séquence analytique.
(2) Les résultats précédés du signe < correspondent aux limites de quantification. Ces limites de quantification sont de la responsabilité du laboratoire et peuvent être dépendantes de la matrice de l'échantillon.
**(3)** Valeurs données en référence à la règlementation en vigueur selon le ca
- Code de la Santé publique pour les analyses effectuées sur les eaux de consommation, de loisirs, les eaux conditionnées, les eaux thermales
- Arrêté du 1er février 2010 relatif à la surveillance des légionelles dans les réseaux de distribution d'eau chaude sanitaire
- Arrêté du 14 décembre 2013 relatif aux installations relevant du régime de la déclaration ou de l'enregistrement au titre de la rubrique n°2921 pour le suivi obligatoire de la concentration en *L. pneumophila* et/ou la surveillance des substances polluantes dans les eaux

Pour déclarer ou non la conformité aux limites ou références de qualité, il n'a pas été tenu compte de l'incertitude associée au résultat.
(4) Les résultats non conformes aux limites ou références de qualité sont signalé par un rond noir.

Les résultats ne se rapportent qu'à cet échantillon. Ce document comporte 2 page(s). La reproduction de ce document n'est autorisée que sous la forme de fac similé photographique intégral.

Seules certaines prestations rapportées dans ce document sont couvertes par l'accréditation. Elles sont identifiées par le symbole *.

Laboratoire agréé pour la réalisation de prélèvements et des analyses terrains et des analyses des paramètres du contrôle sanitaire des eaux - portée détaillée de l'agrément disponible sur demande.
Analyses effectuées par un laboratoire agréé par le ministère chargé de l'environnement dans les conditions de l'arrêté du 27 Octobre 2011.
Tous les éléments de traçabilité, ainsi que les incertitudes de mesure, sont disponibles sur demande.
Pour les résultats issus d'une sous-traitance, les rapports émis par des laboratoires accrédités sont disponibles sur demande.

Julie Herbé
Coordinateur de Projets Clients

**Eurofins IPL Est**
**Rue Lucien Cuenot site Saint Jacques II BP 51005 54521 Maxeville cedex**
**Tél 03 83 50 36 00 - fax 03 83 56 84 22 - site web : www.eurofins.fr/env**
**SAS au capital de 10 249 470 € RCS Nancy 756 800 090 Siret 756 800 090 00257 TVA FR 46 756 800 090**

ACCREDITATION
N° 1- 0685
Site de Maxéville
Portée disponible sur
www.cofrac.fr

cofrac ESSAIS

eurofins | Hydrologie

**BUREAU VERITAS SA**
**Monsieur François VILLAIN**
314 boulevard marcel paul
bp 20162
44802 SAINT HERBLAIN

# RAPPORT D'ANALYSE

N° de rapport d'analyse : AR-15-IX-029109-01 Version du : 20/03/2015 Page 1/2

Référence commande : 1510003606 15 344
Référence dossier : AFFAIRE N° 2776443/1/1

Echantillon N° : 15M013724-011 Référence échantillon : 11
Matrice : Eau de rejet / Eau résiduaire
Date de prélèvement : 13/03/2015 Date de réception : 14/03/2015 07:33:27
Début d'analyse (1) : 17/03/2015
Préleveur : VILLAIN François (CLIENT) - BVFVI -
Commune :

Observations :
L'heure de prélèvement n'étant pas renseignée, les délais de mise en analyse ont été calculés à partir d'une heure de prélèvement fixée par défaut à midi.

| Conservation de vos échantillons | |
|---|---|
| Les échantillons seront conservés sous conditions contrôlées pendant 2 semaines après validation des échantillons. Sans avis contraire, ils seront détruits après cette période sans aucune communication de notre part. Si vous désirez que les échantillons soient conservés plus longtemps, veuillez retourner ce document signé au plus tard une semaine avant la date d'issue. | |
| Conservation Supplémentaire : | |
| Nom : | Signature : |
| Date : | |

**Eurofins IPL Est**
**Rue Lucien Cuenot site Saint Jacques II BP 51005 54521 Maxeville cedex**
**Tél 03 83 50 36 00 - fax 03 83 56 84 22 - site web : www.eurofins.fr/env**
**SAS au capital de 10 249 470 € RCS Nancy 756 800 090 Siret 756 800 090 00257 TVA FR 46 756 800 090**

ACCREDITATION
N° 1- 0685
Site de Maxéville
Portée disponible sur
www.cofrac.fr

cofrac ESSAIS

eurofins | Hydrologie

N° de rapport d'analyse : AR-15-IX-029109-01 Version du : 20/03/2015 Page 2/2

## Hydrocarbures

| | | (4) | Résultat (2) | Unité | Incertitude | Limites Qualité (3) | Réf. Qualité (3) |
|---|---|---|---|---|---|---|---|
| IX578 : **Indice Hydrocarbures (C10-C40)** Prestation réalisée par le laboratoire de Maxéville<br>NF EN ISO/IEC 17025:2005 COFRAC 1-0685<br>*NF EN ISO 9377-2 - Extraction L/L - GC / FID* | | * | 1090 | mg/l | | | |

(1) La date de début d'analyse correspond à la date de lancement d'une séquence analytique.
(2) Les résultats précédés du signe < correspondent aux limites de quantification. Ces limites de quantification sont de la responsabilité du laboratoire et peuvent être dépendantes de la matrice de l'échantillon.
**(3)** Valeurs données en référence à la règlementation en vigueur selon le ca
- Code de la Santé publique pour les analyses effectuées sur les eaux de consommation, de loisirs, les eaux conditionnées, les eaux thermales
- Arrêté du 1er février 2010 relatif à la surveillance des légionelles dans les réseaux de distribution d'eau chaude sanitaire
- Arrêté du 14 décembre 2013 relatif aux installations relevant du régime de la déclaration ou de l'enregistrement au titre de la rubrique n°2921 pour le suivi obligatoire de la concentration en *L. pneumophila* et/ou la surveillance des substances polluantes dans les eaux

Pour déclarer ou non la conformité aux limites ou références de qualité, il n'a pas été tenu compte de l'incertitude associée au résultat.
(4) Les résultats non conformes aux limites ou références de qualité sont signalé par un rond noir.

Les résultats ne se rapportent qu'à cet échantillon. Ce document comporte 2 page(s). La reproduction de ce document n'est autorisée que sous la forme de fac similé photographique intégral.

Seules certaines prestations rapportées dans ce document sont couvertes par l'accréditation. Elles sont identifiées par le symbole *.

Laboratoire agréé pour la réalisation de prélèvements et des analyses terrains et des analyses des paramètres du contrôle sanitaire des eaux - portée détaillée de l'agrément disponible sur demande.
Analyses effectuées par un laboratoire agréé par le ministère chargé de l'environnement dans les conditions de l'arrêté du 27 Octobre 2011.
Tous les éléments de traçabilité, ainsi que les incertitudes de mesure, sont disponibles sur demande.
Pour les résultats issus d'une sous-traitance, les rapports émis par des laboratoires accrédités sont disponibles sur demande.

Julie Herbé
Coordinateur de Projets Clients

**Eurofins IPL Est**
**Rue Lucien Cuenot site Saint Jacques II BP 51005 54521 Maxeville cedex**
**Tél 03 83 50 36 00 - fax 03 83 56 84 22 - site web : www.eurofins.fr/env**
**SAS au capital de 10 249 470 € RCS Nancy 756 800 090 Siret 756 800 090 00257 TVA FR 46 756 800 090**

ACCREDITATION
N° 1- 0685
Site de Maxéville
Portée disponible sur
www.cofrac.fr

cofrac ESSAIS

eurofins | Hydrologie

**BUREAU VERITAS SA**
**Monsieur François VILLAIN**
314 boulevard marcel paul
bp 20162
44802 SAINT HERBLAIN

# RAPPORT D'ANALYSE

N° de rapport d'analyse : AR-15-IX-028743-01 Version du : 19/03/2015 Page 1/2

Référence commande : 1510003606 15 344
Référence dossier : AFFAIRE N° 2776443/1/1

Echantillon N° : 15M013724-002 Référence échantillon : 2
Matrice : Eau de rejet / Eau résiduaire
Date de prélèvement : 13/03/2015 Date de réception : 14/03/2015 07:33:50
Début d'analyse (1) : 17/03/2015
Préleveur : VILLAIN François (CLIENT) - BVFVI -
Commune :

Observations :
L'heure de prélèvement n'étant pas renseignée, les délais de mise en analyse ont été calculés à partir d'une heure de prélèvement fixée par défaut à midi.

| Conservation de vos échantillons | |
|---|---|
| Les échantillons seront conservés sous conditions contrôlées pendant 2 semaines après validation des échantillons. Sans avis contraire, ils seront détruits après cette période sans aucune communication de notre part. Si vous désirez que les échantillons soient conservés plus longtemps, veuillez retourner ce document signé au plus tard une semaine avant la date d'issue. | |
| Conservation Supplémentaire : | |
| Nom : | Signature : |
| Date : | |

**Eurofins IPL Est**
**Rue Lucien Cuenot site Saint Jacques II BP 51005 54521 Maxeville cedex**
**Tél 03 83 50 36 00 - fax 03 83 56 84 22 - site web : www.eurofins.fr/env**
**SAS au capital de 10 249 470 € RCS Nancy 756 800 090 Siret 756 800 090 00257 TVA FR 46 756 800 090**

ACCREDITATION
N° 1- 0685
Site de Maxéville
Portée disponible sur
www.cofrac.fr

cofrac ESSAIS

eurofins | Hydrologie

N° de rapport d'analyse : AR-15-IX-028743-01 Version du : 19/03/2015 Page 2/2

## Hydrocarbures

| | (4) | Résultat (2) | Unité | Incertitude | Limites Qualité (3) | Réf. Qualité (3) |
|---|---|---|---|---|---|---|
| IX578 : **Indice Hydrocarbures (C10-C40)** Prestation réalisée par le laboratoire de Maxéville<br>NF EN ISO/IEC 17025:2005 COFRAC 1-0685<br>*NF EN ISO 9377-2 - Extraction L/L - GC / FID* | * | <0.1 | mg/l | | | |

(1) La date de début d'analyse correspond à la date de lancement d'une séquence analytique.
(2) Les résultats précédés du signe < correspondent aux limites de quantification. Ces limites de quantification sont de la responsabilité du laboratoire et peuvent être dépendantes de la matrice de l'échantillon.
**(3)** Valeurs données en référence à la règlementation en vigueur selon le ca
- Code de la Santé publique pour les analyses effectuées sur les eaux de consommation, de loisirs, les eaux conditionnées, les eaux thermales
- Arrêté du 1er février 2010 relatif à la surveillance des légionelles dans les réseaux de distribution d'eau chaude sanitaire
- Arrêté du 14 décembre 2013 relatif aux installations relevant du régime de la déclaration ou de l'enregistrement au titre de la rubrique n°2921 pour le suivi obligatoire de la concentration en *L. pneumophila* et/ou la surveillance des substances polluantes dans les eaux

Pour déclarer ou non la conformité aux limites ou références de qualité, il n'a pas été tenu compte de l'incertitude associée au résultat.
(4) Les résultats non conformes aux limites ou références de qualité sont signalé par un rond noir.

Les résultats ne se rapportent qu'à cet échantillon. Ce document comporte 2 page(s). La reproduction de ce document n'est autorisée que sous la forme de fac similé photographique intégral.

Seules certaines prestations rapportées dans ce document sont couvertes par l'accréditation. Elles sont identifiées par le symbole *.

Laboratoire agréé pour la réalisation de prélèvements et des analyses terrains et des analyses des paramètres du contrôle sanitaire des eaux - portée détaillée de l'agrément disponible sur demande.
Analyses effectuées par un laboratoire agréé par le ministère chargé de l'environnement dans les conditions de l'arrêté du 27 Octobre 2011.
Tous les éléments de traçabilité, ainsi que les incertitudes de mesure, sont disponibles sur demande.
Pour les résultats issus d'une sous-traitance, les rapports émis par des laboratoires accrédités sont disponibles sur demande.

AMOUR

Mahmoud Amour
Coordinateur de Projets Clients

**Eurofins IPL Est**
**Rue Lucien Cuenot site Saint Jacques II BP 51005 54521 Maxeville cedex**
**Tél 03 83 50 36 00 - fax 03 83 56 84 22 - site web : www.eurofins.fr/env**
**SAS au capital de 10 249 470 € RCS Nancy 756 800 090 Siret 756 800 090 00257 TVA FR 46 756 800 090**

ACCREDITATION
N° 1- 0685
Site de Maxéville
Portée disponible sur
www.cofrac.fr

cofrac ESSAIS

eurofins | Hydrologie

**BUREAU VERITAS SA**
**Monsieur François VILLAIN**
314 boulevard marcel paul
bp 20162
44802 SAINT HERBLAIN

# RAPPORT D'ANALYSE

N° de rapport d'analyse : AR-15-IX-028744-01 Version du : 19/03/2015 Page 1/2

Référence commande : 1510003606 15 344
Référence dossier : AFFAIRE N° 2776443/1/1

Echantillon N° : 15M013724-004 Référence échantillon : 4
Matrice : Eau de rejet / Eau résiduaire
Date de prélèvement : 13/03/2015 Date de réception : 14/03/2015 07:34:07
Début d'analyse (1) : 17/03/2015
Préleveur : VILLAIN François (CLIENT) - BVFVI -
Commune :

Observations :
L'heure de prélèvement n'étant pas renseignée, les délais de mise en analyse ont été calculés à partir d'une heure de prélèvement fixée par défaut à midi.

| Conservation de vos échantillons | |
|---|---|
| Les échantillons seront conservés sous conditions contrôlées pendant 2 semaines après validation des échantillons. Sans avis contraire, ils seront détruits après cette période sans aucune communication de notre part. Si vous désirez que les échantillons soient conservés plus longtemps, veuillez retourner ce document signé au plus tard une semaine avant la date d'issue. | |
| Conservation Supplémentaire : | |
| Nom : | Signature : |
| Date : | |

**Eurofins IPL Est**
**Rue Lucien Cuenot site Saint Jacques II BP 51005 54521 Maxeville cedex**
**Tél 03 83 50 36 00 - fax 03 83 56 84 22 - site web : www.eurofins.fr/env**
**SAS au capital de 10 249 470 € RCS Nancy 756 800 090 Siret 756 800 090 00257 TVA FR 46 756 800 090**

ACCREDITATION
N° 1- 0685
Site de Maxéville
Portée disponible sur
www.cofrac.fr

cofrac ESSAIS

eurofins | Hydrologie

N° de rapport d'analyse : AR-15-IX-028744-01 Version du : 19/03/2015 Page 2/2

## Hydrocarbures

| | (4) | Résultat (2) | Unité | Incertitude | Limites Qualité (3) | Réf. Qualité (3) |
|---|---|---|---|---|---|---|
| IX578 : **Indice Hydrocarbures (C10-C40)** Prestation réalisée par le laboratoire de Maxéville<br>NF EN ISO/IEC 17025:2005 COFRAC 1-0685<br>*NF EN ISO 9377-2 - Extraction L/L - GC / FID* | * | <0.1 | mg/l | | | |

(1) La date de début d'analyse correspond à la date de lancement d'une séquence analytique.
(2) Les résultats précédés du signe < correspondent aux limites de quantification. Ces limites de quantification sont de la responsabilité du laboratoire et peuvent être dépendantes de la matrice de l'échantillon.
**(3)** Valeurs données en référence à la règlementation en vigueur selon le ca
- Code de la Santé publique pour les analyses effectuées sur les eaux de consommation, de loisirs, les eaux conditionnées, les eaux thermales
- Arrêté du 1er février 2010 relatif à la surveillance des légionelles dans les réseaux de distribution d'eau chaude sanitaire
- Arrêté du 14 décembre 2013 relatif aux installations relevant du régime de la déclaration ou de l'enregistrement au titre de la rubrique n°2921 pour le suivi obligatoire de la concentration en *L. pneumophila* et/ou la surveillance des substances polluantes dans les eaux

Pour déclarer ou non la conformité aux limites ou références de qualité, il n'a pas été tenu compte de l'incertitude associée au résultat.
(4) Les résultats non conformes aux limites ou références de qualité sont signalé par un rond noir.

Les résultats ne se rapportent qu'à cet échantillon. Ce document comporte 2 page(s). La reproduction de ce document n'est autorisée que sous la forme de fac similé photographique intégral.

Seules certaines prestations rapportées dans ce document sont couvertes par l'accréditation. Elles sont identifiées par le symbole *.

Laboratoire agréé pour la réalisation de prélèvements et des analyses terrains et des analyses des paramètres du contrôle sanitaire des eaux - portée détaillée de l'agrément disponible sur demande.
Analyses effectuées par un laboratoire agréé par le ministère chargé de l'environnement dans les conditions de l'arrêté du 27 Octobre 2011.
Tous les éléments de traçabilité, ainsi que les incertitudes de mesure, sont disponibles sur demande.
Pour les résultats issus d'une sous-traitance, les rapports émis par des laboratoires accrédités sont disponibles sur demande.

AMOUR

Mahmoud Amour
Coordinateur de Projets Clients

**Eurofins IPL Est**
**Rue Lucien Cuenot site Saint Jacques II BP 51005 54521 Maxeville cedex**
**Tél 03 83 50 36 00 - fax 03 83 56 84 22 - site web : www.eurofins.fr/env**
**SAS au capital de 10 249 470 € RCS Nancy 756 800 090 Siret 756 800 090 00257 TVA FR 46 756 800 090**

ACCREDITATION
N° 1- 0685
Site de Maxéville
Portée disponible sur
www.cofrac.fr

cofrac ESSAIS

eurofins | Hydrologie

**BUREAU VERITAS SA**
**Monsieur François VILLAIN**
314 boulevard marcel paul
bp 20162
44802 SAINT HERBLAIN

# RAPPORT D'ANALYSE

N° de rapport d'analyse : AR-15-IX-028745-01 Version du : 19/03/2015 Page 1/2

Référence commande : 1510003606 15 344
Référence dossier : AFFAIRE N° 2776443/1/1

Echantillon N° : 15M013724-006 Référence échantillon : 6
Matrice : Eau de rejet / Eau résiduaire
Date de prélèvement : 13/03/2015 Date de réception : 14/03/2015 07:34:20
Début d'analyse (1) : 17/03/2015
Préleveur : VILLAIN François (CLIENT) - BVFVI -
Commune :

Observations :
L'heure de prélèvement n'étant pas renseignée, les délais de mise en analyse ont été calculés à partir d'une heure de prélèvement fixée par défaut à midi.

| Conservation de vos échantillons | |
|---|---|
| Les échantillons seront conservés sous conditions contrôlées pendant 2 semaines après validation des échantillons. Sans avis contraire, ils seront détruits après cette période sans aucune communication de notre part. Si vous désirez que les échantillons soient conservés plus longtemps, veuillez retourner ce document signé au plus tard une semaine avant la date d'issue. | |
| Conservation Supplémentaire : | |
| Nom : | Signature : |
| Date : | |

**Eurofins IPL Est**
**Rue Lucien Cuenot site Saint Jacques II BP 51005 54521 Maxeville cedex**
**Tél 03 83 50 36 00 - fax 03 83 56 84 22 - site web : www.eurofins.fr/env**
**SAS au capital de 10 249 470 € RCS Nancy 756 800 090 Siret 756 800 090 00257 TVA FR 46 756 800 090**

ACCREDITATION
N° 1- 0685
Site de Maxéville
Portée disponible sur
www.cofrac.fr

cofrac ESSAIS

eurofins | Hydrologie

N° de rapport d'analyse : AR-15-IX-028745-01 Version du : 19/03/2015 Page 2/2

## Hydrocarbures

| | (4) | Résultat (2) | Unité | Incertitude | Limites Qualité (3) | Réf. Qualité (3) |
|---|---|---|---|---|---|---|
| IX578 : **Indice Hydrocarbures (C10-C40)** Prestation réalisée par le laboratoire de Maxéville<br>NF EN ISO/IEC 17025:2005 COFRAC 1-0685<br>*NF EN ISO 9377-2 - Extraction L/L - GC / FID* | * | <0.1 | mg/l | | | |

(1) La date de début d'analyse correspond à la date de lancement d'une séquence analytique.
(2) Les résultats précédés du signe < correspondent aux limites de quantification. Ces limites de quantification sont de la responsabilité du laboratoire et peuvent être dépendantes de la matrice de l'échantillon.
**(3)** Valeurs données en référence à la règlementation en vigueur selon le ca
- Code de la Santé publique pour les analyses effectuées sur les eaux de consommation, de loisirs, les eaux conditionnées, les eaux thermales
- Arrêté du 1er février 2010 relatif à la surveillance des légionelles dans les réseaux de distribution d'eau chaude sanitaire
- Arrêté du 14 décembre 2013 relatif aux installations relevant du régime de la déclaration ou de l'enregistrement au titre de la rubrique n°2921 pour le suivi obligatoire de la concentration en *L. pneumophila* et/ou la surveillance des substances polluantes dans les eaux

Pour déclarer ou non la conformité aux limites ou références de qualité, il n'a pas été tenu compte de l'incertitude associée au résultat.
(4) Les résultats non conformes aux limites ou références de qualité sont signalé par un rond noir.

Les résultats ne se rapportent qu'à cet échantillon. Ce document comporte 2 page(s). La reproduction de ce document n'est autorisée que sous la forme de fac similé photographique intégral.

Seules certaines prestations rapportées dans ce document sont couvertes par l'accréditation. Elles sont identifiées par le symbole *.

Laboratoire agréé pour la réalisation de prélèvements et des analyses terrains et des analyses des paramètres du contrôle sanitaire des eaux - portée détaillée de l'agrément disponible sur demande.
Analyses effectuées par un laboratoire agréé par le ministère chargé de l'environnement dans les conditions de l'arrêté du 27 Octobre 2011.
Tous les éléments de traçabilité, ainsi que les incertitudes de mesure, sont disponibles sur demande.
Pour les résultats issus d'une sous-traitance, les rapports émis par des laboratoires accrédités sont disponibles sur demande.

AMOUR

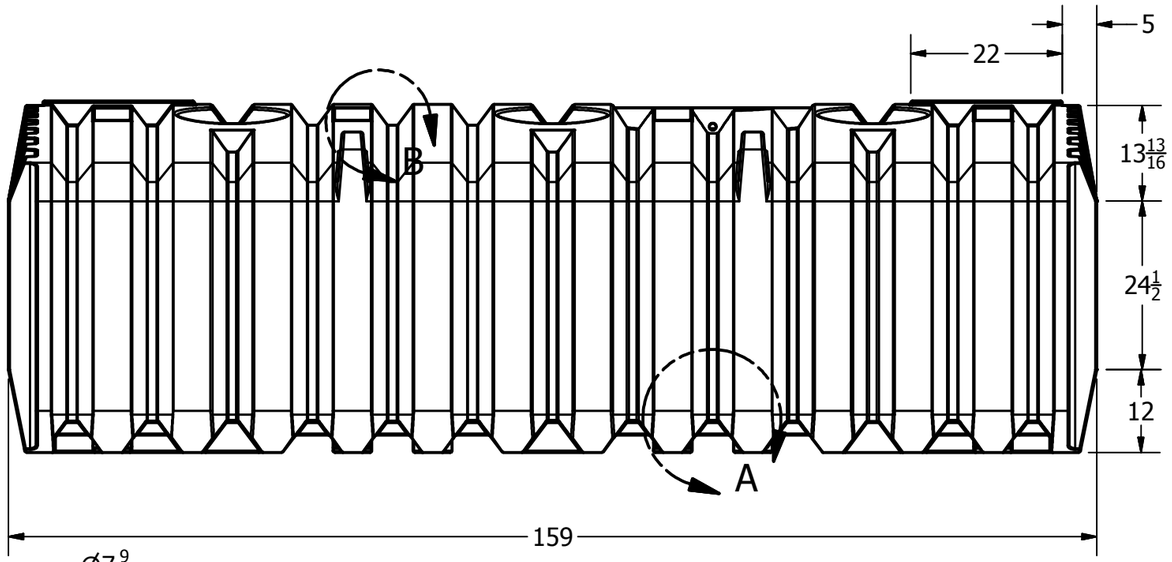
Mahmoud Amour
Coordinateur de Projets Clients

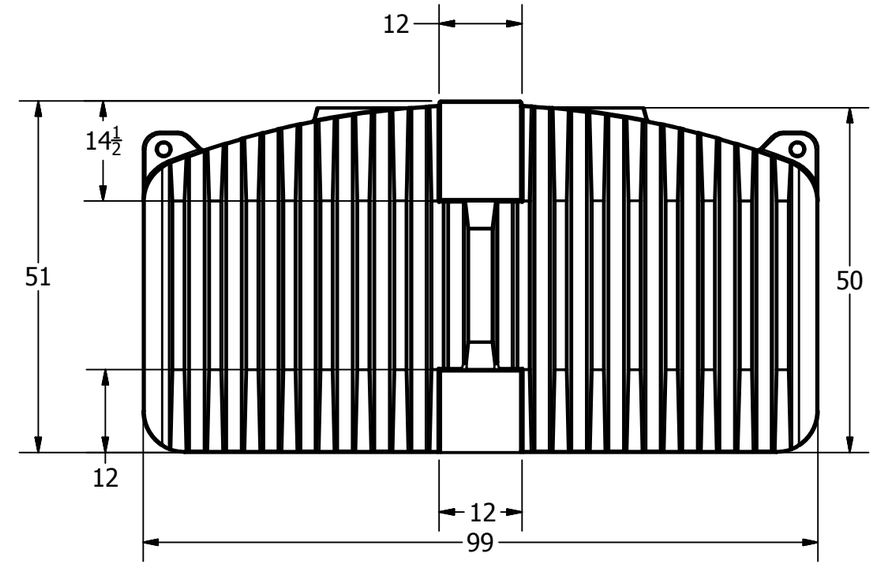
**Eurofins IPL Est**
**Rue Lucien Cuenot site Saint Jacques II BP 51005 54521 Maxeville cedex**
**Tél 03 83 50 36 00 - fax 03 83 56 84 22 - site web : www.eurofins.fr/env**
**SAS au capital de 10 249 470 € RCS Nancy 756 800 090 Siret 756 800 090 00257 TVA FR 46 756 800 090**

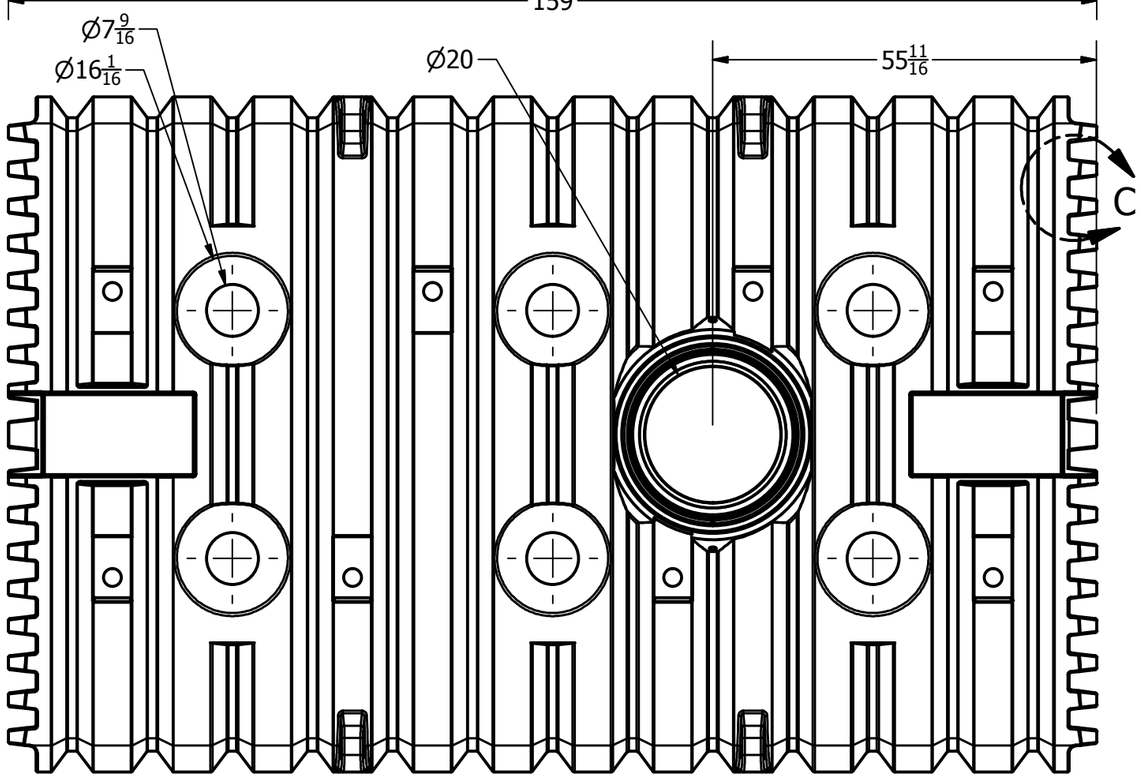
ACCREDITATION
N° 1- 0685
Site de Maxéville
Portée disponible sur
www.cofrac.fr

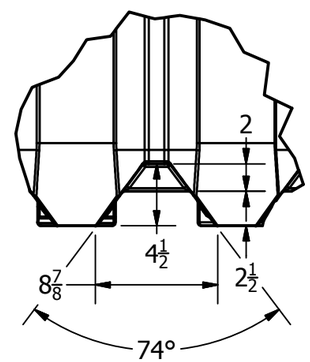
cofrac ESSAIS

# Attachment T. Norwesco Sanitary Holding Tank Detail

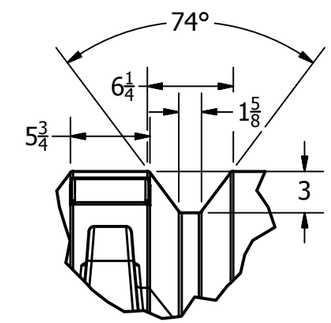


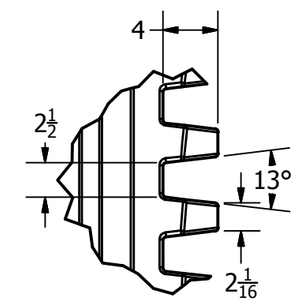




DETAIL A
SCALE 1 / 11




DETAIL B
SCALE 1 / 11




DETAIL C
SCALE 1 / 11

| | | |
|---|---|---|
| DRAWN Todd Bolzer | 11/15/2011 | NORWESCO, INC., ST. BONIFACIUS, MN |
| CHECKED | | TITLE |
| QA | | 2500 GALLON HOLDING TANK |
| MFG | | |
| APPROVED | | SIZE B / DWG NO 44079 / REV A |
| | | SCALE: 1/16 / SHEET 1 OF 1 |

# Attachment U. Spill Control Manhole

# Spill Control Manhole

| Stormwater Management Goals Achieved | Acceptable Sizing Methodologies |
|---|---|
| √ Pollution Reduction[1] (Oil Only)…….. | PRES[1] |
| Flow Control…….…… | NA |
| Destination…… | NA |

This facility is **not** classified as an Underground Injection Control structure (UIC).

SIM=Simplified Approach, PRES= Presumptive Approach, PERF= Performance Approach

**Notes: 1)** Spill control manholes receive credit for oil removal only. They may be used to remove oil from parking lots and other vehicular access areas.

**Description:** Spill control manholes rely on passive mechanisms that take advantage of oil being lighter than water. Oil rises to the surface and can be periodically removed. They consist of a simple underground manhole with a "T" outlet designed to trap small spills. Spill control manholes will not be given credit for basic pollution reduction requirements. They must be used in conjunction with other pollution reduction systems from this chapter to meet oil control and pollution reduction requirements.

**Other Options:** There may be other acceptable oil controls not listed above. Applicants may propose an alternative oil control option under the performance approach. However, proposal of a new oil control will require an additional review process for approval, which may delay issuance of related building permits.

**Design and Sizing Criteria:**

- Spill control manholes shall be used in conjunction with an appropriately sized pollution reduction facility. The spill control sump volume shall be 60 cubic feet *or* 20 cubic feet of sump capacity for each cubic feet per second (cfs) of peak pollution reduction design flow, whichever is greater.

- To maintain efficiencies and reduce size, all roof drainage shall enter the stormwater system downstream of the spill control manhole, unless sized accordingly.

- Any pumping devices shall be installed downstream of the spill control manhole to prevent oil emulsification in stormwater.

- Engineered calculations are required, using the Rational Method (Q=C*I*A).

**Stormwater Report Requirements For Presumptive Approach**: See **Exhibit 2-2**.

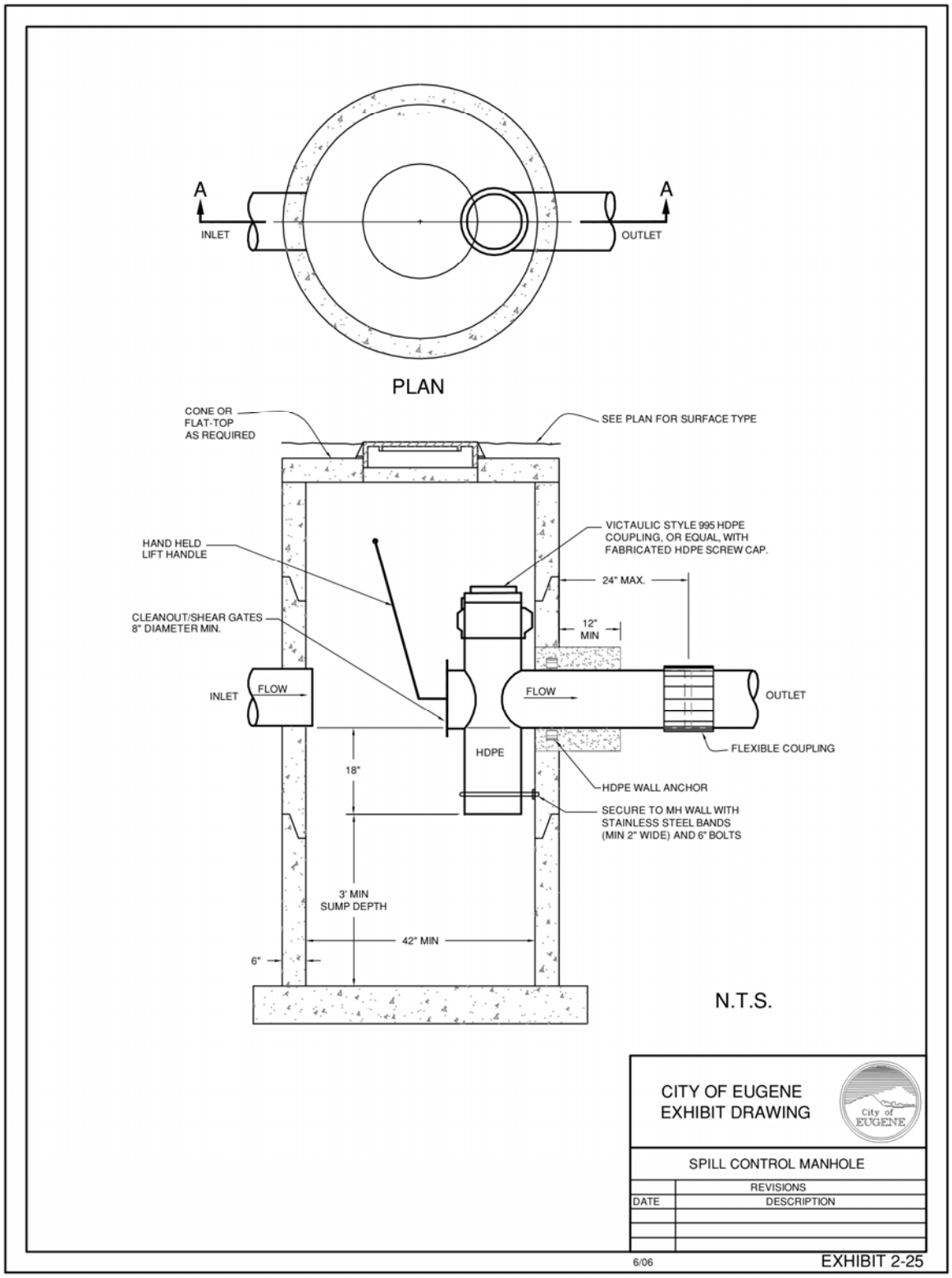
# Spill Control Manhole

**Checklist of minimal information to be shown on the permit drawings:**

1) Facility dimensions and location.
2) Profile view of facility, including typical cross-section details with dimensions. These details shall match manufacturer specifications and details.
3) All stormwater piping associated with the facility, including pipe materials, sizes, slopes, and invert elevations at every bend or connection.

**Inspection requirements and schedule:** The following table shall be used to determine which stormwater facility components require City inspection, and when the inspection shall be requested:

| Facility Component | Inspection Requirement |
|---|---|
| Manhole excavation | |
| Piping | Call for inspection |
| Manhole installation | Cal for inspection |

**Operations and Maintenance requirements**: See **Chapter 3.0**.

# Spill Control Manhole